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Scientific, Technical and Economic Committee for Fisheries (STECF) - Economic Report on the EU aquaculture (STECF-22-17)

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Joint Research Centre

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CONTENTS

Abstract

Commission Decision of 25 February 2016 setting up a Scientific, Technical and Economic Committee for Fisheries, C(2016) 1084, OJ C 74, 26.2.2016, p. 4–10. The Commission may consult the group on any matter relating to marine and fisheries biology, fishing gear technology, fisheries economics, fisheries governance, ecosystem effects of fisheries, aquaculture or similar disciplines.

This report on the Economic Performance of the EU Aquaculture sector 2022 is the eighth report of its kind produced for the sector and provides a comprehensive overview of the latest information available on the production, economic value, structure and competitive performance of the aquaculture sector at the national and EU level. This report includes data for 2008 to 2020 and nowcasting for 2021. The data collected is reported by national totals and by segments divided on species. The EU aquaculture sector reached 1.2 million tonnes in sales volume and €3.9 billion in turnover, in 2020. The overall number of enterprise were estimated to 14 thousand, whereas the total number of employees reached 57 thousand in 2020. Compared to the last report, the sector has experienced a decrease in production, turnover and employment.

The report furthermore contains three special chapters. One on the increasing Energy prices and its impact on the EU aquaculture sector, a chapter on the latest nowcast analysis, and finally a chapter analysing the social data collected under EUMAP for the second time.

SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) - Economic Report on the EU aquaculture (STECF-22-17)

Request to the STECF

STECF is requested to review the report of the STECF Expert Working Group meeting, evaluate the findings and make any appropriate comments and recommendations.

STECF comments

EWG 22-17 met in Ispra, from 24-28th of October 2022. The EWG was attended by a group of aquaculture economic experts consisting of 29 experts from 19 countries and 3 JRC experts. The Economic Report of the EU Aquaculture Sector is made on a biennial basis. The 2022 report is the eighth of its kind. It provides a comprehensive overview of the latest information available on the production, economic value, structure and competitive performance of the aquaculture sector at the Member State and EU level for the years 2008 to 2020. EWG 22-17 focused on 2019-2020 trends and nowcast, covering the marine finfish, shellfish and freshwater finfish, segments.

Following the 2022 call for economic data on the EU aquaculture, EWG 22-17 was requested to analyse and comment on the economic performance of the EU and national aquaculture sectors between 2008 and 2020, produce a nowcast for 2021-22, analyse the impact of energy price increase on aquaculture sector and socio-demographic characteristic of the sector. It should be noted that this report. EWG 22-17 updated the time-series of the previous 2020 report, updating with data for 2019 and 2020. Additionally, and for the second time, social data on gender, age, education and nationality were provided by the Member States under the EU-MAP and were analysed by the EWG.

STECF acknowledges that the EWG delivered a comprehensive report within two weeks after the meeting and acknowledges the difficulty faced during the meeting due to lack of Spanish data that was not provided during the data call.

STECF observes that the total nominal turnover from the EU aquaculture sector was almost €4.1 and €3.9 billion in 2019 and 2020, respectively. This represents a 3% decline in 2020 in comparison with 2019 data. Even though the overall turnover decreased, the overall EU aquaculture sector experienced an increase in most economic performance indicators in 2020 compared to 2019 for the countries reporting data. The positive development in the economic indicators is driven by the marine finfish segment, whereas the segments freshwater fishes and shellfish, experienced a decline.

STECF observes that an effort has been made to present the development of the entire EU aquaculture sector from 2008 to 2020. The totals and the time trends presented in chapter 2 of the report are based on the data collected under DCF and EU-MAP. This has been supplemented with EUROSTAT and FAO data, estimating missing values to be able to give a comprehensive overview of the EU aquaculture sector. Furthermore, a second attempt to do a nowcast for 2021 and 2022 is provided in the report. However, the nowcast only provides estimates for 2021. Due to the significant increase in energy prices because of the Russian invasion of Ukraine and the aftermath of the Covid-19 pandemic, the EWG found it challenging to estimate the development in 2022 due to the level of uncertainty and without having access to data for this year.

STECF also notes that due to the war in Ukraine, energy prices have been increasing all over Europe, which have affected the aquaculture industry as well as other industries dependent on energy and fuel use. Furthermore, prices on raw material (soy, fishmeal and oil) have also been affected by the conflict, which means that prices of feed for aquaculture are also influenced. The effects of the energy prices on the EU aquaculture sector have been analysed in a special chapter.

STECF notes that, despite the progress with analysis and a time series of ten years since the first report in 2012, the EWG continues to experience issues with data submission by Member States. STECF notes that the missing data makes the work of the EWG to obtain key performance indicators of the EU aquaculture sector demanding. The key missing information includes:

- Data not provided for 2019-20 by Spain which is one of the main EU producers.
- Important segment information (e.g., oyster production for the Netherlands and several important segments for France).
- Freshwater production and economic data due to DC-MAP thresholds (mostly from landlocked countries)

STECF observes that in order to provide comprehensive and in-depth analysis of the aquaculture sector in the EU, the data sets, submissions and templates for National analysis should be finalised prior to the meeting. Therefore, STECF requests the bureau to discuss potential actions that could improve the process as follows:

- Explore the possibility to support the work of the EWG through ad hoc contracts to support drafting national chapters before the EWG meeting.
- Explore the possibility of moving to a two-meeting approach in line with the AER for the fishing fleet. The first meeting would focus on data quality checks and National chapter drafting. This could be a shorter online meeting for 3 days). The second meeting would be used to draft EU overviews, sectoral analysis and the responses to topics of special interest.
- Facilitate a discussion on the process with the main parties involved (STECF Bureau, DGMARE, JRC) to define the process and responsibilities for the next meeting with the aim to further improve it.

STCEF notes that errors identified in the data submissions during the meeting and inconsistencies in the time series provided as well as re-uploads during the meeting heavily influence the time available for deeper EU and sectoral economic analysis. Most of the report has been written and finalized after the EWG meeting ended, because data for the EU and sectoral overviews was not ready for experts to analyse during the meeting.

STECF notes to streamline quality checks at national level, Member States could use quality checks through developed R scripts they can run before data submission. This is similar to the quality checks developed by C. Ribeiro and A. Motova in 2012-2015 for the Annual Economic Report on the fishing fleet[1] as well as other economic data calls. However, STECF notes that such “R-based” quality checks require maintenance and update prior to each data call.

STECF notes that according to the EWG report, the datasets analysed contains declarations regarding some species with the generic “nei” - not elsewhere included” - where it is not possible to identify to the species or whether more than one species is included in the same group). Examples include Mytilus mussels nei, Clams etc. nei, Venus clams nei, Cupped oysters nei. This is mainly the case for Spain in the FAO dataset and Portugal in the DCF dataset for sea mussel nei. This is believed to be Mediterranean mussels and is analysed as such, because it in fact corresponds to the Spanish and Portuguese production in 2020.

STECF observes that EWG 22-17 for the second time performed an analysis of social-demographic data collected under the EU-MAP for aquaculture. The data collected covers gender, ages, education and nationality of the people employed in the aquaculture sector. The results show that the persons employed in the sector are primarily male (78%) and that the age class 40-65 constitutes about 46% of total employment. Education level shows large differences between Member States as well as types of production technologies used. The majority (82%) of people employed in the aquaculture sector are nationals of their own country, with the remainder rest coming from other EU Member States.

[1] JRC Publications Repository - R quality checks for DCF data submission: Exploratory Data Analysis for Fishing Fleet economic data call. (europa.eu).

STECF observes that according to EWG 22-17, there is a difference in interpretation of full time equivalent (FTE) jobs submitted by Member States. STECF notes that according to the EU-MAP definitions for aquaculture data collection, the total FTE should include unpaid labour FTE[2]. However currently there is no reference to unpaid labour in the definitions for social data submissions included in the guidance document for the social indicators[3]. In the same document (defining social indicators) there is a requirement that employment data reported in the social data calls should be consistent with the data reported under the aquaculture data call. Therefore, STECF observes that FTE reported under the social data template should include unpaid labour FTEs in line with other calls.

STECF conclusions

STECF concludes that the EWG 22-17 adequately addressed all ToRs including an analysis of the impacts of energy prices on the EU aquaculture sector, the provision of a nowcast for the sector for 2021 and an analysis of the social-demographic data collected under the EU-MAP. Under each national chapter, there is a short summary describing the individual national sectors for each Member States.

STECF concludes that the report provides a good and reliable overview of the economic performance of the EU aquaculture sector. However, the lack of Spanish data, absence of other data due to thresholds and that collection and provision economic data for the freshwater segments is not mandatory, limits the possibilities for an overall EU analysis of the aquaculture sector. It also weakens the conclusions drawn and potentially impacts the nowcast. Furthermore, some data provision issues remain, including non-submission (and continuous submission during the meeting) which reduces the available time that the EWG has to analyse the data and indicators produced.

STECF also concludes that in order to provide comprehensive and in-depth analysis of the aquaculture sector in the EU, the data sets, submissions and templates for National analysis should be finalised prior to the meeting. Therefore, STECF requests the bureau to discuss potential actions that could improve the process.

STECF concludes that Member States should avoid using generic species names ‘nei’. To assist Member States, STECF recommends amending the guidance to Member States for the data declaration, to avoid usage of this generic terminology. The use of this term is to a certain extent incompatible with the provisions of Regulation (EC) N° 708/2007 concerning the use of alien and locally absent species in aquaculture[4].

STECF reiterates its conclusion from PLEN 21-01 that, given the importance of the 40-64 age category which represents a high share of sector employees, Member States should split this category to smaller groups and have the possibility to report the split in the data call. STECF advises RCGECON should update the guidelines for social indicators prior to the next data call and disaggregate this age category into 40-54 and 55-64. This will facilitate a more comprehensive analysis of the trends in age within sector labour force.

STECF concludes that in reporting FTEs for the request for social data, unpaid labour should be included as per existing EUMAP guiding documents. Member states should report FTE with unpaid labour in the social data template. STECF advises that RCGECON should update the guidance documents accordingly for Member States making this requirement clearer in the guidance document for the social variables.

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[2] Guidance document for the aquaculture - living document Aquaculture – European Commission (europa.eu).

[3] Guidance document for the social variables - living document Social – European Commission (europa.eu).

[4] Council Regulation (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture. OJ L 168, 28.6.2007, p. 1–17.

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REPORT TO THE STECF

EXPERT WORKING GROUP ON Economic Report on the EU aquaculture (EWG-22-17)

Hybrid meeting, 24-28 October 2022

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

1 INTRODUCTION

The 2022 biennial Economic Report of the EU Aquaculture Sector is the eight report of its kind produced for the sector and provides a comprehensive overview of the latest information available on the production, economic value, structure and competitive performance of the aquaculture sector at the national and EU level for the years 2008 to 2020.

Europe represents one of the largest markets for seafood and is the second largest trader of seafood products in the world and consumption has steadily increased over the past decades. Per capita consumption is estimated to be 24 kilograms, in 2019 (EUMOFA 2021). On a global level, production of seafood for human consumption is almost equally divided between aquaculture and fishery. However, the EU market is still dominated by products originating from fisheries covering around 75% of the available seafood products. EU's consumption of seafood products is mainly covered by import making up around 60% of the total supply. The EU is therefore highly dependent on imported seafood to the EU market.

The future demand for fish is expected to increase due to increasing population and income and health benefits associated with fish consumption. The growing demand offers a unique opportunity to expand the aquaculture production in the EU. However, this also implies that the EU farmers continuously succeed in staying competitive on the global market for seafood products.

To increase EU own supply of seafood products, aquaculture seems to be the most obvious choice since the supply from fisheries has been stagnating since the late 1990's. However, the EU aquaculture production has over the period from 2008 to 2020 been quite stable and growth in global production is dominated by Asian countries covering about 90% of the global production volume. In contrast, the EU contribution to world aquaculture production (including aquatic plants) has been decreasing significantly over time in both volume and value terms, representing only 1.0% and 1.5% of global production in 2020 (FAO 2022).

A precondition to move the European aquaculture sector forward is to establish and increase the knowledge of the existing aquaculture production. In that respect, this report is an important contribution providing economic information on an overall EU level and furthermore providing a detailed description on the national level on production of main species produced and technique used in the sector.

This report responds to the requirements of the Terms of References (TOR), through the following structure. After the executive summary and key findings, a short introduction is presented in Chapter 1. Chapter 2 provides an overview of the EU aquaculture sector. Chapter 3 includes a detailed analyses of the aquaculture sectors (i.e. marine, shellfish and freshwater) and of the main species produced. Chapter 4 analyses the economic performance, structure and main species produced by each Member States as well as provides an outlook for future production trends.

This report includes three special chapters. Chapter 5 provides an assessment of the effects of the energy prices on the EU aquaculture sector. Chapter 6 provides the second attempted nowcast analysis and an overview of the nowcasting tool is provided in this report. Chapter 7 provides the second analysis of the social data provided under the new EU-MAP for the aquaculture sector.

Again, this year, a special effort has been made to provide time trends for the data collection period from 2008 to 2020 using estimated values when data has not been available under the DCF or EU-MAP. To support this effort, the nowcasting tool has been applied to estimate data for the years 2021 and 2022. However, due to difficulties in obtaining reliable data for the aquaculture production and values in 2022, only estimates for 2021 are presented. The results of this effort can be seen in the EU overview (chapter 2) and the method is further described in an annex.

This report still represents a transition from the former DCF program to the new and the recently implemented EU-MAP program. For this data call, Member States should report data for 2019 and 2020 under the EU-MAP. Due to a new segmentation in the EU-MAP compared to DCF, some segments can only be presented with the new data in order to provide consistent results.

Furthermore, due to the fact that the United Kingdom has left the EU, the United Kingdom is no longer a part of this report.

There has been one major setback in terms of data reporting this year. The largest producer of aquaculture products in the EU, Spain, did not deliver data for this report in time. Spanish data was received after the report was finished, and therefore it could not be reviewed by the working group and is not part of this report. In agreement with DG MARE, the Spanish National chapter therefore builds mainly on FAO data. To populate the overviews with economic data for countries not reporting data, an estimation of enterprises, employment and some economic parameters for 2019 and 2020 have been made based on values and volumes from FAO and historical data, in order to avoid a significant decrease in all parameters in this report. The issue of “other non-reporting” countries, besides Spain (all data) and France (marine finfish data), relates to thresholds for reporting data on aquaculture and that the freshwater sector is not mandatory to report for MS. Details about data issues have been addressed in an annex.

Furthermore, a recurring issue is that countries have to correct data during the meeting, which heavily impacts upon the time available for deeper economic analysis.

Finally, the report is completed with a Glossary, and the list of EWG participants.

1.1 Terms of Reference for EWG-22-17

The report has been produced by a group of aquaculture economic experts convened under the Scientific, Technical and Economic Committee for Fisheries (STECF). The expert group consisted of 29 experts from 19 countries, and 3 JRC experts.

Following the latest call for economic data on the EU aquaculture, EWG 22-15 is requested to analyse and comment on the economic performance of the EU and national aquaculture sectors between 2008 and 2020.

In 2022, the special chapters contain:

- An analysis of energy prices and their effects on the European aquaculture sector in 2022.
- A second attempt to do nowcasting using the data and knowledge provided by the expert group.
- A chapter on social data provided under the EU-MAP for the aquaculture sector.

TERMS OF REFERENCE

Background and objectives

The report on the EU Aquaculture Sector is one of the main sources of economic and socio-demographic data for scientific advice on the performance of the EU aquaculture industry. It is also increasingly used by scientific bodies, national administrations and international institutions.

Following the 2022 DCF/EU-MAP call for economic data on the EU aquaculture sector, **the EWG is requested to analyse and comment on the economic performance of the EU and national aquaculture sectors** between 2019 and 2020 (2021 when available).

The report should provide an in-depth look at the different factors affecting the economic performance of the EU aquaculture industry with a **special focus on the major drivers and issues affecting the sector**. Besides interpreting and explaining the quantitative values, the report should contain qualitative information and analysis on the drivers and trends in aquaculture performance and other aspects of policy relevance **based largely on the scientists' expert knowledge**. The main objectives of the report is **to obtain a high quality interpretation of all data outputs** to ensure the usefulness of the report for DG MARE's policy development, Member States and the industry. Among other aspects, the relevance and role of some or all of the following factors could be taken into account: markets and trade determinants of aquaculture production, competitiveness, market prices and consumption, sustainability, innovation, links and interconnections with the local fishing fleet and the fish processing sector, the role of European Maritime Fisheries Fund support, contribution to the local communities and the Blue Economy, strengths, weaknesses, opportunities and threats.

To achieve that, the main socio-economic **indicators**, if possible and where relevant, **should be put into context with homologous figures** at the EU and national levels, e.g., national average salaries, GDP, etc. Imputation of missing values may be required to obtained coherent time series and indicators that reflect a robust estimate of EU aggregates.

Experts are asked to **analyse the sector and its components**.

Given the social importance of this activity in many communities, particular **emphasis should be paid to the socio-demographic aspects** of the analysis including trends on employment, salaries, labour productivity and breakdown of the aquaculture employment by gender, education level and nationality (nationals, EU nationals, non-EU nationals).

The final draft of the EWG report will be reviewed by the STECF during its plenary meeting in winter 2022.

Structure and content

Being the basis for the structure of the report, the EWG is requested to work and comment on, at least, the following items:

- An **executive summary** containing the key findings (abstract)[1]. This should also include a **2-3 lines**

  abstract of the main features / data **for each Member States**.

- An **overview of the economic performance of the EU aquaculture sector**. This should include the drivers and main trends based on expert knowledge. It must include the following:
  - EU aquaculture sector overview. This would include the evolution for the EU total for the main variables as well as a comparison across aquaculture segments (marine finfish, marine shellfish, freshwater).
  - Economic data and performance indicators (e.g. production, revenue items, cost items, earnings, profitability, etc.).
  - Employment and socio-demographic indicators (e.g. employment by gender, labour productivity and average salaries, education level, nationality, etc.).
  - Comparative across Member States highlighting the differences and similarities of national industries.
  - Analysis of economic performance by aquaculture segment (marine finfish, marine shellfish, freshwater) and species.
  - Drivers, trends and outlook.

- **National chapters** on the economic performance of the aquaculture sector providing:
  - National aquaculture overview including industry structure.
  - Production and sales.
  - Economic performance indicators.
  - Employment and socio-demographic indicators.

- Structure and performance of aquaculture segments.
- Description of trends and drivers based on expert knowledge.
- Outlook.

In the sections on drivers and outlook, the expert should use their expert knowledge to provide an indication about what they considered have been the main consequences of the outbreak of COVID-19 in the EU aquaculture sector and the expected recovery path.

- **Special topic on nowcast:**
  Following up on the previous economic report, a methodology will be applied to attempt the nowcasting exercise. This aims at binging the report more up to date since the data series will be only available up to 2020 or, in a few cases, up to 2021.

- **Special topic on energy costs:**
  The section providing an overview of the energy costs (and recent trends) for each aquaculture segment should be produced subject to the available data.

- **Annexes**
  - Data coverage and quality.
  - Potential complementary charts and tables not included in the main text.

Streamlining of the report and data issues

After six reports, efforts should be invested in streamlining the structure and content of the report. In particular, the following should be taken into account:

It shall be considered whether some specific (sub) sections provide limited value added and therefore should be dropped from the report. The possibility of improving the readability of the report by grouping some of the charts and tables should be explored.

Given the increasing length of the time series, **the tables in the report could be shortened by presenting only indicative numbers** (e.g. one out of two years or one out of five). However, the last three years should appear in the time series tables (both for the EU overview and the national chapters). **The workbook(s)** accompanying the report **should still include the whole database** with all years in the series.

The narrative should add value to the figures compiled in the charts and tables. This could be achieved by highlighting a few figures with special relevance and by explaining what are the drivers and/or consequences.

The experts are expected to add value to the report **from their knowledge of the sector**. This should be an important criteria for the selection of experts invited to participate in the working group. **Experts should provide a forward looking spin to the report** about their knowledge about the developments in the sectors throughout 2021 and 2022.

The main **socio-economic indicators**, if possible and where relevant, should also be **put into context with** homologous figures at the **EU and national levels** (e.g., national average salaries, GDP, etc.), or in relations with the other fisheries sectors (the fishing fleet and fish processing).

Given the experience of the past with missing data and that the collection and transmission of data on fresh aquaculture is only done on a **voluntarily basis**, the **use of complementary source of data (e.g. from Eurostat and FAO**) may be required for some countries.

When aggregating national indicators to obtain the EU totals, special attention should be made to maintain a homogeneous number of Member States. The data for **EU total** should reflect an estimation of the actual evolution and **should not be distorted by the inclusion (or exclusion) of Member States throughout the analysed period**. The compilation of EU aggregates may require the use of imputation in some Member States.

The economic report on the aquaculture sector **is produced on a biennial basis**. **This should be taken into account when presenting the information and making the interpretations**. Besides the long-term evolution, a special focus should be made not only on the last year, but rather on the last two years, when relevant. Indications on the latest developments should be presented in annual terms and not with respect to the previous report (which implies an increase or decrease over two years).

A discussion and explanation about **data coverage, data issues** and how they were addressed should be included in an Annex.

Data transmission

The EWG is requested to ensure that all unresolved data transmission (DT) issues encountered prior to and during the EWG meeting are reported on-line via the Data Transmission Monitoring Tool (DTMT). Guidance on precisely what should be inserted in the DTMT, log-on credentials and access rights will be provided during the EWG.

2 EU AQUACULTURE SECTOR OVERVIEW

For the second time in the EU aquaculture economic report, a nowcast exercise has been conducted. Carrying out the nowcast for aquaculture is a considerable challenge, considering that the availability of official statistics on aquaculture at the European level and in other supranational organizations and global databases is lower than in the fishing or fish processing sector, where a nowcasting exercise has also been performed. This exercise follows the recommendations and principles for estimation of the main variables for EU aggregates approved by the STECF plenary in 2019.

The methodology developed for this report has been applied to make a nowcasting exercise, which could be improved in upcoming reports. The scope of the nowcast for the second attempt is limited to estimating the production in volume (Total weight of sales), the production in value (Turnover), and the employment (both persons employed and persons employed FTE) at national level, which is aggregated to the EU level.

The information obtained during the EWG has allowed a quantitative nowcast at national level for 2021, based on data from EU-MAP and final and estimated data from national public bodies provided by the experts. In the case of the weight of sales and turnover the nowcasting coverage for 2021 is equivalent to 92% and 85% of the production volume and value in 2020, respectively. In the case of employment, the availability of data has been lower and the nowcast coverage decreases to 67% and 39% in the case of employees and FTE, respectively. In the EU overview, the 2021 estimates were produced by the nowcast exercise for EU 27 totals regarding production, turnover and employment. For countries with missing nowcast data for 2021, values from 2020 were used as an approximation.

In the case of 2022, estimates are only obtained from 4 countries, which does not allow for a quantitative nowcast like the one carried out for 2021. Furthermore, the impact of Covid-19 makes extrapolation of data from previous years highly uncertain and the experts have therefore refrained from presenting estimates for 2022.

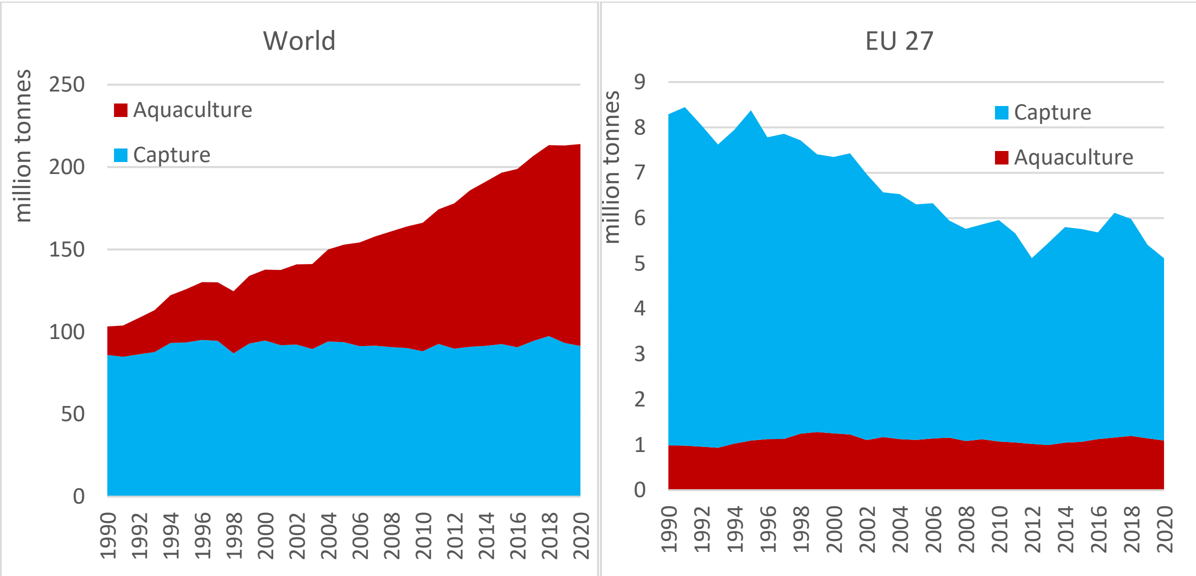
2.1 World and EU-27 seafood production

Aquaculture is one of the fastest growing food producing sectors in the world and is an increasingly important contributor to global food supply and economic growth. The share of global supply of fish products for human consumption from aquaculture went from being 16% in 1990 to 57% in 2020 including aquatic plants. The total estimated global production from captured fisheries and aquaculture increased from 199 million tonnes in 2016 to 214 million tonnes in 2020. The production from world capture fisheries has been fluctuating around 90 million tonnes per year during the last two decades, but has shown an increase from 2016. In contrast, the global aquaculture production has been steadily increasing about 2-3% per year, as shown in Figure 2.1.

The global value of aquaculture production reached €246 billion (281 billion USD) in 2020 (FAO, 2022). The sector has increased production more than 4 times since 1990 (see Figure 2.1). However, this growth has primarily been driven by Asian countries producing 92% of the world aquaculture products. China is the most important producer of aquaculture products in the world, producing 57% of the global aquaculture products. European Union aquaculture production represented only 1.0% of the world aquaculture production in terms of weight and 1.5% in value.

The aquaculture production in the EU has increased by 11% from 1990; however, since 2018 the production has declined by 8% (FAO, 2022). As EU capture fisheries production has been showing a decreasing trend from 1990 to 2020, aquaculture has become relatively more important to supply the seafood market. In 2020, the aquaculture sector provided around 21% of the fish and shellfish supply in the EU.

Figure 2.1: World and EU27 seafood production (capture and aquaculture): 1990-2020.



Source: FAO, 2022

2.2 The EU aquaculture sector

In this section, a special effort has been made by the EWG to present the development of the entire EU aquaculture sector covering all 27 Member States from 2008 to 2020. The totals and the time trends presented in this chapter are based on the data collected under DCF and EU-MAP, supplemented with FAO data, estimating missing values where necessary to be able to give a comprehensive overview of the EU aquaculture sector. The methodology used is included as annex 1 in this report.

Aquaculture production in the 27 EU Member States was almost 1.2 million tonnes and accounted for €3.9 billion in 2020 (DCF and EWG estimates). The EU represents 1.0% of the world aquaculture production in volume and 1.5% in value[5]. EU aquaculture production is mainly concentrated in four countries: Spain (24%), France (21%), Greece (11%) and Italy (10%). These four countries account for 67% of the total EU aquaculture production volume (Figure 2.2).

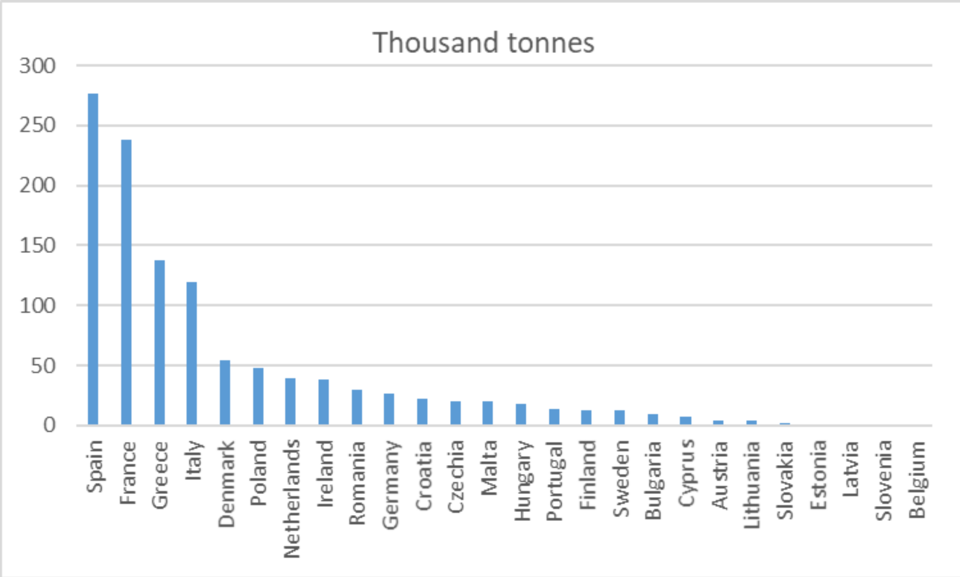
In terms of value, France is the largest contributor in EU with 22% of the total turnover, followed by Spain (15%), Greece (15%) and Italy (9%). These four countries combine 61% of the total EU aquaculture turnover (

Figure 2.3).

It should be noted that even though Spain has the largest aquaculture production volume (24%) it is only second in value (15%). This is due to the relative low market value of mussels, which represented three quarters of the Spanish aquaculture production volume, but only one quarter of the sales value.

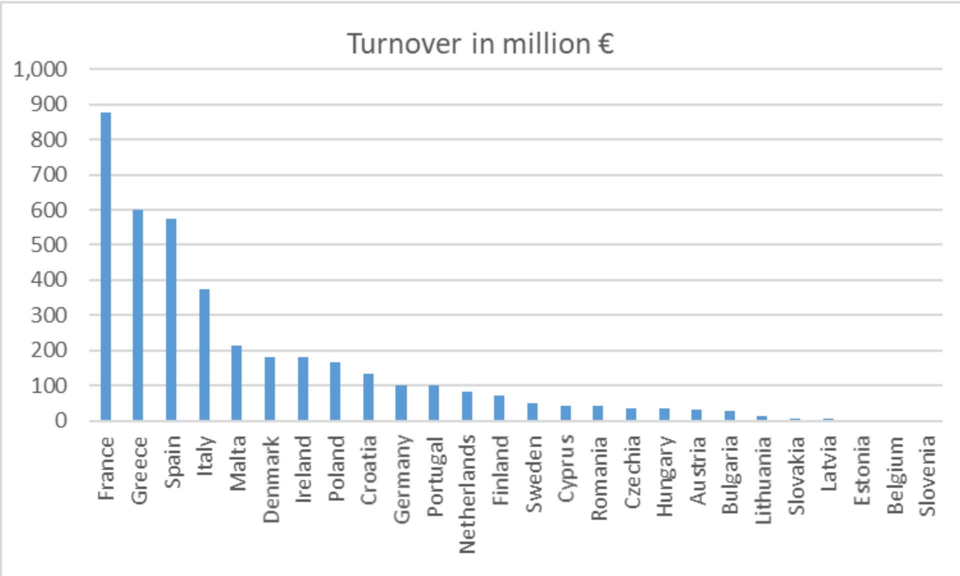
[5] FAO Fishstat production data for fish, crustaceans and molluscs, aquatic plants and animals.

Figure 2.2: Aquaculture production in EU MS in terms of weight: 2020.



Source: EU MS data submission and EWG estimations, 2022.

Figure 2.3: Aquaculture production in EU MS in terms of value: 2020.



Source: EU MS data submission and EWG estimations, 2022.

2.3 Economic performance of the EU aquaculture sector

Table 2.1 provides an overview of the size of the EU aquaculture sector across Member States in terms of number of enterprises, sales volume, turnover and employment. The table shows in more detail the production related to the number of enterprises and employment in each of the countries. For instance, the largest producer France has a sales volume of 238 thousand tonnes, which provided a turnover of €878 million of production. The production was carried out in 2 551 enterprises employing 12 897 persons, corresponding to 6 185 full time employees. A more detailed analysis of each of these indicators is presented in this section.

Table 2.1: Economic and employment indicators for the EU aquaculture sector: 2020.

	Total weight of sales (tonnes)		Turnover (million euro)		Number of enterprises		Employment (number)		FTE (number)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Austria	4 250	4 527	29.6	30.3	175	183	331	333	198	200
Belgium	86	209	0.5	1.4	3	8	6	15	4	9
Bulgaria	12 979	9 796	35.7	27.0	745	780	1 118	1 072	998	930
Croatia	20 443	21 740	120.8	133.0	162	155	1 263	1 283	1 108	1 105
Cyprus	8 173	7 428	50.8	43.1	16	16	511	466	420	388
Czechia	21 151	20 083	39.8	36.4	235	221	1 433	1 433	860	860
Denmark	64 516	54 099	210.7	180.8	94	90	581	585	426	425
Estonia	857	966	3.2	3.8	10	10	57	62	47	51
Finland	12 649	13 108	76.5	73.3	165	160	473	485	320	370
France	242 187	238 215	942.9	878.6	2 544	2 551	13 877	12 897	6 205	6 185
Germany	37 141	26 958	108.7	100.3	2 642	2 403	1 815	1 328	1 415	1 263
Greece	139 240	137 505	564.9	600.8	691	691	4 039	4 074	3 761	3 795
Hungary	17 283	18 373	36.1	35.4	325	325	1 393	1 415	1 320	1 309
Ireland	38 313	37 735	175.3	179.8	292	316	1 980	1 848	1 086	1 007
Italy	125 743	119 459	406.8	372.4	582	582	4 378	4 378	2 042	2 042
Latvia	689	832	4.4	4.3	79	78	323	330	175	223
Lithuania	4 215	4 477	13.5	13.8	80	84	430	446	258	268
Malta	13 825	19 829	161.9	215.4	9	9	341	410	293	300
Netherlands	41 200	38 895	80.4	83.0	101	100	304	291	268	258
Poland	44 719	47 700	154.5	164.7	1 242	1 242	6 172	6 131	3 703	3 678
Portugal	12 881	13 648	118.5	100.0	727	721	1 240	1 262	1 237	987
Romania	17 781	29 947	55.8	42.4	475	471	2 295	2 055	2 295	2 055
Slovakia	2 688	2 296	7.2	5.6	43	34	579	943	347	566
Slovenia	804	551	1.4	1.2	6	6	29	30	25	26
Spain	311 025	276 562	637.1	573.2	2 895	2 895	15 134	12 478	6 221	5 934
Sweden	12 133	12 824	45.2	48.6	85	98	435	543	325	348
TOTAL	**1 206 972**	**1 157 764**	**4 082.1**	**3 948.6**	**14 424**	**14 229**	**60 537**	**56 592**	**35 358**	**34 581**

Source: EU MS data submission (DCF, EU-MAP), Eurostat, FAO and EWG estimations, 2022.

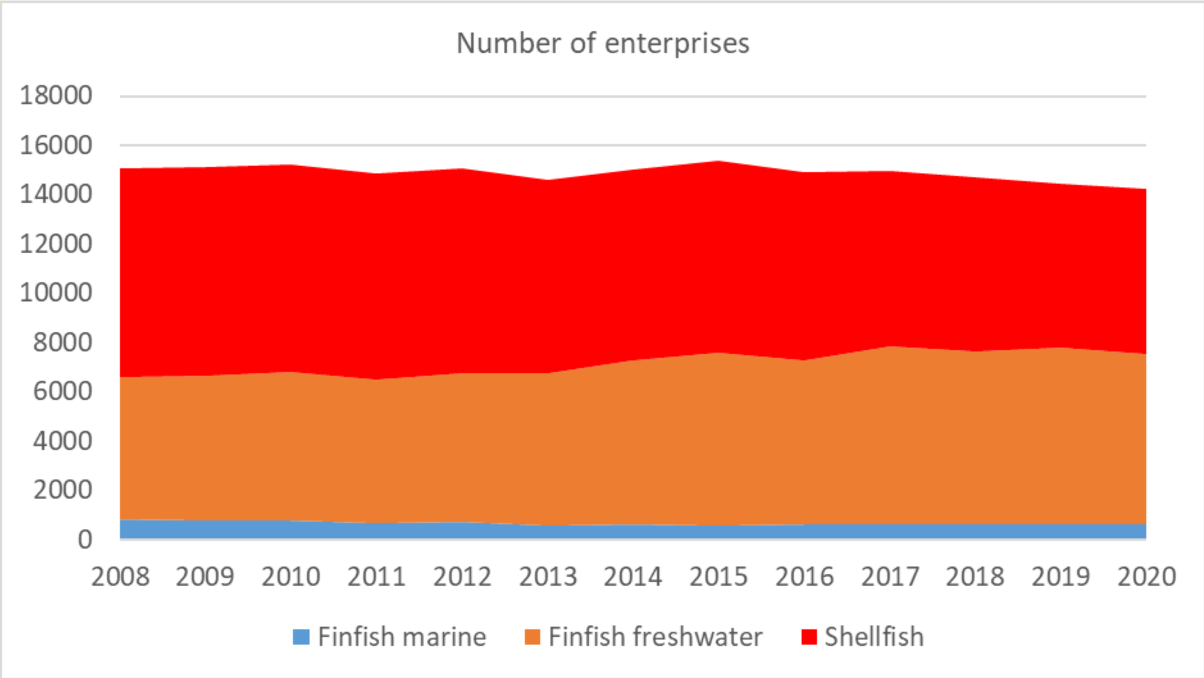
Number of enterprises

A total of 9 123 enterprises were reported under EU-MAP, in 2020. It is further estimated that the total number of enterprises in the EU aquaculture sector is around 14 229 taking into account the EU countries not reporting data. This number has fluctuated around 15 thousand, within a range of a few hundred enterprises, since 2008 and it's decreasing (

Figure 2.4).

The figure 2.4 shows that the enterprises mainly belongs to the freshwater (49%) and the shellfish (47%) sector, whereas only 4% operates in the marine sector. The majority of the enterprises in the EU aquaculture sector are micro-enterprises with less than 10 employees.

Figure 2.4: Total Enterprises in the EU Aquaculture sector: 2008-2020.

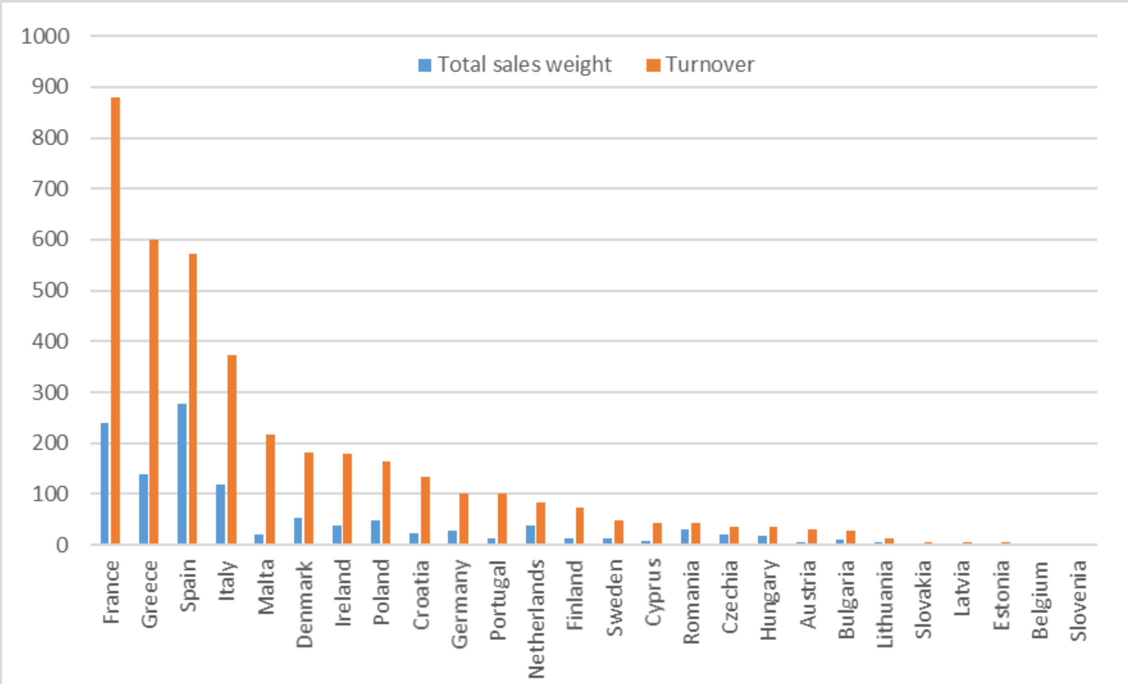


Source: EU MS data submission (DCF, EU-MAP), Eurostat, FAO and EWG estimations, 2022.

Production and sales

The total EU aquaculture production is estimated to be 1 207 and 1 157 million tonnes in 2019 and 2020, respectively. This corresponds to a 0.4% decrease from 2018 to 2019 and a 4% decrease from 2019 to 2020.

Figure 2.5: Total sales weight (in thousand tonnes) and turnover (in million €) in the EU Aquaculture sector per MS: 2020.

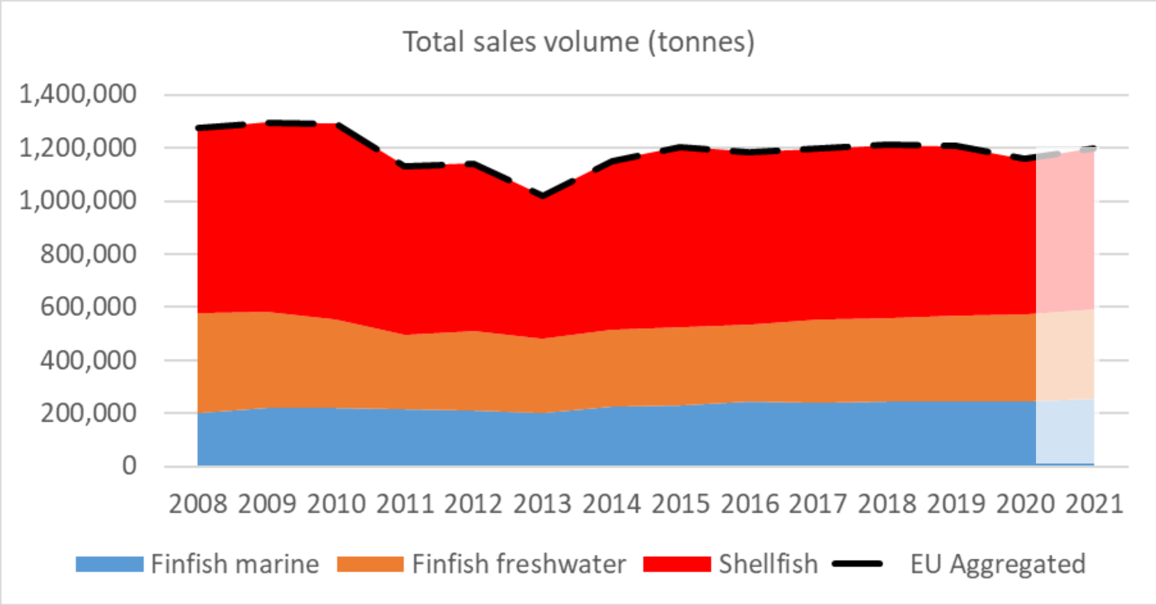


Source: EU MS data submission and EWG estimations, 2022

Large differences in the volumes and turnovers from aquaculture are observed across the 27 EU Member States, with the four main producers being France, Spain, Greece and Italy with reported turnovers between €372 million to €878 million and production being between 119 to 277 thousand tonnes.

Figure 2.6 shows the aggregated total production in the EU aquaculture sector from 2008 to 2020 and a nowcast estimate for 2021. Between 2008 and 2020, the overall EU production seems to be rather stable slightly above 1.2 million tonnes. However, a noticeable decrease is observed between 2010 and 2013, which is mainly due to a decrease in the production of mussels affected by environmental conditions, such as "red ties" in Spain, and shellfish diseases. The recovery from 2013 to 2016 can again be explained by increasing productions of shellfish catching up from earlier years. The shellfish production accounted for 51%, freshwater finfish 28% and marine finfish 21% of the total production in 2020. The nowcast estimate shows a slight increase in production of 3.6% in 2021.

Figure 2.6: Total production in the EU Aquaculture sector: 2008-2020.

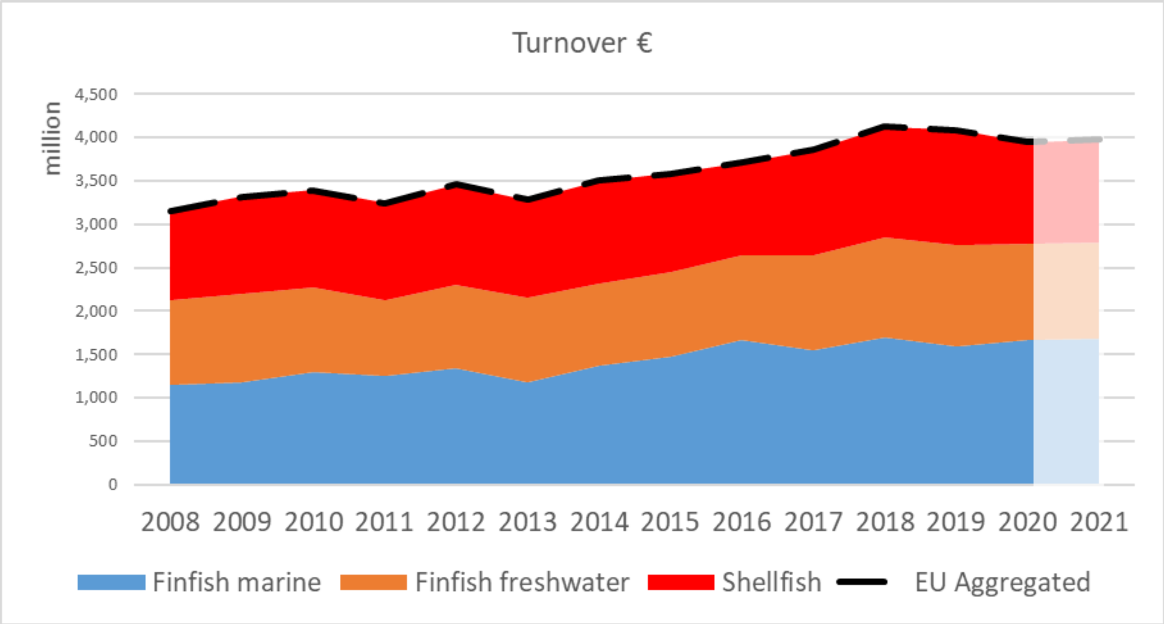


Source: EU MS data submission and EWG estimations, 2022.

Turnover

The total nominal turnover from the EU aquaculture sector was almost €4.1 and €3.9 billion in 2019 and 2020, respectively. This represents a 3% decline in 2020 in comparison with 2019 data. Despite a general rise in prices, the total sales and turnover show a decreasing trend from 2019. The majority of the turnover at the EU level comes from marine finfish production (42%), while shellfish production accounts for 30% and freshwater finfish production 28%. The nowcast estimate for 2021 indicates an increase in turnover to €3 973 million for EU in total due to rise in production volume by almost 4% (figure 2.7).

Figure 2.7: Aquaculture turnover in nominal and real values at EU28 level: 2008-2020.

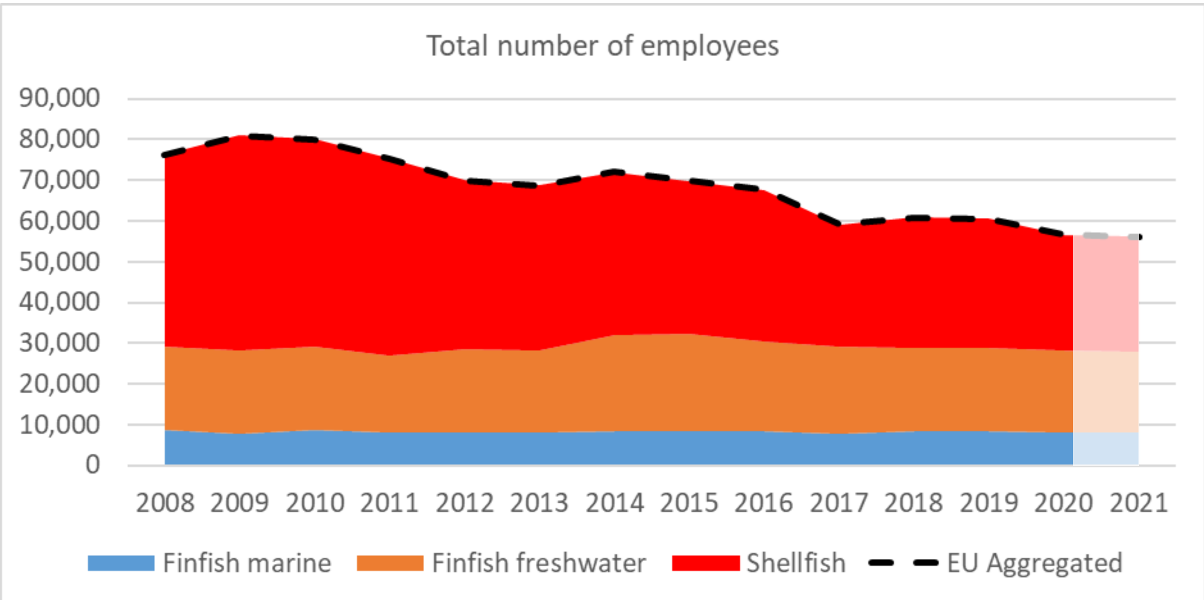


Source: EU MS data submission and EWG estimations, 2022

Employment

From an employment perspective, the social importance of the aquaculture sectors (marine, shellfish and freshwater) is not always reflected in the contribution to the total value in EU totals. Thus, shellfish production employs more labour compared to the marine and freshwater production. The shellfish sector mainly consists of small family owned businesses and has a large social importance for some regions in the EU.

Figure 2.8: Numbers of Employees in the MS Aquaculture sector: 2008-2021.

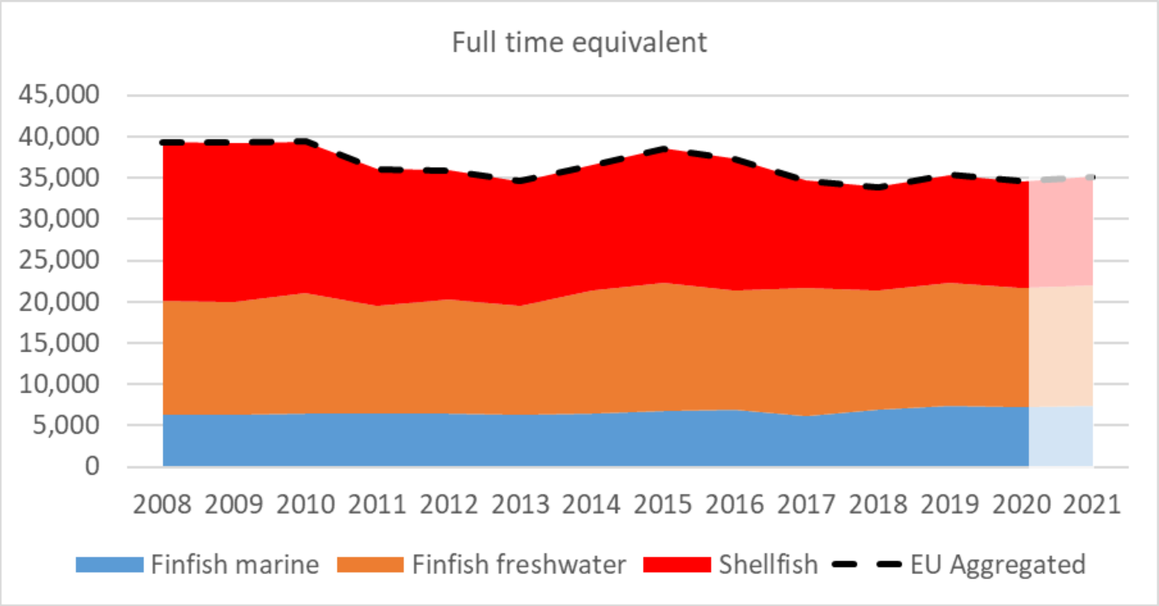


Source: EU MS data submission and EWG estimations, 2022.

The reported EU-MAP data displays an employment of approximately 32 528 persons in 2020, which was 5% less than in 2019 (34 106 employed). Taking into account the estimates for the Member States not reporting data, the EU 27 aquaculture sector directly employed around 56 592 persons in 2020 (figure 2.8). The estimated EU 27 employment in 2019 was 60 537 persons, corresponding to a decrease of 7%. The shellfish sector employs half of the employees in the sector, freshwater finfish production employs 35% and marine finfish production 14% of the persons employed in the EU aquaculture. The nowcast estimate for 2021 indicates a decrease approximately by 1% to 56 085 employees.

Looking at the full-time equivalents (FTEs) of the data collected under EU-MAP, there has been a decrease of 22% from the 27 866 FTEs reported in 2018 to the 21 748 FTEs reported in 2019. In 2020 there was also a slight decline by 3% to 21 112 FTEs in comparison with 2019 data. Overall, it is estimated that the FTEs in the EU 27 countries amounted to 35 358 and 34 581 in 2019 and 2020, respectively. This corresponding to a 4% increase and 2% decrease compared to 2018, respectively (Figure 2.9). The nowcast for 2021 indicates a minor increase of full-time employment equivalents to 35 118 FTEs, corresponding to a rise of 2%.

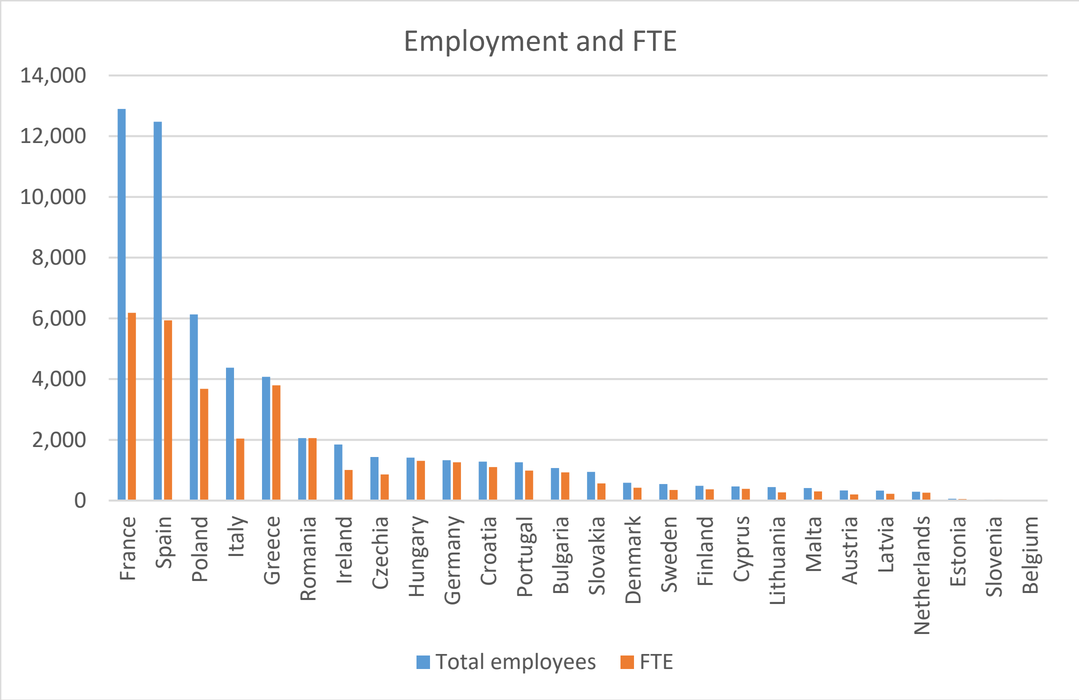
Figure 2.9: Number of FTEs in the MS Aquaculture sector: 2008-2020.



Source: EU MS data submission and EWG estimations, 2022.

The EU aquaculture sector has a significant component of part-time work. This can be seen from the ratio of full time equivalents (FTE) to total employees. The lower the ratio, the more part-time or seasonal work exists, while the higher (closer to 1) the ratio, the more occupation is full time. The estimated data shows that the ratio for the EU aquaculture sector was 0.58 in 2019 and 0.61 in 2020. The raising ratio may be seen in combination with the lower contribution in volume and value from the mussels sector, because a large proportion of part-time and seasonal employment in the aquaculture sector is originating from the shellfish segments.

Figure 2.10: Numbers of Employees and FTEs in the Member States Aquaculture sector: 2020.

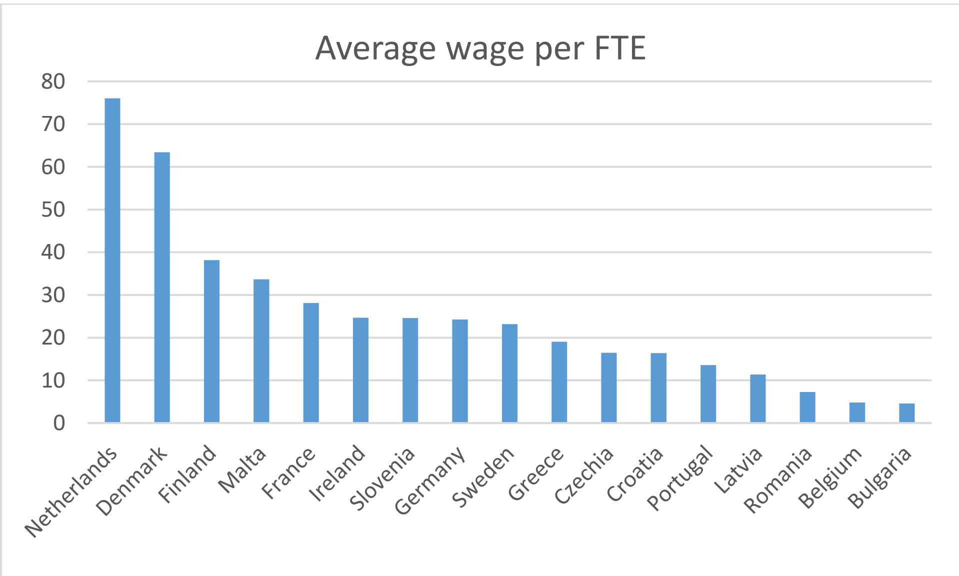


Source: EU MS data submission and EWG estimations, 2022

Mean wages

The average wage is calculated as the sum of the costs in wages and salaries and the imputed value of unpaid labour divided by the total number of FTEs. DCF data from 17 countries show that the average wage per FTE for the EU aquaculture sector in 2019 was about €23 000 per year, and in 2020 it decreased by 1% to €22 800.

Figure 2.11: Average wage in the EU Aquaculture sector per MS: 2020.



Source: EU MS data submission, 2022

Gross Value Added

Gross value added (GVA) is an economic productivity metric that measures the input of a company to an economy. GVA informs about the contribution made by a particular product to the firm's profit. DCF data from 19 countries (some of the countries did not submit the necessary data for calculation of GVA) show that the EU aquaculture sector generated about €1 261 million in GVA in 2019 and €1 350 million in 2020, corresponding to an increase of 7%.

Table 2.2: Economic performance Indicators for the EU aquaculture sector: 2020.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Belgium	-0.1	-0.1	-0.8	-0.3	-5.0	-1.4	-2.2	-3.4	-0.5	-0.6
Bulgaria	16.8	11.1	9.4	3.1	15.0	6.3	14.9	10.7	26.9	22.7
Croatia	64.3	69.1	31.2	43.6	6.9	9.3	55.9	60.8	14.2	14.7
Czech Republic	90.4	92.9	49.1	54.1	39.9	36.5	123.7	119.9	73.5	62.8
Denmark	47.1	37.0	3.8	-6.0	1.4	-2.2	92.4	73.2	16.9	13.7
Finland	19.1	14.7	-0.2	-6.0	-0.1	-4.6	54.2	37.3	14.3	11.3
France	496.5	459.8	137.8	127.8	9.3	9.2	54.1	49.9	33.4	33.0
Germany	67.6	53.5	-2.9	-19.2	-0.9	-6.9	22.4	18.3	21.8	19.1
Greece	59.6	106.8	-47.2	5.2	-3.6	0.3	14.5	25.8	4.6	7.2
Ireland	51.5	72.7	9.4	38.0	3.9	14.4	41.6	67.0	21.1	27.5
Italy	268.5	213.4	189.7	145.7	52.2	46.4			73.9	68.0
Latvia	1.2	0.6	-1.3	-2.1	-4.9	-8.7	7.0	2.5	4.7	2.3
Malta	-27.8	86.8	-42.0	72.4	-73.3	26.4	-95.0	289.9	-48.4	31.7
Netherlands	19.9	24.9	4.7	9.9	4.1	8.7	114.5	146.5	17.3	22.1
Portugal	59.2	70.4	35.8	52.1	18.5	28.1	40.3	55.4	30.6	38.0
Romania		23.1		-1.5		-0.5		11.2		8.5
Slovakia	8.6	0.0	7.6	0.0			33.6			
Slovenia	1.2	0.3	0.0	-0.9	0.1	-13.0	46.9	10.2	17.7	3.9
Sweden	17.8	13.9	4.7	1.6	6.2	1.9	54.1	36.3	23.4	15.9
Total DCF reported	1261.5	1350.7	388.9	517.6	7.4	9.0	52.2	52.6	24.1	23.4

Source: EU MS data submission, 2022.

EBIT (Earnings Before Interest and Taxes or Operating Profit)

EBIT is used to analyse the performance of a firm's primary operations without the costs of the capital structure and tax expenses impacting profit. DCF countries data show that the EU aquaculture sector was less profitable in 2019 with a reported total EBIT of €389 million. In 2020 operating profit increased to €517 million.

ROI (Return On Investment)

ROI is a performance measure to evaluate the profitability of an investment. ROI is calculated as EBIT divided by total assets. DCF countries data show an average ROI of the EU aquaculture sector of 9% in 2020, which is an increase from the 7.4% reported in 2019.

Labour productivity

The labour productivity is calculated as the Gross value added divided by the total number of FTEs. DCF countries data show that the labour productivity for the EU aquaculture sector was about €53 thousand per FTE in 2019 and 2020. There is a large variation between member states in the estimated labour productivity. Some of this variation may be due to an over or under estimation from the number of persons employed to the number of FTEs in each country.

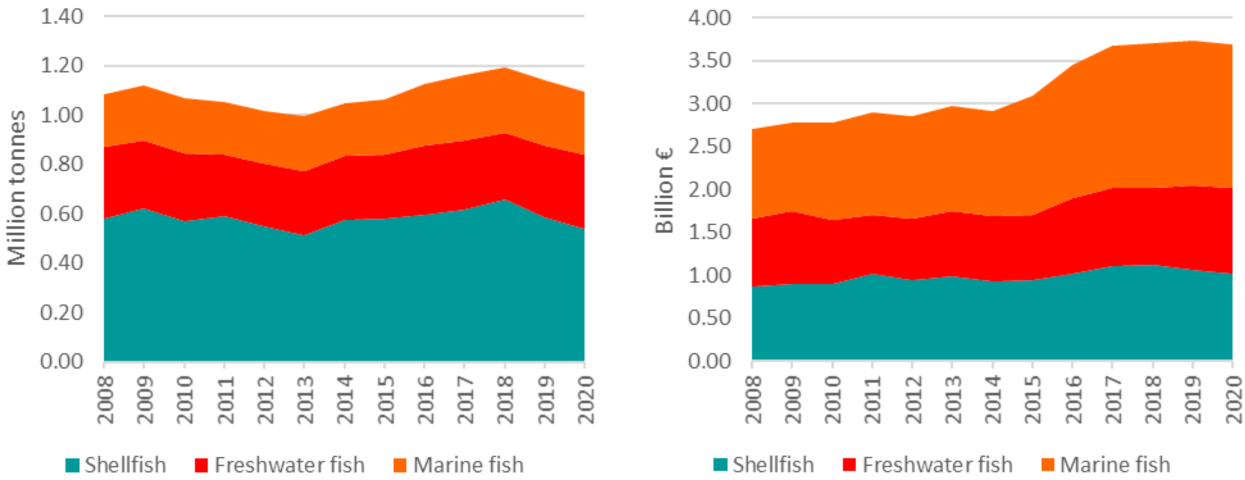
Capital Productivity

Capital productivity is calculated as Gross Value Added (GVA) divided by Capital value (total value of assets) in percentage. The indicator describes the average value added to the economy per unit of capital invested in the aquaculture sector. DCF countries data show that the capital productivity for the EU aquaculture sector was 23.4% in 2020, which was slightly lower than the 24.1% reported in 2019.

3 THE STRUCTURE OF THE EU AQUACULTURE SECTOR

In 2020, marine fishes, freshwater fishes and shellfish accounted for 23%, 27% and 49% of the EU production of aquaculture in terms of weight, respectively. In value terms, marine fishes, freshwater fishes and shellfish accounted for 45%, 27% and 28% of the production value (Figure 3.1).

Figure 3.1: EU (27) aquaculture production in weight and value by subsector: 2008-2020

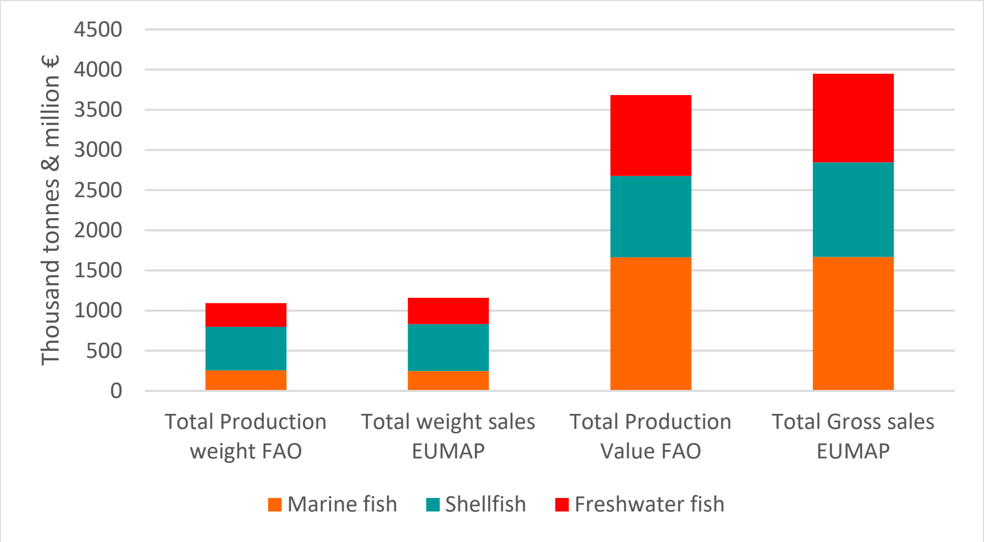


Source: Own elaboration from FAO, 2022

Given that not all Member States report the economic indicators of their aquacultures sector, the EWG performed some estimations of total EU sales and economic performance. Figure 3.2 shows the total sales in weight and value reported by MS under the EUMAP included the EWG estimations and total production from FAO for the EU 27 in 2020. The total weight of sales reported under the EUMAP were 783 thousand tonnes, whereas the total estimated production was 1 158 thousand tonnes, while FAO total production weight was 1 094 thousand tonnes. The total value of sales reported under the EUMAP was €2 993 million, whereas the estimated value of the total production was €3 949 million, while FAO production value was €3 684 million.

The estimates for total production in weight and valued were calculated on the basis of alternative sources (i.e., FAO). However, most economic variables are only available from the DCF/EUMAP data collection and not from those alternative sources. Therefore, the rest of this chapter focuses on DCF/EUMAP data.

Figure 3.2: EU-27 Aquaculture production in weight and value by subsector comparison from EUMAP and FAO: 2020.



Source: EU Member States EUMAP data submission and EWG estimations, 2022 and FAO, 2022.

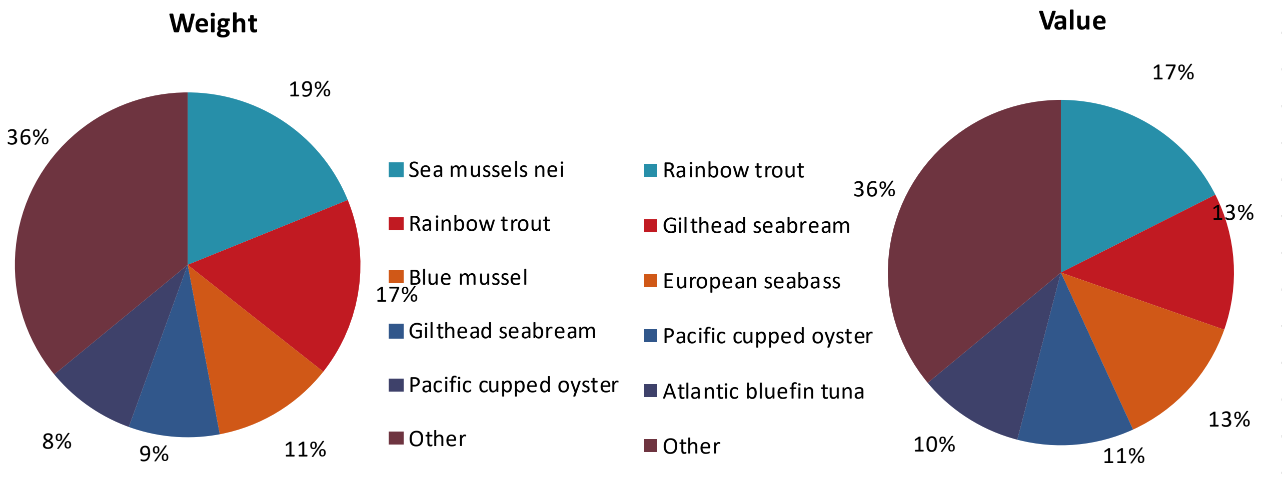
Main species in the EU aquaculture

In 2020, the main aquaculture species produced were sea mussels (without the species being fully specified, but mostly consisting of Mediterranean mussels) with 206 thousand tonnes (19% of total EU production), rainbow trout (183 thousand tonnes, 17%), blue mussels (124 thousand tonnes, 11%), Pacific cupped oysters (93 thousand tonnes, 9%), gilthead seabream (88 thousand tonnes, 8%), Mediterranean mussels (this time with the species fully specified, 78 thousand tonnes, 7%), European seabass (78 thousand tonnes, 7%), common carp (72 thousand tonnes, 7%) and Atlantic bluefin tuna (29 thousand tonnes, 3%). These nine species account for the 87% of the total EU aquaculture production in weight.

We observe a certain specialisation in the production across countries. The major shellfish producers were Spain, France, Portugal and Italy. Pacific cupped oysters were mostly produced in France, whereas Rainbow trout was produced mainly in Denmark, France and Spain.

In 2020, the main aquaculture species produced in value were rainbow trout (€649 million, 17% of total EU value), Gilthead seabream (€473 million, 13%), European seabass (€473 million, 13%), Pacific cupped oysters (€403 million, 11%), and Atlantic bluefin tuna (€367 million, 10%). These five species accounted for 64% of the total EU-27 aquaculture production in value.

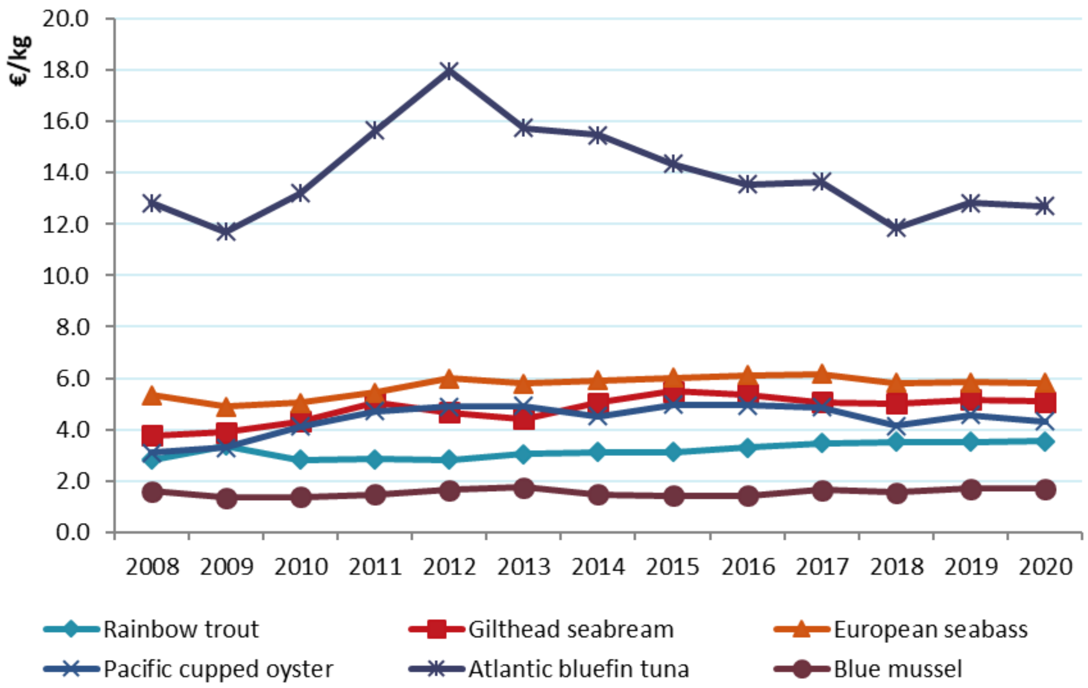
Figure 3.3: Main species produced in EU-27 aquaculture: 2020.



Source: FAO, 2022

In figure 3.4, the average prices for the main species are shown. It can be seen that tuna is the most valuable species, however it is also the price that shows most variability over the period 2008 to 2020. For all other major species prices seems stable over the period 2008 to 2020 even though there are minor fluctuations.

Figure 3.4: Main species prices in EU-27 aquaculture 2008-2020.



Source: FAO, 2022

3.1 Marine finfish aquaculture

Fish production in marine aquaculture is characterised by being capital intensive, in the sense that relatively large investment is needed on physical equipment and stoking of cages compared to the input of labour.

Table.1.1. Economic indicators for the EU marine aquaculture: 2019-20.

Country	Number of enterprises		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Croatia	28	29	16.2	18.5	111.1	126.0	840	854	739	746	21.9	19.5
Denmark	4	4	14.4	11.3	60.8	53.8	90	95	68	69	83.2	87.9
Finland	32	28	8.9	8.7	47.7	40.3	184	153	134	131	37.0	38.3
Greece	358	358	111.7	113.3	539.7	582.7	3,313	3,322	3,187	3,196	22.0	22.0
Ireland	26	28	11.7	13.3	112.1	126.8	243	212	217	159	42.7	42.3
Italy	43	43	11.1	10.9	79.8	84.4	389	389				
Malta	9	9	13.8	19.8	161.9	215.4	341	410	293	300	32.5	33.6
Portugal	50	46	6.4	6.6	46.0	41.3	287	501	485	490	21.1	19.2
Slovenia	1	1	0.1	0.1	0.4	0.5	12	12	12	12	20.7	29.1
Total DCF reported	**551**	**546**	**194.2**	**202.5**	**1,159.5**	**1,271.2**	**5,699**	**5,948**	**5,134**	**5,103**	**24.8**	**24.0**
Other none DCF	215	176	75.9	65.2	549.3	488.8	2,227	1,914	2,006	1,642		
Total EU	**766**	**722**	**270.1**	**267.7**	**1,708.8**	**1,760.0**	**7,926**	**7,862**	**7,140**	**6,745**	**24.8**	**24.0**

* Italian data on FTE and on average wage are not reported as the EWG considers them to be unreliable.
Source: EU Member States DCF data submission 2022 and EUROSTAT

The total sales volume for the European marine aquaculture sector is estimated to be 267.7 thousand tonnes generating €1.76 billion of turnover in 2020. Compare to 2019 total weight of marine aquaculture decreased by approximately 1% (270.1 thousand tonnes in 2019) whereas, turnover increased by 3% (€1.709 billion in 2019). Available data report 722 enterprises in the marine sector in 2020, showing a decrease of 5.7% compared to 2019 (766 companies in 2019). Employment reached 7 862 employees and 6 914 FTEs. Most employees in the marine sector were working full time. On average, the enterprises had 11 employees.

Table.1.2: Economic Performance indicators for the EU marine aquaculture: 2019-20.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Croatia	51.0	64.0	23.8	40.5	6.9	11.4	69.1	85.8	14.9	18.0
Denmark	15.1	12.3	8.2	5.3	16.8	9.6	221.5	178.6	30.9	22.7
Finland	17.6	10.1	11.0	3.3	20.0	6.8	131.4	76.9	32.0	21.1
Greece	41.8	95.1	-55.7	1.6	-4.4	0.1	13.1	29.8	3.3	6.5
Ireland	10.9	33.7	-2.2	22.5	-1.7	16.4	50.0	212.6	8.7	24.5
Italy	43.6	31.0	31.0	19.4	32.6	21.0			46.0	33.7
Malta	-27.8	86.8	-42.0	72.4	-73.3	26.4	-95.0	289.4	-48.4	31.7
Portugal	-1.8	11.3	-14.7	0.8	-10.4	0.6	-3.8	23.1	-1.3	8.4
Slovenia	0.3	-0.4	-0.1	-0.8	-4.3	-34.8	21.2	-29.3	10.2	-15.3
Total DCF reported	150.6	344.0	-40.7	165.0	-1.9	6.4	29.3	67.4	7.0	13.4
Other none DCF	71.4	132.3	- 19.3	63.4						
Total EU	**222.0**	**476.3**	**- 60.0**	**228.4**	**- 1.9**	**6.4**	**29.3**	**67.4**	**7.0**	**13.4**

* Italian data on labour productivity are not reported as the EWG considers them to be unreliable.
Source: EU Member States DCF data submission, 2022

The average wage for the EU marine aquaculture sector was €24 thousand in 2020, with a significant variability across countries (e.g., from €19.5 thousand in Croatia to €87.9 thousand in Denmark). This variability can be explained by differences in labour productivity and the capital and production intensity of the different techniques.

The marine sector provided €476.3 million in GVA and €228.4 million in EBIT (Earnings Before Interest and Tax). Compare to 2019 GVA and EBIT marine aquaculture increased significantly by 42% and 75%, respectively. This is mainly due to the increase of profitability in Malta, Greece and Portugal. The overall economic performance in marine aquaculture was greatly improved in 2020 due to the rise in operating subsidies by more than 300% compare to 2019 and the reduction in livestock costs by approximately 30%. Furthermore, energy cost was decreased by nearly 11% compare to 2019. On the other hand, feed costs increased by around 8%, which is a major input factor. The repair and maintenance may not be one of the major expenses but it was increased remarkably by more than 50%. Labour productivity rose to €67.4 thousand in 2020, compared to merely €29.3 thousand in 2019.

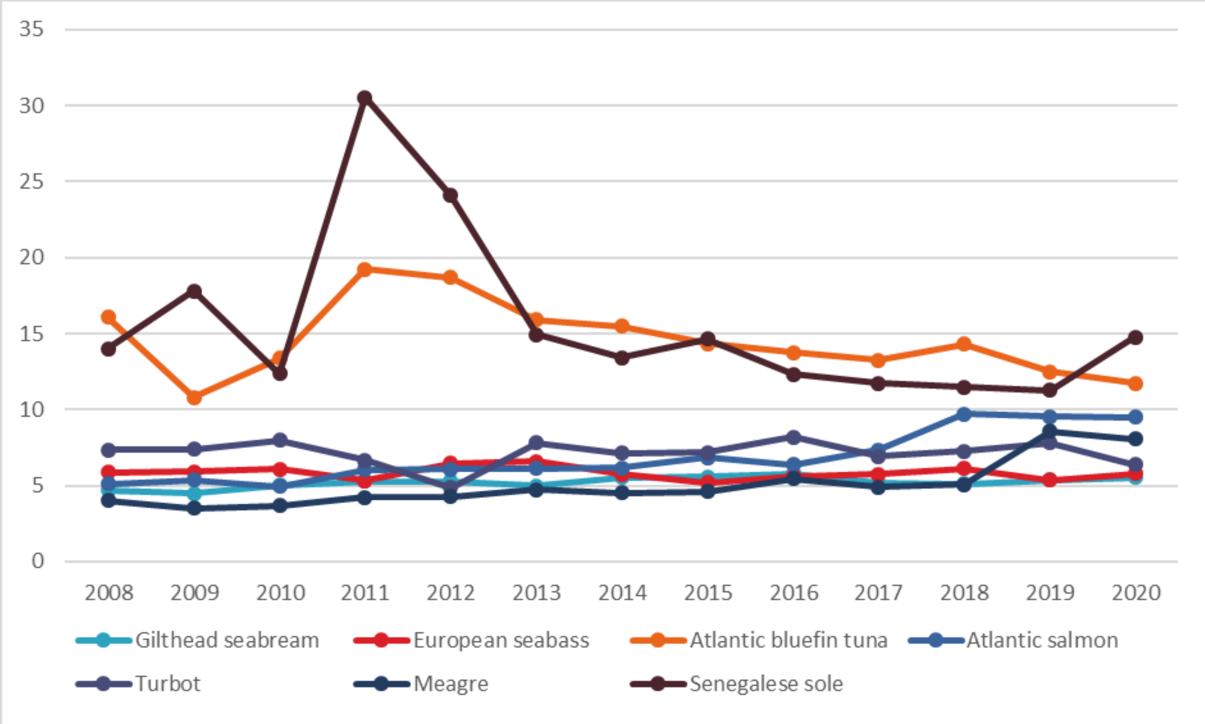
The most produced marine species in terms of sales volume was Gilthead seabream representing 36% of total weight, followed by European seabass (32%) and Atlantic Bluefin tuna (11%). In terms of total sales value, Gilthead seabream represented 29% of total value, followed by European seabass (28%) and Atlantic Bluefin tuna (22%). The fourth place in both weight (5%) and value (7%) is Atlantic salmon. Atlantic salmon was previously the most important species; however, the vast majority was produced in the UK, which is no longer a part of the EU. In 2018, 92% of Atlantic salmon production in the EU-28 originated from UK farms.

During the 2019-2020 period average market price for Gilthead seabream increased slightly by 3% whereas, the European seabass increased by 7.9%. However, the price for Atlantic Bluefin tuna decreased by 6.1%.

Figure 1.1: Main species produced in the EU marine aquaculture: 2020.

Source: FAO, 2022

Figure.1.2: Price (€/kg) evolution of the main species produced in the EU marine aquaculture: 2008-2020.



Source: EU Member States DCF data submission, 2022

3.1.1 Seabass & Seabream

According to FAO production data, the combined production of European seabass (*Dicentrarchus labrax*) and Gilthead seabream (*Sparus aurata*) more than doubled during the 2008 – 2020 period from 245.3 thousand tonnes valued 1 480 million USD in 2008 to 558.5 thousand tonnes valued 2 816 million USD in 2020. Twenty-seven countries were producing one or both species in 2020. Leading production countries are Turkey and Greece producing 46% and 18% of the total volume and 38% and 20% of the total value in 2020, respectively. The ten largest producing countries: Turkey, Greece, Egypt, Spain, Tunisia, Croatia, Saudi Arabia, Italy, Cyprus and Albania produced more than 95% of the total volume in 2020. Turkey, Egypt, Tunisia, Saudi Arabia and Albania have considerably increased the production volume since 2008. The EU member states Croatia and Cyprus have also considerably increased production volume since 2008, whereas the main EU production member state, Greece, during the same period have increased production volume at a lower rate by 18%. Production volume has decreased in France, Italy and Spain by 18%, 11% and 9%, respectively during the same period. Thus, the volume share of the EU producer countries has decreased from 60% in 2008 to 31% in 2020. Accordingly, the value share of the EU producer countries has decreased from 65% in 2008 to 38% in 2020 (FAO, 2022).

Global production of European seabass according to FAO production data, has more than doubled during the 2008 – 2020 period from 115 thousand tonnes valued 781 million USD in 2008 to 276.5 thousand tonnes valued 1 361 million USD in 2020. Turkey and Greece are the world seabass leading producers with 54% and 15% of the volume and 46% and 17% of the value produced in 2020, respectively. The EU member states produced 81 thousand tonnes, valued 540 million USD, in 2020. The main European producer is Greece with 41 thousand tonnes, followed by Spain and Croatia with 23 and 6.7 thousand tonnes, respectively. The volume share of the EU producer countries has decreased from 52% in 2008 to 29% in 2020. Accordingly, the value share of the EU producer countries has decreased from 61% in 2008 to 40% in 2020 (FAO, 2022).

Global production of Gilthead seabream according to FAO production data, increased during the 2008 – 2020 period from 130 thousand tonnes valued 698 million USD in 2008 to 282 thousand tonnes valued 1 455 million USD in 2020. Turkey and Greece are the world Gilthead seabream leading producers with 39% and 22% of the volume and 30% and 23% of the value produced, respectively. The EU member states produced 93 thousand tonnes, valued 540 million USD, in 2020. The main European producer is Greece with 62 thousand tonnes, followed by Croatia, Spain and Italy with 7.8, 6.4 and 6.2 thousand tonnes, respectively. The volume share of the EU producer countries has decreased from 68% in 2008 to 33% in 2020. Accordingly, the value share of the EU producer countries has decreased from 70% in 2008 to 37% in 2020 (FAO, 2022).

The European seabass and Gilthead seabream sector was undergoing a consolidation phase during the past decade. The three major production companies in Greece are now part of a large company group under the same ownership, which also includes companies in Spain. Other large aquaculture companies in Greece have recently been integrated with large fisheries and processing groups with world-wide sales networks. The Spanish production suffered significant damages by the Gloria storm during 2020 allowing other producing countries partially offset the lower demand due to Covid-19. The Spanish seabass & seabream production has already recovered from the effects of Gloria storm in 2022. Covid-19 has negatively affected the sales in Greece, especially in the HoReCa sector mainly due to strict lockdowns. At the same period, sales at the Greek retail sector increased and exports of frozen aquaculture products increased offsetting the lower demand at the HoReCa sector. In Italy, no new companies were registered, but the dynamics of business aggregation continued, generating joint ventures. With respect to the production structures, vertical integration has been strengthened. Upstream integration with feed companies is not common. The seabass and seabream segment in Italy reacted well to the criticalities of the two pandemic waves during 2020-2021. It was because products reach the end-market through sales to large wholesalers, direct supply to large-scale retailer trade, and food supply logistics platforms. Actions to support social acceptability and investigate new markets for seabass and seabream have been implemented in Italy. The “Italian fish in health canteens” project provided for the supply of seabass and seabream in hospital canteens of some Italian regions. The results showed a decrease in fish waste and confirmed a market willing to absorb these species. In Portugal, offshore aquaculture has started to emerge. Croatian production continues to expand, followed by increased investments in processing facilities in order to maintain profitability, enhance the efficiency of business procedures and reach a wide range of target customers through premiumization – providing high valued innovative products and constantly expanding the product portfolio. Although major market disruptions occurred during 2020-2021, which significantly increased costs, the sector managed to adapt and improve logistics to compensate the losses caused by the closures of HoReCa sector, which accounts for 20-50% market for fresh fish.

Table 3.5: Economic indicators for the EU seabass & seabream aquaculture: 2020.

Country	Number of enterprises		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Croatia	23	24	13.0	14.7	76.7	88.4	531	534	459	472	22.1	19.4
Greece	358	358	111.7	113.3	539.7	582.7	3,313	3,322	3,187	3,196	22.0	22.0
Italy	43	43	11.1	10.9	79.8	84.4	389	389				
Malta	2	2	1.8	2.7	9.8	11.2	179	49	147	43	32.5	29.7
Portugal	43	40	2.5	3.0	15.5	17.1	204	303	202	294	20.8	18.2
Slovenia	1	1	0.1	0.1	0.4	0.5	12	12	12	12	20.7	29.1
Total DCF reported	**470**	**468**	**140.2**	**144.6**	**721.9**	**784.3**	**4,628**	**4,609**	**4,007**	**4,017**	**22.4**	**21.6**
Other none DCF	169	132	50.5	40.9	300.8	253.1	1,669	1,303	1,445	1,136		
Total EU	**639**	**600**	**190.7**	**185.5**	**1,022.7**	**1,037.3**	**6,297**	**5,912**	**5,451**	**5,153**	**22.4**	**21.6**

Source: EU Member States DCF data submission, 2022

The vast majority of seabass and seabream is produced and consumed in Southern European and other Mediterranean countries. New markets are steadily emerging and exports to North America and the Middle East are nowadays becoming regular. The European industry in 2020, according to the DCF data consists of 468 enterprises (number of units in the case of Greece which does not correspond to companies), which is almost same as in 2019. When accounting also for EU member states that did not submit DCF data, the industry consists of 600 enterprises in 2020, which is 39 less than in 2019. Most of these firms combine the production of the two species, and volumes of each may change yearly according to the demand, prices, and fingerling availability. When the price of seabream decreases, producers usually increase the production of seabass and vice versa. The production of new species, such as meagre and pagrus is now common for European firms.

Based on DCF data, in the reference period the seabass and seabream segment slightly increased in terms of production volume and value but at the same time decreased in terms of employment. When accounting for EU member states that did not submit DCF data, the segment decreased in terms of both volume and employment, but increased in value. This decrease in volume may be mainly attributed to the effects of storm Gloria in Spain. EU production in 2020 reached 185.5 thousand tonnes, which corresponds to 5 thousand tonnes less than 2019. At national level, growth was recorded in Malta, Portugal, Croatia, and Greece while Italy recorded a decrease in production. In absolute values, both Greece and Croatia increased the production in 2020 by 1.6 thousand tonnes. The value of EU production increased during 2020 to €1 037 million. All DCF countries recorded an increase of the turnover - Slovenia (28%), Malta (15%), Croatia (15%), Portugal (10%), Greece (8%), and Italy (6%). Employment (DCF data, but missing data from Italy) is recorded at slightly more than 4 600 employees corresponding to 4 145 FTEs. When accounting for EU member states that did not submit DCF data, employment is recorded at slightly less than 6 000 employees corresponding to 5 153 FTEs which presents a decrease of 385 employees or 298 FTEs since 2019. On average, the wages in the EU seabass and seabream aquaculture segment slightly decreased, compared to 2019, except in the case of Slovenia where a rather high increase is recorded.

Since 2012, the EU production of seabass and seabream has stabilised. The most important factors driving this stabilization refer to the 2008/2009 price decline and the weak demand in southern Europe as an effect of the lower income due to the debt crisis at the time. Southern European member states have been influenced by the global economic crises (Italy, Slovenia, Croatia, Spain and Greece) during the recent years. Low credit availability in southern Europe also contributed to the stabilization of production. On top, rising feed costs have weakened the economic performance of the sector. Recent liquidity problems of the Greek producers did not allow the sector to fully recover from the 2008/2009 price decline up until 2016. In Greece, the concentration process of the sector during the past years was mainly financed by loans. A large number of Greek SME's and larger aquaculture enterprises were unable to repay these loans and a new restructuring and concentration cycle has started in Greece during 2014. The ownership of the major seabass and seabream aquaculture companies was transferred to the Greek banks during 2015/2016 thus later facilitating the flow of working capital. Ownership was then transferred during 2018 to an investment fund, which now controls the three larger production companies in Greece and companies in Spain under the same brand name. Further consolidation of the seabass and seabream sector in Greece is less likely; nevertheless, other investment funds have also expressed their interest to consolidate production in Greece. On the other hand, in the case of Croatia, there is a growth in production after the opening of the EU market for Croatia in 2013 (250% from 2013 to 2020) and overcoming the economic crises. Following the investments and improvements in technology and distribution of fish products, as well as vertical integration towards processing, and more emphasis on social acceptability through marketing activities, certification and ecolabelling, it is expected to further encourage the total production and may have an impact in further positioning of Croatia in EU aquaculture sector. Also, improvement in logistics and geographical position close to the EU market gradually improved the competitiveness of Croatian aquaculture products.

Since 2008, non-EU countries such as Turkey, Egypt and Tunisia and recently Saudi Arabia and Albania have considerably increased production of the two species. Until 2012, approximately 10% of the Turkish production was controlled by Greek enterprises, but since then, most of these assets were transferred to new owners. While Turkish seabream production is significant, large quantities produced are consumed in the local market. On the other hand, Turkish seabass production is exported to EU countries.

According to FAO market reports, for the last decade, Turkish production has been steadily increasing production volumes due to instabilities in the Greek industry, but also due to advantages in terms of production costs and received substantial investment and government support, which allowed pricing bellow Greek counterparts and entering into established and emerging markets alike. On the other hand, there exists a price premium for the European seabass production, which is attributed to the quality of the product. The delay of approximately one day for Turkish fresh seabass to reach the EU markets is reflected in the quality and the price of the product. The export subsidy that used to compensate for the lower price of the Turkish product has also contributed to the lower price of the product in the EU market. Nowadays, Turkish producers leverage the logistics developed in Greece to facilitate the exports of aquaculture to EU countries so Greece has become the second largest export destination for seabream and seabass of Turkish origin. After the imports clearance in Greece, the Turkish products are distributed (as of Turkish origin) throughout Europe. Processing facilities in Greece have been recently acquired by Turkish owners allowing for the processing of Turkish and other non-EU produced aquaculture products to be processed in the EU.

While export subsidies in non-EU countries seem to have been eliminated, still the playing field is not levelled for the EU seabass and seabream producers. Non-EU production is not regulated to the same extent as in the EU and producers do not need to maintain the same production standards (thus allowing for lower production costs). Nevertheless, both EU and non-EU producers compete in the same markets. A new label “Fish from Greece” has been introduced recently targeting export markets in order to differentiate from non-EU imported products. If successful, this label may aid to level the playing field between the Greek products produced under strictly regulated conditions in the EU and non-EU products.

For the EU countries that reported seabass and seabream economic performance data by segment the turnover reached €1 037 million in 2020, mainly originating from the cages segment. Due to the transition to EUMAP segmentation where some of the countries reported their data in DCF segments and others adapted to EUMAP segments, there could be some inconsistencies in segments compared to previous time series. In addition, as the overall dominance of cage farming techniques is present, economic results on seabass and seabream are being shown in total.

Performance indicators for the EU seabass and seabream producer countries are presented in the table below. In 2020, Croatia, Greece, Italy and Malta obtained positive economic returns, Portugal improved the economic performance but still ended up with negative indicators and Slovenia got worse economic returns in 2020 compared to previous year. GVA in 2020 resulted with increase in Greece (by €53.3 million or 127% respectively), Malta (by €19.1 million or 124% respectively), Portugal (by €6.9 million or 99% respectively, but still negative), and Croatia by €13.4 million or 36% respectively), while others recorded a decrease (Italy by €12.6 million or 29% respectively and Slovenia by €0.6 million or 239% respectively). Total GVA increased by €79.5 million, or 79.5% respectively. When accounting also for EU member states that did not submit DCF data, GVA increased by €95.7 million or 67% respectively.

Table 3.6: Economic Performance indicators for the EU seabass and seabream aquaculture: 2020.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Croatia	37.1	50.5	19.6	35.8	8.5	15.0	80.9	106.9	16.1	21.1
Greece	41.8	95.1	-55.7	1.6	-4.4	0.1	13.1	29.8	3.3	6.5
Italy	43.6	31.0	31.0	19.4	32.6	21.0			46.0	33.7
Malta	-15.4	3.7	-22.3	2.1	-87.9	15.6	-104.7	86.7	-60.7	28.1
Portugal	-7.0	-0.1	-11.8	-5.3	-19.5	-7.4	-34.5	-0.3	-11.5	-0.1
Slovenia	0.3	-0.4	-0.1	-0.8	-4.3	-34.8	21.2	-29.3	10.2	-15.3
Total DCF reported	100.4	179.9	-39.3	52.7	-2.3	2.8	14.2	37.1	5.9	9.5
Other none DCF	41.8	58.1	- 16.4	17.0						
Total EU	**142.2**	**238.0**	**- 55.6**	**69.8**	**- 2.3**	**2.8**	**14.2**	**37.1**	**5.9**	**9.5**

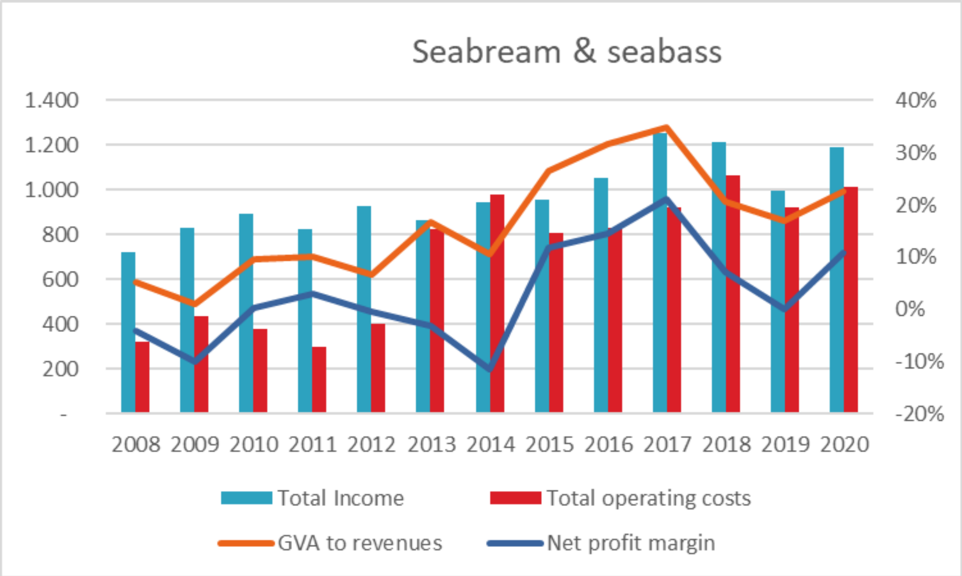
Source: EU Member States DCF data submission, 2022

In the reference period, EBIT increased in all countries except Italy and Slovenia. The biggest growth of EBIT was recorded in Greece (€57.3 million or 103% respectively) and Malta (€24.4 million or 109% respectively). Total EBIT increased by €92 million, or 234% respectively. When accounting also for EU member states that did not submit DCF data, EBIT rose by €125.4 million or 225% respectively.

Labour productivity and capital productivity improved in Croatia, Greece, and Malta; while Portugal and Slovenia showed negative performances, (data for Italy are missing). Total labour productivity increased from €14.2 thousand in 2019 to €37.1 thousand in 2020, while capital productivity increased from 5.9% in 2019 to 9.5% in 2020.

The evolution of the markets during 2019 and 2020 determined that the process of improving the economic results is mostly consolidated, bearing in mind the situation with pandemics' outbreaks. However, increase in supply, the behaviour of prices, and the ability of the industry to diversify products and markets, adapt to rapidly changed market needs, and consolidate improvements in the production process will be the main determining factors of this evolution.

Figure 3.11: Economic performance indicators for seabass and seabream aquaculture: 2008-2020.

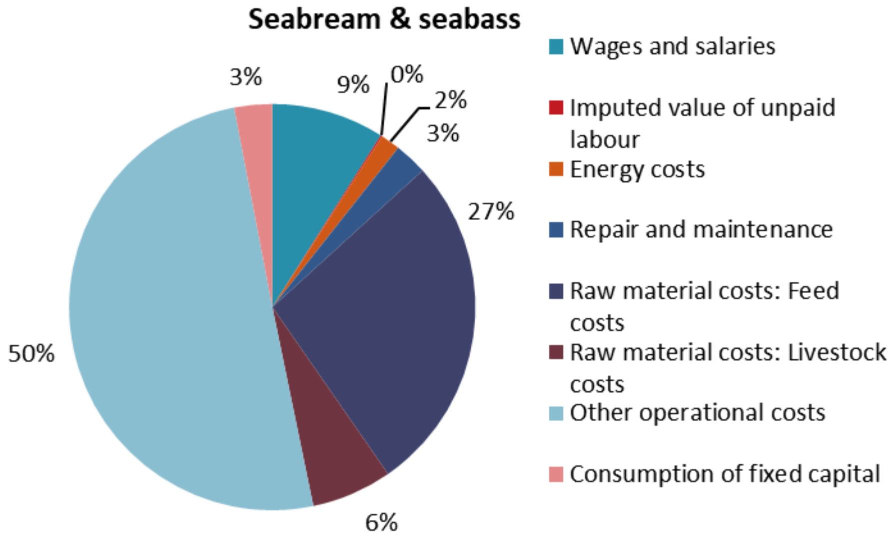


Source: EU Member States DCF data submission, 2022

As presented in the figure above, the EU seabass and seabream segment from 2012-2014, presents operating costs higher than the turnover thus growing losses are recorded for 2013 and 2014. However, due to market stabilization, turnover in 2015 has for the first time since 2010 exceeded the total operating costs. This trend was halted in 2017, when total revenue decreased and operating costs continued to rise. The negative trend continued in 2018, when rising operating costs and stagnant revenues caused the GVA to revenues and net profit margin to fall to pre-2015 levels. The total income decreased again in 2019, but operating costs also decreased so the sector continued the trend of positive indicators overall. In 2020, the total income increased significantly despite market disruptions caused by pandemics and return the segment to the trend of growth.

In the figure below, the cost structure of the EU seabass & seabream aquaculture sector is presented for 2020. In total, raw material (feed costs and livestock) account for 33% of the total cost, slightly increasing from 2008. From 2019 to 2020, feed costs share decreased from 29 to 27%, following while share of livestock costs decreased from 7% to 6%. Other operational costs rose from 47% in 2019 to 50% in 2020, which started an increasing trend compared to varying shares between 15% and 20% since 2008. Wages and salaries account for 10% in 2019 and 9% of the total cost respectively in 2020, with decreasing trend started in 2016. Part of the decreasing trend may be attributed to the decreasing wages and salaries in the southern EU countries but also to the outsourcing of some activities in the segment. After increase from 1% in 2008 to 7% in 2014 reflecting the increasing fuel prices for the period 2008 to 2014, the energy cost share decreased to 2% in 2016 and remained same during 2019 and 2020. According to market reports, in the next reporting period, it is expected to realize improvements in production, processing, logistics and marketing that will help to boost company margins through demand generation and cost savings.

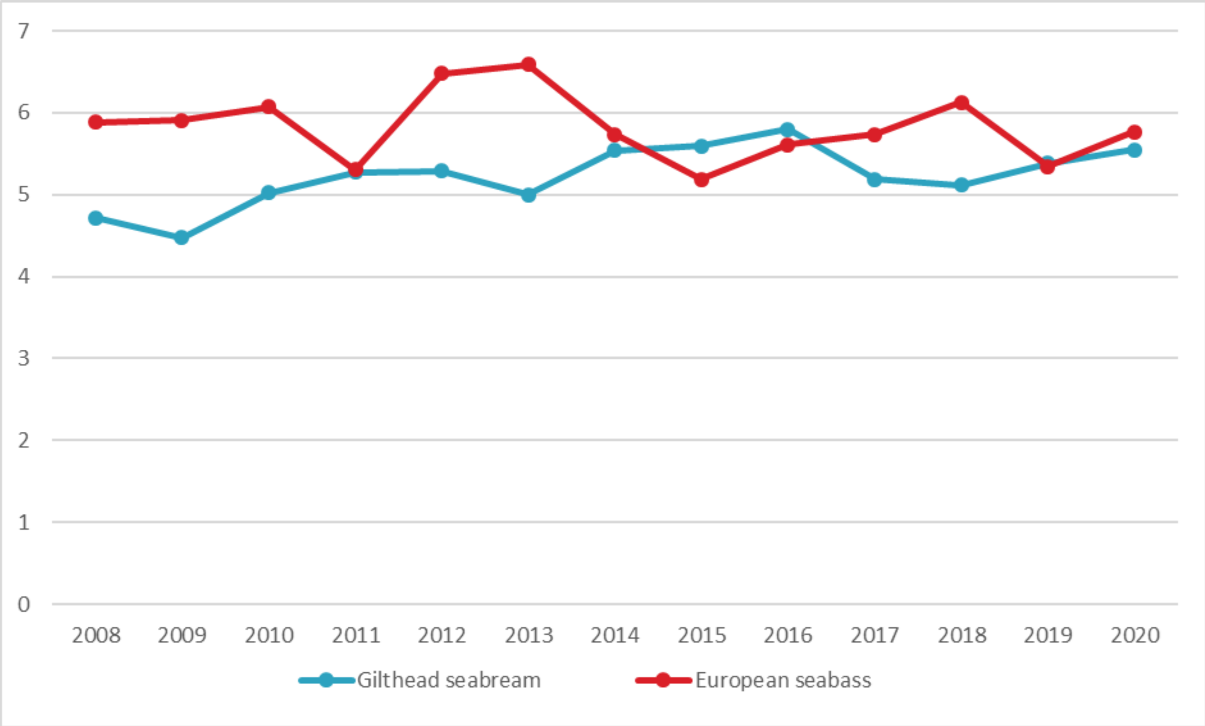
Figure 3.13: Costs breakdown for the EU seabass and seabream aquaculture: 2020.



Source: EU Member States DCF data submission, 2022

In the next figure, the price evolution of European seabass and Gilthead seabream is presented. Low seabream price for 2008-2009 is identified while since 2010 the price is more than €5 per kg with annual fluctuations. On the other hand, seabass price is rather stable until 2011, presenting an upward trend up to 2013 and, for both species, the price seems to converge in 2015 and further in 2016 at approximately €5.6 per kg. The price for seabass continued to grow until 2019, when the price dropped under €6 per kg while the price for seabream continued to increase to €5.5 per kg in 2020. These variations in last two years are due to variations in harvest volume recorded in 2019 and 2020 for the largest producing countries – Turkey, Greece and Spain. Due to Covid-19 and lower demand in the traditional markets, producers in Greece turned to stocking of products (frozen) and new markets while recently announcing the lunch of new mainly ready to cook and ready to eat products. On the other hand, a significant rise in the production of marine species other than seabass and seabream is expected in Greece. In order to maintain stable market prices, it is necessary to level the playing field for EU and non-EU producers, diversify the export markets and develop a wider range of products.

Figure 3.14: Price (€/kg) evolution of the main species of seabass and seabream group: 2008-2020.



Source: EU Member States DCF data submission, 2022

3.1.2 Salmon

Atlantic salmon, according to FAO, is the main species of salmon farmed globally. In 2020, 2.48 million tonnes, worth $16.1 billion were produced which was 32.6% of total finfish aquaculture produced and 4.6% of global seafood supplied that year. It is farmed worldwide, within regions of water temperature levels mainly between 8 and 14 degrees Celsius. The leading producers in 2020, in order of global output volume were: Norway 53.2%, Chile 26.2%, UK 6.45%, North America 5.85% and others, including Faroes, EU, Tasmania, Iceland and The Russian Federation, produced between them, 205 thousand tonnes or 8.27% of global output.

There is a perception within the industry that global peak output volume of salmon, under current levels of technology, biological and regulatory limits, is close to reaching its optimum. Output is expected to continue rising by a modest 4% to 2024. Meanwhile collaboration within the industry and between it and others such as the pharmaceutical sector, regulators, NGOs and other stakeholders is necessary to safeguard the future of the sector according to research within the industry itself.

EUMAP marine finfish data estimates that in 2020 the EU produced 13 332 tonnes of Atlantic salmon, valued at €126.8 million. A small proportion of this value came from Auxiliary freshwater units of the marine businesses that could not be disaggregated from the purely marine generated value. Only Ireland reported marine production for 2019 and 2020 to EUMAP. The production of juvenile salmon smolts in freshwater is conservatively estimated from EUMAP data at 417.2 tonnes, worth just under €7 million in 2020 by Ireland, Sweden, Finland and Bulgaria collectively, though the reporting of freshwater production in EUMAP is considered incomplete. According to FAO data, Denmark, in 2020, produced 1940 tonnes of juvenile salmon, worth €9.7 million and the Dataset is missing the Irish freshwater data and possibly that of other Member states. Exclusion from either dataset may reflect application of MS reporting thresholds or exclusion due to other reasons, e.g.

reporting not mandated if for freshwater production or confidentiality due to limited number of enterprises.

The main indicators for EU marine Atlantic salmon aquaculture collated under EUMAP are presented in table 3.1 below. EU figures from 2019 onwards are dominated by Irish production, with the departure of one of the major world producers, the UK from the Block.

EU sea-pen production in 2020, as indicated in table 3.1 was therefore collectively 13,332 tonnes, whole-round, worth €126.8 million. Employment at sea in 2020 was of 212 persons or 159 full time equivalents (FTE). A significant drop of FTE between 2019 and 2020 of 26.73% is possibly indicative of the pressure on employment level during lockdown despite other indicators of resilience. The average wage per employee, earned at sea was €42,300, a slight drop of 1% on that of 2019 and a drop of 7% on 2018.

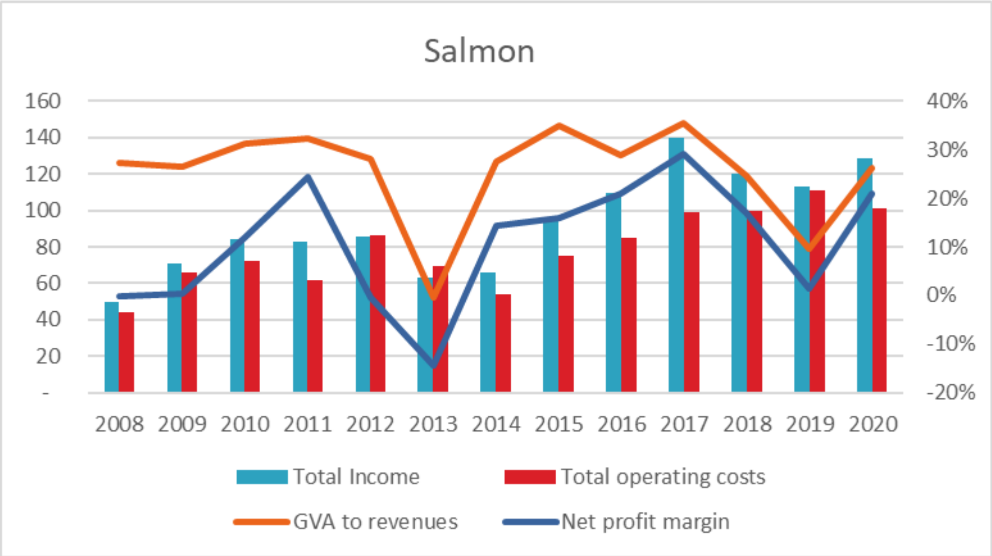
Table 3.1: Economic indicators for EU salmon aquaculture: 2019-2020.

Country	Number of enterprises		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2017	2018	2019	2020
Ireland	26	28	11.7	13.3	112.1	126.8	243	212	217	159	42.7	42.3
Other none DCF	0	0	0.0	0.0	-	-	-	-	-	-	0.0	0.0
Total EU	**26**	**28**	**11.7**	**13.3**	**112.1**	**126.8**	**243**	**212**	**217**	**159**	**42.7**	**42.3**

Source: EU Member States DCF/EUMAP data submissions, 2022

Figure 3.2 below shows a time series of economic performance indicators for salmon aquaculture for 2008-2020. The pattern shows a 5-year cyclical performance trend. Total income shows an increasing trend from 2018, after a drop in 2019. Total operating costs of 2020; €101 million, are similar to 2018; €99 million, having peaked at €111 million in 2019 when margins were negligible.

Figure 3.2: Economic performance indicators for salmon aquaculture: 2008-2020.



Source: EU Member States DCF/EUMAP data submissions, 2022

Gross value-added values for the EU segment varied from €10.9 million in 2019 to €33.7 million In 2020. The other economic indicators also fluctuated considerably, over this time: Earnings before

Interest and tax dipped to -€2.2 million in 2019, then recovered to €22.5 million in 2020. Return on investment dipped to -€1.7 in 2019 and recovered to 16.4% in 2020. Labour productivity varied from €50,000 to €212,600 per FTE, from 2019 to 2020. Capital productivity ranged from 8.7 to 24.5%, 2019 to 2020. The precise values of the trends in general should be treated with caution, owing to the low base of raw data available for deriving the indicators.

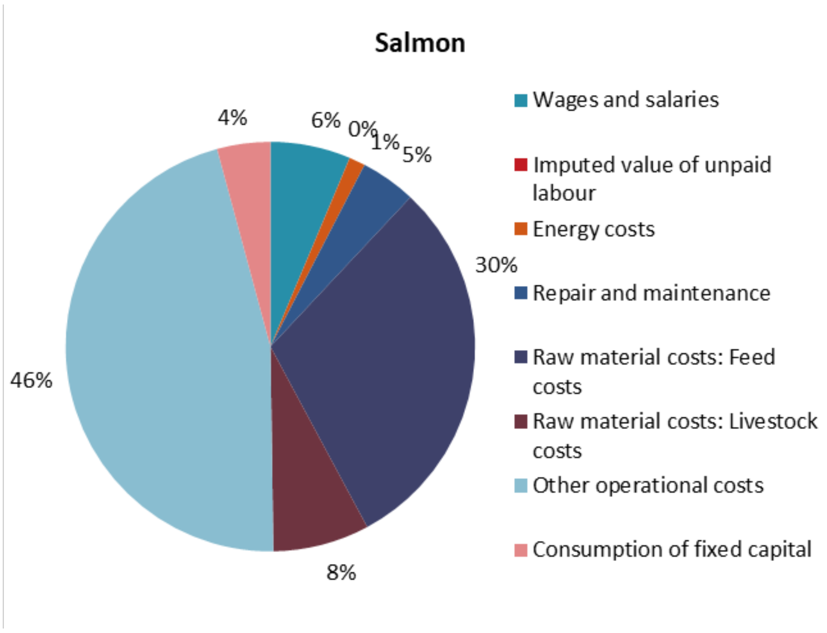
Table 3.3: Economic performance indicators for EU salmon aquaculture: 2018.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Ireland	10.9	33.7	-2.2	22.5	-1.7	16.4	50.0	212.6	8.7	24.5
Other none DCF	-	-	-	-	-	-	-	-	-	-
Total EU	**10.9**	**33.7**	- **2.2**	**22.5**	- **1.7**	**16.4**	**50.0**	**212.6**	**8.7**	**24.5**

Source: EU Member States DCF/EUMAP data submissions, 2022

The most important cost category in 2020 for the EU salmon segment, as is most likely the case for the industry globally, remains ‘Other operating costs’. The collective cost represented 46% of total costs. This variable covers a broad range of supply and service costs associated with a highly developed, technical and capital-intensive global industry such as Research & Development, Quality control, health management, insurance, equipment rental and servicing by specialist suppliers etc. Feed costs are the biggest single expense in 2020, at 30% of the total costs, followed by livestock input at 8%, Wages and salaries at 6%, consumption of fixed capital and repair and maintenance both at 4% and energy costs at 1%. The value of unpaid labour in the EU industry is negligible, reflecting the highly professional nature of commercial salmon farming with a fully contracted workforce.

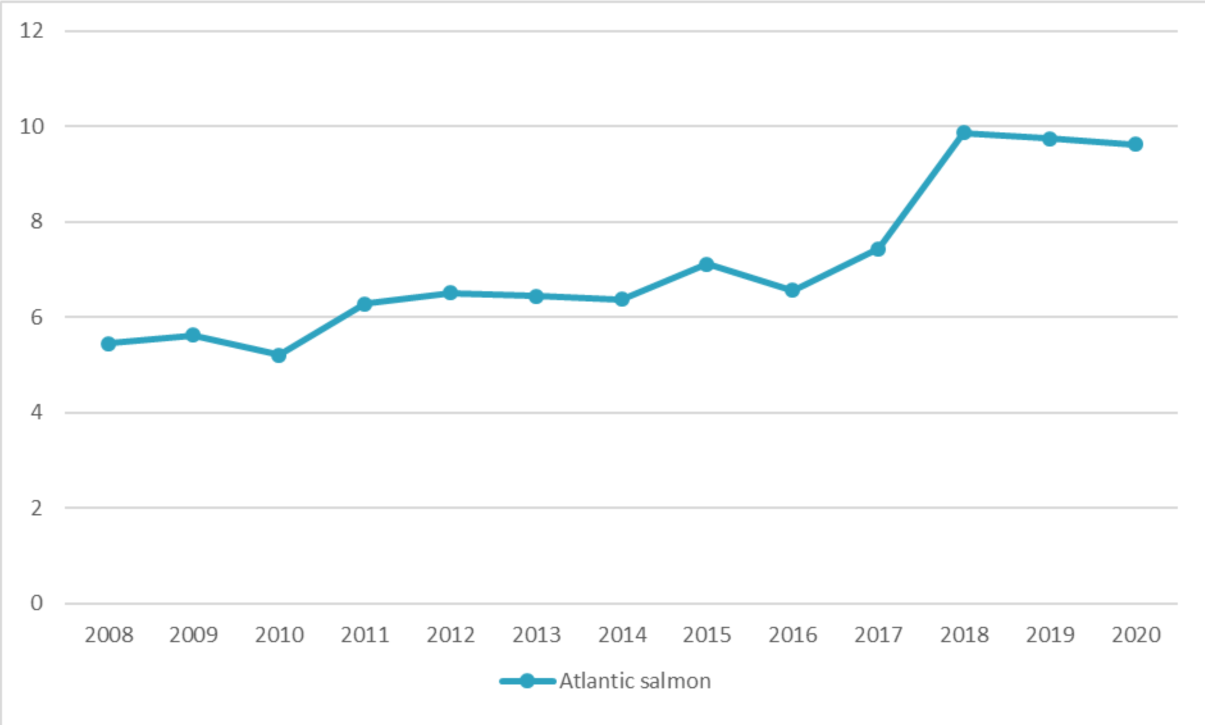
Figure 3.4: Costs breakdown for the EU salmon aquaculture: 2020.



Source: EU Member States EUMAP data submissions, 2022

Figure 3.5 below indicates that the average price of the now mainly organically certified, salmon whole-round product has shown an increasing trend over the period 2008-2018, from €5.5 per kg. to €9.9 per kg. The unit sales value then steadily decreased through 2019 to 2020, to a value of €9.6 per kg. EU Unit sales prices are expected to come under increasing pressure as organic production develops in the UK over the next number of years.

Figure 3.5: Price (€/kg) evolution of salmon: 2008-2018.



Source: EU Member States EUMAP data submissions, 2022

3.1.3 *Atlantic Bluefin Tuna (Thunnus thynnus)*

The current production status of Atlantic Bluefin tuna (*Thunnus thynnus*) farming for 2020 from DCF data shows that Croatia, Malta and Spain are the three EU member states involved in the production of the species. All three countries are operating in the Mediterranean and using the same production method of trapping, on-growing and enhancing in sea cages. The overall total sales volume in 2020 reached 29.8 thousand tonnes. The production overview in Table 3.1.3.1 shows that 57% of production is contributed by Malta, followed by Spain with 30%, and Croatia at 13% in 2020. In general, this contributory share by MS is consistent over the entire time series.

Table 3.1.3.1: Economic indicators for EU tuna aquaculture: 2020.

Country	Number of enterprises		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Croatia	4	4	3.3	3.8	34.4	37.5	301	318	274	272	21.7	19.7
Malta	6	6	12.0	17.1	152.1	204.2	161	361	144	257	32.5	34.2
Portugal	0	2		0.0		0.0				2		33.2
Total DCF reported	**10**	**12**	**15.2**	**20.9**	**186.5**	**241.7**	**462**	**679**	**419**	**531**	**25.4**	**26.8**
Other none DCF	5	5	8.1	8.9	124.9	133.2	246	290	223	227		
Total EU	**15**	**17**	**23.3**	**29.8**	**311.3**	**374.8**	**708**	**969**	**642**	**757**	**25.4**	**26.8**

Source: EU Member States DCF/EUMAP data submissions, 2022

In 2020, with growth in production and sales, overall, the industry also observed increases in employment and FTE figures. Whilst all three contributing Member states observed increases in employment, the sharp increase in Malta's employment figures drove the largest change overall.

Combined, for 2020, the tuna farming segment generated around €375 million in Turnover. Similarly to output values, most of turnover is generated by Malta's activity, generating 54% of the total EU turnover for this specie. Followed by Spain (36% according to FAO data, since DCF data was missing) and Croatia (10%).

The economic performance of the EU tuna aquaculture sector improved in 2020 overall, resulting in an overall positive economic performance in all indicators. GVA reached €127.5 million, EBIT €99 million, and ROI was 20%. This overall increase was mainly driven by the improvements in the economic results of Spain and Malta. The Croatian sector remained profitable but recorded slight decreases in across the same indicators.

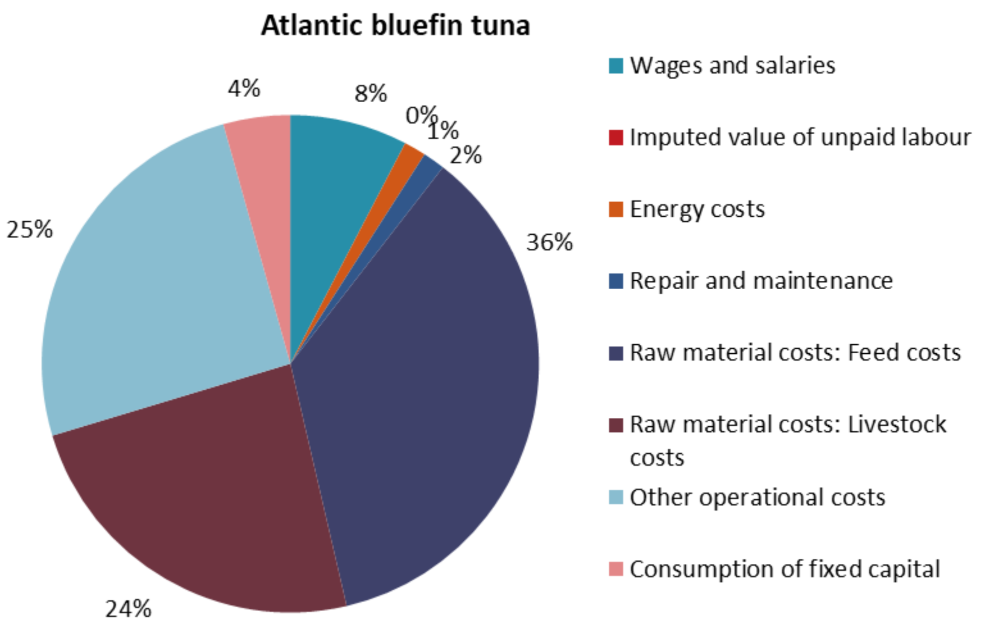
The main operational costs of the EU tuna aquaculture sector are feed costs, representing 36% of the total costs, followed by other operational costs and livestock costs with a 25% and 24% respective share to the total cost structure. Wages and salaries represented the 8% of the total costs, whilst depreciation contributed to 4%.

Table 3.1.4.2: Economic performance indicators for EU tuna aquaculture: 2020.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Croatia	14.7	13.4	5.1	4.7	4.6	4.1	53.6	49.3	13.4	11.7
Malta	-12.3	83.1	-19.6	70.3	-61.5	27.0	-85.1	323.3	-38.6	31.9
Portugal		-0.1		-0.2				-58.1		
Total DCF reported	2.4	96.4	-14.5	74.8	-10.2	20.0	5.7	181.6	1.7	25.7
Other none DCF	1.0	31.1	- 6.1	24.2						
Total EU	**3.4**	**127.5**	**- 20.6**	**99.0**	**- 10.2**	**20.0**	**5.7**	**181.6**	**1.7**	**25.7**

Source: EU Member States DCF/EUMAP data submissions, 2022

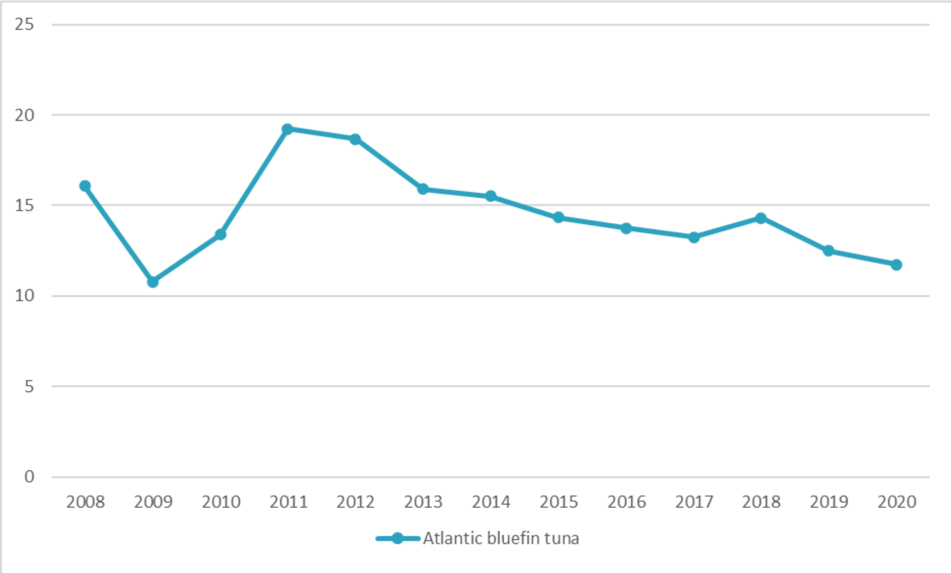
Figure 3.6: Costs breakdown for the EU tuna aquaculture: 2020.



Source: EU Member States EUMAP data submissions, 2022

The average price of Atlantic Bluefin tuna in 2019 was €12.5 per kg and €11.7 per kg in 2020. The price per kg of farmed tuna has seen decreases since 2018.

Figure 3.1.3.3. Average price/kg of Atlantic Bluefin tuna: 2020

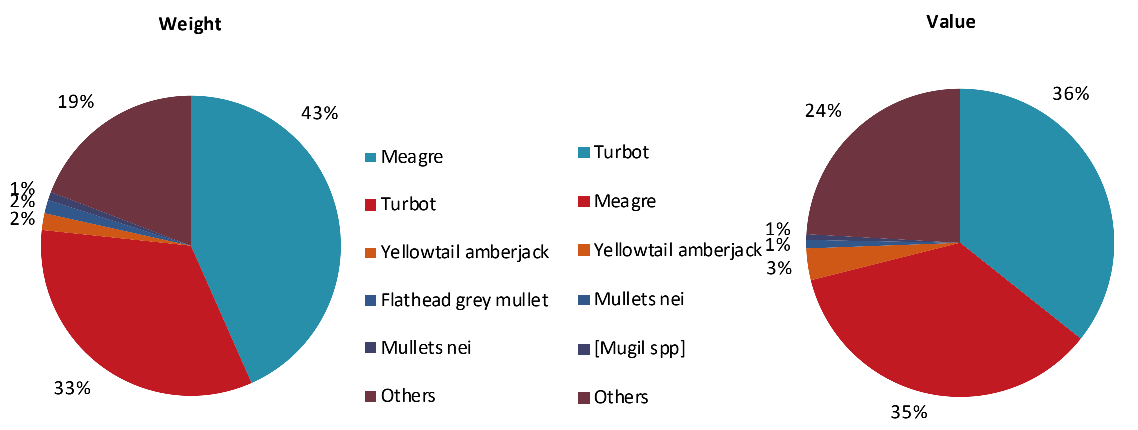


Source: EU Member States EUMAP data submissions, 2022

3.1.4 Other marine fish species

Figure 3.1.4.1 shows the remaining marine species produced in the EU. The total value of those species was €138 million corresponding to 21 thousand tonnes in 2020. Turbot was the most important species in terms of value contributing with €49 million and over seven thousand tonnes. Turbot was mainly produced in Spain and Portugal. The second most valuable species was meagre, contributing with €49 million and nine thousand tones. The main producers for meagre were Spain, Greece, Croatia and Portugal.

Figure 3.1.4.1: Main species, produced in the other marine fish farming facilities: 2020.



Source: FAO, 2022

3.2 Shellfish aquaculture

Worldwide seafood demand for bivalves continue to grow. The main species produced in the world are: Oysters counting for 36% of total production, Clams, Cockles and Ark-shells for 33%, Mussels for 12%, and Scallops or Pectens for 11% (FAO, 2021[6]). The different species of shellfish produced in the EU aquaculture include Mediterranean mussel, Blue mussel, Pacific cupped oyster, Flat oyster, Venus clams, Grooved carpet shell, Cockle, and recently Abalone.

The EU blue growth agenda[7] and the farm to fork strategy show ambitions for making more use of sustainable and healthy food, also derived from the sea, including aquaculture[8]. The Commission has adopted its Guidelines for the development of aquaculture in 2021 [9], and both Parliament[10] and Council[11] acknowledged this proposal very positively recently in 2022. Special attention is reserved to low carbon species like shellfish and algae in the perspective of the mitigation of climate change and an increased EU food security and sovereignty. Despite a continuing Commission support over the last 20 years, data shows another reality: the annual production of shellfish in Europe shows a downward trend[12], while less than 1% of the EU coastal waters[13] is occupied by shellfish concessions in 2020 on the public domain of the Member States.

Unlocking the potential needs more social acceptance on part of:

- Citizens for the allowance of new concessions at sea, including offshore, maybe in coexistence with windfarms,
- Consumers for a more dynamic market able to ingest a production's increase, and for a change of diet (a study released in 2020 shows that such a change made of algae/shellfish produces the same result in reducing the Greenhouse Gas emission by 70% than a vegan diet[14]).

This could be done through a more intense and collaborative action with environmental and consumers' NGOs based on the science-demonstrated benefits of shellfish (neutral in carbon yet, various important ecosystem services provided, excellent seafood for healthy life), on the one hand, and in the other hand by setting up educational schemes with the right information for the next generations.

In parallel, specific attention must be paid to restoring the quality of the Union's coastal waters requiring both major investments and a special effort of raising awareness through the education of the younger generation and the constant attention of adult citizens in their relationship to the water cycle.

The data collection shows in 2020 that sixteen Member States are involved in the EU shellfish sector in 2018.

The reader should note that:

1. The Spanish data was not transmitted through the DCF when experts met, the Spanish economic data used in this chapter are thus extracted from the FAO dataset 2022. This dataset contains the main useful information but does not cover the entire variables included

[6] FAO. 2021. FAO yearbook. Fishery and Aquaculture Statistics 2019/FAO annuaire and Global aquaculture production quantity (1950-2020)

[7] New approach for a sustainable blue economy in the EU Transforming the EU's Blue Economy for a Sustainable Future.

[8]A NEW STRATEGIC VISION FOR SUSTAINABLE AQUACULTURE PRODUCTION AND CONSUMPTION IN THE EUROPEAN UNION.

[9] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030.

[10] REPORT on striving for a sustainable and competitive EU aquaculture: the way forward.

[11] Council approves conclusions on the new aquaculture strategic guidelines for a more sustainable, resilient and competitive aquaculture sector.

[12] Avdelas et al., 2021. The decline of mussel aquaculture in the European Union: causes, economic impacts and opportunities. Reviews in Aquaculture (2021) 13, 91–118.

[13] EMODnet – human activities portal – option aquaculture – option shellfish production areas.

[14] Brent F. Kim et al. – 2020 - Country-specific dietary shifts to mitigate climate and water crises - Elsevier.

in DCF. In the tables below, "other non DCF" should thus read as "Spain" in all the shellfish sections.

2. the dataset analysed below does contains declarations regarding some species with the generic "nei" (Mytilus mussels nei, Clams etc. nei, Venus clams nei, Cupped oysters nei). This is mainly the case for Spain in the FAO dataset and Portugal in DCF dataset for Sea mussel nei, that should thus be read as Mediterranean mussels, which does in fact correspond to the Spanish and Portuguese effective production in 2020.

In the EU producing countries total production decreased to 584 thousand tonnes in 2020, versus 2018 production of 639 thousand tonnes, with a total value of €1.17 billion, comparing with 2018 production value of €1.26 billion, corresponding to a decrease of 9% in weight and a decrease of 7% in value. The downward trend mentioned above in the publication of the JRC on mussel seems to be confirmed for the whole shellfish production in 2020. The downward trend in sale prices does not compensate for this decrease in production.

This volume is mainly produced by small-scale farms (90% of the shellfish enterprises employed in 2020 less than 10 persons), with high employment and therefore has a high importance for socio-economic reasons, especially jobs that cannot be delocalized. The negative trend is thus not good news for the coastal areas of the Union.

This trend is also confirmed by the decrease of the number of enterprises from 7 047 units in 2018 to 6 183 corresponding to a negative trend of 5%, while the number of total employees increased from 32 095 in 2018 to 40 620 employees in 2020 corresponding to a positive trend of 26%. This concentration trend should be reviewed after the next data transmission in 2024.

The most important countries remain France with 2 214 enterprises and 14 823 employees (8 118 FTE), Spain 2 210 enterprises and 14 520 employees (6 058 FTE), Italy 398 enterprises, 6 848 employees (1 823 FTE), and Portugal 654 enterprises, 740 employees (475 FTE).

Table 3.2.1: Economic indicators for the EU shellfish aquaculture: 2019-2020.

Country	Number of enterpri		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	23	23	1.7	1.2	1.5	1.0	66	76	58	67	8.9	5.4
Croatia	102	98	1.1	0.5	2.6	0.8	155	138	84	80	10.4	9.3
Denmark	8	9	8.9	6.9	5.5	3.3	52	50	41	36	29.6	40.8
France	2189	2214	197.6	192.0	725.6	663.0	15,620	14,823	7,959	8,118	30.4	28.7
Germany	9	9	22.0	12.0	42.1	25.3	144	130	132	115	30.0	37.3
Greece	201	201	22.9	21.2	8.7	7.7	651	666	512	529	10.0	9.7
Ireland	259	280	26.0	23.8	61.5	51.1	1,965	1,754	1,003	909	24.2	21.5
Italy	398	398	78.5	74.8	214.9	185.6	6,848	6,848				
Netherlands	64	63	35.7	33.8	49.0	54.0	224	220	224	220	58.4	58.8
Portugal	639	654	5.8	6.5	70.5	56.9	1,363	1,299	906	749	8.2	9.5
Slovenia	5	5	0.7	0.4	1.0	0.7	17	18	13	14	21.1	20.6
Sweden	14	19	2.0	2.3	1.7	1.9	65	78	57	53	132.3	84.5
Total DCF reported	**3,911**	**3,973**	**403.0**	**375.4**	**1,184.7**	**1,051.3**	**27,170**	**26,101**	**10,988**	**10,890**	**27.9**	**26.5**
Other none DCF	2,258	2,210	232.7	208.9	128.9	116.0	15,689	14,520	6,345	6,058		
Total EU	**6,169**	**6,183**	**635.7**	**584.3**	**1,313.6**	**1,167.3**	**42,859**	**40,620**	**17,332**	**16,947**	**27.9**	**26.5**

Source: EU Member States DCF and FAO data submission, 2022

Data submitted by MS shows a decrease in GVA from €794.6 million in 2018 to €791.1 million in 2020, and an EBIT value of €344.7 million in 2020, increasing from €94.9 million since 2018. The peak in 2019 should be analysed because of the COVID episode and the various aids that Member States implemented for helping the enterprises and the exceptional resilience of the sector to the pandemic.

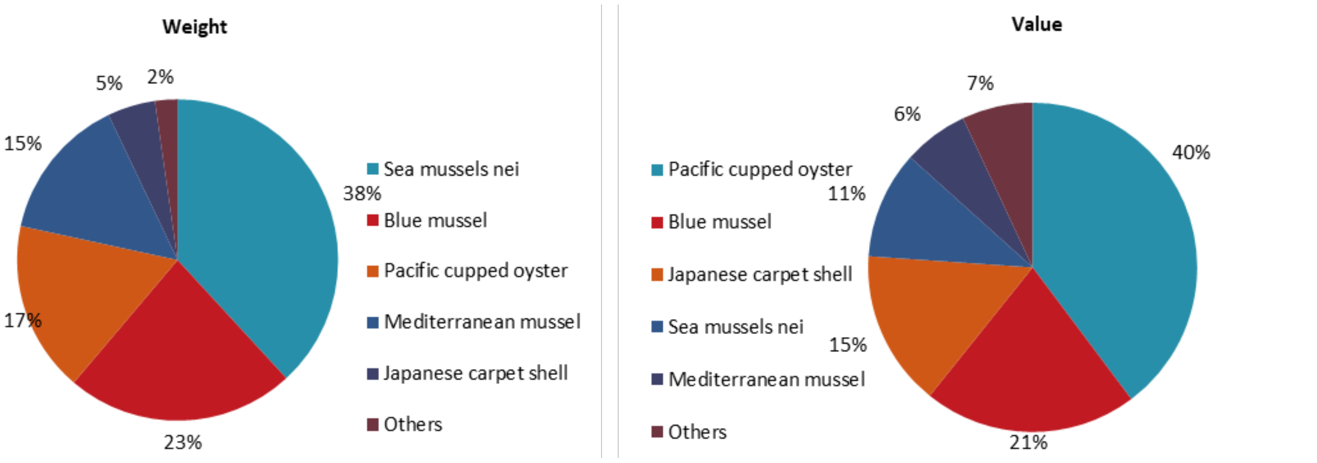
Table 3.2.2: Economic indicators for the EU shellfish aquaculture: 2019-2020.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	1.4	1.1	0.4	0.1	2.9	0.7	23.8	17.0	10.8	11.3
Croatia	2.6	0.6	1.9	0.1	57.7	3.5	30.6	7.5	79.6	18.1
Denmark	4.0	2.3	2.5	0.5	36.1	6.8	98.3	65.7	58.5	34.1
France	428.5	397.7	98.9	100.7	7.3	8.1	53.8	49.0	31.7	31.9
Germany	33.5	17.0	27.8	11.1	24.9	13.1	253.9	147.8	30.0	20.1
Greece	8.1	7.0	2.9	2.7	118.7	111.7	15.9	13.2	328.2	292.6
Ireland	40.4	38.4	11.9	15.3	10.3	12.5	40.3	42.2	35.0	31.3
Italy	174.2	147.0	127.2	107.9	126.7	123.8			173.5	168.8
Netherlands	26.6	33.6	11.4	18.5	9.9	16.4	119.0	152.7	23.1	29.8
Portugal	63.3	61.3	53.6	54.4	113.9	127.7	69.9	81.9	134.5	144.0
Slovenia	0.9	0.6	0.1	-0.1	2.7	-1.5	70.1	45.1	22.0	14.2
Sweden	2.7	5.7	-7.0	-0.8	-17.0	-1.7	48.1	108.0	6.6	12.3
Total DCF reported	786.3	712.4	331.6	310.4	17.3	17.5	71.6	65.4	41.1	40.2
Other none DCF	85.5	78.6	36.1	34.3						
Total EU	**871.8**	**791.1**	**367.6**	**344.7**	**17.3**	**17.5**	**71.6**	**65.4**	**41.1**	**40.2**

Source: EU Member States DCF and FAO data submission, 2022

The main species produced in EU shellfish farming facilities in volume in 2020 were: Mediterranean mussels and Sea mussels for 53%, Blue mussels for 23%, and Pacific cupped oyster for 17%. In value terms, the most important species are Pacific cupped oyster for 40%, Blue mussel for 21%, Mediterranean mussels and sea mussels for 17%, and Carpet shell for 15%.

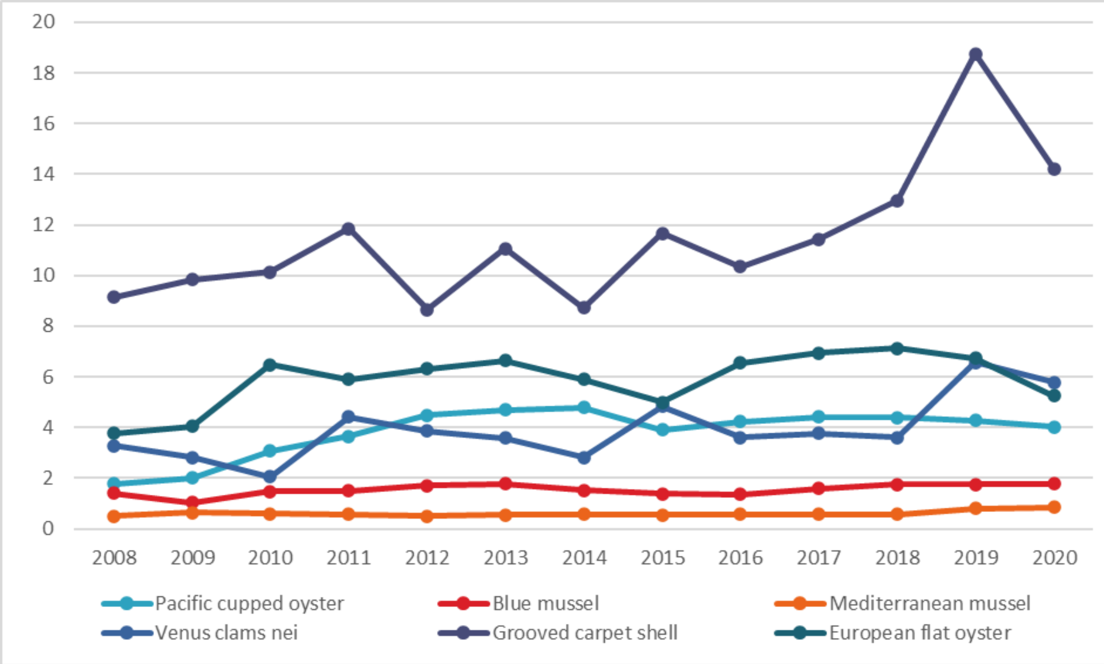
Figure 3.2.1 – composition in weight and value of the main shellfish species produced by the EU aquaculture sector: 2020



Source: EU Member States DCF and FAO data submission, 2022

The price evolution of shellfish prices during 2008-2020 analysed period is shown in Fig. 3.2.2. Grooved carpet shell starts in 2016 a continuous trend from €10.3 per kg up to €14 per kg in 2020, directly linked to the rarefaction of spat collection in Italy and Spain due to a low acidification of the sea water, and partially compensated by seed production in French hatcheries. Pacific cupped oyster is stable from €3.9 per kg in 2015 until €4 per kg in 2020. A slow upward trend is observed for Blue mussel in the last years from €1.5 per kg in 2014 up to €1.8 per kg in 2020. A relative stability of price level is recorded for Mediterranean mussel and Venus clams. Flat oysters' prices are more subject to variation, but the general trend shows a continuous increase of prices since 2008.

Figure 3.2.2 - Average prices (€/kg) for the main shellfish species produced by the EU aquaculture sector: 2008-2020



Source: EU Member States DCF and FAO data submission, 2022

3.2.1 Mussel

World´s total mussel production reached 2.1 million tonnes and 4.5 billion USD in 2020 (FAO, 2021[15]). According to the data reported to FAO, the EU represents approximately 20% of world production of blue and Mediterranean mussel, both in volume and value. However, it is known that some countries do not report production per species, instead opting to refer to the country of production (e.g. Chilean mussel, New Zealand mussel, Korean mussel).

The main species of mussels farmed in the EU are blue mussel (*Mytilus edulis*) and Mediterranean mussel (*Mytilus galloprovincialis*). Other species of mussels relevant in the international markets and farmed outside the EU are Chilean mussel (*Mytilus chilensis*) or (*Mytilus edulis platiensis*); the New Zealand green-lipped mussel, (*Perna canaliculus*); and the Korean mussel (*Mytilus Coruscus*) and (*Crenomytilus grayanus*).

In Table 3.2.1.1 economic indicators for the mussel sector in the EU is shown. According to data collected under DCF for the year 2020, the volume of mussels produced in the EU is 400 thousand tonnes, valued at €369 million. In comparison to 2019, this represents a 8% decrease in volume and a 6% decrease in value. This is in large part due to the 10% decrease of production in Spain. For Spain, the main EU producer of mussels, this results in an 11% decrease in turnover. The sales volume in Germany decreased by 46% and the turnover decreased by 40%. Blue mussel prices have remained stable compared to 2018, while Mediterranean mussel prices have increased. Two main species produced in EU in 2020 are Mediterranean mussel (300 thousand tonnes) and blue mussel (127 thousand tonnes).

86% of the companies reported under the DCF/EUMAP area are concentrated in four countries: Spain (51%) France (14%), Italy (11%), Greece (10%). More than 82% of the sales volume is concentrated in the same countries, with a turnover representing 75% of the total segment (2020). Spain represents 51% of the sales volume and accounts for 29% of the total turnover. Although France only accounts for 13% of the sales volume, it also represents 32% of the total turnover. An analysis of employment data shows that the four Member States account for more than 86% of

[15] FAO Global aquaculture production quantity (1950-2020).

employment, which corresponds to around 84% FTE of the mussel segment in the EU. The highest average salary of all EU Member States is paid to Swedish workers (about €84.5 thousand per year) followed by Dutch workers (about €76 thousand per year) and Danish workers (about €40.8 thousand per year). In Bulgaria, the average wage is €5.4 thousand, the lowest average wage recorded. In Croatia, the average wage is about 35% lower than the average EU one. The average wages differ significantly between countries, which can be seen as an indicator of technological and organisational development in the various countries.

Table 3.2.1.1: Economic indicators for the EU mussel aquaculture: 2020.

Country	Number of enterpri		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	23	23	1.7	1.2	1.5	1.0	66	76	58	67	8.9	5.4
Croatia	86	78	1.1	0.5	2.4	0.7	139	112	76	64	9.9	10.4
Denmark	8	9	8.9	6.9	5.5	3.3	52	50	41	36	29.6	40.8
France	252	278	47.3	53.6	108.7	119.4	1,888	1,926	1,015	1,138	27.1	31.2
Germany	9	9	22.0	12.0	42.1	25.3	144	130	132	115	30.0	37.3
Greece	201	201	22.9	21.2	8.7	7.7	651	666	512	529	10.0	9.7
Ireland	88	90	15.2	14.7	14.8	13.3	496	452	304	264	19.6	21.1
Italy	224	224	52.5	50.3	44.6	44.1	1,039	1,039				
Netherlands	43	42	33.2	31.5	42.3	45.3	174	170	174	170	75.2	76.0
Portugal	13	9	0.7	1.0	0.4	0.7	154	38	152	36	11.6	19.0
Slovenia	5	5	0.7	0.4	1.0	0.7	17	18	13	14	21.1	20.6
Sweden	7	10	0.0	2.3	1.7	1.8	54	64	55	53	136.0	84.5
Total DCF reported	**959**	**978**	**206.2**	**195.6**	**273.6**	**263.3**	**4,873**	**4,741**	**2,531**	**2,487**	**26.7**	**28.7**
Other none DCF	1,061	1,022	228.2	204.5	118.6	105.7	5,393	4,956	2,802	2,599		
Total EU	**2,020**	**2,000**	**434.4**	**400.1**	**392.2**	**369.0**	**10,267**	**9,697**	**5,333**	**5,086**	**26.7**	**28.7**

Source: EU Member States DCF and FAO data submission, 2022

Social importance of mussel sector

The mussel sector has strong correlations with local employees. It guarantees stable work to which is added temporary and seasonal work, concentrated above all in the vicinity of the harvest.

In Spain, mussels are mainly cultivated in Galicia, where it is a traditional and consolidated sector. This industry represents an important part of the Galician economy, as it is a high-volume production sector. The workers are often self-employed and there is a lot of part-time employment. For example, fishermen who work on the rafts when the fishing season is closed. A significant proportion of the workers are from the same family as the owner. It is important to underline that the sector is strongly linked to the canning industry, which is also located in the same areas, and where most of the inputs come from Galicia.

France is the second country where mussels are cultivated mainly using two production techniques. The first is a specific rearing system on poles, called "bouchots". This method has existed since the Irishman Patrick Walton fortuitously invented it in 1235, after a shipwreck in the Bay of Aiguillon. These poles are now part of the landscape of the Atlantic coast and the English Channel. The second is in the Mediterranean basin, where they use tables. These are mainly family businesses. Throughout the country, these companies are becoming more and more important, with many salaried jobs, which benefit the inhabitants of the coast. Some of these companies have also started to deploy offshore longlines in the Mediterranean and Charente Maritime. Investments are becoming much more important and the jobs much more specialized.

In Italy the scale of the mussel sector is important because it guarantees about 80% of the employees and almost 90% of the FTE. The sector is improving its social acceptability through structural interventions in the organization of micro-enterprises: trade associations are supporting farmers to set up consortia and Producer Organizations. Other actions to support social acceptability are leveraging investigations into the contribution of mussels in capturing greenhouse gas emissions. Experiments are verifying the ecological transition towards the use of non-disposable plastics, in accordance with the European Single Use Plastics Regulation (SUP). The biggest weaknesses still lie in an inability to pass on the price of numerous efforts that have taken place in the sector over the past 4 years.

Main techniques

Three main farming techniques are being used in the production of mussels in the EU. Rafts, long line and bottom harvest are well differentiated methods of production, which set further differences in terms of costs and market prices.

The bulk of the whole EU mussel's production is harvested in the Spanish Northwest region of Galicia where rafts are the dominant technique. A raft is a floating platform with pending ropes of around 30 meters in the form of a matrix, which can be folded according to the depth where the platform is located. The mussels are attached to the rope and covered with a net produced with organic materials that will be progressively disappearing until the mussel fixes to the rope in a natural way. Every row in the matrix corresponds to a particular harvest, which will be collected and replaced in the appropriate date maintaining a continued production along the whole year. Rafts require a minimum depth of around 8 to 10 metres to result in efficient outputs.

Long line cultivation in Italy, Ireland, and more recently in The Netherlands, shares with rafts the use of a main rope of 500 metres where vertical ropes or mussel bags are hanged. This fact results in larger needs of space which are not always available due to competing water usages near the coasts. However, it allows mussel culture in shallow waters where rafts would not be suitable. This technique is also the only one that can be envisaged in the context of offshore production and can now be combined spatially with floating or fixed wind farms (pilot project in Belgium).

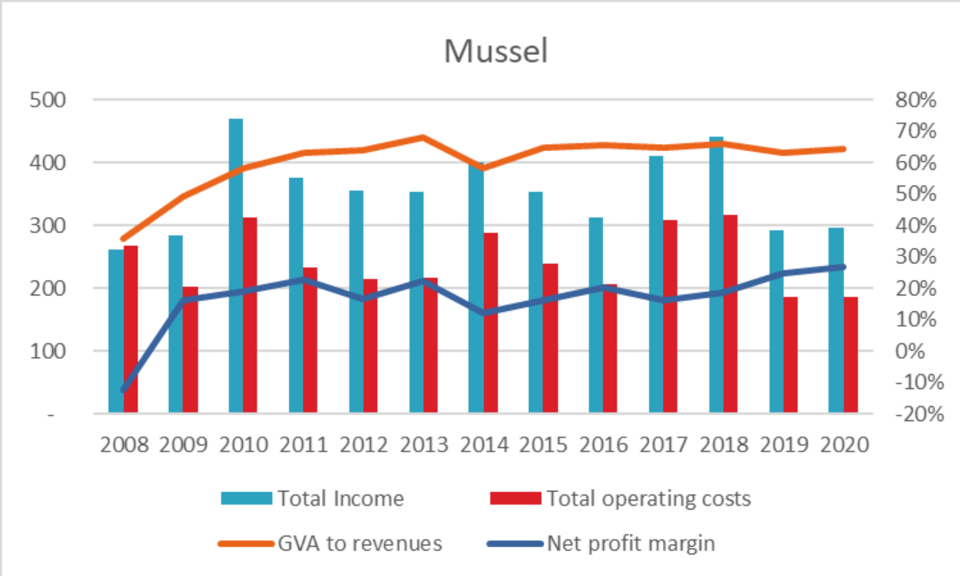
Bottom cultivation uses beds in the Netherlands and Ireland or poles (bouchots) and tables, very similar to rafts fixed in the seabed in France where the mussels are deposited or attached. This type of breeding "on bouchot" also makes it possible to benefit from the swaying of the tides, the mussels being alternately emerged and submerged and thus feeding on the various nutrients existing in the entire height of the water column. This specificity gives the mussels thus cultivated an inimitable taste which is crowned by a European "Traditional Specificity Guaranteed (TSG)".

The seed mussels are collected from special areas and are then carried to areas where the growth conditions are better for the mussels. These areas are assigned by state authorities for a certain fee and time limited. In the case of bouchot, the excess seed is collected from the wild in Charente Maritime and Vendee on ropes suspended over the seabed on tripods, and they are then wound up and fixed helically on the poles.

The mussels are then, after mainly one year, more rarely two, harvested from the cultural fields. The harvest is done by dredges or beam trawl from the bottom, with a special sucker to collect the mussels fixed on the poles, with a specific pulley to turn the long lines and recover the ropes attached vertically and the mussel rolls that have developed there.

Small volume of product harvested are mostly sold directly to the local supermarkets or fishmongers. For larger important quantities, the supermarket purchasing centres and the auction at Yerseke in the Netherlands play a major role: the most important markets for mussels from Germany and Denmark are sold for consumers in the Benelux-countries, France, and in Germany especially the Rhineland. About 80% of the production is sold to consumer into supermarkets, packaged in 1 to 2 kg trays.

Figure 3.2.1.1: Development of economic performance for the EU mussel aquaculture: 2008-2020.



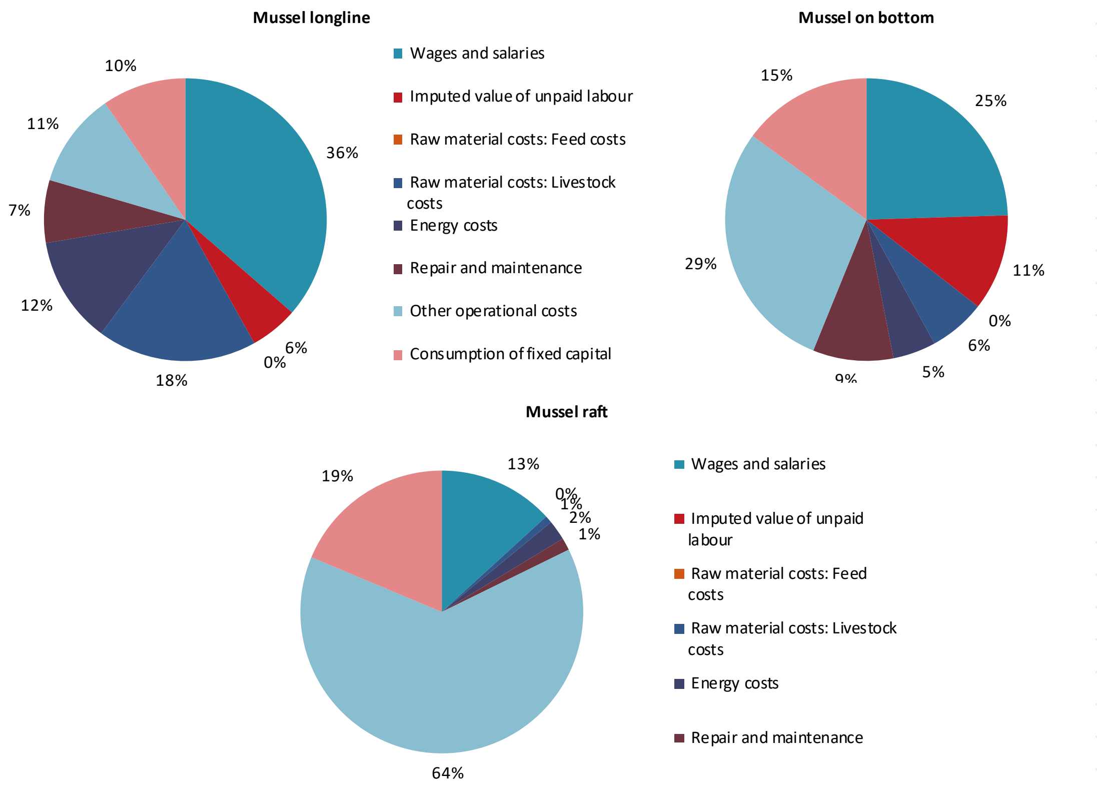
Source: EU Member States DCF data submission, 2020

The volume of seed mussels varies from year to year. In some years in the last decade, almost no seed fall could be noticed. With a time, lag of one to two years, the volume of mussels for consumption varies accordingly. Predation by sea bream on the long lines, and by protected birds on the bouchots are observed with increased level year after year. Recently a specific predation by sea-spider is also observed in the Channel. Seed abundance and predation level are the two main reasons for the fluctuation of income in this sector. The employment shows a downward trend since 2018 from 11795 employees to 9697 in 2020 (-17%).

The evolution of operating costs in Figure 3.2.1.1 shows different trends in the mussel segments. Of all segments, the mussel long line has the highest profit margin of on average 27% in 2020. In the segment mussel other, the net profit margin was again negative in 2020 (-15%) compared to 2016, when the net profit margin was positive at 20%.

The evolution of operating costs in Figure 3.2.1.1 shows the trends for the entire European mussel sector. The total income and operating costs for the mussel sector fluctuates over time but have remained relatively steady between 2014 and 2020. The net profit margin has been slowly rising over time while GVA to revenues has remained stable.

Figure 3.2.1.2: Costs breakdown for the EU mussel aquaculture: 2020.



Source: EU Member States DCF data submission, 2022

As may be expected, the important technical differences across the three techniques results in significantly different cost structures in terms of what are the relevant items and their magnitudes, as shown in figure 3.2.1.2.

One of the cost categories setting differences across techniques is the imputed value of unpaid labour. This has to do with the legal form of the enterprise. Raft and bottom culture record many employees and family-owned business in which other members of the family random or periodically contribute to the activity without a formal contract or salary. In contrast, the long line segment is mainly composed by cooperatives and consortia and such kind of informal labour is rarely present. Unpaid labour represented in 2018 49% of the total raft costs (and is not represented in 2020 due to the Spanish data missing in DCF) and 11% in bottom culture, but only 6% in long line. This is also reflected in the importance of the formal wages and salaries which are 36% in long line, 25% in bottom culture and 13% in raft culture. The energy costs are significantly higher for mussel longline (12%) compared to 5% in the on-bottom segment and 2% for rafts. The on-bottom segment has the highest other operational costs of all segments (29%) compared to the other segments. The 64% of “other operational costs” in mussel raft is due to the missing “unpaid labour” from Spain in this segment: with an unpaid labour in mussel raft at 49%, the other operational costs should become 21% only, and not 64% as the figure seems to indicate.

A shown in Table 3.2.1.2, for most mussel farmers, the total costs of production are almost fixed, given the absence of feed and livestock costs. With production, and thereby turnover, varying significantly per year, labour productivity shows high variation as well from year to year for a specific country. This, however, is not explained by changes in the workforce, instead reflecting natural variation in production and the level of predation. The differences in labour productivity across countries show the different capital intensity in the reported countries. In Denmark, Germany and the Netherland production is based on a high input of physical capital, while in other countries the production is more labour intensive.

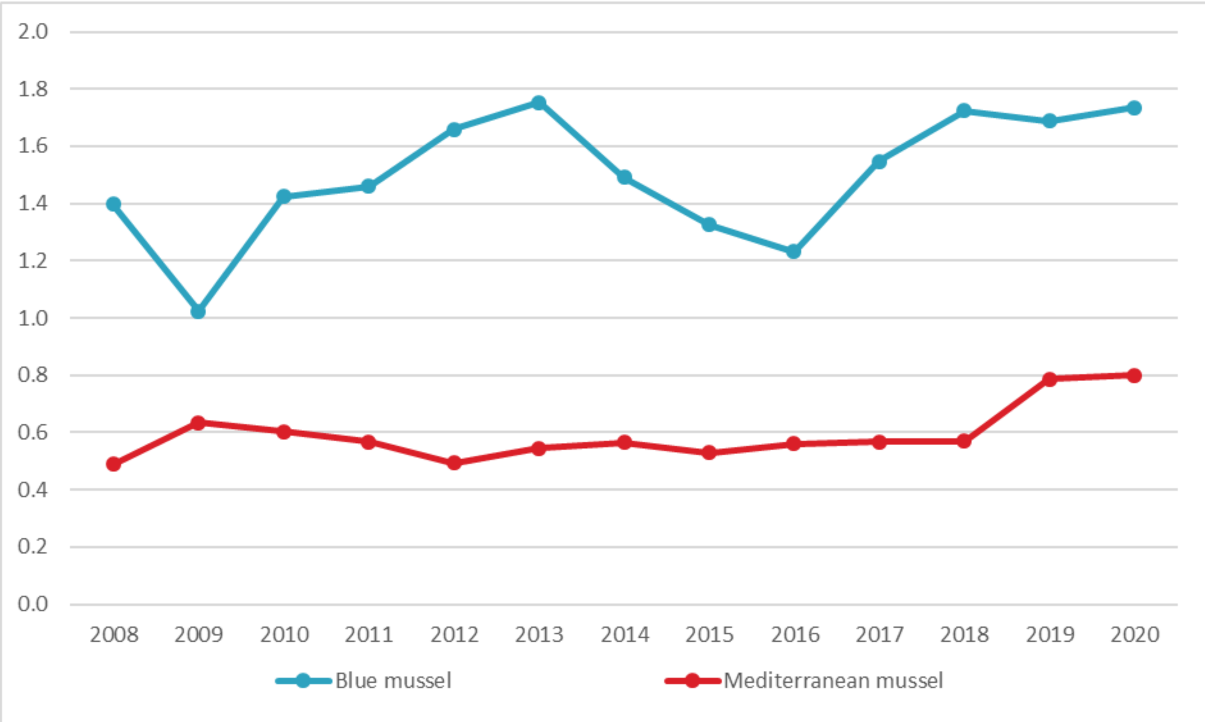
Table 3.2.1.2: Economic Performance indicators for the EU mussel aquaculture: 2019-20.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	1.4	1.1	0.4	0.1	2.9	0.7	23.8	17.0	10.8	11.3
Croatia	2.3	0.5	1.7	0.0	57.7	1.4	30.9	7.8	78.2	16.7
Denmark	4.0	2.3	2.5	0.5	36.1	6.8	98.3	65.7	58.5	34.1
France	78.8	88.0	39.0	37.9	16.8	12.5	77.7	77.4	33.9	29.0
Germany	33.5	17.0	27.8	11.1	24.9	13.1	253.9	147.8	30.0	20.1
Greece	8.1	7.0	2.9	2.7	118.7	111.7	15.9	13.2	328.2	292.6
Ireland	10.2	12.7	2.6	5.7	6.2	14.4	33.4	48.1	23.9	32.2
Italy	26.5	26.5	12.9	14.1	32.8	39.3			67.2	74.0
Netherlands	19.9	24.9	4.7	9.9	4.1	8.7	114.5	146.5	17.3	22.1
Portugal	-4.3	1.1	-8.4	-0.2	-54.5	-3.3	-28.3	29.4	-27.8	16.5
Slovenia	0.9	0.6	0.1	-0.1	2.7	-1.5	70.1	45.1	22.0	14.2
Sweden	2.7	5.7	-7.0	-0.8	-17.1	-1.7	49.3	107.6	6.6	12.3
Total DCF reported	184.1	181.9	86.3	81.6	12.6	12.3	62.3	64.8	29.4	28.6
Other none DCF	79.8	73.0	37.4	32.8						
Total EU	**263.9**	**254.9**	**123.7**	**114.4**	**12.6**	**12.3**	**62.3**	**64.8**	**29.4**	**28.6**

Source: EU Member States DCF and FAO data submission, 2022

The EU mussel aquaculture gross value added reached more than €254 million, which is a decrease of 3% compared to 2019. EBIT reached almost €114 million, 7% lower than 2019. The ROI decreased slowly to 12.3% from 12.6 in 2019. Labour productivity reached around €65 thousand per year, increasing slowly compared to 2019. A capital productivity of 28.6% in 2020 compared to 29.4 in 2019.

Figure 3.2.1.3: Price (€/kg) evolution of the main species of mussel group: 2008-2020.



Source: EU Member States DCF data submission, 2022

Figure 3.2.1.3 shows the market price for a kilo of blue mussels was more than €0.6 more expensive than for Mediterranean mussels in 2009. Since that date, the gap between the price of Mediterranean mussels and blue mussels is increasing to €1.1 in 2020. Mediterranean mussels had an average price around 60 cents per kilo along the period observed and has increased 33% between 2009 and 2020. The price for blue mussel increased 21% per kilo from 2009 until reaching €1.7 per kg during 2020. In 2016, prices for blue mussel have fallen to almost €1.4 per kg, and then rose to €1.7 per kg in 2020. The average yearly growth from 2008 to 2020 is therefore 20%.

Outlook

Mussel production can be considered as an environmentally friendly business, as no feed is necessary and the mussels take nutrients from the water column. It should also be noted that mussels provide ecosystem services to the environment: they sequester carbon, eliminate excess nitrogen, and clarify water while feeding to produce a food recommended by dieticians. Mussels are therefore a food in harmony with the Green Deal of the European Union and the "Farm to Fork (F2F)" and Biodiversity Strategies: Kim et al. (2020)[16] compared greenhouse gas (GHG) and water footprints of various diets in 140 countries and concludes that in relation to exclusively plant-based (vegan) diets, those diets consisting basically of plant foods supplemented with low-food chain animals, like mussels, have comparatively small GHG and water footprints and offer greater flexibility, so these is a healthy and sustainable diet. Several recent publications describe the ecosystem services provided by both the natural beds of bivalves and by the aquaculture of molluscs[17]. Clear level of carbon sequestration by shells is still in discussion in the scientific community on this service[18], but Joël Aubin[19] analysed in 2017 the Life Cycle Assessment of blue mussel in the Bay of Mont-Saint-Michel in the Channel and concluded to have a very limited environmental impact. Recently the Aquaculture Advisory Council released in April 2022 a recommendation on the carbon sequestration by molluscs[20].

In some areas, like Spain and France, the problem of red tides is very relevant. In the Netherlands and Germany, the problem of lacking seed mussels is an obstacle for stable and growing production.

[16] Kim, B.F.; R.E. Santo, A.P. Scatterday, J.P. Fry, C.M. Synk, S.R. Cebron, M.M. Mekonnen, A.Y. Hoekstra, S.de Pee, M.W. Bloem, R.A. Neff and K.E. Nachman. (2020). Country-specific dietary shifts to mitigate climate and water crisis. Global Environmental Change 62: 101926.

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Van der Schatte Olivier, A.; L. Jones, L. Le Vay, M. Christie, J. Wilson, S.K. Malham (2018). A global review of the ecosystem services provided by bivalve aquaculture. Reviews in Aquaculture 2020, 12: 3–25 https://doi.org/10.1111/raq.12301

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Pouliquen, A. (2019). Les services écosystémiques de la conchyliculture. 72pp.

[18] Filgueira, R.; T.Strohmeier & Ø. Strand (2019). Regulating Services of Bivalve Molluscs in the Context of the Carbon Cycle and Implications for Ecosystem Valuation In: Goods and Services of Marine Bivalves (ed. Smaal, A., Ferreira, J., Grant, J., Petersen, J. K., & Strand, Ø.) pp 231-251. Springer Nature. Cham, Switzerland.

Moore, D. (2020). A biotechnological expansión of shellfish cultivation could permanently remove carbón dioxide from the atmosphere. Mexican Journal of Biotechnology 5 (1): 1-10. Https://doi.org/10.29267/mxjb.2020.5.1.1

[19] Aubin, J. ; Fontaine C., Callier M., Roque d'Orbcastel E (2017). Blue mussel (Mytilus edulis) bouchot culture in Mont-St Michel Bay : potential mitigation effects on climate change and eutrophication. Springer 2017 https://doi.org/10.1007/s11367-017-1403-y

[20] Recommendation on carbon sequestration by molluscs – 2022-16.

Bird and fish predation becomes significant in Greece, Italy, and France. Recently the specific predation by sea-spiders in the Channel becomes heavy (20 to 30% of loss reported in some French regions).

Bottom culture depends on the supply of mussel seed, either from the market or by own collection. There is natural variation in the amount of mussel seed available. Concerns about the ecological impact of mussel seed collection in the Wadden Sea have led to harvest restrictions.

One producer organization in Spain obtained the recognition of “Protected Designation of Origin (PDO)” product”, another one in France valorised the “bouchot” cultivation system through a “Traditional Specificity Guaranteed (TSG)”, but environmental conditions continue damaging production expectations. The organic certification is in danger due to recent European regulatory developments governing it: shellfish waters where a product would be "organic" shall now be classified A, within the meaning of the Hygiene Package for microbiological criteria and shall be in "good ecological condition". The microbiological criterion is new and was not included in the previous version of the regulation: In 2022 50% of the French Mediterranean enterprises previously certified as organic lose their accreditation. The quality of the water is, remains and will continue to remain, the sole responsibility of the Member States and their regions, not under that of the mussel growers. In this context, the European mussel farming sector thus may face some tensions between the willingness of F2F Strategy to develop organic productions and the organic production regulation, which spatially limits this possibility.

Recent developments in offshore long lines, often linked to offshore wind farms (Belgium, France) are at the study or pilot project stage. Others (Netherlands, Italy, and Ireland) are unrelated to wind farms. But they are all part of a vision shared between the Industry, Member States, and the Commission in the Green Deal: to ensure the development of a sustainable activity and food security for Europe. This trend will be followed in future reports.

Segmentation by species and technique cannot clearly be differentiated due to different understanding by Member State when submitting data and due to different dominant technique in different countries.

Regarding the impact of the COVID-19 pandemic, the European mussel farming sector has suffered relatively less than all other aquaculture sectors. In fact, the first confinement in March and April 2020 corresponded to a period when mussels were growing on their supports (rafts, long lines, poles, tables, on the seabed) and required little or no maintenance on site. The reopening of social activities during the summer of 2020, with that of restaurants, travel authorizations and holidaymakers corresponded to the usual period of main marketing of mussels in Europe. Those sold later in autumn, when restrictive pandemic control measures were put in place, are usually done through supermarkets (self-service sales) which have remained open and accessible to consumers. The sales volume and the corresponding turnover should therefore be affected to a lesser extent than the trends announced in the specific COVID chapter of this report. The two only causes announced for a decrease in production on the market come from producers who have suffered significant predations and some summer mortalities, which have been recurring since 2014 mainly in France.

Recently the cost of the energy increased due to the war in Ukraine. Mussel farming is variably sensitive to this change: longline mussel is more sensitive than other segments. In parallel in 2022, French shellfish farmers are testing in real conditions of cultivation a new photovoltaic vessel, while some other are testing hydrogen as an alternative source of energy. The next report should scrutinize the real impact of these trends on the effective financial results.

The desire of certain mussel growers to develop, within their own company, a transformation of their product, by extracting the flesh and using it as ready-made meals, should be given special attention. The integration of product processing is potentially a significant change, including keeping processed products to market at the most opportune time.

Finally, recent political, regulatory, and societal developments will have consequences for shellfish farming companies: the Single-use plastic Directive establishes the principle of extended producer responsibility, making it necessary to recycle plastics. The nets used in European mussel farming are intended only to protect the farms against predation (sea breams and birds, and recently sea-spiders). A significant R&D effort is underway to supply nets made from bio-based materials. The cost of such materials is higher than that of plastics currently in use. The Biodiversity Strategy also requires, particularly in the context of a circular economy, that shellfish waste must be recycled. Professionals have tested and developed techniques for recovering this waste at company level during handling. The immense amount of waste that remains untreated today is that rejected by consumers of mussels. These purchases could be valued in a similar way, but the establishment of a specific collection requires action from the regions concerned. This may end up implying an additional tax for mussel aquaculture companies. It will be interesting to analyse the behaviour of consumers in the face of these developments, which will logically result in an increase in the prices of products on the shelves of retailers.

3.2.2 Oyster

The oyster species produced in European aquaculture include Pacific cupped oyster, Cupped oysters nei (declared by Portugal), European flat oyster, Flat and cupped oysters nei. 6 European countries reported oyster production: Croatia, France, Ireland, Netherlands, Portugal, and Spain.

Pacific cupped oysters represent the most important production in Europe in volume and in value. Croatia produced in 2020 only European flat oyster as Bulgaria produced a very small amount of Pacific cupped oysters. For France and Ireland, the main producers in Europe, respectively 99% and 97% of the production in volume (98% and in value for both) is focused on Pacific cupped oysters. The other production is European flat production.

Main segments concerned by the oyster production are Oyster Rafts (seg11.9), Oyster On-bottom (seg11.11), Multispecies On-bottom (seg15.11).

Ireland: Licenced sites are being renewed, and some new sites are coming on-stream, along with start-up production units in the expanding oyster segment The farmed oyster segment made up 23% by sales volume and 20% by sales value of 2020 output, unit sales value for farmed oyster rose from €2 per kg to €4.4 in 2017, then slipped to €4.2 in 2020. The unit sales value for oysters varied greatly from bay to bay in 2020, depending on the specific oyster product desired by the market and availability of such products when the market reopened, after lockdown. Many stocks grew out of the required specifications during the lockdown period.

European flat oyster unit price per kg rose from €3.9 in 2008 to €6.9 in 2017 then slipped steadily thereafter to €5.1 per kg in 2020. The scarcity of this product over recent years, caused the market to switch away to the more readily available Pacific cupped oyster products.

In 2020, the reported data under the EUMAP and FAO for Spain demonstrates an oyster aquaculture total sales volume of 139.8 thousand tonnes, which is a 3% decrease compared to 2018.

There is a prevalence of Pacific cupped oyster production (97% of the total oyster's production in weight). As France represents 90% of the total oyster volume and value, the European productions and prices and cost shares are fully impacted by the French production and market. The second largest European producer is Ireland, far from France, representing 6% of volume and 6.6% of value.

In France, the Pacific oyster experienced a growth in valuation from 2016 to 2019 but a decline since 2020. Its selling price was €4.40/kg in 2018 but only €4.03/kg in 2020. This is partly due to higher production volumes in these years.

The number of enterprises of oyster aquaculture farming in EU amounted to 2 197, in 2020. 84% of the enterprises are in France, followed by Ireland (8%) and Portugal (5%). The number of companies is relatively stable between 2019 and 2020, except for Portugal which saw an increase of 67%. Oyster farming enterprises employed 7,624 FTEs with an average wage of €26 thousand a year. However, these last figures do not show the discrepancies between oysters' producers. In fact, Portugal and Croatia had lower average wage with respectively €14.5 thousand and €4.9 thousand in 2020.

Table 3.2.2.1: Economic indicators for the EU oyster aquaculture: 2019-2020.

Country	Number of enterprises		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Croatia	16	20	0.0	0.0	0.2	0.1	16	26	8	16	15.6	4.9
France	1853	1856	130.2	124.5	550.7	493.6	12,547	12,354	6,511	6,651	29.6	27.0
Ireland	162	174	10.7	9.0	46.4	37.6	1,437	1,272	685	631	26.1	21.8
Netherlands	21	21	2.5	2.4	6.7	8.7	50	50	50	50	0.0	0.0
Portugal	66	110	1.9	3.0	15.2	26.9	160	281	150	232	12.2	14.5
Total DCF reported	**2,118**	**2,181**	**145.4**	**138.8**	**619.3**	**566.8**	**14,210**	**13,983**	**7,406**	**7,579**	**28.7**	**26.0**
Other none DCF	18	16	1.2	1.0	4.4	3.3	119	102	53	44		
Total EU	**2,136**	**2,197**	**146.6**	**139.8**	**623.7**	**570.1**	**14,329**	**14,086**	**7,459**	**7,624**	**28.7**	**26.0**

Source: EU Member States DCF and FAO data submission, 2022

Table 3.2.2.2 presents the economic performance indicators for EU oyster aquaculture in 2020. France, the main contributor to the oyster sector, demonstrated a decrease both for GVA and EBIT (respectively -10% and -15%). Ireland followed the same trend for GVA decreasing by 15% but had stability for EBIT, ROI and labour productivity. However, capital productivity lost 10.3 points compared to 2019.

Table 3.2.2.2: Economic Performance indicators for the EU oyster aquaculture: 2019-2020.

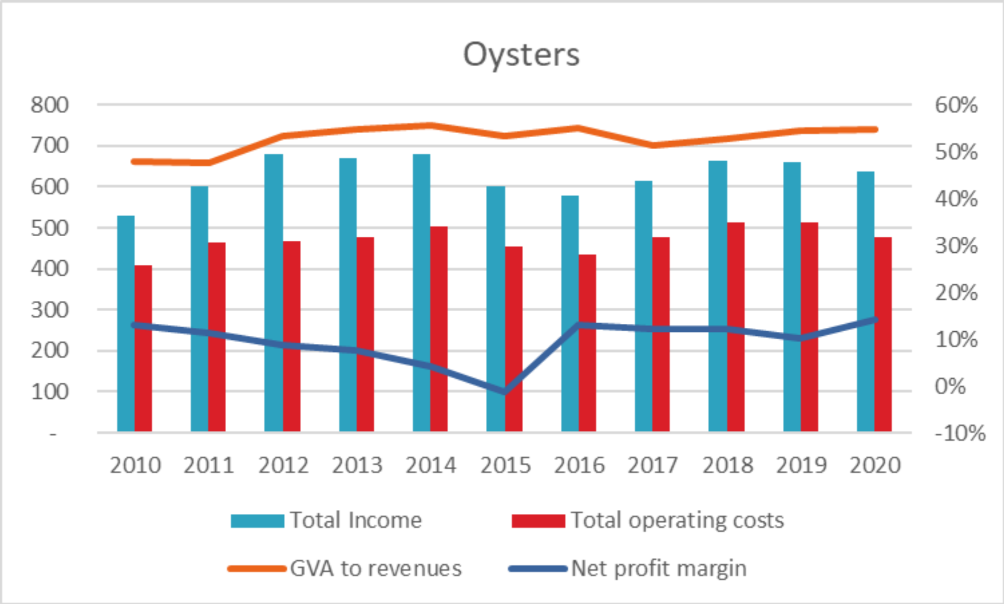
Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Croatia	0.2	0.1	0.1	0.1	57.7	21.5	27.9	6.6	96.1	29.8
France	308.4	278.4	51.3	57.4	5.1	6.6	47.4	41.9	30.9	32.0
Ireland	30.0	25.8	8.7	9.1	12.1	11.0	43.8	40.9	41.7	31.4
Portugal	13.4	25.8	11.1	22.3	93.7	88.2	89.2	111.0	113.6	101.7
Total DCF reported	352.1	330.1	71.2	88.9	6.6	9.1	47.5	43.5	32.5	33.7
Other none DCF	2.5	1.9	0.5	0.5	-	-	-	-	-	-
Total EU	**354.6**	**332.0**	**71.7**	**89.4**	**6.6**	**9.1**	**47.5**	**43.5**	**32.5**	**33.7**

Source: EU Member States DCF data submission, 2022

In 2020, total operating costs increased significantly for rafts cultures and other, but it is a slowdown trend for Oyster on-bottom since 2017. But the increase of turnover in 2018 led to a 10% increase of net profit as well.

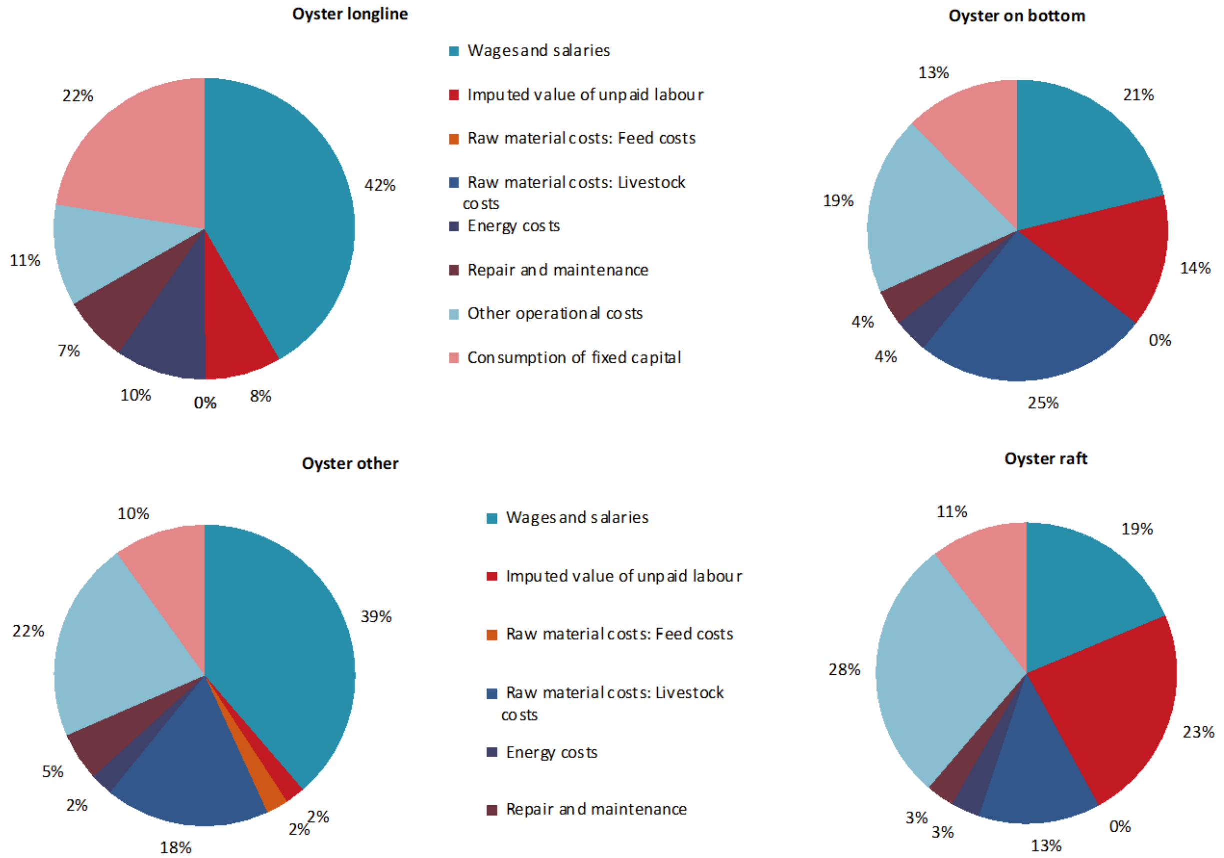
The oyster on-bottom segment represents 85% of total income in the oyster aquaculture sector and 86% of net profit. The segment's GVA to revenues reached 53% and the respective net profit margin reached 20% in 2020. The segment oyster rafts demonstrated in 2020 a positive value of net profit margin (11%). The oyster other segment returned to its previous level demonstrating the highest net profit margins of oysters' production with GVA to revenue reaching 68% in 2020, 38% in net profit margin.

Figure 3.2.2.1: Development of economic performance for the EU oyster aquaculture: 2010-2020.



Source: EU Member States DCF data submission, 2022

Figure 3.2.2.2: Costs breakdown for the EU oyster aquaculture: 2020.



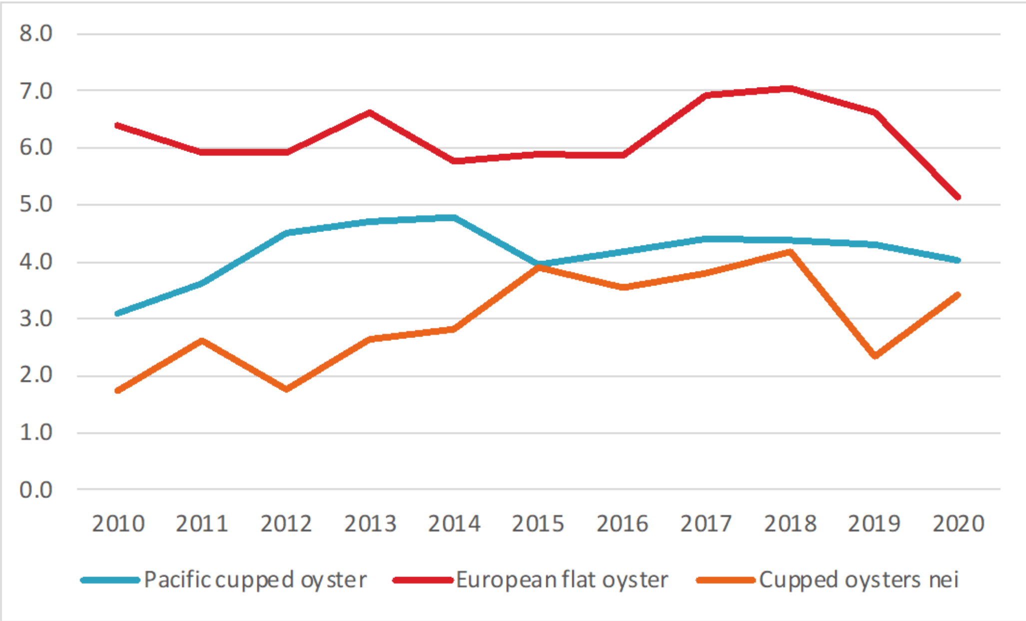
Source: EU Member States DCF data submission, 2022

The costs breakdown is very different from one segment to another. It highlights the different techniques used by oyster farmers and the different types of equipment used to raise oysters. The distances to be covered (offshore, on the foreshore, in the marshes) according to the different type of vehicles (tractors, boats of different sizes with different engines) explain the variability of the different costs according to the different segments.

The type of workforce (employed or unpaid labour) is also very different from one country to another. For example, in France (12 354 employees for 6 651 FTE), Portugal and Croatia, most of workforce are unpaid labour, whereas in Ireland, for the segment “Oyster other”, workforce is paid labour.

Also, for the raw material costs represented 22% of the total cost for oyster longline, twice as much as the other segmentations.

Figure 3.2.2.3: Price evolution of the main species of oyster group: 2010-2020.



Source: EU Member States DCF data submission, 2022

From one year to the next, price changes partly reflect the level of oyster supply (prices increase when volumes decrease). The availability of different sizes of oysters and ranges of oysters (refined or not) that make up the average price influences the price level each year. Price variations can also result from the relationship between the types of suppliers (shellfish farmers, shippers) and customers (wholesalers, restaurants, fishmongers, supermarkets, etc.).

In France, the Pacific oyster experienced a growth in valuation from 2016 to 2018 but a decline since 2019. Its selling price was €4.40 per kg in 2018 but only €4.03 per kg in 2020. This is partly due to higher production volumes in these years.

From 2010 to 2018, EU prices of reared Pacific cupped oyster and European flat oyster show a general common increasing trend. The lockdown had an impact on the sales, mostly in for European flat oyster.

In Ireland, European flat oyster unit price per kg rose from €3.4 in 2008 to €5.9 in 2016 then slipped steadily thereafter to €3.5 per kg in 2020. The scarcity of this product over recent years, caused the market to switch away to the more readily available Pacific cupped oyster products.

Pacific cupped oyster price is fluctuant between 2019 and 2020 and the European flat oyster prices had decreased 27%. Flat oysters’ results price is €2.7 per kg higher than Pacific cupped oyster but this trend is highly depending on the scarcity of the products and of environmental and health conditions.

3.2.3 Clams

The three most important species of clams produced globally are Japanese carpet shell (*Ruditapes philippinarum*) Constricted tagelus (*Sinonovacula constricta*), and Blood clocke (*Anadara granosa*). Total production of Japanese carpet shell in volume over 4 million tonnes (FAO, 2021), valued €6.7 billion[21] (FAO, 2021).

The two main clam species cultured in the EU are Japanese carpet shell (*Ruditapes philippinarum*) and grooved carpet shell (*Ruditapes decussatus*).

In this chapter, the data about Spain are extracted from the FAO dataset and reported as "Other non DCF" in the tables below, as the country has not transmitted the data for 2019-2020 in EUMAP. In Spain, although clam production is much lower than mussel and oyster ones, clam cultivation is also relevant. On the Spanish Mediterranean coast, the natural banks and shellfish parks have seen a total reduction in the production of clams and other shellfish due to the presence of the blue crab (*Callinectes sapidus*), a very voracious invasive species. In Italy, the price of clams increased in 2019 and remained high in 2020, too. It was due to a lower volume of availability caused by environmental problems that affected the product, but also marginally contributed to an increase in enhancement policies (certifications) and better traceability and qualification of the product. Furthermore, the segment has seen a benefit thanks to Producer Organizations (POs) that aggregate the volume raised and place them on the market having greater stability in both supplies and prices.

In 2020, European sales of clams were almost 29 thousand tonnes. This production decreased compared to 2019 with -6% in volume, and -21% in value with a corresponding turnover of €183.2 million. The downward trends since 2017 is confirmed (41.9 thousand tonnes in 2017 vs 29.2 in 2020, -30%). The professionals are facing a decrease of natural spat and seed collection due to acidification of sea waters and salinity changes. According to a study released in December 2020[22], decreasing pH would impact negatively on reproductive potential, but in all simulations under warmer conditions, reproductive potential values were higher than current, suggesting that temperature increase would compensate losses due to acidification. The increase of temperature mentioned in this study is not yet sufficient to compensate. In the meantime, professionals are forced to resort to more expensive breeding products from hatcheries since 2018. The combination of supply price and resource scarcity also explains price trends for the Grooved carpet shell.

The main EU countries produce clams are Italy (83% of the EU production), Portugal (10%) and Spain (7%) using two types of technologies: on-bottom (especially widespread in Italy and Portugal) and raft. Furthermore, in Portugal, the most important segment (in terms of production weight and sales value), is the clam based on-bottom farms producing Grooved Carpet Shell, in small areas of land in intertidal zone, usually with less than 1 hectare.

The number of companies in both Italy and Spain is stable, but decreases slowly in Portugal, they were altogether 767 in 2020, which is reflected in the number of employees who have been quite stable at 7350. The number of FTE has strongly been reduced in Portugal from 696 in 2017 to 467 in 2020, -33% corresponding to the difficulty to harvest natural seed from the coastal tidal areas.

[21] Used https://mercati.ilsole24ore.com/strumenti/converti-valute?refresh_ce=1 (verified Oct.2022).

[22] IMPACT OF TEMPERATURE INCREASE AND ACIDIFICATION ON GROWTH AND THE REPRODUCTIVE POTENTIAL OF THE CLAM RUDITAPES PHILIPPINARUM USING DEB.

Table 3.2.3.1: Economic indicators for the EU clam aquaculture: 2019-2020.

Country	Number of enterprises		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Italy	174	174	26.0	24.5	170.3	141.6	5,809	5,809				
Portugal	556	533	3.0	2.5	54.0	29.3	1,039	965	598	467	6.4	4.7
Total DCF reported	**730**	**707**	**29.0**	**26.9**	**224.3**	**170.8**	**6,848**	**6,774**	**598**	**467**	**6.4**	**4.7**
Other none DCF	56	60	2.2	2.3	12.4	15.5	523	576	46	40		
Total EU	**786**	**767**	**31.2**	**29.2**	**236.7**	**186.3**	**7,371**	**7,350**	**644**	**507**	**6.4**	**4.7**

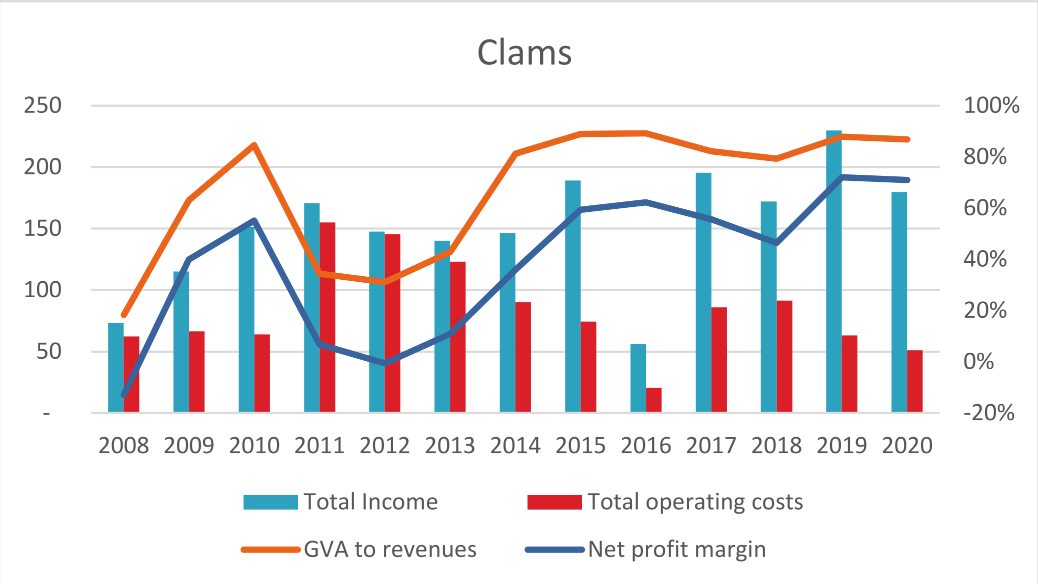
Source: EU Member States DCF and FAO data submission, 2022

In Portugal, the average wage was €4.7 thousand in 2020. The legal enterprises are mostly small familial units managed by the owner and their relatives. These micro farms have no organized accountant system, and it can therefore be difficult to collect economic information from these units.

In Italy, wages and salaries was €28.3 thousand in 2020 it has decreased from 2019, when the average wage was €35.4 thousand. Italian wages are higher than the EU average wage. There workers are also motivated by other things than the salary, represented by payment in natural clam seed shoals. In Italy, the clam sector has an important social role. The most productive areas are in Northern Emilia Romagna and Veneto. In these areas, many families base their economy on clam farms. Many businesses are started and owned by female producers. The dynamic has allowed both the increase in the number of companies since the mid-1980s, and the volume produced. Many women were first employed in the textile manufacturing sector, and then converted into the clam sector.

The EU clam aquaculture gross value added reached €160 million in 2017 compared to €169 million in 2020 but with fluctuation in 2018 and 2019. The EBIT was €106 million in 2017 but increased in 2020 to €138.5 million. The decrease of operating cost is mainly driven by the reduction of the raw material cost since 2018: the use of hatchery products limits the labour cost of harvesting natural products. Net profit increased accordingly.

Figure 3.2.3.1: Economic indicators for the EU clam aquaculture: 2008-2020



Source: EU Member States DCF data submission 2022

However, labour productivity decreased from €99.2 thousand in 2018 to €73.8 thousand, in 2020 corresponding to a loss of 26%. Capital productivity on the other hand declined from 167.1% in 2018 to 296.2% in 2020, corresponding to an increase of 77% and remaining still at high level due to low capital-intensive production combined with the use of products from hatcheries.

Table 3.2.3.2: Economic performance indicators for the EU clam aquaculture: 2019-2020.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Italy	147.7	120.5	114.3	93.8	187.3	183.0			242.2	235.1
Portugal	53.2	34.5	50.1	33.3	253.4	3158.0	89.0	73.8	269.5	3270.9
Total DCF reported	201.0	154.9	164.4	127.0	203.5	242.9	89.0	73.8	248.9	296.2
Other none DCF	11.1	14.0	9.1	11.5						
Total EU	**212.1**	**169.0**	**173.4**	**138.5**	**203.5**	**242.9**	**89.0**	**73.8**	**248.9**	**296.2**

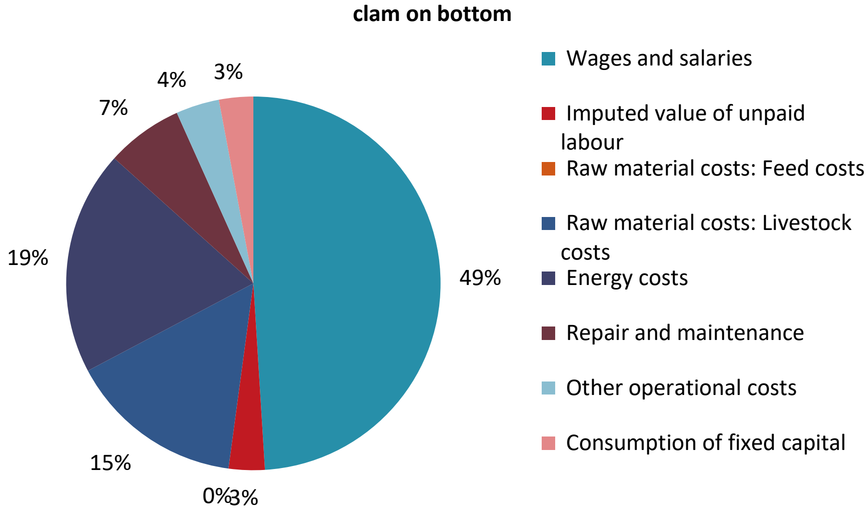
Source: EU Member States DCF and FAO data submission, 2022

The analysis of the performances of the top three producing countries shows different production and turnover pushes.

Italy registered a declining trend in most economic indicators which points towards an economic decline in the sector. Labour costs and labour productivity in Italy may appear inconsistent and excessive compared to data from similar sectors in other European countries. The data is consistent with respect to the working dynamics of producers directly involved in shellfish cooperatives. Part of their salary also compensates for their work to bring seed and other skills (commercial and different professionalism) within the predominantly work-based mutuality cooperatives. When interpreting the costs of the clam segment it is important to understand the dynamics within the sector. The clam farm often has the legal form of a cooperative, including both fishers fishing for seed (livestock) and the actual clam farmers. One part of the year fishers provide input in terms of seed (livestock) to the farms. The trends is accentuated by the difficulties to harvest a sufficient quantity of natural spat.

The cost structure in the clams on-bottom farms, underline the high share represented by wages and salaries plus the estimate of unpaid work. The percentage, taken as a whole, is 52%. This aspect, already noted previously, is due to the typical nature of the economic activity of clam organizations. The sector, populated above all by businesses and micro-enterprises, has an immense mix of workers and owners, so the salary, for example, tend to compensate for other ancillary jobs to the activity of breeder in *stricto sensu* (for example, administrator, but also administrative, commercial manager, but also a worker on the vessels to go to the installations every day). To this should be added, the activity like fishing, which is equivalent to the care of clam fields destined to reproduce seed, to the fishing of the seed to its transfer in nursery areas, and their "cultivation". This indicates that the clam production activity is very labour intensive with less use of capital equipment. The decrease of the part corresponding to livestock cost reflects the use of products from hatcheries. The new hatchery implemented in Spain should explain the positive trend of GVA and EBIT in this country and should be reviewed in the next report in 2024.

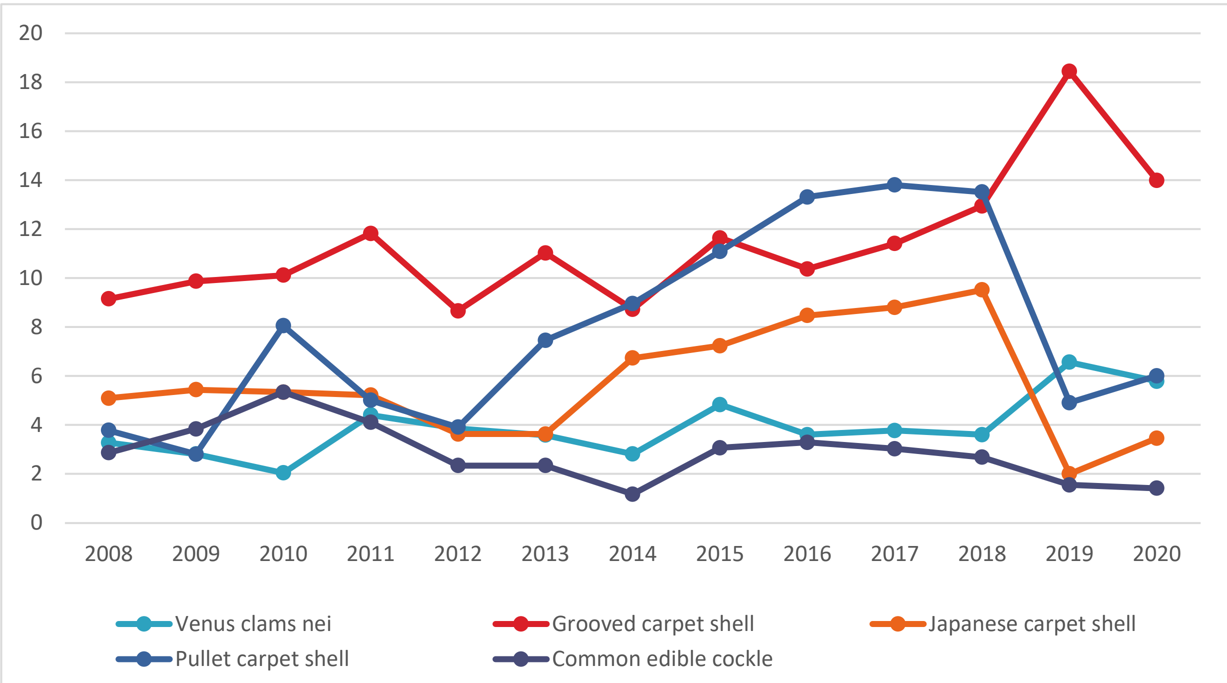
Figure 3.2.3.2: Costs breakdown for the EU clam aquaculture: 2020



Source: EU Member States DCF data submission 2022

EU prices (and world prices) of grooved carpet shell showed an increase trend during the period 2008 to 2020. There have been some decreases in prices during 2012 and 2014, but from there prices has increased from 2014 to 2020 to €14 per kg., with a peak during 2019, where the price was more than €18 per kg., which is the highest price reported during the whole period.

Figure 3.2.3.3: Price (€/kg) evolution of the main species of clam group: 2008-2020.



Source: EU Member States DCF data submission, 2022

The price for grooved carpet shell reflects the characteristics of production. This species is reared in protected areas and the timing of growth is very similar to that of the natural life cycle. This production is perceived of high quality because it follows a natural growth. Production of this species is labour intensive rather than capital intensive. On the other hand, the *venus* clams price show an opposite evolution than the carpet shell, with a price €6 per kg. In this case, the prices are rather stable in nominal terms, suffering a slight reduction in its average prices since 2011 until the end of the period analysed. The two other species, Japanese carpet shell and Pullet carpet shell, instead, recorded a drop in their price which on the time series had always been significantly higher. The contraction of the Japanese carpet shell was (-)64% compared to 2018; the decrease for the Pullet carpet shell was (-)56% compared to 2018.

Outlook

In the clam segment, important milestones have been reached to mitigate conflicts with other anthropic activities that are in the same coastal areas.

In Italy, the regions in which clam aquaculture is mainly concentrated, have been obtained exclusive areas of nursery for the reproduction of the seeds, but the areas allocated exclusively to aquaculture and to *venericulture* have not yet been defined. In the past, the criticality of clam farms in the Northern Adriatic regions (especially the Emilian area of Goro) in Italy was represented by the hydrodynamics of the water, a problem that was partially solved but always present because it is common for the waters to circulate in a regular way, risk anoxia, which leads to the death of clams on farms. Since last year, however, the main problem is linked to the availability of clam seed. For various reasons also linked to climate change, salinity change and acidification, the reproductive cycle that allowed farmers to find juveniles in some areas declared by the Emilia Romagna region, Biological Protection Areas, was interrupted and slowed down. These nursery areas have been granted in concession to clam’s companies, based on a specific regulation and under the supervision of a recognized scientific institute.

French hatcheries provide also selected seed trying to adapt to the new climate situation and are developing a new product in 2022: a pre grow juvenile clam of one year.

In Spain a new hatchery is implemented in a joint venture with the French hatchers.

In Portugal, similarly to what is accessed in other EU MS, the investments in aquaculture are based on spatial planning, seeking not only to minimize possible conflicts with other users. They will favour environmental standards in the implementation of the physical structures, but mainly in the use of aquaculture production methods compatible with the protection and improvement of the environment. Investments to introduce improvements in management practices of production and marketing including through the intensification of new information and communication technologies are also encouraged. Structural modernisation is also being promoted within the current fisheries management plan.

3.2.4 Other shellfish species

The distribution of weight and value of other shellfish species is based on FAO production data. According to the FAO data, shrimp production dominates the group of other shellfish species in weight and value in 2020.

The other shellfish species (i.e., not considering mussels, oysters and clams) includes Atlantic ditch shrimp, Corrugated venus, Whiteleg shrimps, Kuruma prawn, Giant tiger prawns. While Atlantic ditch shrimp is most produced species in terms of production volume covering 243 tonnes and €735 thousand in value, Corrugates venus is dominating the sales value with €2.4 million and a volume of 144 tonnes.

Figure 3.2.4.1: Main species, produced in the other shellfish farming facilities: 2020.

Source: FAO, 2022

3.3 Freshwater aquaculture

The total volume of EU freshwater aquaculture sales was 306.7 thousand tonnes in 2020, generating a value of €1.01 billion (table 3.3.7). For the total sales volume of freshwater aquaculture this was an increase of 1.4% compared to 2019, whereas the value decreased by 4.4%.

The top three largest producing countries in the EU freshwater segment (in sales volume) were France (13%), Denmark (12%) and Italy (11%) in 2020. In terms of value of sales, France was the largest (16%) followed by Denmark (12%) and Italy (10%).

Table 3.3.5: Economic indicators for the EU aquaculture freshwater subsector: 2020.

Country	Number of enterprises		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	696	731	11.3	8.6	34.2	26.1	1324	1216	1075	974	3.3	4.5
Croatia	32	28	3.1	2.7	7.1	6.2	367	375	328	310	9.8	10.7
Denmark	82	77	41.2	35.9	144.4	123.7	533	530	401	401	64.3	61.1
Finland	133	132	3.8	4.4	28.8	33.0	341	366	218	261	41.5	38.2
France	327	313	38.0	40.0	159.6	160.7	1,566	1,446	1,215	1,102	19.5	23.9
Germany	2633	2394	15.1	15.0	66.6	75.0	5,222	4,413	2,887	2,808	21.5	23.7
Greece	132	132	4.7	3.1	16.4	10.4	419	430	406	414	9.5	8.4
Ireland	7	8	0.6	0.6	1.7	1.9	22	22	17	18	26.6	29.5
Italy	141	141	36.2	33.8	112.1	102.4	568	568				
Latvia	79	78	0.7	0.8	4.4	4.3	323	330	175	223	13.6	11.4
Portugal	38	21	0.7	0.6	1.9	1.8	80	37	79	31	8.1	23.0
Romania	474	470	17.8	29.9	55.8	42.4	2,295	2,055	2,295	2,055	6.8	7.3
Sweden	71	79	10.2	10.5	43.5	46.7	379	561	268	295	29.8	23.9
Total DCF reported	**4,845**	**4,604**	**204.4**	**206.0**	**716.2**	**670.9**	**13,439**	**12,349**	**9,364**	**8,891**	**16.9**	**18.5**
Other none DCF	2,323	2,249	98.0	100.6	338.4	340.9	6,443	6,032	4,489	4,343		
Total EU	**7,168**	**6,853**	**302.4**	**306.7**	**1,054.6**	**1,011.8**	**19,883**	**18,381**	**13,853**	**13,234**	**16.9**	**18.5**

Source: EU Member States DCF data submission, 2022 & FAO, 2022.

*Note: Italian average wage is not reliable due to an insufficient number of FTE reported, therefore, Average wage do not include Italian data.

For the economic and employment indicators, 13 out of the 27 EU MS have reported EUMAP data, for the remaining countries estimations were made to represent the EU total. Some MS do not report freshwater aquaculture data to EUMAP due to production thresholds.

EUMAP data and estimations for 2020 show that there were 6 853 enterprises in the freshwater sector and compared to 2019 this is a decreased of 4.4%. The sector employed 18 381 people (Table 3.3.1), which approximately correspond to 13 234 FTEs. The average wage was around €18.5 thousand (excluding Italy); however, the wage varies significantly across MS. Salaries are dependent on the technique used and the species produced. The highest salaries were reported in Denmark, where intensive trout aquaculture dominates. The lowest salaries were paid in Bulgaria and Romania, where extensive carp production dominates. Compared to 2019, the average wages increased by around 9%.

In 2020, the EU freshwater aquaculture industry generated €359.5 million in GVA and compared to 2019 this was a decrease of 9.4%, whereas profitability in terms of EBIT dropped by 58.6% to €47.0 million. Decline of profitability was partly caused by COVID-19 constrains and pandemic control measures. Labour productivity in EU (excluding Italy) freshwater decreased by 22.7% to €23.9 thousand in 2020, whereas capital productivity declined by 22.4%. The highest capital productivity was found in France, Greece, and Italy.

Table 3.3.6: Economic Performance indicators for the EU aquaculture freshwater subsector: 2020.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	15.5	10.0	9.1	3.0	18.1	7.8	14.4	10.2	30.9	25.7
Croatia	10.7	4.4	5.5	2.9	5.1	2.7	32.5	14.4	9.9	4.0
Denmark	28.0	22.3	-6.9	-11.7	-3.1	-5.6	69.8	55.6	12.6	10.7
Finland	1.5	4.6	-11.2	-9.2	-14.2	-11.3	6.8	17.6	1.9	5.6
France	68.0	62.1	39.0	27.1	28.9	18.4	56.0	56.4	50.4	42.1
Germany	34.1	36.5	-30.7	-30.2	-15.5	-15.5	11.8	13.0	17.2	18.7
Greece	9.7	4.7	5.5	0.9	35.7	5.4	23.8	11.4	62.5	28.6
Ireland	0.2	0.7	-0.3	0.1	-9.4	2.4	9.9	36.5	4.7	15.6
Italy	50.6	35.3	31.5	18.4	18.8	13.7			30.1	26.2
Latvia	1.2	0.6	-1.3	-2.1	-4.9	-8.7	7.0	2.5	4.7	2.3
Portugal	-2.3	-2.3	-3.0	-3.1	-58.0	-34.8	-28.8	-73.1	-43.9	-25.4
Romania		23.1		-1.5		-0.5		11.2		8.5
Sweden	12.0	9.4	-1.3	0.2	-1.4	0.3	44.6	32.0	13.6	14.5
Total DCF reported	268.9	238.4	77.0	31.1	6.9	2.4	30.9	23.9	24.5	19.0
Other none DCF	127.8	121.1	36.6	15.8						
Total EU	**396.7**	**359.5**	**113.6**	**47.0**	**6.9**	**2.4**	**30.9**	**23.9**	**24.5**	**19.0**

Source: EU Member States DCF data submission, 2022.

*Note:

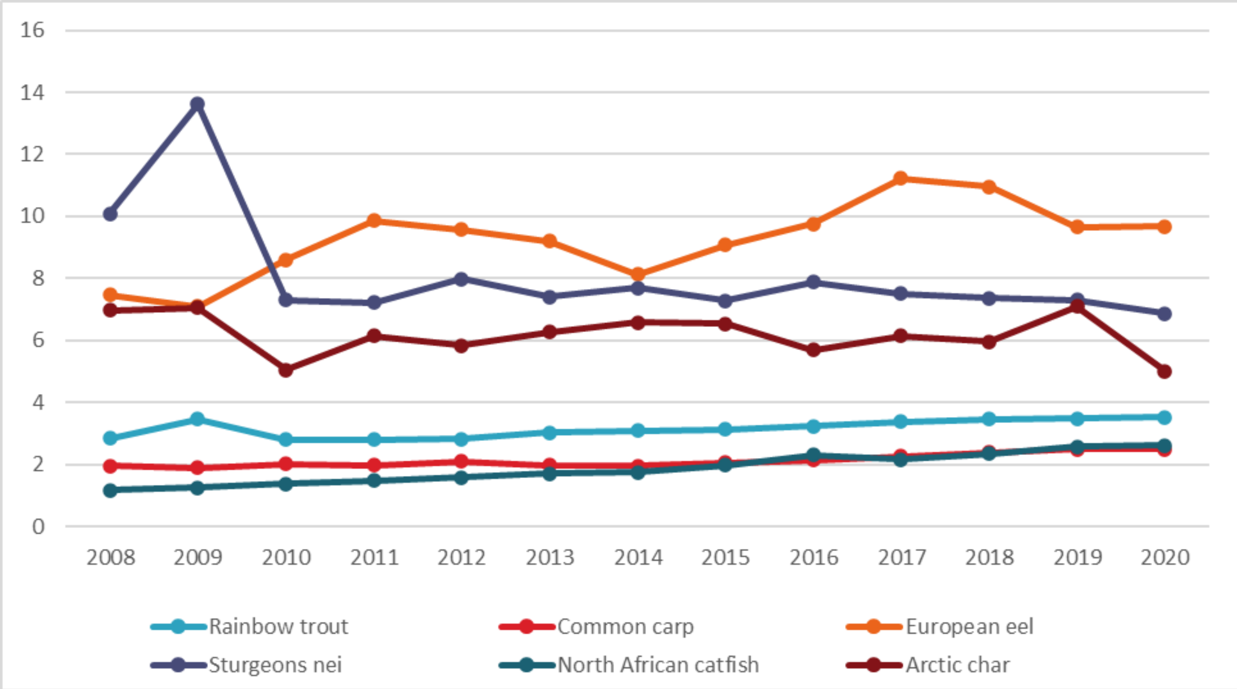
- Italian Labour productivity is not reported due to an unreliable data on number of FTE reported.
- Romanian data is excluded due to data quality issues in 2019
- Other non DCF, show estimated values for MS, which did not provide economic data.

Figure 3.3.4: Main species produced in the EU freshwater farming facilities: 2020.

Source: FAO, 2022

Rainbow trout dominates this segment with 57% of the volume and 59% of the value of total EU production. The common carp is the second most important species with volume and value of 24% and 18%, respectively. Production of European eel generated 2% of the total volume and 5% of the total value. (See Figure 3.3.1). The farming of the two most important species (rainbow trout and common carp) has some distinct economic and employment characteristics. Trout aquaculture production is mostly obtained from more intensive technologies, whereas carp producers use more extensive technologies.

Figure 3.3.2: Price (€/kg) evolution of the main species, produced in the EU freshwater farming facilities: 2008-20.



Source: FAO, 2022

3.3.1 *Trout*

Global production of rainbow trout (*Oncorhynchus mykiss*) increased during the 2008 - 2020 period from 518 thousand tonnes valued €1 952 million in 2008 to 960 thousand tonnes valued €3 744 million in 2020. Globally the leading producers are Iran, Turkey, Norway and Chile producing 21%, 15%, 10% and 9% of the total volume and 18%, 9%, 9% and 18% of the total value in 2018, respectively. The four leading countries covered 55% of the global volume and 54% of the global value, according to FAO data.

The EU production of rainbow trout in 2008 and 2020 reached to 204 thousand tonnes in both years. However, the production value increased from €590 million in 2008 to €771 million in 2020. The leading EU producers are Denmark, France and Italy covering 21%, 20% and 17% of the total volume, respectively, and 22%, 20% and 14% of the total value, respectively, in 2020. The three countries covered 58% of the total volume and 56% of the total value.

In Europe, most of rainbow trout are produced in freshwater and grown to a size between 300-500 grams. The flesh is white and competes on the large markets for whitefish in Europe. A few countries also produce rainbow trout in marine waters in cages, where the leading producer is Norway, however, Denmark and Finland also have smaller productions in the Baltic Sea. The trout grown at sea have red meat and is competing on the market for salmon. It should be noted that the primary product from Denmark is trout eggs, however, the meat is also sold for consumption. Within this chapter the total production of rainbow trout in EU is included. Furthermore, due to the change of segmentation between DCF and EU-MAP the rainbow trout are only showed as a combined segment for the economic variables, because there is only three years data available under the new segmentation. However, for the cost structures the new segmentation has been used showing cages, ponds, tanks and raceways and hatcheries and nurseries. In future reports, this is the segmentation that will be used for the rainbow trout production.

The global share of rainbow trout production weight covered by EU countries has decreased from 39% in 2008 to 22% in 2020. Accordingly, the global share of value for the EU countries has also decreased from 30% in 2008 to 20% in 2020.

Table 3.3.1.1. Economic indicators for the EU trout aquaculture: 2020

Country	Number of enterprises		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	124	100	5,1	4,3	21,5	17,2	326	326	301	294	3,9	6,4
Croatia	17	16	0,4	0,4	1,4	1,5	60	56	55	53	10,4	10,0
Denmark	75	70	49,9	42,8	174,6	155,1	503	503	379	378	67,7	63,3
Finland	78	70	12,5	12,4	73,7	66,9	418	397	322	323	41,3	40,7
France	327	313	38,0	40,0	159,6	160,7	1 566	1 446	1 215	1 102	19,5	23,9
Germany	977	911	10,5	10,2	51,3	57,9	2 400	2 360	1 623	1 499	26,2	31,8
Greece	68	68	2,0	2,1	5,4	6,0	176	183	163	167	10,7	8,1
Ireland	7	8	0,6	0,6	1,7	1,9	22	22	17	18	26,6	29,5
Italy	141	141	36,2	33,8	112,1	102,4	568	568				
Portugal	35	21	0,7	0,6	1,9	1,8	76	37	74	31	8,1	23,0
Romania	137	127	5,2	8,4	16,2	11,9	249	365	249	365	18,3	11,5
Total DCF reported	**1 986**	**1 845**	**161,1**	**155,6**	**619,3**	**583,1**	**6 364**	**6 263**	**4 399**	**4 230**	**26,0**	**28,5**
Other none DCF	589	577	47,8	48,7	188,3	188,2	1 887	1 960	1 304	1 324		
Total EU	**2 575**	**2 422**	**208,9**	**204,3**	**807,6**	**771,3**	**8 252**	**8 223**	**5 703**	**5 553**	**26,0**	**28,5**

*Note: FTE and Average wage data for Italia are not reliable and have therefore been removed.
Source: EU Member States DCF data submission, 2022; Values of “Total sales volume” and “Turnover” for Other none DCF are obtained from FAO data, the remaining values for Other none DCF are estimated.

The number of enterprises engaged in trout production in the EU was 2 422 in 2020, which was a 6% reduction from 2019. The enterprises employed 8 223 people, remaining rather stable compared to 2019. The persons employed corresponding to 5 553 FTE, which was a decrease compared to 2019 of 3%. The freshwater trout sector has a significant component of part-time workers (about 0.73 ratio between FTE and employment). There is a large variation in the average wages between the countries. Countries with smaller productions experience large fluctuation in the average salary. The salaries varied from €6.4 thousand in Bulgaria to €63.3 thousand in Denmark.

The economic performance indicators show that the trout sector is not doing as well as it was year ago. In 2020, the GVA in the sector amounted to €262 million, which was a 7% decrease compared to 2019. EBIT decreased to €48.8 million, which was a decrease of 43% from 2019. The weakened economic performance is also confirmed by the ROI indicator decreasing to 4.9% in 2020. Both Labour productivity and Capital productivity decreased from 2019 to 2020 by falling to €38.5 thousand and 26.5%, respectively.

The economic performance in the different Members States shows large variation in the economic performance indicators, because of the different sizes of the sectors and the use of different production techniques.

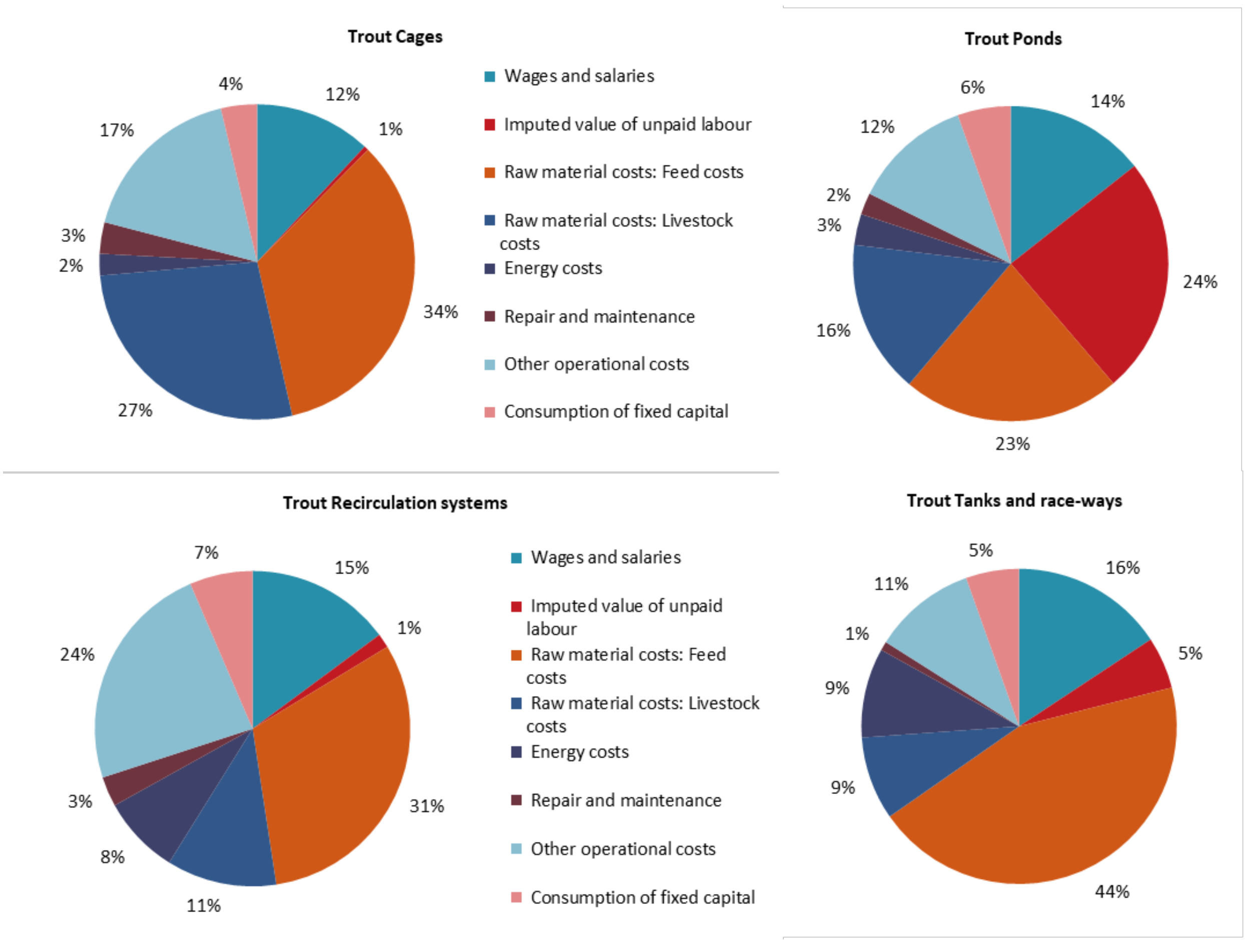
The data submitted to EU-MAP, shows that the cost structure is different depending on the trout farming technique. The most dominant costs of the rainbow trout sector are raw material (feed and livestock costs), which represent 39% of the total costs in the ponds segment, 53% in tanks and race-ways, 42% in recirculation systems and 61% in the cages segment. The next major costs in the sector are wages and salaries and other operational costs. The imputed value of unpaid labour is high for ponds segment with 24% of the total. The highest shares of energy costs are in tanks and trace-ways and in recirculation systems. Consumption of fixed capital is pretty much the same in all segments - representing 4-7% of the total costs. Repair and maintenance costs are very similar corresponding to 1-3% of total costs. The share of other operational costs is lowest in tanks and race-ways segment (11%) and the highest in trout recirculation systems (24%).

Table 3.3.1.2. Economic performance indicators for the EU trout aquaculture: 2020.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	12,7	9,3	10,3	6,8	47,3	44,2	42,3	31,5	58,4	60,5
Croatia	0,7	0,5	0,1	-0,1	1,6	-0,5	12,5	8,9	8,9	4,8
Denmark	37,4	40,7	6,2	11,4	3,6	7,1	98,8	107,6	21,6	25,1
Finland	18,0	12,0	-0,3	-6,0	-0,2	-4,9	55,9	37,1	13,9	9,9
France	68,0	62,1	39,0	27,1	28,9	18,4	56,0	56,4	50,4	42,1
Germany	26,8	31,2	-19,5	-18,0	-44,8	-33,3	16,5	20,8	61,4	57,7
Greece	3,4	2,3	1,4	0,6	10,7	4,3	21,1	13,8	26,5	16,4
Ireland	0,2	0,7	-0,3	0,1	-9,4	2,4	9,9	36,5	4,7	15,6
Italy	50,6	35,3	31,5	18,4	18,8	13,7			30,1	26,2
Portugal	-2,0	-2,3	-2,6	-3,1	-54,1	-34,8	-26,3	-73,1	-39,9	-25,4
Romania		6,5		-0,4		-0,5		17,7		8,5
Total DCF reported	216,0	198,1	65,8	36,9	9,4	4,9	39,9	38,5	30,8	26,5
Other none DCF	65,7	64,0	20,0	11,9						
Total EU	**281,7**	**262,1**	**85,8**	**48,8**	**9,4**	**4,9**	**39,9**	**38,5**	**30,8**	**26,5**

*Note: Italian labour productivity is not reliable due to an insufficient number of FTE reported and has therefore been removed. Romania is excluded due to unreliable data in 2019.
Source: EU Member States DCF data submission, 2022.

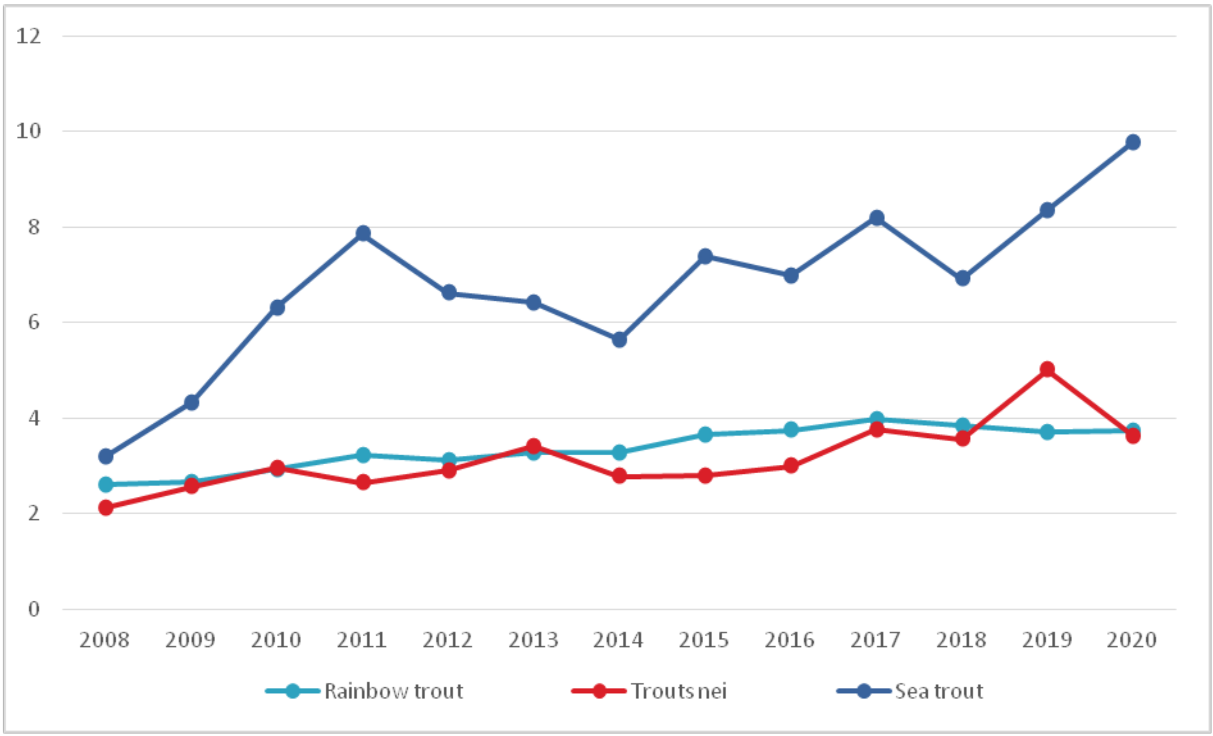
Figure 3.3.1.2. Costs breakdown for the EU trout aquaculture: 2020.



Source: EU Member States DCF data submission, 2022.

The average price of the main species of trout group has shown an overall increasing trend for 2008-2020. The average price for rainbow trout has increased by 44% during this time period and reached to €3.7 per kg in 2020. Market prices for sea trout have been higher and more fluctuating than for rainbow trout. From 2008 the price for sea trout has increased three times and in 2020 it was €9.8 per kg.

Figure 3.3.1.3. Price evolution of the main species of trout group: 2008-2020.



Source: EU Member States DCF data submission, 2022

3.3.2 Carp

Global production of common carp, the most important cyprinid species in the EU by volume and value, increased from 3.3 million tonnes in 2010 to 4.2 million tonnes in 2020, representing 8.6% of global Finfish production in fresh water aquaculture. The world-leading producer of common carp is China, which is responsible for 70% of global production (FAO 2020). With 0.07 million tonnes in 2020, production of common carp in Europe is comparable low and often dedicated for domestic markets.

The history of common carp (*Cyprinus carpio)*, dates back almost a thousand years in Europe. In fact, it is the longest farmed species in European freshwater aquaculture and the only culture (FAO, 2016), which knows different breeding lines. The Cistercian monastic order played a central role in the domestication of carp in Central and Eastern Europe in medieval times (cf. Lasner et al., 2020[23]). The traditional extensive polycultural techniques are still used by many present day carp farmers in Europe. Hence, carp farms are seen as low input aquaculture, providing both cultural and ecosystem services. In some countries like Germany, a societal debate has started, which argues to acknowledge carp cultures for their provided ecosystem services. Partly, carp farmers gain already public payments from contractual nature conservations under specific restrictions. Earthen carp ponds have similar construction and tend to differ only in scale and stocking density. Water supply derives from precipitation or surface water (e.g. stream). Annual carp production depends heavily on climate. A strength of carp is his high tolerance towards water temperature and low degrees of in water soluted oxygen. The robustness of carp is analogical strong and not

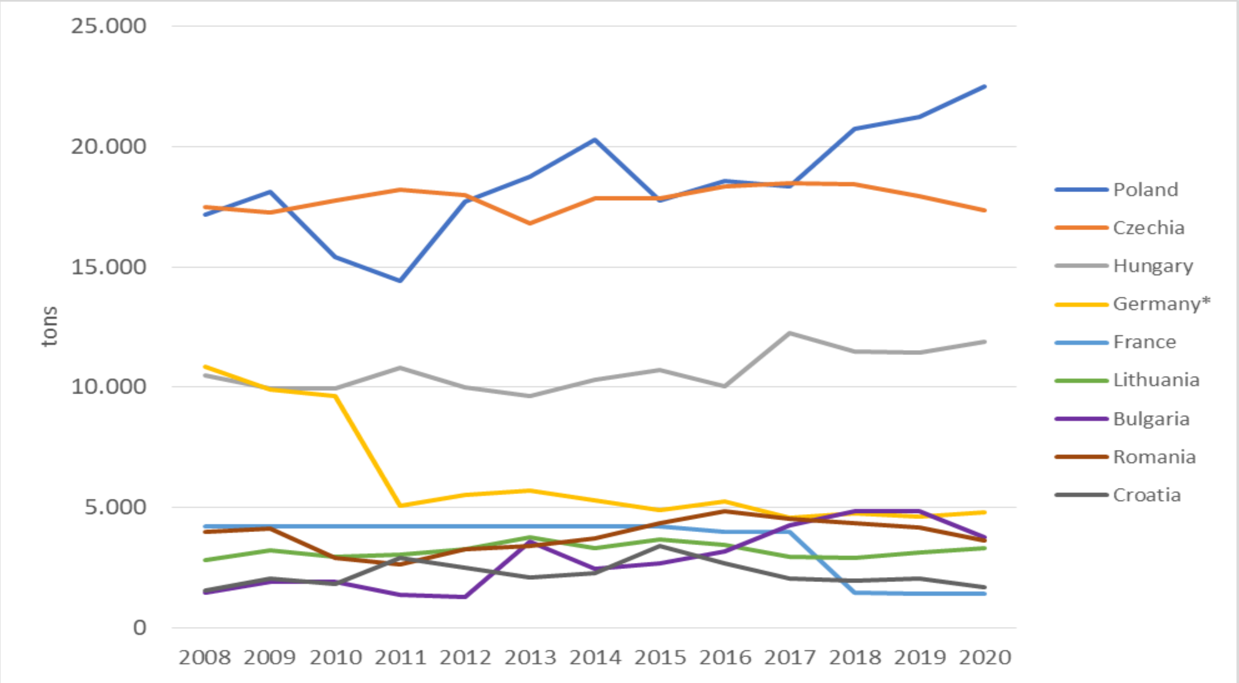
[23] Lasner T., Mytlewski A., Nourry M., Rakowski M. and Oberle M. (2020) Carp Land: Economics of Fish Farms and the Impact of Region-Marketing in the Aischgrund (DEU) and Barycz Valley (POL). Aquaculture 519, 734731.

susceptible to external impacts as other species. Nevertheless, climate change impacts are one of the greatest challenges of today's carp farming.

Various cyprinid species are produced in the EU besides the common carp. After common carp, the main species produced by weight are bighead carp (*Hypophthalmichthys nobilis*), grass carp (*Ctenopharyngodon idellus*), and silver carp (*Hypophthalmichthys molitrix*) in 2020. Notwithstanding, common carp is by far the most important cyprinid species in the EU by volume and value. According to FAO data, EU member states (exl. the UK) produced 72 524 tonnes of common carp in 2020. Take into account, that Germany as the former third biggest producer changed its data collection method and reported around 5 000 tonnes per year less since 2011 in consequence. Bearing that fact in mind, the production has remained more or less stable in the last 10 years. Poland, Czechia, Hungary, Bulgaria, Germany, Romania, Lithuania and France are responsible for more than 90% of EU carp production. Poland and Czechia alone have a share of more than 50% of total EU production. The value of common carp sales was €181 million in 2020.

With the exception of Czechia, EU production of common carp is produced for domestic markets. Poland is the main consumer market for carp in Europe. The domestic demand for carp has a strong seasonal peak at Christmas time in some MS due to catholic culture. Although there is a range of different processed carp products, the tradition is still to buy freshly slaughtered carp or even live carp that can be prepared at home. Approximately 40% of the produced fish is sold in December due to the Christmas holidays, and there is also another peak in the sales near Eastern.

Figure 3.3.2.1: Quantities of common carp by main producers in EU (in tonnes) 2008-2020



Source: FAO (2022)

* The “decline” in German carp production is caused by changed survey methods in 2011.

As in many MS in Germany and Poland, two of the main EU consumer markets for carp consumers tend to switch to other fish species nowadays (Zander & Feucht, 2018[24]). But, carp producers have started, e.g. in Poland and Germany, to intensive investments in direct marketing of more processed carp products (Lasner et al., 2020) to meet the preferences of changing consumers preferences for more convenient fish food.

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[24] Feucht Y. & Zander K. (2018) D2.4: Report on the potential of selected innovative products in European markets. Strategic Use of Competitiveness towards Consolidating the Economic Sustainability of the European Seafood sector (SUCCESS), final report, Grant Agreement no: 635188.

On the production side, some carp farmers suffer extremely under fish loss due to protected wildlife fish predators (e.g. cormorant, heron and otter), draughts, which cause water shortage (in particular in the years 2015, 2018, and 2019) and in some parts loss due to diseases (Koi herpes virus, KHV). Together these factors can have a significant impact on the profitability of carp farms.

Economic Performance

Due to the poor freshwater aquaculture data reported under the DCF, especially for landlocked countries, which are also the main carp producing countries, it is difficult to give a detailed picture of the economic performance of the EU cyprinid aquaculture sector. Based on the submitted information, it is only possible to analyse four countries, which are included in Table 3.3.2.1. In 2020, the EU aquaculture sector consisted of 2 404 registered enterprises, with a total sales volume of 51.9 thousand tonnes according to reported DCF data, which do definitely not correspond to the real number of farms and sales (cf. FAO data above).

The majority of the enterprises were situated in Germany, Bulgaria, and Romania. In 2020, the carp segment employed 4 770 people corresponding to 3 763 FTEs (Table 3.3.2.1). Total turnover was €95.1 million. In 2020, FAO data for the following countries: Austria, Bulgaria, Croatia, Czechia, France, Germany, Hungary, Italy, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia and Spain, shows that these countries generate a total sales volume of cyprinids of 96.8 thousand tonnes and turnover of €217.5 million.

Table 3.3.2.1: Economic indicators for the EU cyprinids aquaculture: 2020.

Country	Number of enterprises		Total sales volume		Turnover		Employment		FTE		Average wage	
	number		thousand tonnes		million €		number		number		thousand €	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	501	583	5,9	4,0	11,9	7,7	879	769	660	568	3,1	3,6
Croatia	15	12	2,7	2,4	5,7	4,6	307	319	274	257	9,7	10,8
Germany	1.656	1.483	4,6	4,8	15,3	17,1	2.822	2.053	1.264	1.309	15,6	14,5
Romania	323	326	12,1	20,7	37,9	29,2	1.990	1.629	1.990	1.629	5,4	6,3
Total DCF reported	**2.495**	**2.404**	**46,6**	**51,9**	**110,6**	**95,1**	**5.998**	**4.770**	**4.188**	**3.763**	**8,4**	**9,1**
Other none DCF	2.320	2.082	43,3	44,9	120,9	122,3	5.578	4.131	3.894	3.259		
Total EU	**4.815**	**4.486**	**89,9**	**96,8**	**231,5**	**217,5**	**11.576**	**8.901**	**8.082**	**7.022**	**8,4**	**9,1**

Source: EU Member States DCF data submission, 2022

The Expert working group was not able to analyse and evaluate the overall performance of the carp sector by segments due to the limited data and due to differences in segmentation within DCF and EU MAP. Therefore, the situation for carp production is presented as one aggregated segment, which includes all cyprinids not only common carp. According to the data reported the average wage in the segment was €9.1 thousand in 2020 and increased compared to 2019 (€8.4 thousand) for an 8%.

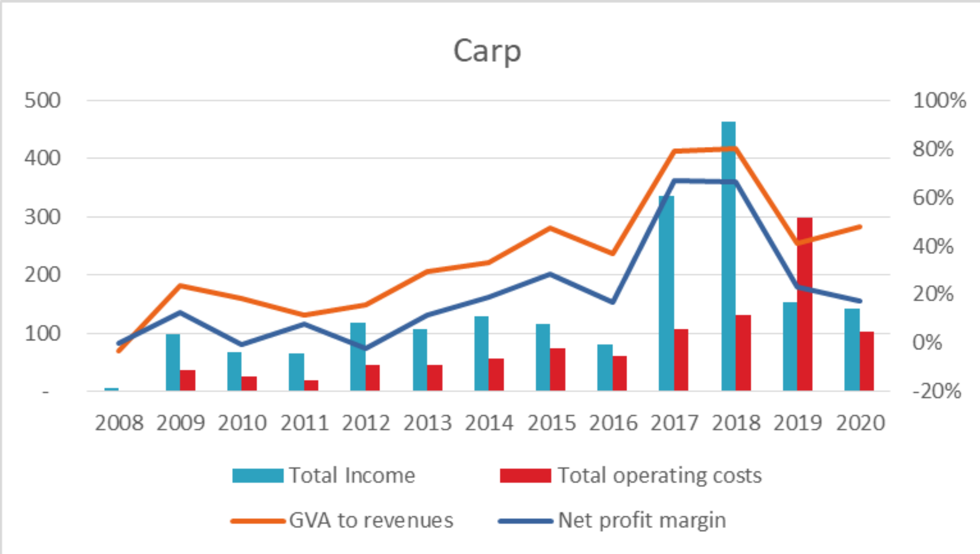
Table 3.3.2.2: Economic performance indicators for selected EU carp aquaculture: 2020.

Country	GVA		EBIT		ROI		Labour productivity		Capital productivity	
	million €		million €		%		thousand €		%	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Bulgaria	4,0	1,8	0,8	-1,3	4,1	-8,4	6,1	3,2	20,1	11,6
Croatia	10,0	4,0	5,4	3,0	5,4	3,0	36,5	15,5	10,0	3,9
Germany	7,3	5,3	-11,2	-12,3	-7,3	-8,7	5,8	4,1	4,7	3,8
Romania		15,9		-1,0		-0,5		9,8		8,5
Total DCF reported	61,0	63,5	34,8	24,8	12,7	5,6	27,8	16,9	22,3	14,3
Other none DCF	66,8	81,6	38,0	31,9						
Total EU	**127,8**	**145,1**	**72,8**	**56,8**	- **11,6**	**4,6**	**32,3**	**46,2**	**18,5**	**26,6**

* due to unreliable data some of the 2019 data for Romania were not used

Source: EU Member States DCF data submission, 2022

Figure 5.3.2.2: Economic performance indicators for carp aquaculture: 2008-2020



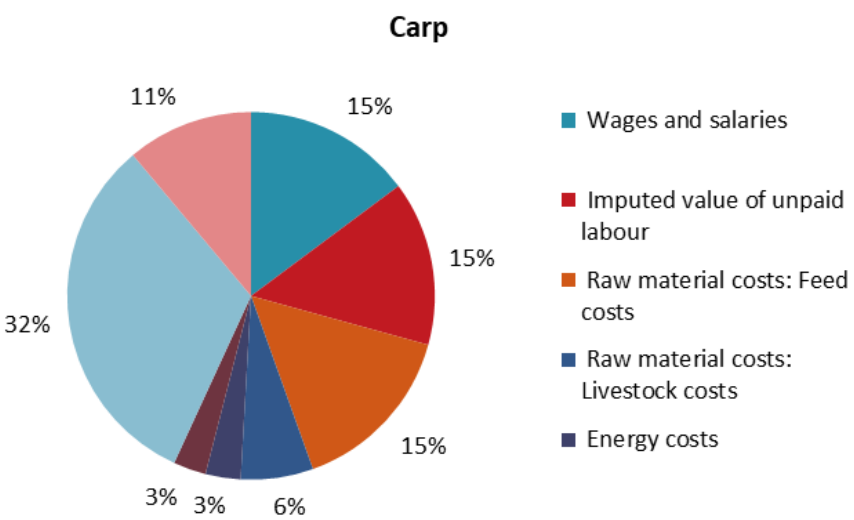
Source: EU Member States DCF data submission, 2022

In terms of economic indicators, according to DCF data, the amount of GVA, EBIT, and Labour productivity generated by the EU carp aquaculture sector in 2020 was €63.5 million, €24.8 million, and €16.9 thousand, respectively. ROI and Capital productivity achieved -0.5% and 14.3% in the same year. All of the indicators, except of GVA, in 2020 decreased compared to 2019. EBIT and Labour productivity decreased by 29% and 39% respectively, while GVA increase for 4% in the same period. ROI and Capital productivity decreased by 55% and 43%.

However, it should be emphasized that the Romanian data for 2019 were not taken into account in the analysis due to unreliability.

The largest part of costs according to the provided data was feed costs, which covered 39% of the total costs. Consumption of fixed capital represented the second largest cost with 23% of the total cost. Wages and salaries also represented 19% of the total. The imputed value of unpaid labour, which actually is net income to family farms represents 1% of the total costs.

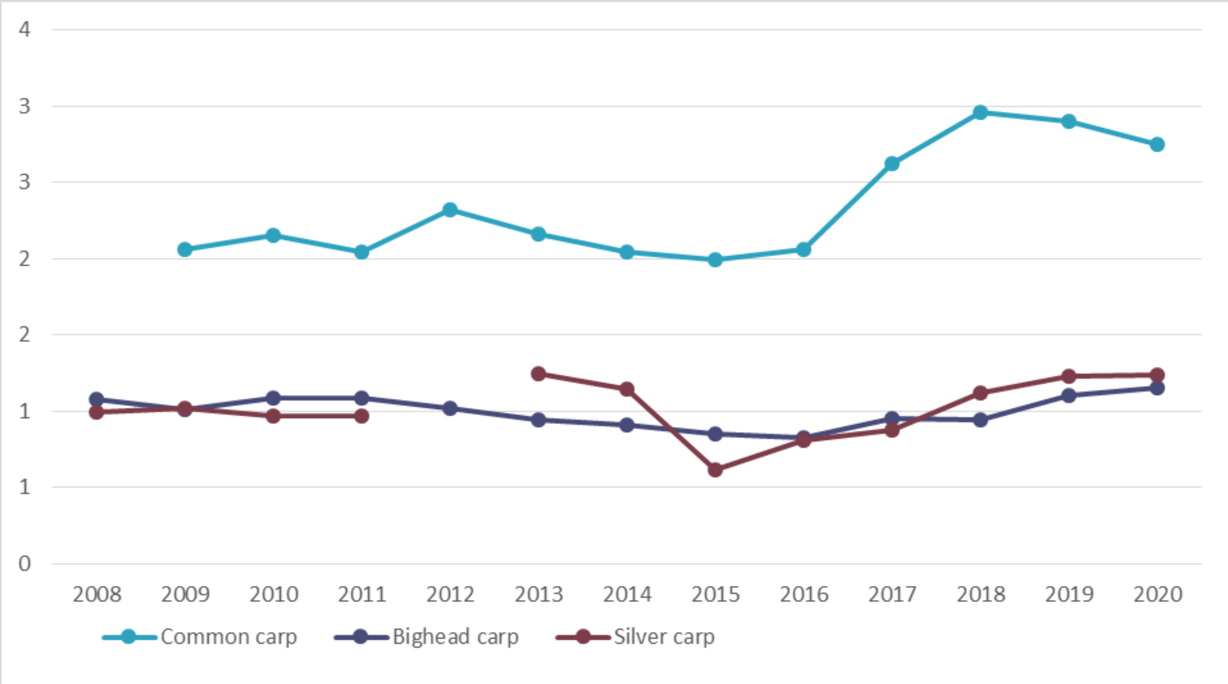
Figure 3.39: Costs breakdown for the EU carp aquaculture: 2020



Source: EU Member States DCF data submission, 2022

The price for cultured common carp shows an increasing trend, as illustrated in Figure 3.40, although there is a slight drop in prices for Common carp in the period 2018-2020. This is in line with world prices for carp (FAO). The price of common carp in the EU is almost one and a half as high as the price on the world market. This price difference is likely to reflect the difference between European and Asian consumer income, and the incorporation of lower value cyprinid species (big head carp and silver carp) within the world price for carp.

Figure 3.40: Price evolution of the main species of carp group: 2008-2020



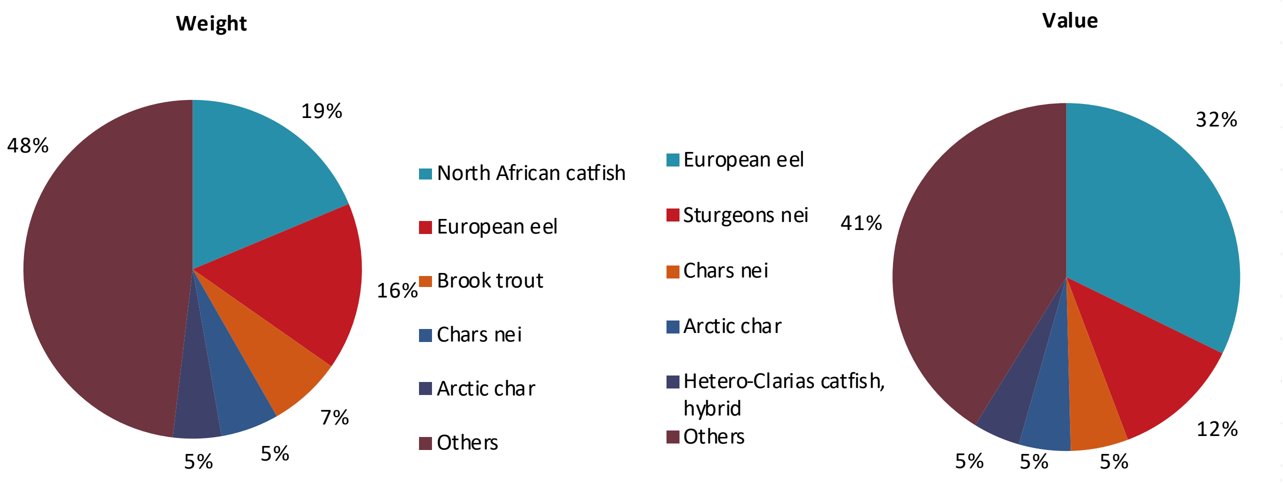
Source: EU Member States DCF data submission, 2022

3.3.3 Other freshwater species

Figure 3.3.1 shows the most important remaining fresh water species produced in the EU. North African catfish and European eel are the most important in terms of weight contributing 19% and 16%, respectively. In terms of value, European eel represents the highest value at 32% and Sturgeons nei represents 12% each.

In total, the production was 30.9 thousand tonnes, valued €149 million in 2020. The contributing most to the value in this segment are the Netherlands, Germany and Italy.

Figure 3.3.1: Main species produced in the EU Member States for Other freshwater species group: 2020.



Source: FAO 2022

4 NATIONAL CHAPTERS

4.1 Austria

Overview of Austrian aquaculture

Austria is a landlocked country producing only freshwater aquaculture products. The data collection of freshwater aquaculture is not mandatory. Since no data were submitted in the related data call, FAO data were used instead.

Total Production and sales

The Austrian aquaculture sector produced 4.5 thousand tonnes in 2020 and the estimated production value was €30.3 million (FAO, 2022). Austria does not have marine or shellfish aquaculture production.

The total weight of production has doubled (increase of 42%) during the analysed period from 2008 to 2020. In 2020, the total weight increased by 7% from the previous year and increased significantly by 42% compared over the period 2008-2020. The value of the production in 2020 increased slightly by 2% compared to 2019 and nearly 50% compared over the period 2008-2020. The development over the last 12 years is incredible showing a rise both in production weight and value.

Table 4.1.1 Production and sales for Austria: 2008-2020.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 19-20	Develop. 2020/(08-19)
Production weight (thousand tonnes)	**2.1**	**2.1**	**2.2**	**2.9**	**3.1**	**3.2**	**3.4**	**3.5**	**3.5**	**3.9**	**4.0**	**4.3**	**4.5**	***7%***	***42%***
Marine	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	2.1	2.1	2.2	2.9	3.1	3.2	3.4	3.5	3.5	3.9	4.0	4.3	4.5	7%	42%
Production value (million €)	**12.7**	**13.9**	**20.4**	**16.9**	**17.9**	**18.4**	**20.2**	**20.2**	**22.5**	**25.3**	**26.4**	**29.6**	**30.3**	***2%***	***49%***
Marine	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	12.7	13.9	20.4	16.9	17.9	18.4	20.2	20.2	22.5	25.3	26.4	29.6	30.3	2%	49%

SOURCE: FAO (2022)

Main species produced

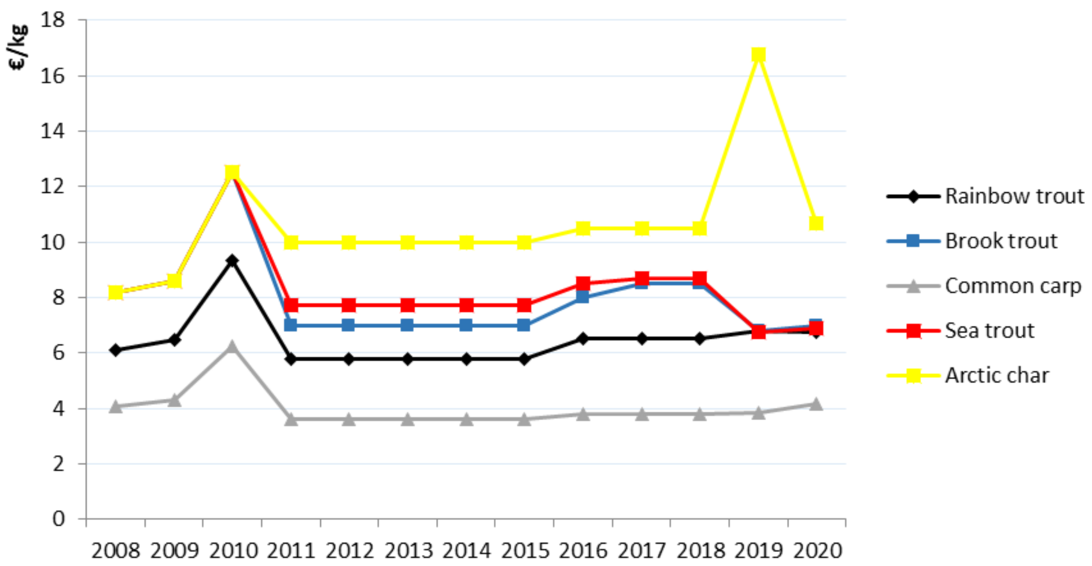
Rainbow trout remains the main species produced by the Austrian aquaculture sector representing 34% of the total weight and 33% of the total value of production in 2020. Other important species are brook trout covering 13% of the weight and 17% of the value, sea trout (also known as brown trout) accounting for 12% of the weight and 15% of the value, and common carp with 16% of the weight and 9% of the value.

Almost all aquaculture prices have had a similar trend over the period 2008 to 2018. Prices peaked in 2010 and after a drop in 2011, they were stable with a slight increase since 2016. But the picture changed during the last two years 2019-2020. Arctic char is the most valuable species which enjoyed a significant increase in price for 2019 but in 2020 it dropped down to approximately the same levels as in 2018. On the other hand, sea trout and brook trout dropped significantly in 2019 and they were stable for 2020. Common carp has the lowest price.

Figure 4.1.1 Main species in terms of weight and value in Austrian production: 2020.

Source: FAO (2022)

Figure 4.1.2 Average prices for the main species produced in Austria: 2008-2020.



Source: FAO (2022)

COVID-19 impact

According to reports from producer organisations, aquaculture production itself was basically not affected by Covid-19. Regarding sales, the lockdown of restaurants and hotels first caused a major decline; fortunately, this could be compensated by the increased household demand for regional fish, which resulted in increases in farm-gate sales, sales at farmers‘ markets, and sales through domestic retailers, preventing serious overall losses. According to producer organisations as well as to statistical data, no employment effects were identified so far. It should be noted that the overall number of employees in the Austrian aquaculture sector is very low in general.

Data Coverage and Data Quality

The data collection of freshwater aquaculture is not mandatory under the DCF and EU-MAP programmes of the EU data collection. So landlocked countries are not obliged to provide economic data for this report. The analysis of the Austrian aquaculture sector is therefore based on data extracted from FAO.

4.2 Belgium

Overview of Belgian aquaculture

Although Belgium is not a landlocked country, it has only freshwater aquaculture. The data collection of freshwater aquaculture is not mandatory under the DCF. Considering no data were submitted in the related data call, FAO data were used instead.

Production volume and value

According to FAO data, total freshwater aquaculture sector in Belgium produced 0.2 thousand tonnes in 2020 valued at €1.4 million.

Table 4.2.1 Production and sales for Belgium: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
(thousand tonnes)	**0.1**	**0.2**	**0.3**	**0.2**	**0.0**	**0.1**	**0.1**	**0.1**	**0.2**	143%	26%
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	0%
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	0%
Freshwater	0.1	0.2	0.3	0.2	0.0	0.1	0.1	0.1	0.2	143%	26%
Sales value (million €)	**0.3**	**1.6**	**2.2**	**1.0**	**0.4**	**0.7**	**0.8**	**0.5**	**1.4**	159%	43%
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	0%
Shellfish	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	-100%
Freshwater	0.3	1.4	2.2	1.0	0.4	0.7	0.8	0.5	1.4	159%	46%

SOURCE: FAO, 2022

Industry structure

The Belgian fresh water aquaculture sector consists of only 7 companies. It is mainly characterized by small-scale, extensive production units, with low employment rate. Only a limited number of farms form an exception to this rule of thumb. In the northern part of Belgium (Flanders) the companies can be identified, in the southern part of Belgium (Wallonia) the situation is more complicated.

The biggest production is situated in Wallonia, where mostly rainbow trout (*Oncorhynchus mykiss*) and to a lesser extent brown trout (*Salmo trutta fario*) and brook trout (*Salvelinus fontinalis*) are cultured. These farms are mostly family-based operations that often have no further personnel on the payroll and subsequently, do not have significant alternative employment opportunities. Hence, farmers are prepared to accept incomes, which would not be acceptable to publically limited liability companies and keep producing trout under non-profitable conditions. In addition, leaving and getting back into business is fairly easy, because the infrastructure is not expensive to maintain. Nowadays, big producers of trout, import large size of trout (from Italy, Greece and Turkey) and keep them in outdoor ponds until there is a demand for trout. To our knowledge there is no full cycle production (from broodstock via eggs to market sized product) of trout in Belgium.

In Flanders, several fish farms are active in the production of ornamental fish (koi, goldfish, shubunkins, sarasa's), game fish (e.g. bream, carp, catfish, ide, minnow, pike, tench) and consumption fish (carp and tilapia) in fish ponds.

Mariculture is very rare in Belgium and is limited to the production of oyster, blue mussel and tropical shrimps.

Overall Economic performance and total employment

Despite the fact that the collection of freshwater aquaculture data is not mandatory under the DCF, Belgium collected expenditure data for 2019-2020. These data are presented below as national totals.

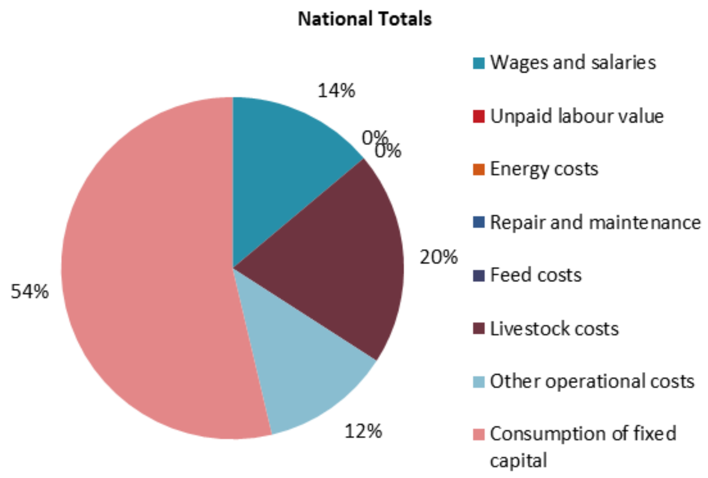
The total number of persons employed in 2020 was 38, corresponding to 31 FTE. Compared to 2019, the number of employees decreased significantly by 25%, whereas the number of FTE decreased by 14%.

Table 4.2.2 Economic performance of the Belgian aquaculture sector: 2019-2020.

Variable	2019	2020	Change 2019-20
Number of enterprises	7	7	0%
Persons employed	51	38	-25%
FTE	36	31	-14%
Total income	0.2	0.2	43%
Total operating costs	0.4	0.5	24%
Total wages	0.2	0.1	-3%
Gross Value Added	-0.1	-0.1	-34%
Depreciation of capital	0.6	0.6	-2%
Earning before interest and taxes	-0.8	-0.8	-1%
Financial costs, net	0.2	0.2	16%
Net profit	-1.0	-1.1	-4%
Total value of assets	16.1	17.4	8%
Capital productivity (%)	-0.5	-0.6	-24%
Return on Investment (%)	-5.0	-4.7	7%

Source: Own elaboration from EU Member States DCF data submission

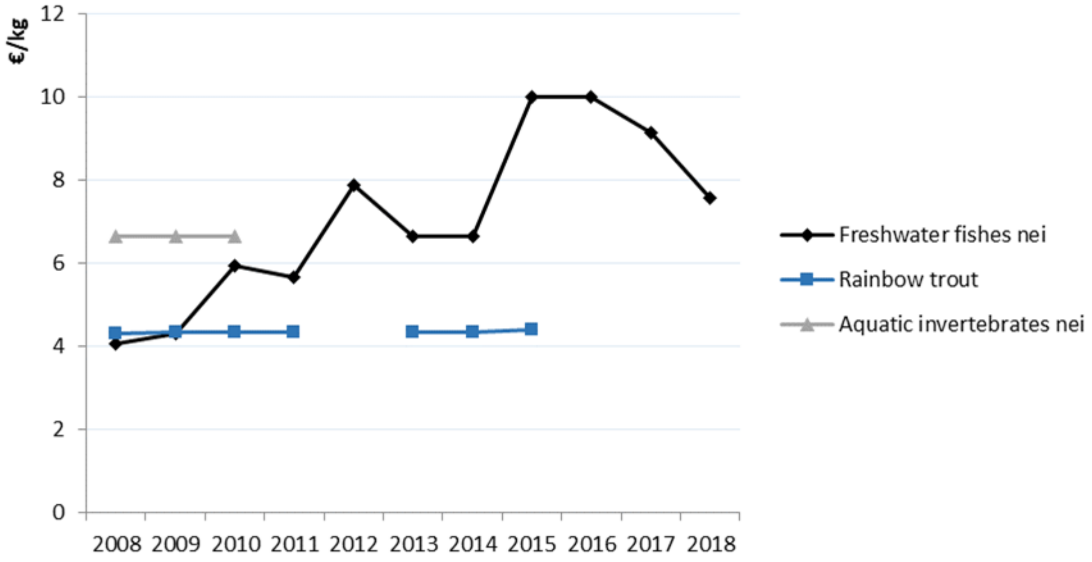
Figure 4.2.1 National Total Expenditures in Belgium: 2020.



Source: Own elaboration from EU Member States DCF data submission

Total turnover in 2019 was estimated at €165 216 and in 2020 was increased to €236 843. In fact, the total income increased by 43% in 2020 compared to the previous year 2019, while operating cost increased by 24%. The total wages were reduced by 3% and depreciation of capital was rather steady showing a slight decrease of 2%. The main expenditure of the sector is the Consumption of fixed Capital whose share in total expenses reaches 54%. The next biggest expense is the livestock cost which accounts for 20% of total expenses and then the wages and salaries at 14%. The sector faced negative profits both in 2019 and 2020 at €1.0 million and €1.1 million respectively.

Figure 4.2.2 Average prices for the main species produced in Belgium: 2008-2018.



SOURCE: FAO (2021)

Outlook

A Belgian national strategic plan for aquaculture has been developed that focuses on sustainability and production with high added value. In Belgium, regional differences are noticeable. In Flanders, the focus lies on starting up and perfecting production systems that offer an ecological and economic performance. In Wallonia, the emphasis is placed on improving the economic performance of small businesses. Recently, both domestic and foreign investors have announced major initiatives for land and sea based aquaculture.

Data Coverage and Data Quality

This is the first time that Belgium submits data on the aquaculture sector. The data collection of freshwater aquaculture is not mandatory under the DCF and EU-MAP programmes of the EU data collection. Since Belgium only produces freshwater aquaculture products, it is not obliged to provide economic data for this report. The analysis of the Belgian aquaculture sector is complemented with data extracted from FAO.

4.3 Bulgaria

Overview of Bulgarian aquaculture

The overall performance of the Bulgarian aquaculture sector has improved significantly in the last decade as the total income, generated mainly from turnover, in 2020 increased by 27% compared to the average value for the period 2012-2019. In 2020, the crisis due to the COVID-19 pandemic was the main driving force for the decline of overall performance during the year. Compared to 2019 the total sales weight and value in 2020 decreased by 25% and 24% respectively.

The most important species in the country are trout and carp. In terms of the value of the sales, the biggest turnover was generated by the segments trout ponds followed by trout cages and carp ponds.

4.3.1 Total Production and sales

The aquaculture sector in Bulgaria had stable performance over the period 2008-2012 and after 2013, the sales volume increased rapidly. In 2019, the total sales weight and value reached the highest rate compared to 2008 or 2012. In 2020 the crisis due to the COVID-19 pandemic was the main driving force for the decline of the overall performance. Compared to 2019 the total sales weight and value in 2020 decreased by 25% and 24% respectively, which is a drop close to the performance in 2017.

In 2012, the turnover from sales was €11.0 million and in 2019 the turnover increased by 86% compared to the period 2012-2018 and amounted to €35.7 million. Compared to 2018, the turnover in 2019 increased by 17%. In 2020 the turnover from sales was €27 million which is a 55% increase compared to the average for the 2008-2019 period. The total sales volume in 2020 increased by 15% over the period 2012-2019 and by 41% compared to the period 2008-2019.

Table 4.3.1 shows that only the number of enterprises grew gradually during the period 2012-2020. In 2020 there has been an increase in the sales volume and value in both freshwater and shellfish sectors compared to the 2008-2019 period but also a decrease compared to 2019.

4.3.2 Industry structure and total employment

In 2020, Bulgaria had 754 registered aquaculture enterprises. A total of 369 farms from the total population have sales, turnover and employees, the rest of the 228 registered enterprises have declared that they have no sales. There were 706 enterprises with 5 or less employees, 30 enterprises with 6-10 employees and 18 enterprises with more than 10 employees. Total employment in 2020 was 1 292 jobs, corresponding to 1 040 FTEs. The level of employment decreased between 2009 and 2012, but increased in the period 2013 – 2017, followed by a 10% increase in 2019 when the total employment was 1 390 jobs. Among the possible reasons for these fluctuations are the unstable economic situation in the country and the COVID-19 pandemic. The number of enterprises in 2020 with less than five employees and enterprises with 6-10 employees has increased by 4% and 7% respectively, compared with 2019, while the number of enterprises with more than 10 employees increased by 38% compared to 2019. The average wage in 2020 increased by 25% compared to 2019.

Since 2017, the social variables like gender, age classes, education, nationality and employment status were collected together with the economic variables. Due to the type of the table that was used for the collection of the social variables, it was also possible to provide combined variables like: education by gender, age distribution by gender, nationality by gender and employment status by gender.

The mean wage in the sector decreased in 2015 and 2016, but from 2017 to 2020 it was gradually increasing, probably due to the increase in the minimum salary in the country. Total FTEs in 2020 decreased by 8% compared to 2019 but increased by 16% compared to the average for the period 2012-2019. The changes regarding the total employees are similar – there was a 7% decrease compared to 2019, but a 22% increase compared to the average for the period 2012-2019.

Table 4.3.1 Production and sales, industry structure and employment for Bulgaria: 2008-2020.

Variable	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(12-19)
Sales weight (thousand tonnes)	**4.3**	**6.2**	**6.8**	**7.1**	**9.5**	**9.8**	**11.4**	**13.0**	**9.8**	-25%	15%
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	-6%
Shellfish	0.8	1.0	1.3	1.5	1.6	1.6	1.3	1.7	1.2	-27%	-9%
Freshwater	3.5	5.2	5.5	5.6	7.9	8.2	10.0	11.3	8.6	-24%	20%
Sales value (million €)	**11.0**	**14.8**	**17.2**	**17.3**	**21.0**	**22.4**	**30.5**	**35.7**	**27.0**	-24%	27%
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	-68%
Shellfish	0.6	0.9	1.0	1.3	1.2	1.1	1.0	1.5	1.0	-35%	-10%
Freshwater	10.3	13.8	16.1	16.0	19.8	21.3	29.5	34.2	26.1	-24%	29%
Number of enterprises	**163**	**318**	**355**	**575**	**588**	**597**	**627**	**719**	**754**	5%	53%
Marine	0	1	1	1	0	0	0	0	0	0%	-100%
Shellfish	11	26	23	30	33	31	27	23	23	0%	-10%
Freshwater	152	291	331	544	555	566	600	696	731	5%	57%
Employment	**454**	**777**	**924**	**1,013**	**1,093**	**1,572**	**1,262**	**1,390**	**1,292**	-7%	22%
Marine	-	4	4	0	0	0	0	0	0	0%	-100%
Shellfish	37	92	77	104	94	103	49	66	76	15%	-2%
Freshwater	417	681	843	909	999	1,469	1,213	1,324	1,216	-8%	24%
FTE	**454**	**756**	**679**	**830**	**966**	**1,355**	**990**	**1,130**	**1,040**	-8%	16%
Marine	0.0	4	4	0	0	0	0	0	0	0%	-100%
Shellfish	37	92	60	96	82	75	43	55	66	19%	-3%
Freshwater	417	660	616	734	884	1,280	947	1,075	974	-9%	18%

Source: EU Member States DCF data submission, 2022

The total income in 2020 has decreased compared to 2019 by 22% but compared to the average for 2008-2019 has increased by 55%. The value of total operating costs after 2010 is increasing proportionally to the increase of the total income and in 2019 their value is 10% higher than in 2018 but in 2020 decreased by 8% compared to 2019. Labour productivity is rather unstable for the whole period 2008-2020.

4.3.3 Overall Economic performance

The economic performance of the Bulgarian aquaculture sector has deteriorated between 2008 and 2010, but in the last decade, the situation significantly improves. The amount of total income generated by the Bulgarian aquaculture sector in 2020 was €30 million. The Total income value in 2020 decreased by 22% compared to 2019, but it is 55% higher than the average value for the period 2012-2019. The largest part of the income remained from the turnover from sales, which represented 90%, followed by other income, which was 5%. The income from subsidies in 2020 is stable during the last three years. Unlike the turnover for 2020, which was 24% lower than in 2019, the other income increased by 32%.

The total operating costs of the Bulgarian aquaculture sector in 2020 were €22.2 million and represented 74% of the total income. The total operating costs in 2020 increased by 63% compared to the average of the period 2008-2019. The largest expenditure item in 2020 was raw material: feed costs with €10.1 million, followed by wages and salaries €4.6 million and other operational costs with €3.3 million. Expenditures for other operational costs, raw material: livestock costs and raw material: feed costs in 2020 decreased by 4%, 33% and 14% compared to 2019, respectively.

According to capital cost, consumption of fixed capital is the main cost with the amount of €4.7 million. In 2020, the consumption of fixed capital decreased by 2% compared to 2019, the financial costs decreased by 255% and the financial expenditures increased by 34%. In regards to capital value, the total value of assets and debt amounted to €49.1 million and €22.7 million, respectively. The total value of assets in 2020 decreased by 22% compared to 2019, but it should be noted that there was a significant increase in the variable in 2019. The debt also increased in 2019, by 62% compared to 2018 and in 2020 decreased by 12% compared to 2019 but compared to the period 2015-2019 increased by 47%.

Table 4.3.2 Economic performance of the Bulgarian aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Total income	25.2	33.3	38.3	30.0	-22%	-7%
Total operating costs	17.6	21.9	24.1	22.2	-8%	5%
Total wages	3.7	3.5	4.1	4.8	17%	26%
Gross Value Added	11.3	15.0	18.3	12.6	-31%	-15%
Depreciation of capital	5.4	3.8	4.8	4.7	-2%	1%
Earning before interest and taxes	2.2	7.6	9.4	3.1	-67%	-52%
Financial costs, net	0.6	0.2	0.2	-0.2	-255%	-178%
Net profit	1.7	7.4	9.3	3.3	-64%	-45%
Total value of assets	52.3	40.7	62.7	49.1	-22%	-5%
Capital productivity (%)	21.6	36.7	29.2	25.6	-12%	-12%
Return on Investment (%)	4.2	18.7	15.0	6.3	-58%	-50%

Source: own elaboration from EU Member States DCF data submission, 2022

The amount of raw material volume: feed and raw material volume: livestock in 2020 were 16.1 thousand tonnes and 1.1 thousand tonnes respectively. Raw material volume: feed in 2020 decreased by 12% compared to 2019, and raw material volume: livestock in 2020 decreased by 18% compared to 2019.

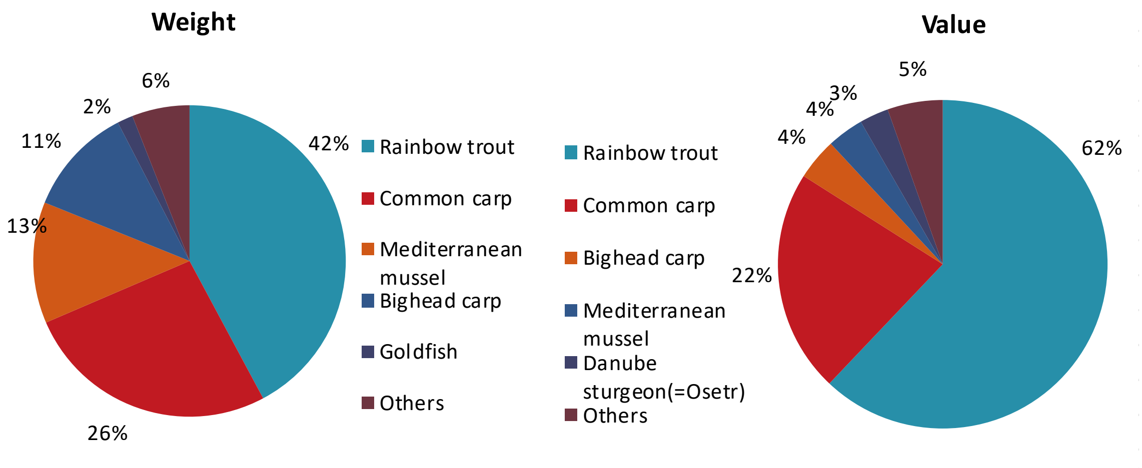
The GVA generated by the Bulgarian aquaculture sector was €12.6 million in 2020, representing 42% of the total income. The GVA in 2020 decreased by 31% compared to 2019 but increased by 72% compared to the period 2008-2019. EBIT was equal to €3.1 million in 2020 and decreased by 67% compared to 2019 when the value was €9.4 million and compared to the average for the 2008-2018 period increased by 156%. The net profit generated by the Bulgarian aquaculture sector in 2020 was €3.3 million and decreased by 64% compared to 2019 but compared to the period 2008-2019 increased by 34%.

4.3.4 Main species produced and economic performance by segment

The segments with the highest economic and social importance in 2018 were trout ponds, trout cages, carp ponds and mussel long line. In terms of net profit, the most valuable one was the trout ponds segment, followed by the trout cages. The largest segment, regarding the number of enterprises and number of employees and FTE was carp ponds. In terms of the value of the sales, the one that generated the biggest turnover was the trout ponds followed by trout cages and carp ponds.

In terms of sales volume, the volume of the rainbow trout represented 42% of the total sales volume of the Bulgarian aquaculture sector in 2020, followed by common carp (26%) and Mediterranean mussel (13%). Turnover from rainbow trout represents 62% of the total turnover in the same year, followed by common carp with 22%.

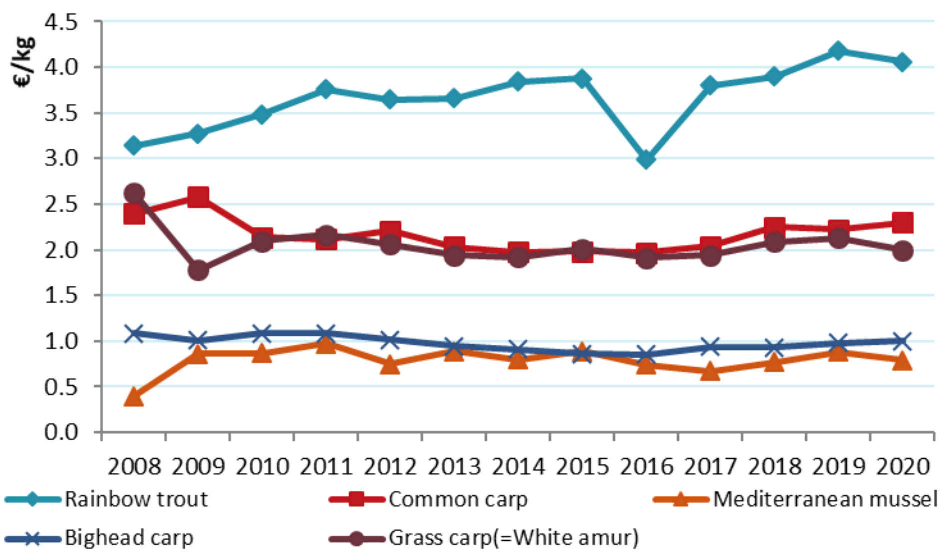
Figure 4.3.1 Main species in terms of weight and value in Bulgaria: 2020.



Source: EU Member States DCF data submission, 2022

The average prices for the period 2008-2020 of the most important species for the Bulgarian aquaculture sector are presented in Figure 4.7.2. The average price of rainbow trout was €4.1 per kg in 2020, which was similar to the price from 2019 of €4.2 per kg. The average price of common carp was stable at €2.3 per kg in the period 2018-2020 with a 20% increase compared to 2015-2017. The average price of Mediterranean mussel was €0.8 per kg in 2020 and decreased by 10%, so in 2019 it was €0.9/kg, which is also the price of the Mediterranean mussel for 2015.

Figure 4.3.2 Average prices €/kg for the main species produced in Bulgaria: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022

The most relevant segments in the Bulgarian aquaculture are presented below.

The economic performance of four Bulgarian segments is shown in Figure 4.3.3 and Table 4.3.3. The data provided the time series for the detailed economic data from 2012 to 2020, because before 2012 the questionnaires for data collection were anonymous and voluntary, so data could not be divided into segments.

Segment 1: Trout ponds

The most important segment regarding the sales value and volume in 2020 was trout cages. This segment consisted of 75 active enterprises, where, as in the trout cages segment, the main produced species is rainbow trout with 99%. The value of total income in 2020 was €12.7 million, which is 23% less than in 2019, and 68% more compared to the average for the period 2012-2019. The amount of total sales volume in 2020 also decreased, by 22% compared to 2019 and also increased, by 60% compared to the period 2012-2019.

In terms of economic indicators, the amount of GVA generated by the trout ponds segment in 2020 was €6.3 million and has decreased by 25% compared to 2019 and increased by 61% over the period 2012-2019. The amount of net profit in 2020 was €4.3 million and decreased by 31% compared to 2019 and increased by 45% over the period 2012-2019.

The largest cost item of trout ponds segment in 2020 remained the raw material costs: feed costs with the 48% and wages and salaries with 18% of all operational costs. Raw material costs: livestock costs represented 10% and other operational costs was 8%.

For the proposes of this report and in order to have matching between DCF and EU-MAP segmentation the segment trout ponds represents two segments from DCF, which were reported separately in the previous years: trout combined and trout on growing. The same approach was followed for the segment carp ponds, reported in the past as carp combined and carp on growing. Bulgaria prepared the data based on the segments from EU-MAP, where the segments are more appropriate for the current situation in the sector. In order to continue the time series and to have reliable data despite the changes in the format of segments, combining historical data for both segments was the only possible solution.

Segment 2: Trout cages

It should be mentioned that the segment is composited of almost the same 17 enterprises in the last 7 years. A good sign for the development of the segment is the establishment of few new farms, and with them, in 2020 the segment consists of 25 active enterprises, which production was 82% rainbow trout. The value of total income in 2020 was €5.1 million with the amount of total sales volume of 1.3 thousand tonnes. The value of the total income in 2020 decreased by 7% compared to 2019, and by 22% compared to the average of the period 2012-2019. Total sales volume in 2020 is the same compared to 2017 but decreased by 25% compared to the average of the period 2012-2019.

Segment 3: Mussels long line

The segment is the only one representative of marine aquaculture, which unites 23 enterprises, same as 2019, but decreased by 15% compared to 2018 and decreased by 10% compared to the 2012-2019 period. The production from this segment is only Mediterranean mussel. The value of the total income in 2020 was €1.5 million, 75% of the income came from the sales, 23% is from other income. The total income in 2020 decreased by 7% compared to 2019 and by 9% to the 2012-2019 period. The amount of total sales volume was 1.2 thousand tonnes in 2020, which was 27% less than in 2019, and 9% less than the average value for 2012-2019.

In terms of economic indicators, the amount of GVA generated by the mussel long line segment in 2020 was €1.1 million and has decreased by 16% compared to 2019 and increased by 6% over the period 2012-2019. The amount of total operational costs in 2020 was €0.5 million and decreased by 26% compared to 2019 and 2% over the period 2012-2019. The net profit in 2020 was zero and decreased significantly compared to 2019 and compared over the period 2012-2019, getting back near to the amount in 2017, which was last year with a generated loss.

The largest cost item of the mussel long line segment in 2020 was the consumption of fixed capital with 66%. Wages and salaries represented 26% of all operational costs and other operational costs were 6%.

With the decrease in sales and the low average price of the Mediterranean mussel the segment generated net loss for the first time since 2017 which might be because of the reduction of the total sales volume and almost stable costs.

Table 4.3.3 Economic performance of main Bulgarian aquaculture segments: 2017-2020.

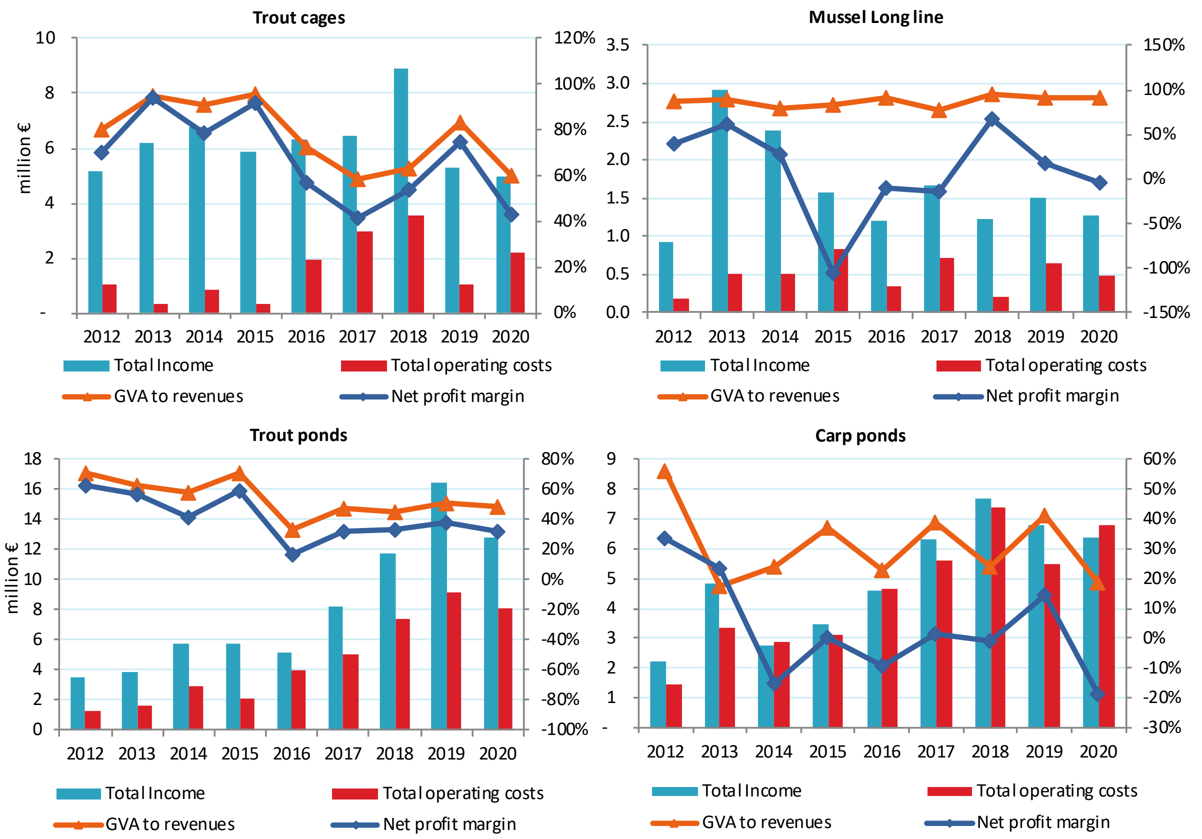
Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Mussel Long line					**Trout cages**				
Number of enterprises	31	27	23	23	0%	23	26	31	25	-19%
FTE	91	45	58	67	17%	70	66	47	70	51%
Average wage (thousand €)	3.5	3.5	8.9	5.4	-39%	4.1	4.2	3.3	3.4	4%
Labour productivity (thousand €)	13.9	26.7	23.8	17.0	-28%	54.5	85.5	94.8	42.9	-55%
Total sales volume (thousand tonnes)	1.6	1.3	1.7	1.2	-27%	1.9	2.4	1.3	1.3	3%
Total income (million €)	1.7	1.3	1.6	1.5	-7%	6.5	8.9	5.3	5.1	-3%
Total operating costs (million €)	0.7	0.2	0.7	0.5	-26%	3.0	3.6	1.1	2.2	108%
Gross Value Added (million €)	1.3	1.2	1.4	1.1	-16%	3.8	5.6	4.4	3.0	-32%
Net profit (million €)	-0.2	0.9	0.3	0.0	-118%	2.7	4.8	4.0	2.2	-44%
Total value of assets (million €)	7.8	8.9	12.7	10.2	-20%	8.6	5.5	5.3	5.1	-3%
Net investments (million €)	0.2	2.2	2.0	0.6	-67%	0.0	0.0	0.0	0.0	-53%
Capital productivity (%)	16.3	13.4	10.8	11.3		44.3	101.6	83.7	58.5	
Return on Investment (%)	-2.9	9.7	2.2	-0.5		31.0	87.5	75.5	43.2	
Future Expectation Indicator (%)	-13.3	22.2	11.0	-2.9		-9.1	-8.5	-5.1	-12.0	
	Trout Ponds					**Carp Ponds**				
Number of enterprises	77	89	93	75	-19%	396	414	471	554	18%
FTE	196	191	255	224	-12%	794	517	488	454	-7%
Average wage (thousand €)	3.6	4.6	4.0	7.3	83%	2.2	2.9	3.1	3.6	16%
Labour productivity (thousand €)	19.7	27.5	32.7	27.9	-15%	3.1	3.6	5.7	2.7	-54%
Total sales volume (thousand tonnes)	2.1	2.9	3.9	3.1	-22%	3.5	4.1	3.6	3.2	-11%
Total income (million €)	8.3	12.1	16.5	13.3	-20%	6.8	8.2	7.3	6.6	-10%
Total operating costs (million €)	5.1	7.4	9.2	8.1	-11%	5.6	7.4	5.5	6.8	24%
Gross Value Added (million €)	3.9	5.3	8.3	6.3	-25%	2.5	1.9	2.8	1.2	-57%
Net profit (million €)	2.6	4.0	6.3	4.3	-31%	0.1	-0.1	1.1	-1.2	-212%
Total value of assets (million €)	7.1	4.9	16.5	10.2	-39%	10.8	11.0	7.6	10.6	40%
Net investments (million €)	0.2	0.2	0.2	0.7	231%	1.5	1.8	2.2	1.4	-37%
Capital productivity (%)	54.2	106.9	50.4	61.6		22.8	16.9	36.9	11.4	
Return on Investment (%)	37.0	80.7	37.8	42.6		0.9	-0.5	14.2	-11.4	
Future Expectation Indicator (%)	-4.1	-7.9	-5.0	0.1		4.9	7.8	18.3	4.3	

Source: own elaboration from EU Member States DCF data submission, 2022

The amount of GVA generated by the trout cages segment in 2020 was €3 million, which is 32% less than 2019 and by 40% over the period 2012-2019. Total operating costs in 2020 was €2.2 million and increased by more than 100% compared to 2019 and by 46% over the period 2012-2019. The amount net profit in 2020 was €2.2 million and decreased by 44% compared to 2019 and by 50% over the period 2012-2019.

The largest cost item of the trout cages segment in 2020 was the feed costs with 31% of all the total operational costs. The other operational costs made up 26% of all operational costs and consumption of fixed capital was 22%.

Figure 4.3.3 Economic performance indicators (in € million) for the main Bulgarian segments: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022

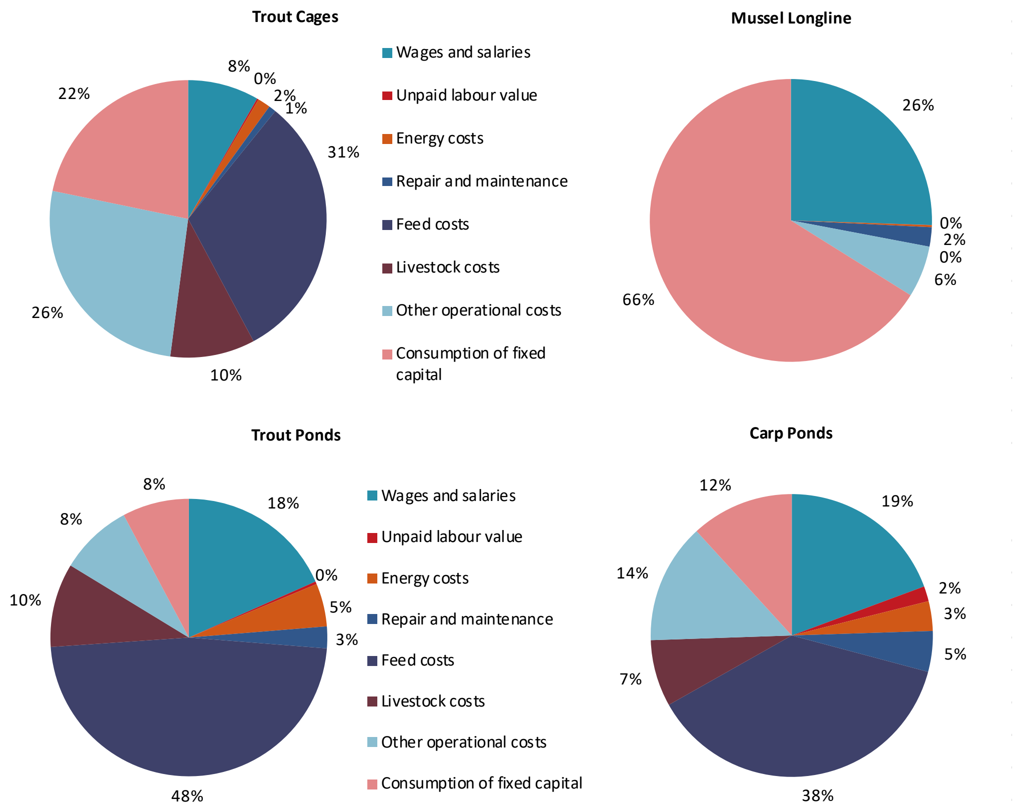
Segment 4: Carp ponds

This segment is the biggest one in terms of the number of enterprises in it - 554. It represented 73% of all the active enterprises in Bulgaria and it also employed 44% of the FTE in the sector. Most of the enterprises in this segment can be characterized as extensive. The value of total income in 2020 was €6.6 million, which was a 10% decrease compared to 2019, and an increase of 29% compared to the average for 2012-2019. The amount of total sales volume was 3.2 thousand tonnes in 2020, which represented an 11% decrease compared to 2019 and 24% increase compared to the average value for 2012-2019.

In terms of economic indicators, the amount of GVA generated by the carp ponds segment in 2020 was €1.2 million and has decreased by 57% compared to 2019 and by 19% over the period 2012-2019. The amount total operational costs in 2020 were €6.8 million and increased by 24% compared to 2019 and 61% over the period 2012-2019. The amount of net profit in 2020 was €-1.3 million and significantly decreased compared to 2019 and over the period 2012-2019.

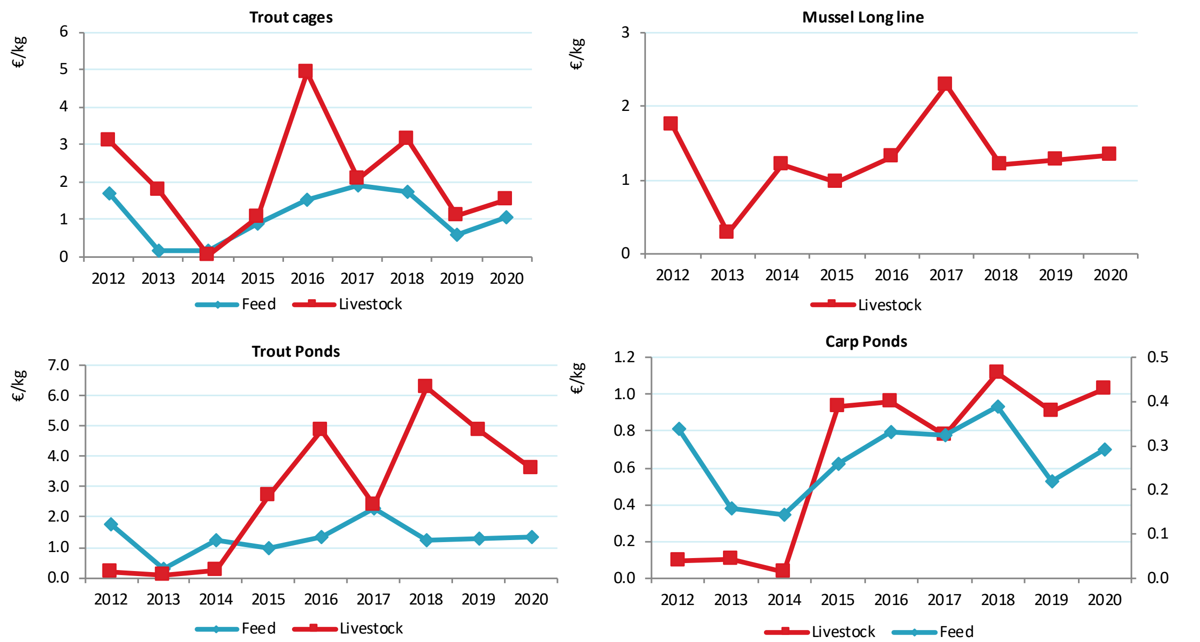
The largest cost item of carp ponds segment in 2020 was the raw material costs: feed cost with the 38%. Wages and salaries represented 19% of all operational costs and other operational costs were also 14%.

Figure 4.3.4 Cost structure of the main segments in Bulgaria: 2020.



Source: EU Member States DCF data submission, 2022

Figure 4.3.5 Feed and livestock average prices €/kg for the main Bulgarian segments: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022

4.3.5 Outlook

Nowcasts for 2021-22

The increase in aquaculture production could be supported through the production of species with high market prices, as well as additional investments in organic production. This goal from the Bulgarian national strategy on aquaculture seems achievable by the introduction of innovations and the development of market chains.

According to the data analysed for the 2008-2020 period, we can expect a deterioration for the Bulgarian aquaculture sector. According to 2020 data, Bulgarian aquaculture production decreased by 25% in terms of volume and by 24% in value when compared to 2019. This negative sign together with the crisis due to the COVID-19 pandemic and the unstable situation in the Black sea region is expected to deepen the situation in the sector.

The data for 2021 shows an increase of 9% in total sales volume and 15% in turnover compared in to 2020 and when we compared to the average for the 2012-2020 period total sales increased by 25% and the turnover increased by 41%. This positive sign for the recovery of the sector is based only on sales data and should be noted that 2021 was also a year impacted by the COVID-19 pandemic and the increase in electricity prices.

Trends and triggers

A significant part of Bulgarian aquaculture consists of the production of rainbow trout, carp, and Mediterranean mussels. The production of carp is a positive trend in last years, due to the culture and traditions of the people. Compared to 2019 carp production marks decline by a decrease of 32% in terms of volume and 29% in terms of value. This decline was mainly due to the limitation of export during 2020. The cultivation of Mediterranean mussels drop down in 2020 as the demand and compared to the past the production of these species drop down to the level of 2014 because of the domestic market and also the low export. Even with the increasing interest in trout farming and almost stable average price in the last three years the production by the segments producing trout also decreased in 2020, by 24% compared to 2019, and drop down to the production from 2017. Funding from European Funds (EMFF, EMFAF) such as modernization of the existing capacities also plays an important role in the development of the sector.

Market structure

The market structure in Bulgaria continues the slow process of development with a need for well organised and constructed chains of retail stores and wholesale distribution networks of fish and fish products, including exchanges and specialized centres for purchasing fish not only near the seaside but also in the middle of the country. In some mountain and rural regions, the distribution of fresh fish is absent so the consumption of fish in these regions is much lower than the average per capita in the country.

The main kinds of products produced for consumption are the chilled rainbow trout, the life species from the carp family from the freshwater, and frozen Mediterranean mussels from the marine species. The production was increasing in terms of volume and value year by year due to stable demand on the domestic market and increased export of processed products with added value and their good market price.

The main drivers are still the market with export-oriented products as well as the prices of the products with added value.

The production of sturgeon species still is not significant both in volume and value but continues to grow up. The slow growth of production can be explained by the fact that the main purpose of growing these species is reaching sexual maturity and the production of caviar, which takes a significant amount of time.

Despite the increasing interest in cage farming and recirculation system farming, only a few enterprises take the initiative to produce new species like coho salmon, Atlantic salmon, and African catfish. For now, the result is visible only with African catfish where the reaching of market size is quite short.

COVID-19 impact

The main impacts suffered by the Bulgarian aquaculture industry during the pandemic outbreaks were the loss of market due to constraints for traveling at all, at the beginning of the period. The restrictions for traveling led to a reduction of the export to zero in the early stage of the pandemic. The reduction of export was crucial for the Bulgarian aquaculture industry because the sector, usually realise a bigger part of the production out of the country market.

The data shows that the sales for 2020 decreased by 25% compared to 2019, and turnover also decreased by 24%. The average prices in 2020 mark a slight decrease compared to 2019. In mussel farming, the decrease in sales, turnover, and average price was more visible 27%, 35%, and 10%, respectively. The consequences for mussel farming were mainly due to the national market was not able to consume the big quantity which was not released for export and decreased in price at the same time.

With the support of the EU and EMFF, 68 Bulgarian aquaculture farms were compensated under the measures due to COVID-19 with a total of €1 205 639.

High energy prices

An increase in the price of electricity in 2021 led to an increase in the price of aquaculture products. The increase, which was expected to be within 20%, significantly exceeded this value in 2022. This, in turn, led to additional difficulty for the sector. The compensatory measure was adopted by the Bulgarian government but for most of the operators in the sector, this was not enough to compensate them.

Social acceptance

The consumption of fish and other sea products in Bulgaria is still under the average for the EU countries. Bulgarian citizens are placed in one of the last places in the EU and the main reason is the low salaries in the country and difficulty to purchase fish products. In fact, the consumption of aquaculture products is highly linked to the social practices and culture in the country where the consumption of carp is traditional. In the last few years, people prefer to include more healthy products such as different dietary fish than carp, in their diet.

4.3.6 Data Coverage and Data Quality

Data quality and availability

Data quality: The achieved sample rate for economic data for 2020 was 100%, as in the last six years. This achieved sample rate has an impact on the quality of the data provided by the sector, which also understood the importance of data provision.

Data availability: Data for the aquaculture sector is published once a year. The aquaculture statistic is published in Agricultural Report and on the website of the Executive agency for fisheries and aquaculture approximately 12 months after the end of the reference year.

Confidentiality: In 2020, there was no confidentiality issue because the number of enterprises in each segment was more than five.

All segments are divided by species and technique. If an enterprise produces more than one species, then it is allocated to the segment of the species that represents the biggest volume of sales.

Some enterprises own more than one farm using different techniques, but these activities are separated into different segments because the enterprise is used as a data collection unit. There are very few examples of enterprises using more than one production technique.

Other data issues or missing data

No other data issues or missing data.

4.4 Croatia

Overview of Croatian aquaculture

Croatian aquaculture is, in terms of volume and value of production and employment, dominated by two segments – Seabass and seabream cages and Tuna cages. There were 155 enterprises in with aquaculture as main activity, producing 21.7 thousand tonnes in 2020 and creating 1 366 jobs totalling 1 136 FTEs. During period 2012-2020, Croatian aquaculture sector overall recorded steady growth in terms of sales volume and sales values.

4.4.1 Total Production and sales

Croatian aquaculture sector, altogether marine and freshwater, produced 20.4 thousand tonnes in 2019, and 21.7 thousand tonnes in 2020, which is 60% of increase compared to 2012 and 6.3% increase compared to 2019. The total value of production was €133 million in 2020, which corresponds to an increase of 10% over the same period in 2019. During period 2012-2020, Croatian aquaculture sector overall recorded steady growth in terms of sales volume and sales values. Production and sales in marine aquaculture in total follow the objectives of the National Strategic Plan for Aquaculture 2014-2020. In earlier years, there was no data collection under DCF in Croatia as country joined the EU in July 2013.

The most important species, in this context, are European sea bass (*Dicentrarchus labrax*), Gilthead sea bream (*Sparus aurata*) and Atlantic Bluefin tuna (*Tunnus thynnus*) of fish species and Mediterranean mussel (*Mytilus galoprovincialis*) and European flat oyster (*Ostrea edulis*) of shellfish species. The most important species in freshwater farming are common carp (*Cyprinus carpio*) and rainbow trout (*Oncorhynchus mykiss*). Unlike marine aquaculture, production and sales in freshwater aquaculture is falling behind the objectives of the National Strategic Plan for Aquaculture 2014-2020. Still, concerning funds allocated for aquaculture, it could be expected that production in this segment will be back on the track until the end of operational period (2023).

4.4.2 Industry structure and total employment

Majority of Croatian total number of enterprises are small family owned shellfish farms concentrated around several naturally suitable and protected areas for shellfish farming. Despite some signs of consolidations and the important role they in sustainable regional development, most of these businesses are, individually, in terms of sales volume and value and employment, insignificant. Many of these often have only one family member working on a farm and selling products directly to customers or restaurants. On the other hand, large companies in Marine segment (Tuna and Seabass & Seabream) gather about 64% of total number of employees, 79% of total sales weight and 92% of total sales value which makes them convincingly the most important segment of aquaculture industry in Croatia. The number of freshwater aquaculture farms is steadily decreasing and the enterprises are also individually reducing production, sales and number of employees with lowest production in 2020. Although number of aquaculture companies remained steady in the last time series, there were some changes in structure of companies, which are the reflection of changes in administrative procedures and also new business openings and merging some smaller enterprises. Namely, between 2018 and 2020, according to the regulations of the new Aquaculture Act, all the licences for aquaculture were revised and reissued which caused slight variation in number of enterprises, especially in the largest, shellfish segment.

The total number of persons employed in the Croatian aquaculture sector in 2019 was 1 360, corresponding to 1 150 FTEs and 1 366 in 2020, corresponding to 1 136 FTEs. The number of employees have variations primarily because lot of workers in aquaculture, especially in freshwater aquaculture, have temporary job, some of them are working as seasonal employees, part of employees with full time job are working partly in aquaculture, and partially in other activities in the same enterprise. Considering a strong trend of diversification and vertical integration –

including processing industry and fisheries in marine aquaculture and other agricultural activities in freshwater aquaculture, variations in number of employees could be further expected.

Table 4.4.1 Production and sales, industry structure and employment for Croatia: 2012-2020.

Variable	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(12-19)
Sales weight (thousand tonnes)	**13.6**	**13.8**	**17.3**	**17.1**	**19.7**	**20.4**	**21.7**	6%	32%
Marine	7.5	9.3	12.5	12.9	15.9	16.2	18.5	14%	57%
Shellfish	1.3	0.7	0.7	1.0	0.9	1.1	0.5	-55%	-43%
Freshwater	4.8	3.8	4.0	3.3	2.9	3.1	2.7	-11%	-28%
Sales value (million €)	**77.7**	**77.5**	**108.6**	**101.0**	**120.0**	**120.8**	**133.0**	10%	35%
Marine	68.4	69.5	99.3	92.3	111.6	111.1	126.0	13%	41%
Shellfish	1.6	1.0	1.4	1.7	1.7	2.6	0.8	-70%	-48%
Freshwater	7.7	6.9	7.9	7.0	6.7	7.1	6.2	-13%	-17%
Number of enterprises	**174**	**179**	**187**	**173**	**161**	**162**	**155**	-4%	-11%
Marine	26	36	27	30	26	28	29	4%	3%
Shellfish	107	110	117	103	97	102	98	-4%	-9%
Freshwater	41	33	43	40	38	32	28	-13%	-27%
Employment	**1,882**	**2,371**	**2,196**	**1,476**	**1,389**	**1,360**	**1,366**	0%	-25%
Marine	871	1,052	1,029	795	768	838	853	2%	-6%
Shellfish	173	193	169	242	256	155	138	-11%	-29%
Freshwater	838	1,126	998	439	365	367	375	2%	-49%
FTE	**1,451**	**1,585**	**1,647**	**1,153**	**1,122**	**1,150**	**1,136**	-1%	-19%
Marine	757	685	988	686	702	737	746	1%	-6%
Shellfish	76	67	100	96	114	84	80	-5%	-11%
Freshwater	618	833	559	371	306	328	310	-6%	-41%

Source: EU Member States DCF data submission, 2022

4.4.3 Overall Economic performance

Total income increased from €224.7 million in 2019 to €226.1 million in 2020, or 6.2% respectively, and total operating costs made up for 75% of total income in 2020, compared to 79% in 2019.

The contribution of the sector to the economy was €67.4 million in 2019 and €75.7 million, which accounts for 33% of total income. Relatively high contribution of other income (43% in 2019, 37% in 2020) is a sign of diversification of economic activities and vertical integration, especially for large aquaculture companies, often involved in other types of production besides aquaculture and, increasingly often, processing industry. Although all the companies in population were registered primarily for aquaculture as main activity, large part of income is generated from carrying out other diverse activities, from agriculture, fishing, processing, to tourism.

Some of these activities were financed through subsidies, through specific lines promoting processing and marketing of seafood products in the context of EMFF and Croatian National Strategic Plan for Aquaculture 2014-2020. Besides promoting processing and marketing of seafood products, a significant part accounted for investments in aquaculture. On the other hand, in case of some of the companies from freshwater aquaculture, investments in other agricultural activities completely took over fish production and caused major decrease in number of employees in aquaculture.

Economic performance indicators improved from 2018 and 2019, and remained positive. The evolution of EBIT margin and Net profit margin shows trend of growth started in 2016 with highest net profit of the 2012-2019 period marked in 2017 and then returned to trend of moderate growth of €43.6 million in 2020. The total value of assets increased by 22% during the period of analysis, reflecting large investments, mostly oriented to vertical integration towards hatcheries and processing industry. ROI turned positive at the end of the reference period with 9.3%, which is increase of 34.7% compared to 2019, and implies the efficient use of companies' asset base to generate sales.

Table 4.4.2 Economic performance of the Croatian aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Total income	182.9	198.2	224.7	226.1	1%	12%
Total operating costs	121.9	155.0	177.5	169.0	-5%	12%
Total wages	16.6	17.7	20.2	18.6	-8%	2%
Gross Value Added	77.6	60.9	67.4	75.7	12%	10%
Depreciation of capital	13.1	14.8	16.0	13.5	-16%	-8%
Earning before interest and taxes	47.9	28.4	31.2	43.6	40%	22%
Financial costs, net	-2.4	0.5	0.8	1.1	50%	396%
Net profit	50.3	27.9	30.4	42.5	39%	17%
Total value of assets	416.4	441.4	453.8	470.5	4%	8%
Capital productivity (%)	18.6	13.8	14.9	16.1	8%	2%
Return on Investment (%)	11.5	6.4	6.9	9.3	35%	12%

Source: own elaboration from EU Member States DCF data submission, 2022

4.4.4 Main species produced and economic performance by segment

There is only a few dominate species in Croatian aquaculture; Carp and Trout in freshwater; Blue fin tuna, Seabass and Seabream in marine aquaculture; mussel and oysters in shellfish production.

The most important species is seabass, which is most often farmed in combination with sea bream and together take for about 67% of volume and 66% of total value of Croatian aquaculture production. Most farms are located on the middle part of coast, on the Zadar area. Around 74% of seabass and seabream production has been exported on the EU market, and the rest is exported to neighbouring countries or sold on the local market, with a significant share in HoReCa channel. Before Croatia joined the EU export was restricted by quotas. For that reason, as expected, there was an increase in production and export during last seven years.

The second most important individual species in Croatian aquaculture is Bluefin tuna, covering the 26% of the total value and 15% of total volume. There were only 4 tuna farms in Croatia, and they are exporting most of their products to Japan, with only very small share of fresh products sold on Croatian market, starting from 2019. Since tuna farming is based on catching wild juveniles, and it is under the strict ICCAT surveillance, further increase of production is relying on the available quota.

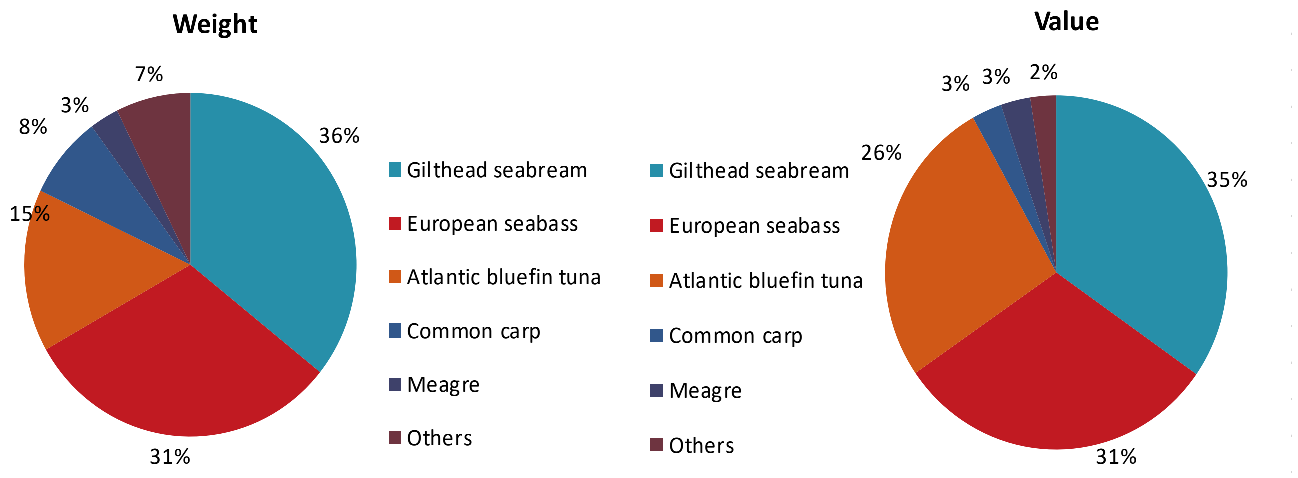
These three species represent 92% of total Croatian aquaculture production in value and 82% in volume, arriving to 90% when considering also common carp.

Mediterranean mussel covers about 2% of total production volume and 0.5% of the total value and is almost completely (92.7%) sold on domestic market, mostly during tourist season, to restaurants and directly to the customers. Almost all shellfish farm are producing both oysters and mussels, but dominated by mussels in value and volume. Shellfish production decreased in the last period and due to disruption of market conditions during pandemic and significantly weaker tourist season 2020The freshwater aquaculture production is mostly sold at the national market, and only about 15% of total volume is exported to the EU market and neighbouring countries. Main species in freshwater aquaculture is carp with 7.8% of total weight and only 2-8% of total value. All carp farms are located in inland part of Croatia, and most of enterprises have its own production of eggs and larva, as well as fish feed. Second most common species is trout, with decreasing production and struggle of the segment to increase the competitiveness with imported fresh products from Italy and other neighbouring countries. These trends reveal still present problems in this segment of aquaculture, which, despite the steps taken to improve the regulatory framework and realized production investments 2014-2020, make it impossible to achieve greater stability in production and the expected growth. The causes of this state of affairs can be partly connected with the recent disruptions in the market caused by the Covid-19 virus pandemic, but also stem from the problem of using basic resources in production, especially disruptions in the availability of water due to increasingly pronounced and prolonged dry periods, as well as the problem of predatory species on farms, and the need for more systematic monitoring and prevention of diseases in farming.

In Croatia, the aquaculture production has been divided into 10 segments in 2013, and 9 segments in 2014 based on the species produced and the technique used. Regarding the new EUMAP segmentation and recent trends in aquaculture, the number of segments has been decreased to 5. Due to low activity of companies previously segmented in segments of hatcheries and nurseries (Carp, Trout) those segments have been removed and data from segment of Sea bass and Sea bream hatcheries and nurseries was not shown due to the confidentiality.

Beside carp and trout most farms are growing some other freshwater species, like grass carp, bighead carp, silver carp, wels catfish, pike and zander, but in smaller quantities.

Figure 4.4.1 Main species in terms of weight and value in Croatian production: 2020.



Source: EU Member States DCF data submission, 2022

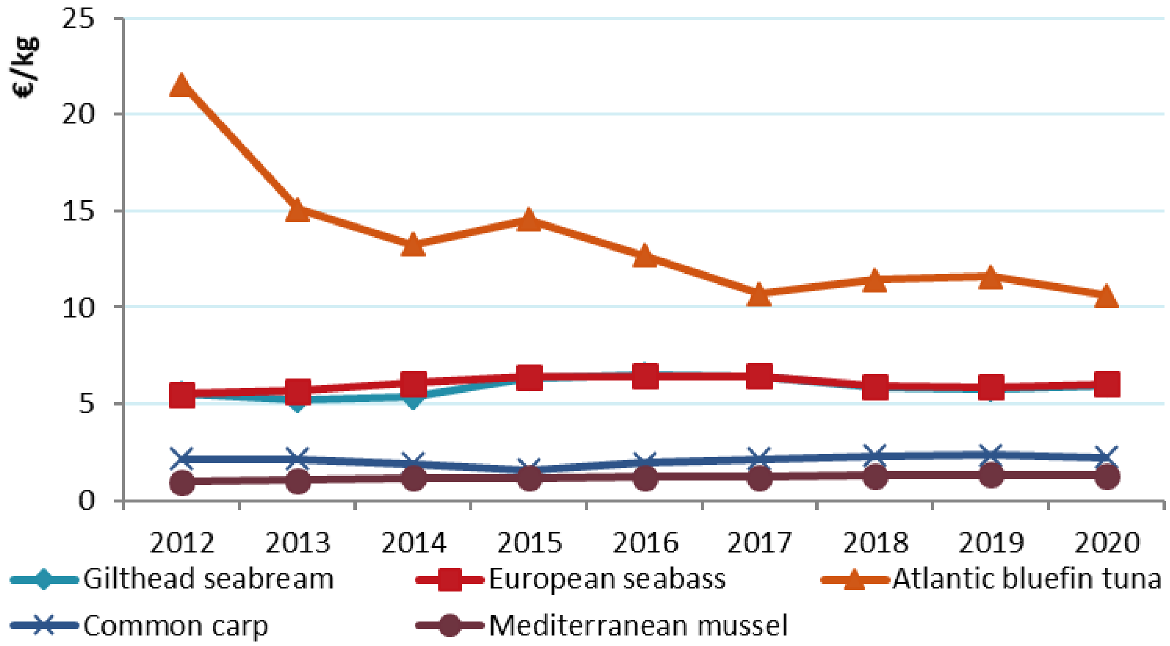
Average prices for all species stayed at the same level between 2019 and 2020, with a most significant decrease of 8.5% for Bluefin tuna from 2019 to 2020 which follows the increase in total volume of sales.

After reaching the highest price of €6.5 per kg in 2017 (regarding period 2012-2020), from 2019 to 2020 Sea bass decreased -8.5% and remain stable in 2019 and 2020 with price of €5.9per kg, similar as Sea bream which reached the highest price in 2016 and 2017 (€6.5 per kg) and then decreased to €5.9. Due to increase in production, it could be expected that this segment, in order to improve profitability also increase sale of products with added value to attract different target consumers.

The average price of Carp, after reaching the lowest price in 2015 (€1.6 per kg) remained stable, with price of €2.2 per kg in 2020. Trout prices, which are slowly increasing from 2015 to 2019, increased for 6% in 2020. In general, prices in freshwater aquaculture did not change significantly due to well established end-market network. Opportunities for growth could be in products with added value, such as smoked fish, which is in line with demand in tourism and HoReCa channel.

The price of Mediterranean mussel increased from €1 per kg in 2012 to €1.3 per kg in 2020 (and remained stable during 2019-2020), due to increased sale during tourist season, directly to customers or to restaurants. However, shellfish sector in general was greatly affected by COVID crisis in 2020 and decreased demand in tourism, so volume decreased by 55% and value of sales dropped by 70%.

Figure 4.4.2 Average prices €/kg for the main species produced in Croatia: 2012-2020.



Source: own elaboration from EU Member States DCF data submission, 2022

The most relevant segments in the Croatian aquaculture are:

- Other marine fish cages: Bluefin tuna
- Seabass and seabream cages
- Carp ponds
- Mussels long line

Segment 1: Other marine fish cages: Bluefin tuna

The most important segment in terms of value is tuna farming; however, it is not the largest segment measured in terms of quantity. Besides value, it is also important to point out that significant part of small pelagic fishery is directly related to tuna farming, since tuna can be fed only with the small pelagic fish. The fact that all tuna production is being exported, gives additional importance to this segment. Limiting factor is the fact that this kind of production is based on the catch of wild juvenile tuna, and it is under the strict ICCAT surveillance and restricted by quota. In Croatia, there is a large potential and interest for this production and it can be expected further growth of this sector in case ICCAT increase quota for Bluefin tuna fishing.

In 2020, there were 4 active tuna farms with 272 FTEs, and they had a production of 3 786 tonnes of tuna primarily (88%) and smaller quantities of Sea bass and Sea bream and mussels. Total value corresponded of more than €37 million. The production value of this segment corresponds to 28% of the total Croatian aquaculture production.

In 2020, the segment reached the highest value of Total income (€54.8 million), which corresponds to increase of 11% compared to 2019. Total operating costs rose by 14% (€46 million) from 2019 so net profit dropped by 14% to €3.5 million, which follows the trend of last three years.

Labour productivity had a decrease of 8% compared to record 2019. Average wages in this segment amounted for €19.7 thousand, which is a decrease of 9% compared to 2019and increase of 1% compared to 2012-2020 average.

Although the total sales volume improved during the period since 2012, overall performance in 2020 is marked with decline. Variations between reference years could imply dependency and limitation of one primary factor and need to diversify business activities, which could be expected in the following years due to increased investments

The structure of cost in 2020 is similar to that for Sea bass & Sea bream cages, comprised mainly of feed costs (51%), other operational costs (22%) and wages and salaries (11%). Due to earlier investments, share of consumption of fixed capital is rather large, 8%.

The average price of fish feed reflects the average price of small pelagic fish on Croatian market, which makes the largest share of total fish feed used in this segment, while other costs together make for 8%.

Table 4.4.3 Economic performance of main Croatian aquaculture segments: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Tuna Cages					**Sea bass & Sea bream Cages**				
Number of enterprises	4	4	4	4	0%	25	21	23	24	4%
FTE	260	269	274	272	-1%	419	427	457	472	3%
Average wage (thousand €)	17.4	19.5	21.7	19.7	-9%	18.8	19.6	22.2	19.4	-12%
Labour productivity (thousand €)	54.5	74.6	53.6	49.3	-8%	86.5	64.8	81.1	107.0	32%
Total sales volume (thousand tonnes)	2.6	3.7	3.3	3.8	16%	10.3	12.1	13.0	14.7	13%
Total income (million €)	37.0	51.2	49.6	54.8	11%	101.0	114.9	131.0	130.0	-1%
Total operating costs (million €)	27.1	35.8	40.5	46.0	14%	72.2	94.9	103.4	87.5	-15%
Gross Value Added (million €)	14.2	20.1	14.7	13.4	-9%	36.3	27.6	37.1	50.5	36%
Net profit (million €)	8.1	10.6	4.1	3.5	-14%	23.1	12.9	19.2	36.4	89%
Total value of assets (million €)	108.1	116.6	110.0	114.6	4%	183.7	215.6	230.7	239.0	4%
Net investments (million €)	1.5	4.4	0.4	3.8	817%	12.5	10.5	8.7	6.1	-30%
Capital productivity (%)	13.1	17.2	13.4	11.7		19.8	12.8	16.1	21.1	
Return on Investment (%)	7.5	9.1	3.7	3.0		12.6	6.0	8.3	15.2	
Future Expectation Indicator (%)	-1.6	0.8	-3.3	-0.2		3.2	1.5	0.3	-0.2	
	Trout Tanks and race-ways					**Carp Ponds**				
Number of enterprises	20	18	17	16	-6%	20	20	15	12	-20%
FTE	46	47	55	53	-3%	324	259	274	257	-6%
Average wage (thousand €)	8.5	8.4	10.4	10.0	-3%	8.2	9.5	9.7	10.8	11%
Labour productivity (thousand €)	9.3	10.9	12.5	8.9	-29%	76.6	41.1	36.5	15.5	-58%
Total sales volume (thousand tonnes)	0.4	0.4	0.4	0.4	5%	2.9	2.5	2.7	2.4	-14%
Total income (million €)	1.6	1.5	2.8	2.3	-16%	39.9	27.4	37.1	36.6	-1%
Total operating costs (million €)	1.4	1.3	2.5	2.2	-11%	17.6	19.3	28.3	31.4	11%
Gross Value Added (million €)	0.4	0.5	0.7	0.5	-31%	24.8	10.6	10.0	4.0	-60%
Net profit (million €)	-1.2	0.1	0.1	0.1	-3%	20.7	5.9	6.1	2.4	-62%
Total value of assets (million €)	5.9	3.1	7.7	9.8	27%	114.0	96.9	99.7	101.1	1%
Net investments (million €)	0.0	0.1	0.0	0.1	270%	6.4	5.4	4.2	8.3	101%
Capital productivity (%)	7.3	16.7	8.9	4.8		21.8	11.0	10.0	3.9	
Return on Investment (%)	-20.1	2.5	1.2	0.9		18.1	6.1	6.2	2.3	
Future Expectation Indicator (%)	-1.0	1.2	-1.7	-0.9		3.2	2.6	0.7	6.1	

Source: own elaboration from EU Member States DCF data submission, 2022.

Segment 2: Seabass and seabream cages

This is the segment with the largest production, which covers 68% of total sales volume in 2020, compared to 63% of total sales volume in 2019. All of these farms are growing both sea bass and sea bream, with a small quantity of other marine finfish species. It is remarkable, that this segment has a half of the value of the total value of assets, and greatest share in subsidies in investments.

An increase in production has been noted between 2019 and 2020 in terms of weight and value for this segment and the same trend is expected in the following years. During the period of investigation, total sales volume increased by 13% and total income decreased from €131million to €130 million or 1% respectively. A significant increase in production of other marine fish species in this segment should also be noticed. This segment consists of 24 enterprises in 2020, which produced 14.7 thousand tonnes of fish and employed on average 472 employees.

In general, enterprises in this sea bass and sea bream segment did not have production of eggs and larvae but some of them started their own production in the reference period; therefore, buying juveniles partly from other Croatian hatcheries and import from other EU countries decreased, along with share of livestock costs in cost structure from 2017 (12%) to 2018 (9%) and 2019 (8%). In 2020, share of livestock costs stabilised at 8%. The largest part of total costs are feed costs (57%), other operational costs (15%), wages and salaries (10%), and livestock costs (8%) while other costs make up for 10%.

GVA and net profit increased in 2020. GVA rose by 38% or €50.5 million and net profit reached the highest value since 2012 - €36.4 million. However, since there have been changes in segmentation, values from previous time series are not completely comparable. After reaching record values of net investments in 2017, investments in 2019 declined to €8.3 million or 34% respectively and to €6.1 million or 30% respectively. The evolution of Future Expectation Indicator shows a trend of decline started in 2015 recording the lowest values in 2020.

To conclude, the production in this segment continues to expand, followed by realization of investments in vertical integration, i.e. processing facilities, in order to maintain profitability, enhance the efficiency of business procedures and reach wide range of target customers through premiumisation – providing high valued innovative products and constantly expanding the product portfolio.

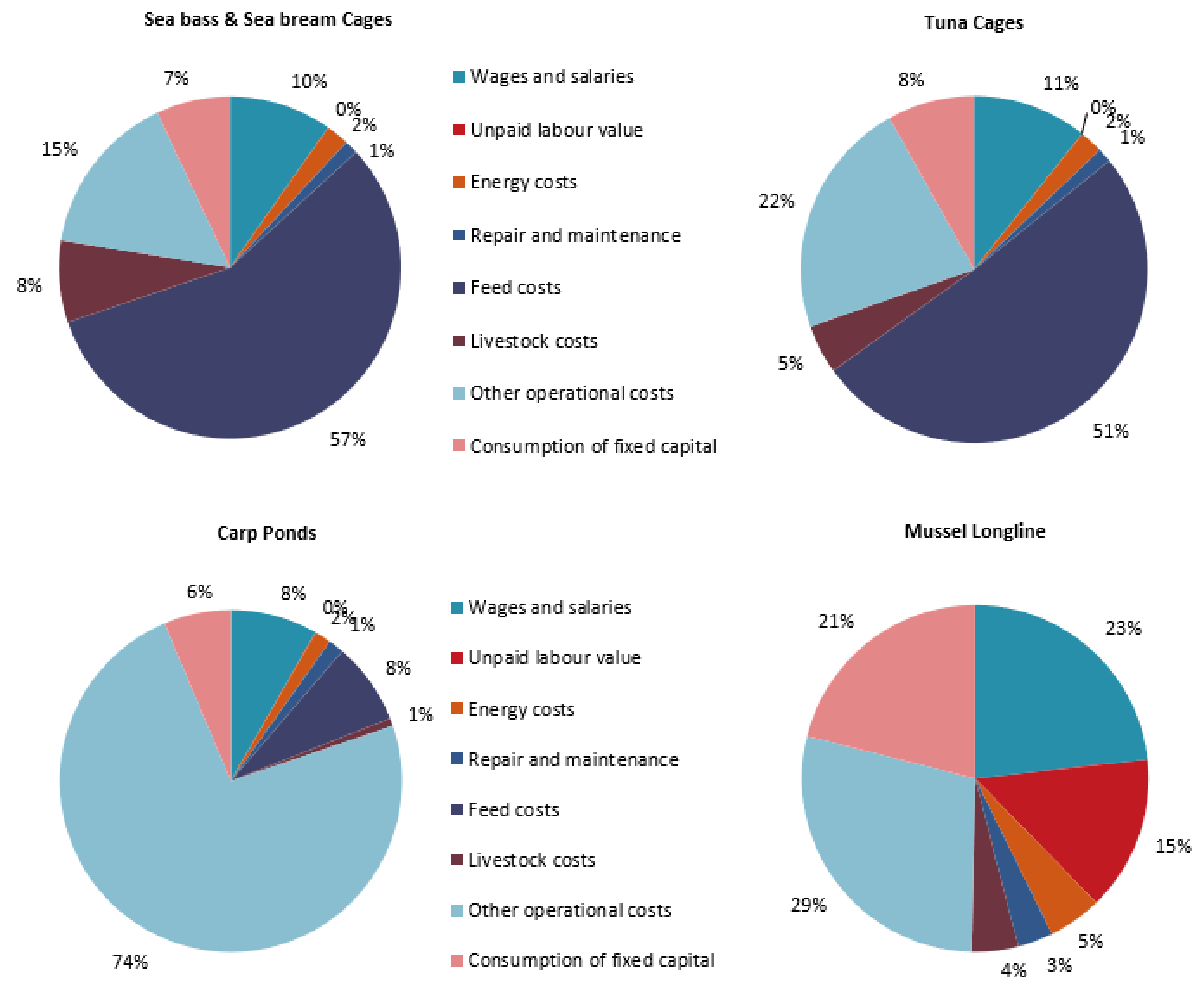
Figure 4.4.3 Economic performance indicators (in € million) for the main Croatian segments: 2012-2019.

Source: own elaboration from EU Member States DCF data submission, 2022

Segment 3: Carp ponds, 2022.

Similar as for Sea bass and sea bream segments, due to the recent changes in EUMAP segmentation and dominant farming techniques used at carp farms, but also due to stagnation in carp production, all companies with predominant production of carp were aggregated into a segment Carp combined from 2015 and to Carps ponds in 2017 which could explain some inconsistencies in time series. In total, about 71% of production in the segment accounts for carp, which is a decrease compared to 2019 (75%) and could imply a diversification in farming. Still, from 2019 to 2020, volume of carp production, so as value, declined from 2 037 tonnes to 1 691 tonnes. Production of the other freshwater fishes decreased by 4% in 2020 in volume and 7% in value. Although carp production in Croatia has over a 120 years tradition, currently is in a phase of decline and struggling to diversify activities. On the other hand, other inputs from the industry envisage the signs of technological recovery. Technological procedure of fish farming for recently renovated carp farms encompasses whole system of farming – from spawn and juveniles of all farming categories to market size commercial fish. According to National plan, results of diversification and investments in processing equipment should be even more visible in the next reporting period in terms of production volume and value and involving some new species in farming cycle.

Figure 4.4.4 Cost structure of the main segments in Croatia: 2020.



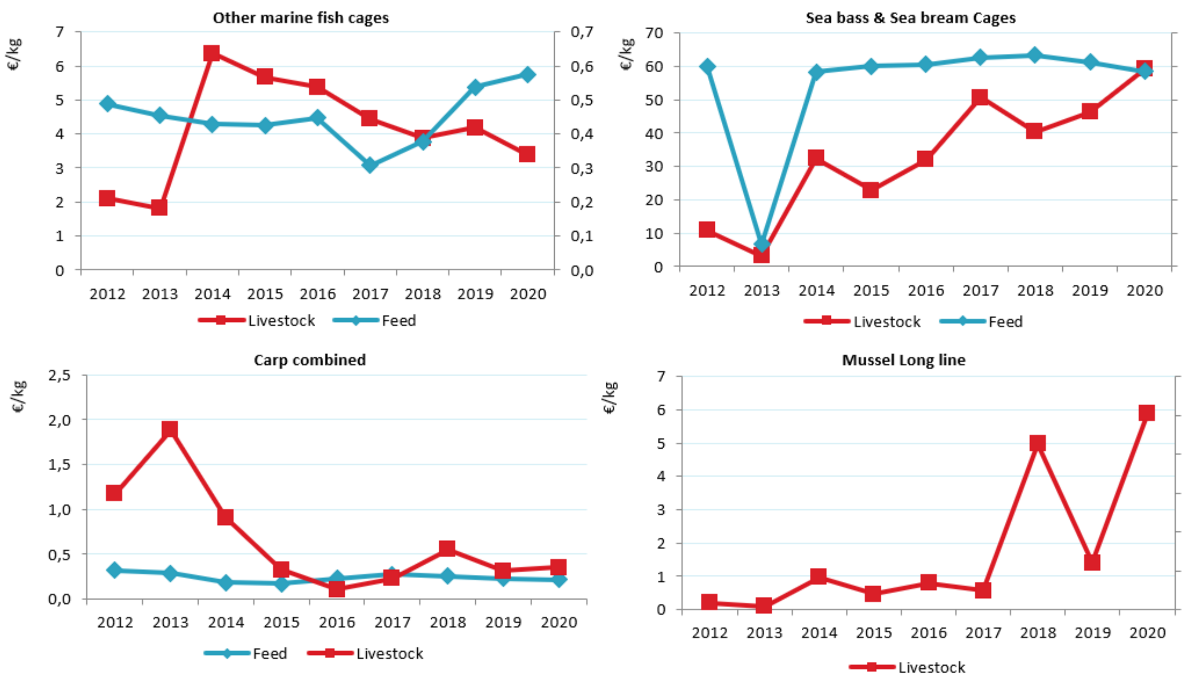
Source: EU Member States DCF data submission, 2022.

Segment 4: Mussels long line

Although the mussel long line segment represents only 2% of the total weight, and less than 0.5% of the value, it is an important segment in terms of number of enterprises and employees. The segment contains around 86 enterprises in 2019 and 78 enterprises in 2020, but since almost all of these enterprises are small-scale families businesses, it can be assumed that more people are involved and dependent on this segment production. It has to be taken into account that most of these farmers carry aquaculture as an additional activity; they are often retired or have other income apart from mussel farm enterprise. Nevertheless, total income has been increasing steadily from 2012 until 2016 but decreased since.

Almost all enterprises in segment are producing mussels and oysters and increasingly often Sea Bass and Sea Bream, but about most of of sales value comes from mussel production. The production is based on the collecting of shellfish in early stages from the nature, but some of the producers are buying additional juvenile shellfish's from other farms in order to increase production. Volumes in this segment are probably underreported taking into account family character of enterprises but should be taken into account that latest regulation of Aquaculture Act should improve reporting. Also, indicators related to mussel farms are dependent on few larger companies which increased their investments and business in general in past two years. Following the Croatian accession to the EU, it was expected for shellfish export to the EU market to increase since restrictions have been removed. However, decrease of export to insignificant volume did not approve the expectations yet. This segment was largely affected by COVID crises which caused a major decline in production and consequently number of active enterprises, and at the same time is extremely vulnerable to environment indicators and predators. Traditionally, in this segment oysters are also farmed in variable proportions, depending on market demand.

Figure 4.4.5 Feed and livestock average prices €/kg for the main segments: 2012-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

4.4.5 Outlook

Current production trends and main drivers

The production in Croatia continues to grow. The growth is not equally distributed among the sector, so the most significant improvement was recorded in marine aquaculture, namely in the production of sea bass and sea bream. The investments in this segment in past few years encouraged growth in terms of production, but also in diversification of production, vertical integration with processing and overall process of qualitative improvement oriented to different target consumers and maintain high goals of production along with high profitability.

Production of Bluefin tuna is determined by ICCAT quotas and prices on the world market, so this production follows world market trends. It is expected development and recovery regarding economic performance in this area. These companies also have their own fishing fleet (purse seiners) which allows them to expand the production to processed products of small pelagic fish.

As expected in previous time series, in past two years market conditions improved, so about 69% of production is intended for the export. Improvements in technology of farming, so as in a system of distribution and logistics enabled better availability of aquaculture products for consumers in foreign markets, which enabled flexibility in the situation of pandemics' outbreak.

Other marine aquaculture segments, Mussels long line and Oysters long line, after very challenging 2020, are expected to stabilize in terms of production and move towards protected designations of origin and the possibility of organic production to encourage growth towards export to EU market, which requires more attention on environmental indicators since oyster production strictly depends on environmental conditions.

Freshwater aquaculture, compared to improvements in marine aquaculture and to potential for growth is falling behind. Until now was targeting most on domestic market, and now most enterprises are trying to break into to EU market as there is a growing market demand for freshwater aquaculture products. Also, some of the freshwater aquaculture companies focus on diversification of production and preparation of some new species which, for now, address only limited markets and could hardly stimulate a general growth of the sector. Additionally, the process of vertical integration towards processors is present also in this sector but with less capital, smaller production and, in general, more challenges. Major carp farms, in order to add value to the products, started processing aquaculture products and took over the challenging task of developing new technologies, and investments and finally, introducing premium freshwater aquaculture products to end customers. On the other hand, in general, smaller trout farming enterprises, although some of them have potential and know-how in processing, are less willing to risk and prefer direct and safe sale channels for fresh fish (preferably direct sale to the customers and farmers' markets) rather than to rely on middleman or uncertain contracts with processing companies. Investments in processing are for small producers often too complex in terms of capital, technology, market and branding. However, some trout farms during the reference period started cooperation with large processing companies, which took over development of innovative, locally-branded products in order to present freshwater aquaculture products to retail customers.

Social acceptability

The Croatian market went through a period of intensive changes and improvements over the last several years. First, there has been an improvement in public perception of aquaculture products, which is reflected in domestic consumption. Producers are making progress in marketing and production technologies, as well as in processing and placing aquaculture products. This is especially the case with large companies, resulting in increased investments in marketing and sales. Also, in the National Aquaculture Development Strategy 2014-2020, in the part of appropriate positioning of aquaculture products on the market, increasing competitiveness and improving the promotion and consumer perception in the period until 2020, marketing activities were undertaken, such as the campaign "Croatian fish - eat what it's worth". within the framework of which the quality and sustainability of all domestic fishery products, including aquaculture products, were promoted, with the aim of increasing consumption and improving the perception of consumers about these high-value food products, or advertising spots that targeted aquaculture products, as well as their nutritional value, but also a contribution to sustainable development and protection of nature and the environment. Aquaculture products were also promoted through the application of suitable certification models, such as obtaining a mark of authenticity for the Maloston oyster.

The general goals of the development were to strengthen the social, business, and administrative environment for the development of aquaculture, as well as to improve the perception and increase the national consumption of aquaculture products. In addition to the general development goals, the Plan also determined the number of development priorities, grouped into several thematic areas aligned with the then-current Strategic Guidelines of the European Commission for the sustainable development of EU aquaculture from 2013.

During the preparation of the Croatian National Development Plan for Aquaculture for 2021-2027, several workshops have been held with farmers, scientists, and other stakeholders of the sector, in order to identify strengths, weaknesses, threats, and opportunities for each segment. Good social acceptability was identified across the sector mostly due to ensuring jobs and supporting rural development. Also, due to the accessibility of certified and quality fresh products, and relatively affordable prices (compared to rising prices of wild fish), there is growing support for the sector.

High energy prices

During 2021 and 2022 aquaculture sector has been affected by increased energy costs, as well as by high logistic costs and trade disruption. Eurostat data on Harmonised Indices of Consumer Prices (HICP) that measure the changes over time in the prices of consumer goods and services acquired by households shows the increase of annual average indices for all items out of which the highest ones are in energy, transport and food. The crisis caused by the Russian war against Ukraine is likely to have serious consequences on the supply of grain (in particular maize and wheat) and oilseeds (sunflower, rapeseed) or starch-derivatives from Ukraine and Russia to the EU, leading to a strong increase in feed prices.

Outlook for future production trends

Since Sea bass and sea bream production is representing more than 60% of total Croatian production value, there is strong interest in further development of this sector. Croatian coastline is suitable for further development of marine aquaculture in generally, but it is necessary to establish good practice in coastal zone management in order to ensure sustainable development of aquaculture production. This also applies for tuna production and shellfish farms. At the same time it is necessary to improve market organisation and legal framework to assure further development and control.

It is noticed that some marine aquaculture segments have increased their investment in new technologies, and start with introducing new species beside Sea bass and Sea bream. It can be expected that this trend of diversification will have further development.

In freshwater aquaculture development is restricted by available area, but with successful improvements in production technologies it can be expected to increase in production of cyprinid species in total, especially in some newly introduced species.

In aquaculture, especially in marine aquaculture, over recent years there has been a steady increase in the production of new species due to increased consumption in the domestic market, as well as the stabilization of prices in the EU market, but on the other hand, there is a low purchase price.

According to SWOT analysis of freshwater aquaculture, threats are transmission of disease and the damage from predators. General priorities are establishing and implementing protocols to prevent and control diseases and welfare of aquatic animals in farms, protection and compensation for damages caused by predators.

COVID-19 impact

The aquaculture industry in Croatia faced several challenges during the pandemics' outbreaks, including direct, short-term obstacles and long-term consequences. The sector and government reacted promptly after the initial shock and manage to mitigate the damage caused by closures by providing subsidies during 2020 and 2021 and, however, there is still uncertainty regarding long term-consequences, due to long production cycles and ongoing investments.

Regarding the first mentioned, the closure of the HoReCa channel had the greatest impact on the aquaculture market, since a significant share (around 30-50%) of fresh fish and especially shellfish consumption relies on this channel, particularly during tourist season. One smaller part of this decline in market demand has been compensated by growth in retail (especially of packed fish), but closure inevitably created surplus and problems with storage and logistics, increased costs (feed costs, material costs, personnel costs) and affected liquidity. Some larger companies managed to maintain export channels, mostly to Italy, and in very difficult conditions directly deliver fish to the international market. Positioning on the market, advanced technologies and recognizing the needs of the market were key factors in overcoming COVID-19 crisis. Where increased health risk occurred due to large number of employees, companies invested in equipment, such as additional vessels to provide safer work conditions.

In a long-term period, problems are more complex, including disturbances in production cycles (1.5 - 3 years) where is not possible to react immediately and reduce production as market circumstances change. Despite the crises and increased risk in return on investments, the companies are aware that investments are indispensable in order to break on new markets and increase competitiveness.

4.4.6 Data Coverage and Data Quality

Data quality

Data for all segments have been collected by census, except shellfish farms, where collection has been based on the probability sampling survey.

Data collection was performed through questionnaires created for this purpose. To ensure data consistency for all segments, together with definition of each variable in guidelines, link was made to accounting code in balance sheets. Some of variables were collected from Croatian Directorate of Fishery (DoF) database and subsidies register, since it is mandatory for all aquaculture producers in Croatia to report the production in volume and value each year at the farm level. But some of the variables were taken from questionnaires although it was planned to use DoF data. It was detected that DoF register is not complete and that some information is not suitable for this purpose. Some other variables, e.g. subsidies, were collected through DoF register and questionnaire. One of the main problems was low response and cooperation. Since some changes regarding data collection have been implemented in legal framework, it is expected to improve results in data collection. This is especially important for some segments with small-scale companies where it will be necessary to put additional effort in future data collection.

Data availability

Data for the aquaculture sector is going to be published on the segment level approximately 12 months after the end of the reference year.

Confidentiality

All segments are distinguished both concerning the species and technique. If an enterprise produces more than one species, then it is allocated to the segment of the species that contributes the most to the turnover.

Some enterprises own more than one farm using different techniques, but these activities are grouped together, because the enterprise is used as data collection unit. There are very few examples of enterprises using more than one production technique.

Differences in DCF data compared with other official data sources

The Croatian data for DCF is, in most cases, in line with both value and production registered in FAO and EUROSTAT. Only in the shellfish production there is significant difference between the data sources. However, explanation for that is probably difference in methodology. While shellfish data delivered for EUROSTAT in 2012 and 2013 are result of Croatian Chamber of Economy and Chamber of Trades and Crafts estimates, on the other hand DCF data for shellfish farms are estimation based on the sample. Regarding marine and freshwater fish production, data between EUROSTAT and DCF are mostly in line. Differences that appear are again the result of different methodology. In 2020 and 2019total quantity and volume by specie corresponds to quantity and volume reported by Eurostat.

4.5 Cyprus

Overview of Cypriot aquaculture

Cyprus produces only a small amount of aquaculture products (i.e., below a certain threshold). As a result, Cyprus was not obliged to provide economic data for this report. Since no data were submitted in the related data call, FAO data were used instead.

4.5.1 Total Production and sales

The Cyprus aquaculture industry is mainly based on marine fish. According to FAO data, total aquaculture production in 2020 was 7.3 tonnes valued approximately €37 million. This corresponds to a significant decrease in weight of 9% in regards to previous year 2019 but a tremendous increase of around 35% if compared to the period 2008 – 2020. The same picture stands for the value of production where a big share reduction of 15% is shown if compared to last year 2019 but a rise of 35% if compared to 2020 over the period 2008 -2019. This trend mainly follows the tendency of the major sector of the Cyprus aquaculture, the marine one.

Table 4.5.1 Production and sales for Cyprus: 2008-2020.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 19-20	Develop. 2020/(08-19)
Production weight (thousand tonnes)	**3.4**	**3.7**	**4.2**	**4.7**	**4.3**	**5.3**	**4.8**	**5.5**	**6.6**	**7.3**	**7.3**	**8.1**	**7.3**	***-9%***	***35%***
Marine	3.3	3.6	4.1	4.6	4.3	5.3	4.8	5.4	6.6	7.2	7.3	8.0	7.3	-9%	36%
Shellfish	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-24%	-7%
Freshwater	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-34%	-34%
Production value (million €)	**26.1**	**23.0**	**21.2**	**27.3**	**23.5**	**29.2**	**27.7**	**32.3**	**37.8**	**37.5**	**39.0**	**43.8**	**37.0**	***-15%***	***21%***
Marine	25.5	22.3	20.7	26.7	22.9	28.4	27.1	31.7	35.7	36.8	38.3	43.1	36.6	-15%	22%
Shellfish	0.2	0.1	0.0	0.1	0.1	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.2	-24%	-9%
Freshwater	0.4	0.6	0.5	0.6	0.5	0.5	0.4	0.3	1.8	0.3	0.4	0.5	0.3	-34%	-44%

SOURCE: FAO, 2022

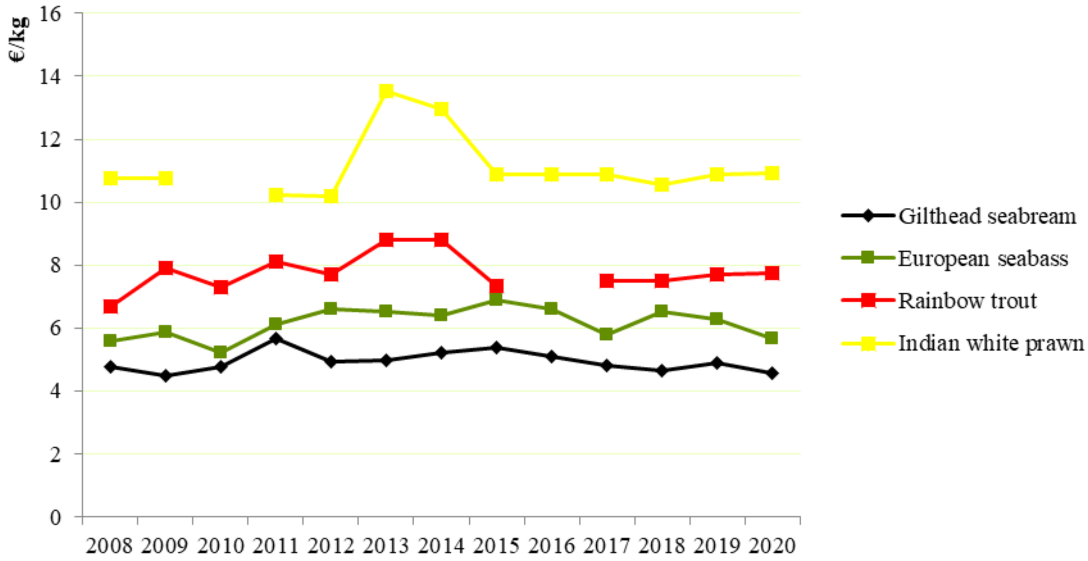
4.5.2 Main segments

Gilthead seabream remains the main species produced by the Cypriot aquaculture sector representing nearly 60% of the total weight and 54% of the total value of production in 2020. The other important species is European seabass accounted for 40% of the production volume and 45% of the total value. Freshwater fish and other species represent less than 1% of total volume and of total value.

Figure 4.5.1 Main species in terms of weight and value in Cyprus production: 2020.

Source: FAO, 2022.

Figure 4.5.2 Average prices for the main species produced in Cyprus: 2008-2020.



Source: FAO, 2022.

4.5.3 Outlook

Trends and triggers

Aquaculture in Cyprus shows a growing trend and the sector adjusts to different consumer needs. Recently, one of the main companies of the sector entered dynamically in the field of processing its own products. It is mainly engaged in filleting sea bream and sea bass.

Main drivers:

- Progress of Marine Spatial Planning in such a way that aquaculture can have necessary ground infrastructure. (Further analysis follows in “Social acceptance” chapter).
- Funding from European Structural Funds (EMFF, EMFAF) such as modernization of the existing capacities and the use of more advanced technologies.
- New markets for export of aquaculture products.
- Entered dynamically in fish processing that increases added value of products and diversifies the supply.

Main challenges:

- Increasing operational costs, especially the rise in fuel prices that reduces profitability.
- Very competitive market.

COVID-19 impact

Strict "lock down" measures on a national as well as international level were implemented in order to face COVID -19. These measures have had negative impact on the aquaculture industry. Sales and production have been decreased and aquaculture units are facing serious and increasing liquidity and working capital issues. The aquaculture sector has had a major reduction in sales resulting in great economic losses and creating a serious cash flow situation for all enterprises.

Cyprus submitted an amendment of the Operational program co-financed by the EMFF to add Measures for aquaculture Public health (Article 55) to support the sector.

Social acceptance

Cyprus has recently progressed with Marine Spatial Planning in such a way that aquaculture can have necessary ground infrastructure combined for more units where possible. Specifically, within the framework of this legislation provisions are included both for securing marine areas for the operation of marine aquaculture units and for its future development.

With the adoption of this legislation, the planning and use of the maritime space in Cyprus will no longer be done in a piecemeal manner and will be done on the basis of an integrated spatial plan that focuses on sustainable development. In this way, a stable zoning framework is expected to emerge which will provide legal certainty and predictability and will have a positive impact in terms of promoting investments in various sectors and industries operating in the Marine area, including aquaculture.

4.5.4 Data Coverage and Data Quality

The data collection of freshwater aquaculture is not mandatory under the DCF and EU-MAP programmes of the EU data collection. Cyprus only produces a small amount of aquaculture products (i.e., below a certain threshold). Thus, Cyprus was not obliged to provide economic data for this report. The analysis of the Cypriot aquaculture sector is therefore based on data extracted from FAO.

4.6 Czechia

Overview of the Czech aquaculture

The Czech Republic is a country with a long tradition of fish farming. Being a landlocked country, only freshwater species can be bred in the country. Aquaculture production in Czechia is generally characterized by extensive and semi-intensive fish farming in ponds – about 21 000 tonnes annually.

Czechia is a landlocked country producing only freshwater aquaculture products. The data collection of freshwater aquaculture is not mandatory. The Czech Republic submitted beyond the obligation initial socioeconomic data (2017-2020), but for consistency reasons, it was preferred to use FAO data instead.

4.6.1 Total production and sales

Annual fish production has been constant at approximately 21 thousand tonnes. In 2020, the production slightly decrease to 20.4 thousand tonnes accounting for €39.7 million – 8.2% less than the 3 previous year's average.

According to FAO data, in 2020, production from aquaculture excluding hatcheries and nurseries were 20 402 tonnes, of which 85% was common carp. There is no marine and shellfish production in the Czech Republic.

Table 4.6.1 Production and sales for Czechia: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**20.4**	**20.4**	**20.8**	**20.1**	**21.0**	**21.7**	**21.8**	**21.0**	**20.4**	-3%	-1%
Marine	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	20.4	20.4	20.8	20.1	21.0	21.7	21.8	21.0	20.4	-3%	-1%
Sales value (million €)	**41.5**	**40.3**	**41.7**	**37.7**	**39.8**	**43.3**	**45.5**	**41.9**	**39.7**	-5%	-3%
Marine	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	41.5	40.3	41.7	37.7	39.8	43.3	45.5	41.9	39.7	-5%	-3%

Source: FAO, 2022.

4.6.2 Industry structure and total employment

There are approximately 480 Czech aquaculture businesses, the majority of which are small and medium-sized enterprises (SMEs). A special feature of the sector is the existence of companies whose primary business activity is not aquaculture; they engage in fish farming alongside other activities. The main farmed fish is carp followed by salmonids (mainly rainbow trout) and other fish, such as pike, amur, and tench.

The pond farming areas are located throughout Czechia, but most of the enterprises are situated in the South Bohemian Region. The aquaculture and fishery sector provided work for approximately 2 188 in 2020.

The carp aquaculture is based on seasonal demand, with a peak during the Christmas period and very low sale levels for the rest of the year. This activity results in important seasonal employment demand and additional sources of income in rural areas. The quality of domestic products is high. Several products are trademarked (Czech carp) or carry the protected geographical indication or protected designation of origin labels.

Table 4.6.2: Industry structure and economic performance of the Czech aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Number of enterprises	480	480	480	480	0%	0%
Employment	2332	2189	2193	2391	9%	7%
FTE	841	810	731	775	6%	-2%
Total income	111.0	114.2	130.0	133.5	3%	13%
Total operating costs	49.9	51.4	51.3	49.0	-5%	-4%
Total wages	16.3	16.7	16.4	12.8	-22%	-22%
Gross Value Added	77.3	79.5	95.1	97.3	2%	16%
Depreciation of capital	29.4	29.7	29.6	30.4	3%	3%
Earning before interest and taxes	31.6	33.1	49.1	54.1	10%	43%
Financial costs, net	0.0	0.1	0.0	-0.2	-442%	-1769%
Net profit	31.6	33.0	49.1	54.3	11%	43%
Total value of assets	115.7	134.3	123.0	148.0	20%	19%
Capital productivity (%)	66.8	59.2	77.3	65.7	-15%	-3%
Return on Investment (%)	27.3	24.6	39.9	36.5	-8%	19%

Source: EU Member States DCF data submission, 2022.

4.6.3 *Main species produced*

Common carp accounts for 85% of the total aquaculture production in weight and 80% in value. Other species farmed in the country include other carps, such as grass or silver carps, and rainbow and brook trout. Rainbow trout account for the second highest share of production value with 7% and 3% weight share. Grass carp represents the third highest share of production value with 3% and 3% weight share.

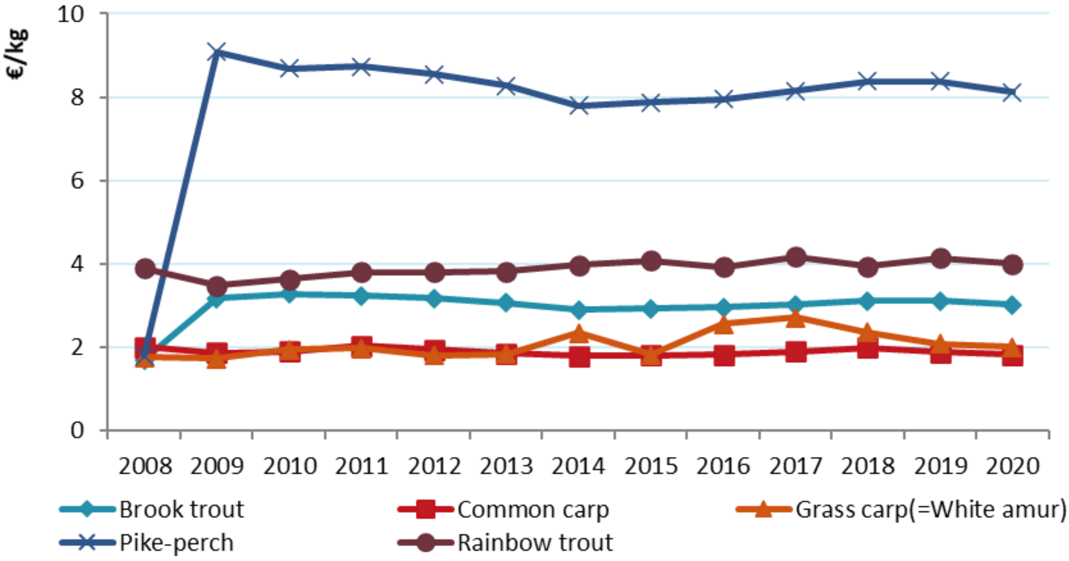
Figure 4.6.1 Main species in terms of weight and value in Czechia production: 2020.

Source: FAO, 2022.

The highest prices are observed for pike-perch, with €8.1 per kilo in 2020. The average price for rainbow trout in 2020 was €4.1 per kilo and €3.0 per kilo of brook trout.

For the main Czech species, Common carp prices were on average €1.8 per kilo and €2.0 per kilo for grass carp.

Figure 4.6.2 Average prices for the main species produced in Czechia: 2008-2020.



Source: FAO (2022)

4.6.4 Outlook

COVID-19 impact

COVID-19 particularly influenced fish farmers, mainly in terms of the exporting of live fish to other countries. Furthermore, the Czech Republic reported that COVID-19 negatively influenced the sale of market fish in the main seasons of Easter and especially Christmas.

4.6.5 Data coverage and data quality

The data collection of freshwater aquaculture is not mandatory under the DCF and EU-MAP programs of the EU data collection. Nevertheless, the Czech Republic started the voluntary collection of socio-economic data under the Data Collection Framework (DCF) for the years 2017, 2018, 2019, and 2020. The total frame population of the enterprises in the Czech Republic are 480 companies. The expected return of questionnaires of all contacted fish enterprises was 20%, but in fact, it was 10% (the achieved sample number were 48 questionnaires). However, this 10% of subjects included the biggest fish enterprises in the Czech Republic and covered about 70-75% of the aquaculture production of the Czech Republic.

4.7 Denmark

Overview of Danish aquaculture

The Danish aquaculture sector mainly produces trout in cages, ponds and recirculation systems. In 2020, production of other species only accounted for 5% of total value and 14% of total weight. Total sales weight and sales value show a steady increase from 2008 to 2019, however, from 2019 to 2020 the sales weight and value decreased for all segments resulting in an overall decrease of 16% and 14% respectively.

4.7.1 Total Production and sales

In total, the Danish aquaculture sector produced 54 099 tonnes in 2020, which is a slight decrease compared to 2018, however, a rather significant decrease of 16% compared to 2019. The total value of production was €180.8 million in 2020, which is a decrease from 2018 and 2019 of 12% and 14%, respectively. Compared to the average of 2008 to 2019, the total volume has increased 12%, and the total sales value increased 8% in 2020.

4.7.2 Industry structure and total employment

In 2020, the total population of commercial aquaculture farms was 195, distributed amongst 90 enterprises. The sector is dominated by small enterprises with less than 5 employees, which amounted to around 70% of the enterprises in 2020.

Table 4.7.1 Production and sales, industry structure and employment for Denmark: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**44.1**	**42.6**	**44.2**	**46.4**	**48.2**	**53.6**	**55.9**	**64.5**	**54.1**	-16%	12%
Marine	7.9	11.0	14.0	14.1	12.6	13.8	14.4	14.4	11.3	-22%	-11%
Shellfish	1.5	1.1	1.1	1.6	1.7	2.4	3.1	8.9	6.9	-22%	206%
Freshwater	34.7	30.4	29.1	30.8	33.9	37.4	38.4	41.2	35.9	-13%	7%
Sales value (million €)	**130.0**	**136.1**	**155.0**	**159.8**	**185.0**	**205.1**	**205.9**	**210.7**	**180.8**	-14%	8%
Marine	36.2	45.9	57.2	57.4	62.4	74.3	71.8	60.8	53.8	-12%	-5%
Shellfish	1.3	0.7	0.9	1.3	1.3	1.4	2.3	5.5	3.3	-39%	112%
Freshwater	92.5	89.5	96.9	101.0	121.3	129.3	131.9	144.4	123.7	-14%	13%
Number of enterprises	**162**	**154**	**130**	**115**	**107**	**100**	**99**	**94**	**90**	-4%	-28%
Marine	6	6	6	7	5	4	4	4	4	0%	-27%
Shellfish	10	13	10	6	5	4	6	8	9	13%	9%
Freshwater	146	135	114	102	97	92	89	82	77	-6%	-31%
Employment	**606**	**468**	**490**	**506**	**549**	**662**	**681**	**675**	**675**	0%	22%
Marine	106	91	125	155	150	137	146	90	95	6%	-23%
Shellfish	20	13	10	6	10	21	28	52	50	-4%	188%
Freshwater	480	364	355	345	389	504	507	533	530	-1%	29%
FTE	**349**	**282**	**304**	**336**	**366**	**474**	**481**	**502**	**499**	-1%	37%
Marine	61	56	79	103	100	98	104.98	68	69	2%	-15%
Shellfish	12	5	1	4	7	12	16	33	29	-11%	211%
Freshwater	276	222	224	230	259	364	360	401	401	0%	47%

Source: EU Member States DCF data submission, 2022.

The total number of persons employed in 2020 was 675, corresponding to 499 FTE. From 2018 to 2020, the number of employees decreased by 1%, whereas the number of FTE increased with 4%. Compared to the average from 2008 to 2019, the number of FTE has increased by 37%.

4.7.3 Overall Economic performance

From 2019 to 2020, total income decreased by 14%, while operating cost decreased by 11%. The total wages was reduced by 2% and depreciation of capital increased by 2%, which resulted in a negative profit of €8.7 million. This is the lowest net profit obtained by the industry over the period 2008-2020. The reason for the poor economic result should be found in the segment containing "other recirculating" companies producing a variety of species in closed recirculating aquaculture system. This segment alone contribute with a negative net profit of €13 million in 2020.

Table 4.7.2 Economic performance of the Danish aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Total income	208.7	217.4	222.6	190.8	-14%	-12%
Total operating costs	177.5	192.9	208.2	185.9	-11%	-4%
Total wages	26.4	31.1	32.6	32.0	-2%	7%
Gross Value Added	57.6	55.6	47.1	37.0	-22%	-31%
Depreciation of capital	8.9	9.5	10.6	10.9	2%	12%
Earning before interest and taxes	22.3	15.0	3.8	-6.0	-256%	-143%
Financial costs, net	2.9	2.9	1.3	2.7	113%	16%
Net profit	19.5	12.0	2.5	-8.7	-443%	-177%
Total value of assets	225.9	260.3	278.3	269.6	-3%	6%
Capital productivity (%)	25.5	21.4	16.9	13.7	-19%	-36%
Return on Investment (%)	9.9	5.8	1.4	-2.2	-261%	-139%

Source: Own elaboration from EU Member States DCF data submission, 2022.

4.7.4 Main species produced and economic performance by segment

The three main species produced in the Danish aquaculture sector are rainbow trout, blue mussel and European eel.

Rainbow trout as the dominating species constitutes 86% of the production weight and 95% of production value.

Blue mussel constitutes 13% of production weight but only 2% of production value, due to a low price on mussels per kilo produced. On the other hand, European eel constitutes only 1% of production weight but 3% of production value due to a higher price per kilo.

Figure 4.7.1 Main species in terms of weight and value in Denmark: 2020.

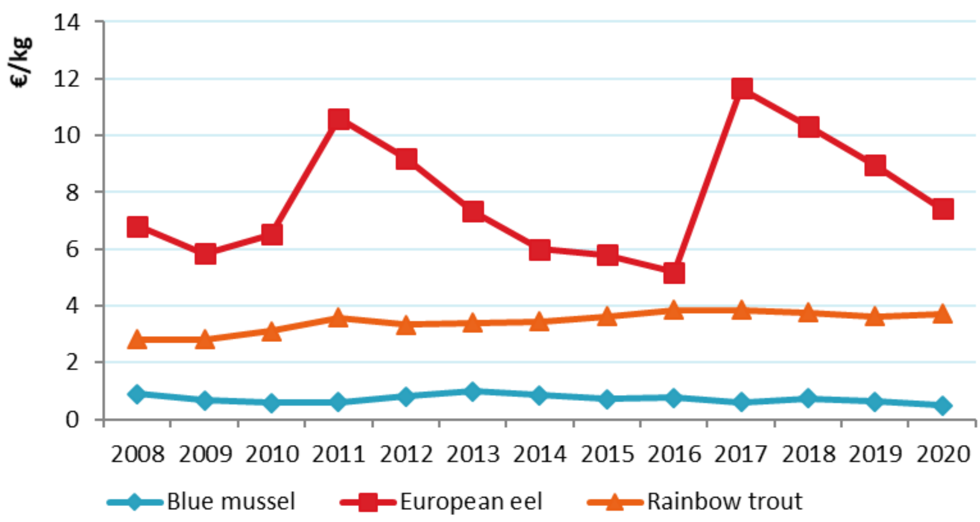
Source: EU Member States DCF data submission, 2022.

The price of blue mussel has been relative constant from 2008 to 2020, fluctuating between €0.6 and €0.9 per kg. However, the production volume has almost increased 4 times over the period, which has resulted in an increasing in turnover of 154%.

The price of rainbow trout has increased slightly in the same period, rising from €2.8 per kg in 2008 to €3.7 per kg in 2020, an increase of 32%. In the same period, production has increased by 16%, which has resulted in an increasing turnover of 53%.

The price of European eel has fluctuated over the years, showing a low point in 2016 at €5.2 per kg and a high point the year after at €11.7 per kg. The production volume decreased by 72% from 2008 to 2020, mainly due to reduced availability of glass eel.

Figure 4.7.2 Average prices €/kg for the main species produced in Denmark: 2008-2020.



Source: Own elaboration from EU Member States DCF data submission, 2022.

The most important sectors in the Danish aquaculture sector in terms of production volume and value are:

- Trout Ponds
- Trout Recirculation systems

- Trout Cages
- Mussel Longline

The EUMAP segments Trout Ponds and Trout Recirculation systems were formerly reported together under one DCF segment Trout Combined. Thus, the time series available for these two segments is only 2017 to 2020, which is presented in tables and figures.

In Table 4.7.3, the economic performance of four Danish segments is presented. It is seen that the gross value added is positive for all segments, but the net profit varies significantly from 2017 to 2020. In 2020, all the main segments presented below show a positive net profit. However, the overall result for the sector is heavily influenced by the segment Other recirculated systems that have a significant negative net profit in 2020.

Table 4.7.3 Economic performance of main Danish aquaculture segments: 2008-2020.

Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Trout cages					**Mussel Longline**				
Number of enterprises	4	4	4	4	0%	4	6	8	9	13%
FTE	98	105	68	69	2%	15	21	41	36	-13%
Average wage (thousand €)	63.4	59.0	83.2	87.9	6%	46.2	40.3	29.6	40.8	38%
Labour productivity (thousand €)	210.3	187.8	221.5	178.6	-19%	48.9	71.8	98.3	65.7	-33%
Total sales volume (thousand tonnes)	13.8	14.4	14.4	11.3	-22%	2.4	3.1	8.9	6.9	-22%
Total income (million €)	75.7	74.9	60.6	55.8	-8%	1.5	2.5	5.5	3.8	-31%
Total operating costs (million €)	61.3	61.4	51.2	49.6	-3%	1.5	1.8	2.7	2.9	8%
Gross Value Added (million €)	20.6	19.7	15.1	12.3	-18%	0.7	1.5	4.0	2.3	-42%
Net profit (million €)	12.1	11.6	8.0	5.0	-37%	-0.1	0.5	2.4	0.4	-82%
Total value of assets (million €)	56.3	51.2	48.8	54.5	12%	2.7	3.6	6.9	6.9	-1%
Net investments (million €)	1.6	1.6	3.1	2.2	-27%	0.0	0.0	0.3	0.1	-69%
Capital productivity (%)	36.6	38.5	30.9	22.7		27.6	42.0	58.5	34.1	
Return on Investment (%)	21.4	22.7	16.4	9.2		-5.1	12.5	35.4	6.3	
Future Expectation Indicator (%)	-0.4	-0.1	3.8	2.2		-6.2	-5.1	0.0	-4.7	
	Trout Ponds					**Trout Recirculation systems**				
Number of enterprises	66	61	54	49	-9%	18	17	17	17	0%
FTE	232	216	207	193	-7%	87	69	104	115	11%
Average wage (thousand €)	46.3	55.6	54.5	55.7	2%	63.4	95.9	83.6	61.5	-26%
Labour productivity (thousand €)	77.9	79.8	68.6	89.5	30%	118.5	142.7	78.6	95.6	22%
Total sales volume (thousand tonnes)	17.0	17.7	17.6	15.4	-12%	16.3	15.1	17.9	16.1	-10%
Total income (million €)	62.4	64.8	66.0	58.6	-11%	47.2	47.2	58.9	49.3	-16%
Total operating costs (million €)	55.1	59.6	63.1	52.0	-18%	42.4	44.0	59.4	45.4	-24%
Gross Value Added (million €)	18.1	17.3	14.2	17.3	22%	10.4	9.8	8.2	11.0	35%
Net profit (million €)	3.6	2.0	0.9	3.6	316%	1.3	0.9	-2.2	2.3	205%
Total value of assets (million €)	67.5	63.4	61.7	60.4	-2%	61.7	56.5	63.1	47.0	-26%
Net investments (million €)	5.4	1.4	2.8	3.2	15%	2.4	3.2	7.8	4.9	-37%
Capital productivity (%)	26.8	27.2	23.0	28.6		16.8	17.4	13.0	23.5	
Return on Investment (%)	5.3	3.1	1.4	5.9		2.1	1.7	-3.5	4.9	
Future Expectation Indicator (%)	4.1	-1.6	0.9	0.9		-0.3	2.4	8.9	6.9	

Source: Own elaboration from EU Member States DCF data submission, 2022.

Segment 1: Trout ponds

The most important segment in Denmark is the land-based production of trout in ponds. In most cases, enterprises in Denmark combine the production in hatcheries and nurseries with grow out farms. The product from these farms is mainly portion size trout of 300 to 400 grams with white meat. The segment consists of 49 enterprises. The production volume was 15.4 thousand tonnes with a corresponding income of €58.6 million. This constitutes 32% of the total production volume and 29% of the total production value in 2020.

Segment 2: Trout Recirculation systems

The second segment is land-based farms producing trout in recirculation systems. The product from these farms is mainly the same as the product from the farms producing in ponds. However, the farms are much larger and use more technology to clean the water on the farm and when discharged from the farms. The segment consists of 17 enterprises. The production volume was 16.1 thousand tonnes with a corresponding income of €49.3 million. This constitutes 30% of the total production volume and 26% of the total production value in 2020.

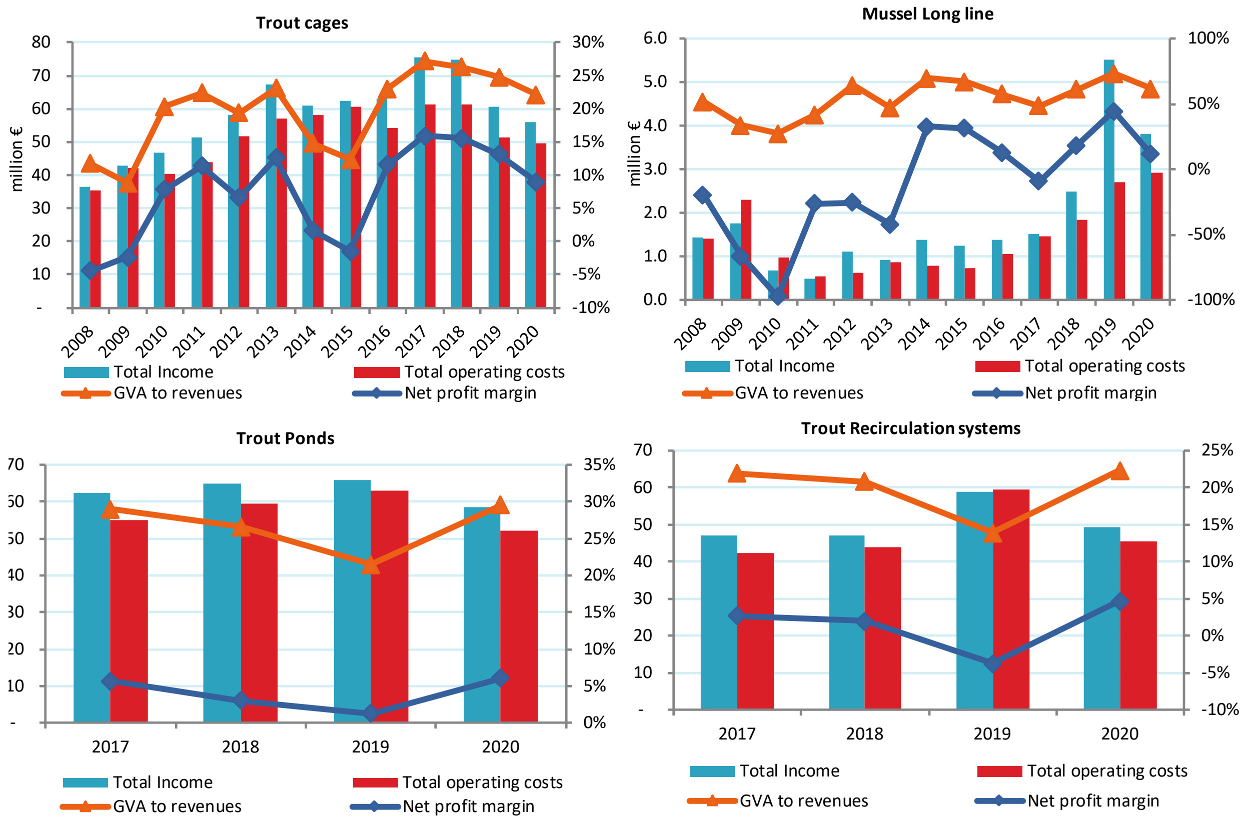
Segment 3: Trout cages

The third segment is the sea cage farms producing trout in the Baltic Sea. The main product, besides fish, is trout eggs for consumption. In 2020, there were 19 farms distributed among 4 enterprises. The production volume was 11.3 thousand tonnes bringing about a total income of €55.8 million. This segment covers 21% of the volume and 29% of the value of total Danish production in 2020.

Segment 4: Mussels long line

The fourth segment is blue mussels on long lines. The production was 6.9 thousand tonnes, which generated at turnover of €3.8 million in 2020. The segment had 9 enterprises. The segment covers 13% of the volume and 2% of the value of the total Danish production in 2020.

Figure 4.7.3 Economic performance indicators (in € million) for the main Danish segments: 2008-2020.



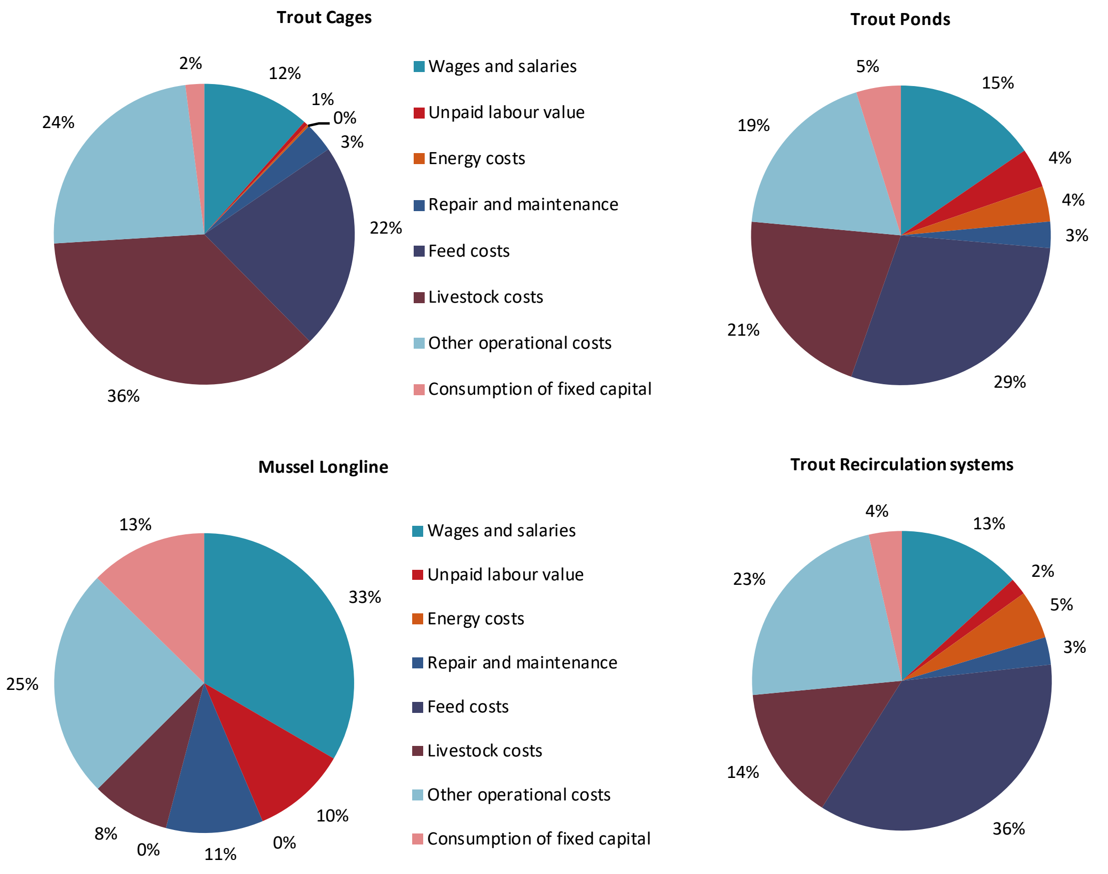
Source: Own elaboration from EU Member States DCF data submission

Other segments

The Danish aquaculture sector also have production in two other segments, Eel Recirculation systems and Other freshwater fish Recirculation systems, which produce European Eel and other species in land based recirculation systems. In 2020, these two segments produced a total volume of 4.4 thousand tonnes, which generated a turnover of €22.3 million. This correspond to 8% of the volume and 12% of the value of the total Danish production in 2020.

In Figure 4.7.3, economic indicators for the four main segments are shown. It shows that Net profit margin is positive for all segments in 2020. For Trout ponds and Trout recirculated systems GVA to revenues and Net profit margin increases from 2019 to 2020. For Trout cages and blue mussel production GVA to revenues and Net profit margin decreases from 2019 to 2020.

Figure 4.7.4 Cost structure of the main segments in Denmark: 2020.

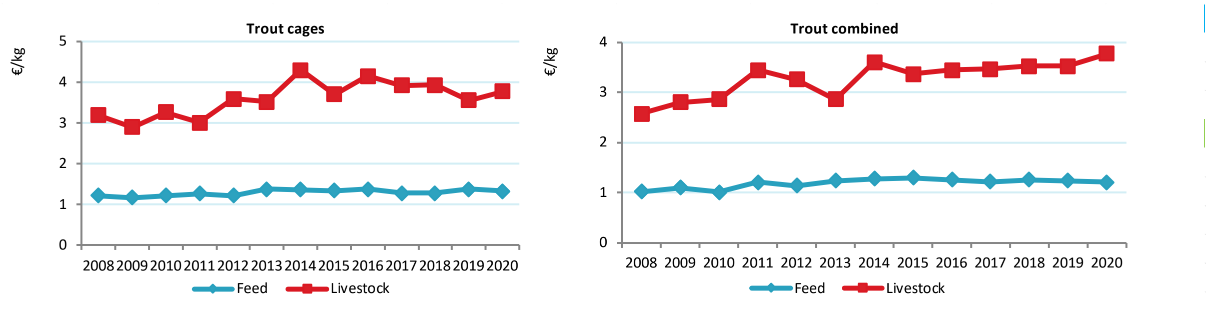


Source: EU Member States DCF data submission, 2022.

Figure 4.7.4 shows the cost structure for the four main segments. The four segments account for more than 92% of the Danish aquaculture production and 88% of the sales value. It is noticeable that Feed cost is an increasing part of total costs as production methods get more specialized. Conversely, Livestock costs decrease as production methods get more specialized. Another reason for the decreasing cost shown for fingerlings (livestock) is that there is vertical integration in the sector, which means that hatcheries and nurseries becomes a part of the grow out farms and the cost for fingerlings (livestock cost) are not presented separately but as a part of other operational costs for the enterprises. The more specialized the sector becomes the more it is a matter of effectively converting feed to food.

Figure 4.7.5 below shows feed and livestock prices for Trout cages and a combined segment of Trout ponds and Trout recirculation systems. Even though cost structures are different for Trout ponds and Trout recirculation systems, the prices of feed and livestock are largely similar. Hence, the two land-based trout segments are shown as Trout combined.

Figure 4.7.5 Feed and livestock average prices €/kg for the main Danish segments: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

It can be seen that the price of feed is also largely similar for the sea based production method Trout cages and the land based production methods Trout combined. It is noticeable, though, that the price of livestock is higher for Trout cages. This is because the sea cage production uses larger smolt (livestock) with a weight of 300-500 grams, whereas the land based production methods use smaller fry at a weight of 5-10 grams.

4.7.5 Outlook

Nowcasts for 2021-22

Danish production volumes and values collected by the Danish Directorate of Fisheries for 2021 have been used for the nowcasting of the Danish sales volume and value for the year 2021. The data collected here form the background for the Danish aquaculture account statistics, but is the net production data. Therefore, the value and volumes are estimated based on 2021 data, but adjusted according to the difference experienced in 2020 between data from the Danish Directorate of fisheries and the Danish account statistics for aquaculture. Data for 2022 is not yet available and therefore data for 2021 is used as a guesstimate.

Trends and triggers

There is a moratorium for sea cage farming in Denmark. Thus, no new farms is expected in the near future, which also means that the current production will be stable at the current level at 10-15 thousand ton.

The land-based production has shown a downward trend of production over the years. The production was expected to increase when the new regulation going from feed quotas to nitrogen quotas were fully implemented, however, the transition takes time and the number of farms have been reduced in the meantime. Thus, the production will stay at the current level around 30 thousand ton.

Mussel farming in Denmark has been increasing and been quite successful in terms of increasing both volume and value from the sector. This trend is expected to continue if new production cites is made available.

Market structure

The Danish aquaculture sector has managed to increase labour productivity over the period investigated. The labour cost per unit of output is also relatively low compared to other countries producing trout.

The sector consists of many small producers at the primary level, whereas there are only two to three enterprises buying and processing the trout. This market structure can be a hindrance because the market is not functioning optimally with regard to competitiveness.

In recent years, a segment of organic aquaculture producers has been established. In 2020, there were 21 organic aquaculture producing farms distributed at 11 land based farms and 1 sea cage farm all producing trout and 9 blue mussel farms. The organic producers of trout have higher costs for feed and fry, but they are also receiving a price premium for their products. The segment is producing a little more than 7 000 ton, which is mainly mussels. It is, however, questionable how large the trout production volume can grow before the price premium will disappear.

Issues of special interest

In Denmark, a few new farms are experimenting on the production of new species and using new technology. The species produced is Pikeperch, Atlantic salmon and Yellowfin Kingfish (Seriola Lalandi) in recirculating systems. In a land based recirculated facility the control of the production process is higher than in a sea cage farm and there is a better opportunity to control the emission of nitrogen, phosphorus and organic material etc., on the other hand, the operating cost is expected to be higher than in the sea cage farms. When the new farms are fully operational they will produce in excess of 8 000 ton per year. However, the high investment cost in these facilities does not seem to generate a positive economic outcome so far.

Outlook for future production trends

Before 2012, all farms in Denmark were regulated by a feed quota system. Under this regulation the farmer's main focus was to optimize production under the restriction of input (feed), whilst the farmer had no incentive to reduce the emissions discharged from the farm. A regulatory change in 2012 to individual emission rights on nitrogen was implemented to give the farmers an incentive to reduce pollution in order to increase production and profitability. This should also secure a further development and adoption of new environmentally friendly production methods and technologies. So far, only 20 large farms in the group of recirculated land based farms has moved to the new regulatory system. Therefore, it is questionable if this change has had a larger effect on the production volume in 2019 and 2020, because of bureaucratic procedures of changing from the old system to the new one.

COVID-19 impact

All segments of the Danish aquaculture sector seem somehow to be affected by COVID-19. Even though most firms report diminishing sales it is difficult to find this effect on production and prices (Nielsen et al. 2022). Thus, some may have lost sales to restaurant and the fresh fish markets during the Covid-19 pandemic but others may have gained by changing channels of distributions to supermarkets or the frozen or smoked product markets.

High energy prices

In particular, farms with recirculation systems are affected by the higher energy costs due to their design and need for continuously recirculating the water with electric pumps. Farms relying more on older flow through systems, sea cage and mussel farms are less affected by the increasing prices. However, the increase in energy prices also affect the price of feed because the making of fishmeal and oil is an energy demanding process. It also affects the production of fingerlings which in many cases is done in recirculated systems. Thus, even though the farms in sea cages and traditional aquaculture systems are not directly affected, they will be indirectly be affected by higher feed prices.

Social acceptance

The attitude towards the aquaculture sector in Denmark is both positive and negative.

On the positive side, it is acknowledged that the farms provide high quality and safe food for consumers.

On the negative side, people believe that the emission from the sector is harmful to the environment and climate, even though that is has been shown that aquaculture perform better than many other animal protein producing sectors (Gephart et al. 2021; Bianchi et al. 2022).

Especially the negative perception hinders new licences to be issued. The competition for space and emission on land with the agriculture sector leaves little room for expanding the sector. At sea other industries (truism and sailing) will not share the space with the aquaculture sector which takes up place as well for finfish as for mussels farms. Even though mussels can improve the water quality.

Finally, many people do not know which fish are caught wild and whish is farmed. This may give a misperception on what aquaculture is and what quality of fish is produced and the effects on environment and climate.

4.7.6 Data Coverage and Data Quality

Data quality

The account statistic for 2020 is based on a sample of 93 aquaculture farms, which covers 48% of the total population of 195 farms. In the data set sales volume and value are available for all farms.

The Danish Fisheries Agency (formerly The Danish AgriFish Agency) has registered the total population of farms and enterprises engaged in aquaculture production in Denmark. It is mandatory for all aquaculture producers in Denmark to report the production in volume and value each year at the farm level. The species produced and the technique used in the production are also reported.

The data for The Danish Account Statistics for Aquaculture is collected by Statistics Denmark. The collection is based on the total population of farms provided by The Danish Fisheries Agency. The data is collected at farm level, and can be aggregated to the enterprise level. The data is collected at farm level to get the most homogeneous segments in terms of species and technique. The Danish Account Statistics for Aquaculture collects economic data for costs and earnings and balance sheets. Data is collected on a voluntary basis from the owner’s chartered accountant. The accountant’s task is to report the accounts of his aquaculture clients to Statistics Denmark in a special form in which the account information is harmonized for statistical use. Statistics Denmark validates the data from each account in a specially designed data system for quality control.

The extrapolation of the sample to the total population is done in two steps. In the first step, all results from the collected accounts are entered into a database containing information on all existing aquaculture producers in Denmark. From the collected accounts, an average is calculated for all indicators in each segment. In the second step, an account for the remaining population is estimated based on the average calculated in the first step and the information collected by The Danish Fisheries Agency. The underlying assumption for this calculation is that the production function for each farm is identical within each segment. If the production function is identical, the costs and earnings can be distributed from the sales volume and value in each account.

Data availability

Data for the aquaculture sector is published once a year in an aggregated form at farm level for each segment. The aquaculture statistics are published on Statistics Denmark's website approximately 12 months after the end of the reference year.

Other data issues or missing data

Confidentiality

To avoid problems with confidentiality, segments should in general include more than 10 enterprises. In Denmark, both the production of the sea cages farms and the production of eel and other species in land based recirculation systems are quite significant in terms of value, and even though these segments include less than 10 companies, they are surveyed. In order to present detailed data collected from these segments, nearly all enterprises have agreed to participate in the survey.

All segments provided by Statistics Denmark have a high degree of homogeneity with regard to species and technique. At farm level, the separation of species into segments is 100%, but if an enterprise produces more than one species, the firm is allocated to the segment of the species that contributes the most to the turnover.

Some enterprises own more than one farm, which may use different techniques. In Denmark, these activities are split up, because the farm is used as the data collection unit. When farms are aggregated into enterprises again, the enterprise is allocated to the segment of the technique that generates the most turnover. There are very few examples of enterprises using more than one technique.

Differences in EUMAP data compared with other official data sources

The Danish data for EUMAP is, in most cases, in line with value and production registered in FAO and EUROSTAT. However, the Danish data for the freshwater sector provided for the EUMAP also contains value and volume for the Danish hatcheries and nurseries and production of smolts for the sea cage farms. The volume and value therefore exceeds the volume and value registered by FAO and EUROSTAT, which only contains the value and volume for fish produced for consumption.

Furthermore, there are some differences in the volume and value collected by the Danish Fisheries Agency, who reports to EUROSTAT and FAO, and Statistics Denmark who reports to the EUMAP. In general, both volume and value are higher in Statistics Denmark Aquaculture Account Statistics. The reason is that the value and volume in the Account Statistics are sales volume and value registered by the enterprises, while the numbers from the Danish Fisheries Agency are measured as farm gate volume and value. Secondly, the data collected by Statistics Denmark are account data and the account year does not necessarily coincide with the calendar year.

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4.8 Estonia

Overview of Estonian aquaculture

Estonia has mainly freshwater aquaculture. There is also a company in Estonia which started fish farming in sea cages in 2018. Since no data were submitted in the related data call, FAO data were used instead.

4.8.1 Production volume and value

According to FAO data, total aquaculture production in 2020 were 1090 tonnes valued €4.3 million. Compared to 2019, the production weight and value increased by 3% and 15%, respectively. The development over the last 12 years also showed increasing trend in the production weight and value. The average price for rainbow trout in 2020 was €3.4 per kilo which remained rather stable compared to 2019 (€3.3 per kilo).

Table 4.8.1 Production and sales for Estonia: 2008-2020.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 19-20	Develop. 2020/(08-19)
Production weight (thousand tonnes)	**0,8**	**0,7**	**0,6**	**0,4**	**0,6**	**0,7**	**0,9**	**0,8**	**0,9**	**0,9**	**0,9**	**1,1**	**1,1**	***3%***	***43%***
Marine	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	17%	40%
Freshwater	0,8	0,7	0,6	0,4	0,6	0,7	0,9	0,8	0,9	0,9	0,9	1,1	1,1	3%	43%
Production value (million €)	**2,9**	**2,2**	**2,0**	**1,6**	**2,4**	**2,8**	**3,5**	**3,4**	**3,9**	**3,7**	**4,2**	**3,7**	**4,3**	***15%***	***43%***
Marine	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-9%	37%
Freshwater	2,8	2,2	2,0	1,5	2,4	2,8	3,5	3,4	3,9	3,7	4,2	3,7	4,3	16%	43%

SOURCE: FAO, 2022.

4.8.2 Industry structure

According to the data of the Estonian Agriculture and Food Board, 48 registered companies were operating in the aquaculture sector in 2020; 24 of them farmed fish and 24 were engaged in crayfish farming. Fish farms are small, with low employment rate. Due to the small volume the production are mainly marketed domestically.

4.8.3 Main segments

Rainbow trout remains the main species produced by the Estonian aquaculture sector representing 80% of the total weight and 68% of the total value of production in 2020. In most cases, fish of 1-2.5 kg intended for human consumption are farmed. Rainbow trout in portion size (250-400g) is also produced to some extent, but the demand of Estonian consumers for this product is low. Some farms are also engaged in pre-farming of fish for other farms as an additional activity when necessary.

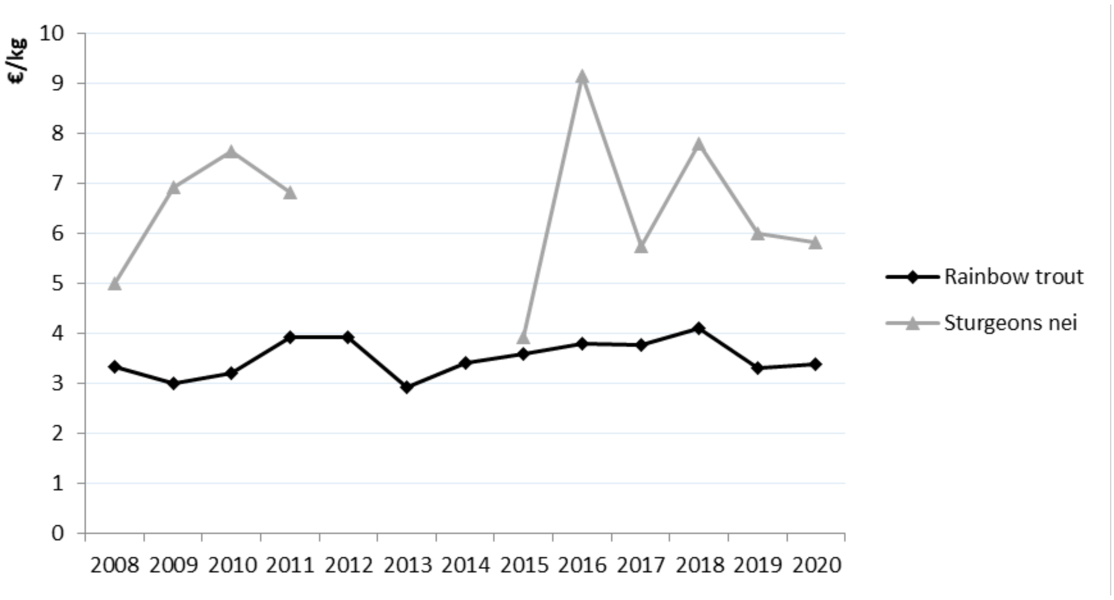
4.8.4 Nowcasts for 2021-2022

According to Statistics Estonia, Estonian fish farmers sold 849 tonnes of production in 2021. The total weight of production decreased 22%, compared to 2020. The main reason for the decline is the effect of Covid-19. Increase in energy cost is also affecting economic performance of the aquaculture sector in 2022.

Figure 4.8.1 Main species in terms of weight and value in Estonia production: 2020.

Source: FAO (2022).

Figure 4.8.2 Average prices for the main species produced in Estonia: 2008-2020.



Source: FAO (2022).

4.8.5 COVID-19 impact

Although the total aquaculture production increased slightly in 2020, Covid-19 had negative impact on Estonian trout farmers whose total production decreased by 6% in 2020 and by 23% in 2021 compared to 2019. Mainly were affected fish farmers who marketed their production in the HoReCa sector. The impact was smaller for companies that marketed their products in retail. The Estonian government decided to implement the subsidies to compensate the decrease in sales of fish farmers, if sales decreased by more than 15% due to the pandemic.

4.8.6 Data Coverage and Data Quality

The data collection of freshwater aquaculture is not mandatory under the DCF and EU-MAP programmes of the EU data collection. Also the aquaculture production of Estonia is less than 1% of the Union aquaculture production volume and value. The analysis of the Estonian aquaculture sector is therefore based on data extracted from FAO.

4.9 Finland

Overview of Finnish aquaculture

In year 2020, the Finnish aquaculture industry produced 13.1 tonnes of fish and fry generating total turnover of €73.3 million. There were 160 main activity aquaculture enterprises covering marine and freshwater aquaculture. Industry employed 485 persons totaling 371 in FTEs. The year 2020 was very difficult for Finnish aquaculture sector. The sector made net loss of €7.4 million. There are big differences in performance of different segments inside the Finnish aquaculture sector. Losses of the recirculation systems segment makes whole Finnish aquaculture sectors performance appear negative.

4.9.1 Total Production and sales

In year 2020 Finnish aquaculture sector produced 13.1 tonnes of fish and fry and generated turnover of €73.3 million. Sales weight increased 4% whereas sales value decreased 4%. About 91% of the total production weight and 76% of the production value was generated by rainbow trout in 2020. European whitefish production is also important part of the Finnish food fish supply. European whitefish accounted for 14% of the production value and 5% of the total production weight in 2020. Together these two species accounted for 96% of production weight and 90% of production value of total fish farming in Finland.

The production of fry in fish farms consists mainly of rainbow trout fry for food fish farming. Fish farms produce also fry of Baltic salmon, landlocked salmon, brown trout, sea trout, char, brook trout and grayling. Hatcheries and nurseries segment generated 24% of the total turnover of the sector in 2020. There were 5 companies using RAS technology in 2020, which produced 1 500 tonnes of fish with a total income of €7.2 million.

4.9.2 Industry structure and total employment

In Finland in year 2020 there were 160 enterprises whose main economic activity was aquaculture. Decrease from the previous year was 5 enterprises. The sector employed 485 persons totaling 371 in FTEs. The sector is in general very concentrated. Most of the enterprises are micro enterprises and there were only 8 enterprises who employed more than 10 persons in year 2020.

Table 4.9.1 Production and sales, industry structure and employment for Finland: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**11.2**	**10.1**	**11.1**	**11.7**	**12.5**	**12.6**	**11.9**	**12.6**	**13.1**	4%	15%
Marine	6.0	5.5	4.3	5.2	9.0	9.0	8.2	8.9	8.7	-2%	36%
Freshwater	5.2	4.6	6.8	6.5	3.5	3.6	3.7	3.8	4.4	16%	-11%
Sales value (million €)	**28.2**	**56.6**	**53.6**	**59.7**	**69.6**	**84.0**	**78.9**	**76.5**	**73.3**	-4%	18%
Marine	21.8	26.6	12.4	20.2	40.3	51.0	48.0	47.7	40.3	-15%	34%
Freshwater	28.2	30.1	41.1	39.5	29.3	33.0	30.9	28.8	33.0	15%	-2%
Number of enterprises	**138**	**163**	**164**	**170**	**173**	**177**	**157**	**165**	**160**	-3%	-3%
Marine	42	33	16	19	28	28	29	32	28	-13%	1%
Freshwater	138	130	148	151	145	149	128	133	132	-1%	-6%
Employment	**387**	**473**	**430**	**515**	**495**	**512**	**453**	**473**	**485**	3%	2%
Marine	105	126	70	89	185	177	153	168	147	-13%	13%
Freshwater	282	347	360	426	310	335	300	305	338	11%	-2%
FTE	**300**	**367**	**339**	**329**	**341**	**350**	**320**	**320**	**370**	16%	8%
Marine	91	101	57	69	140	132	111	122	126	3%	26%
Freshwater	209	266	282	260	201	218	209	198	244	23%	0%

Source: own elaboration from EU Member States DCF data submission, 2022.

4.9.3 Overall Economic performance

Since 2014 the economic performance of the sector has been improving. In 2019, the upward trend turned again to be downward and in year 2020 the profitability of the industry decreased to its all-time low. In 2020, the total income of the sector was €73 million making losses of €6 million before interest and taxes (EBIT). Net profit of the industry was negative €-7.4 million. Total costs were €76.2 million exceeding the total income by €300 thousand. In 2020, the biggest operating costs were feed costs 35%, wages and salaries 17% and livestock costs 17% of the total operating costs.

Table 4.9.2 Economic performance of the Finnish aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Total income	85.6	81.5	78.3	75.8	-3%	-7%
Total operating costs	75.3	73.1	73.2	76.2	4%	3%
Total wages	14.8	13.2	14.0	15.0	7%	7%
Gross Value Added	25.1	21.6	19.1	14.7	-23%	-33%
Depreciation of capital	3.7	4.7	5.3	5.7	7%	24%
Earning before interest and taxes	6.5	3.8	-0.2	-6.0	-2946%	-278%
Financial costs, net	-3.8	1.5	1.5	1.4	-5%	573%
Net profit	10.3	2.3	-1.7	-7.4	-340%	-302%
Total value of assets	148.0	131.4	133.7	129.6	-3%	-6%
Capital productivity (%)	16.9	16.4	14.3	11.3	-21%	-29%
Return on Investment (%)	4.4	2.9	-0.1	-4.6	-3042%	-295%

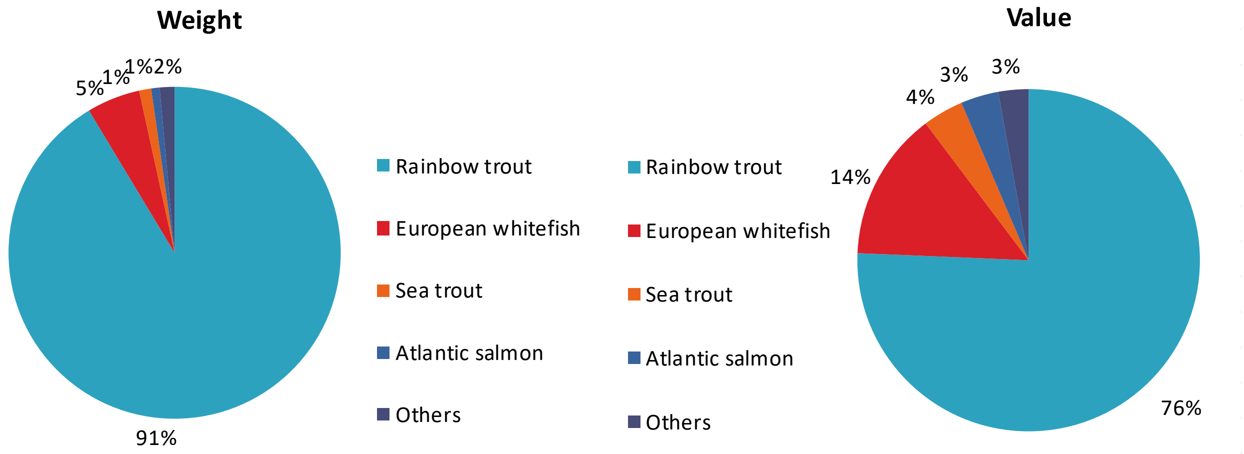
Source: own elaboration from EU Member States DCF data submission, 2022.

4.9.4 Main species produced and economic performance by segment

The food fish production consisted mainly of rainbow trout. 91% of the total production weight and 76% of the production value was generated by rainbow trout in 2020. Second largest specie in terms of production weight and production value was European whitefish accounting 5% of production weight and 14% of production value.

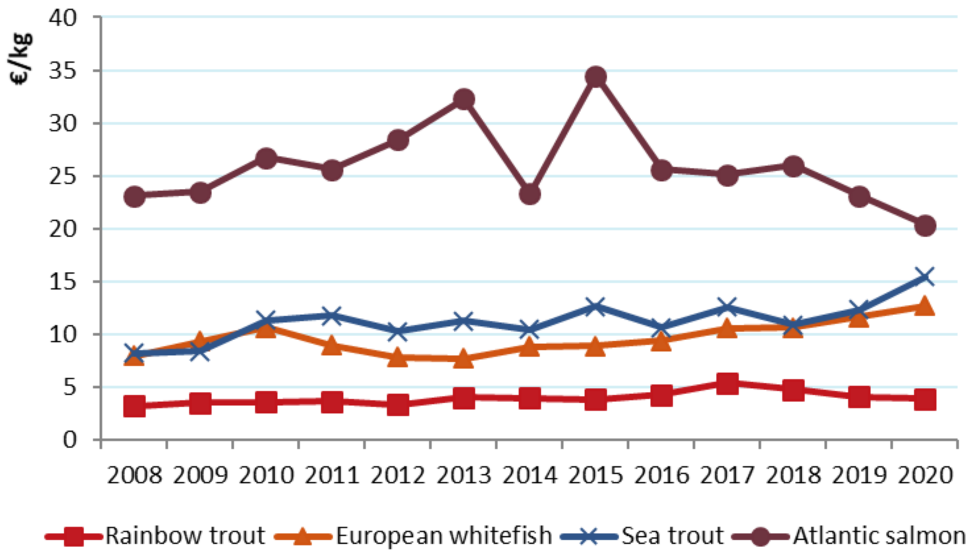
The production of fry in fish farms consists mainly of rainbow trout fry for food fish farming. Fish farms produce also fry of Baltic salmon, landlocked salmon, brown trout, sea trout and grayling. Hatcheries and nurseries segment generated 27% of the total turnover of the sector in 2020.

Figure 4.9.1 Main species in terms of weight and value in Finnish production: 2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Figure 4.9.2 Average prices €/kg for the main species produced in Finland: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Finnish aquaculture sector is divided in new EUMAP segmentation into 5 segments:

- Segment 1: Trout Cages;
- Segment 2: Trout Tanks and raceways;
- Segment 3: Trout Recirculation systems;
- Segment 4: Trout Hatcheries and nurseries;
- Segment 5: Other freshwater Fish Ponds;

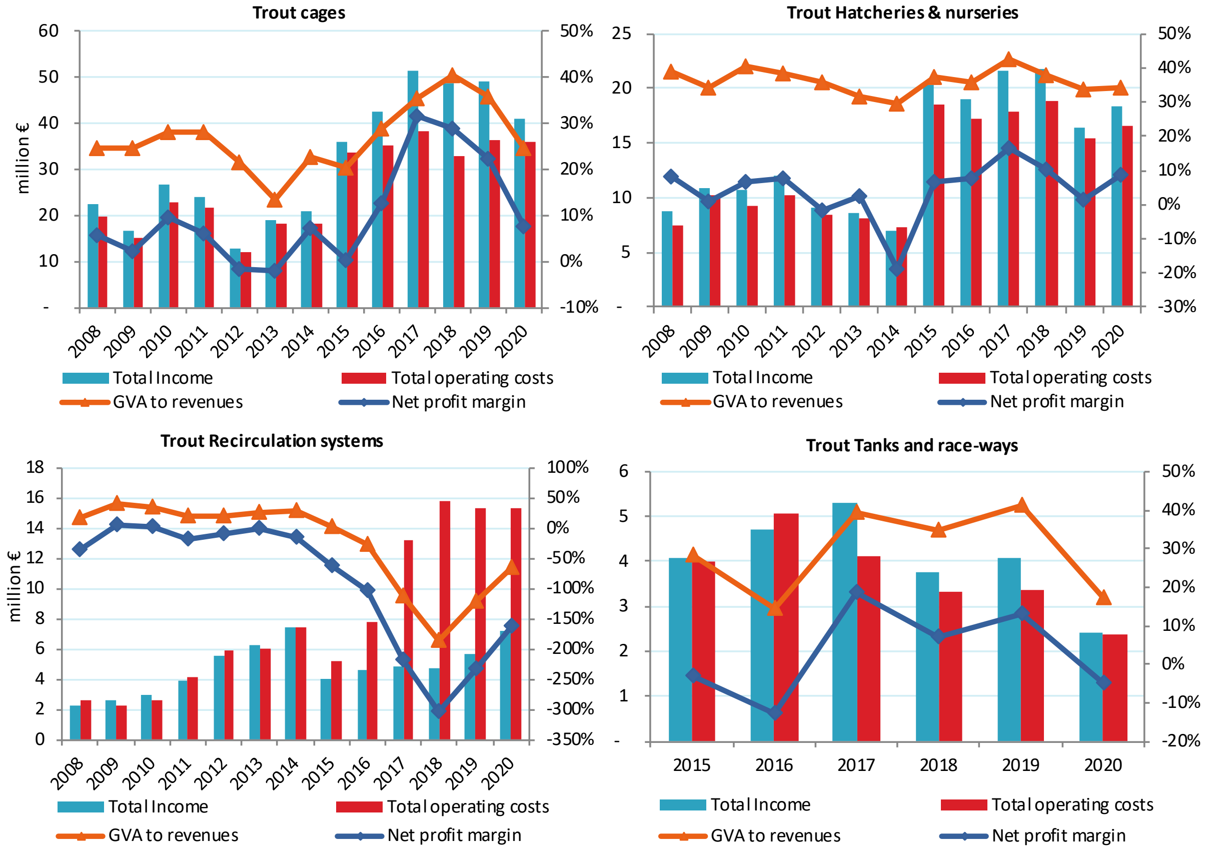
The most important farming method is the trout cage farming that covers marine rainbow trout and European whitefish production. Two other trout production methods are inland food fish production in tanks and raceways and Recirculation systems. Hatcheries and nurseries segment include also farms that have rainbow trout production. The last and least segment consists of natural food ponds that produce freshwater juveniles for restocking.

In the previous segmentation according to DCF, there was a segment of combined production of juveniles and food fish that was the biggest segment of the sector. These companies are allocated for 2015 onwards according to EUMAP based on main type of production. This has increased significantly the production and revenue of the Trout cage production and Hatcheries and nurseries segments compared to the results based on previous segmentation for 2008-2014. Fish ponds were included in hatcheries and nurseries until 2014.

Segment 1: Trout cage production

In year 2020 the most important segment in terms of production was marine production of rainbow trout and European whitefish in cages with total income of €41 million. The production consisted mostly of rainbow trout (8.4 thousand tonnes), but also 270 tonnes of European whitefish were produced. The gross value added decreased to €10.1 million while the segment made a net profit of €3.1 million in 2020. Although the net profit was lowest since 2015, the marine production in cages in by far the most profitable segment in the sector. Although the segment made a little profit, all economic indicators for the segment show significant decrease. The year 2020 was the most difficult year for the sector since 2015. Return on investment was 6.8% in year 2020.

Figure 4.9.3 Economic performance indicators (in € million) for the main Finnish segments: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Segment 2: Trout tanks and raceways

Trout tanks and raceways are traditional inland aquaculture production methods. In 2020, the segment produced 423 tonnes of rainbow trout and 47 tonnes of European whitefish. The total weight of sales declined by 26% from previous year and the total income decreased 41% to €2.4 million. After couple of profitable years, the segment made €-0.1 million loss in year 2020.

Segment 3: Recirculation systems

Recirculating aquaculture systems is a developing segment in Finland. While it is becoming more common type of production it still struggles to make production profitable. From the environmental point of view the recirculating systems are very potential type of production since the nutrient load for the environment can be easily managed and optimal culturing conditions can be maintained throughout the year.

There have been significant investments in recent years in RAS production. But the segment is still making big losses. The losses of the segment are large enough to make all aquaculture sector in Finland to make losses.

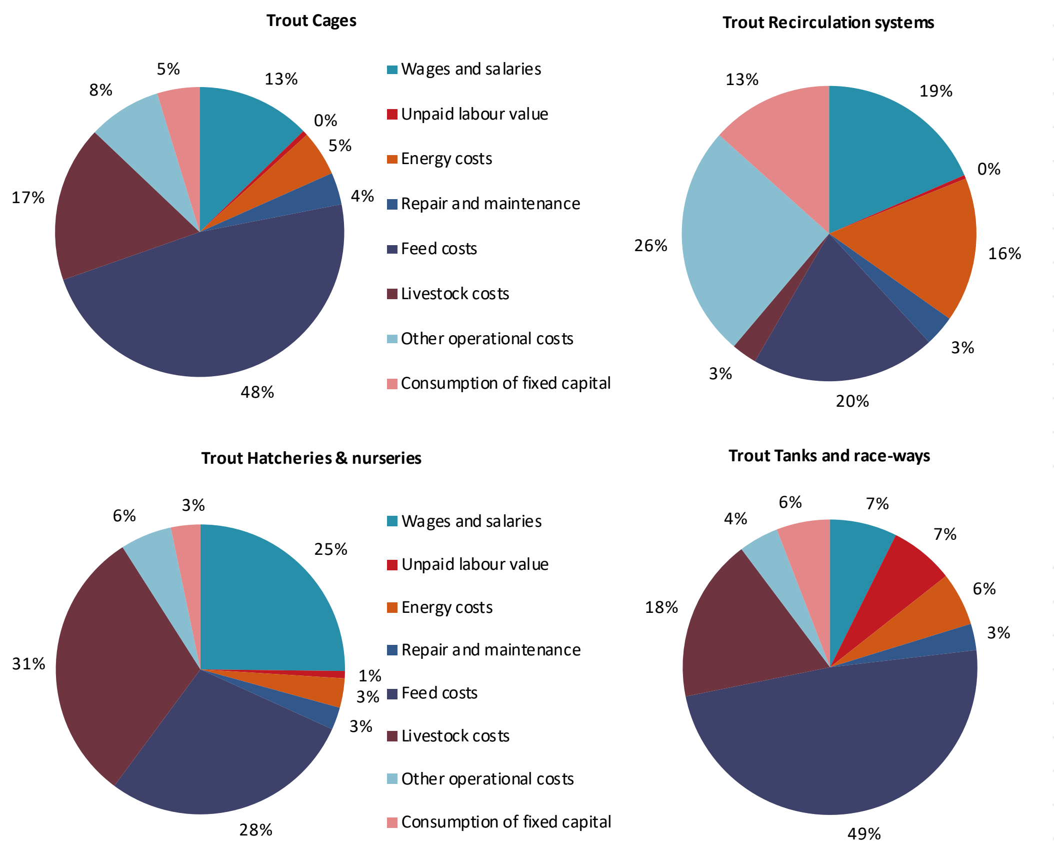
There were 5 enterprises in recirculation systems segment in year 2020 which produced 1.5 million tonnes of fish with a total income of €7.2 million. Total income of the segment decreased 27% compared to previous year. In the past five years the total income has nearly doubled. In year 2020 the total operating costs stayed on a same level as previous years. Although the performance of the segment looks a bit better compared to previous years it still made losses of €11.9 million.

Segment 4: Trout Hatcheries and nurseries

The total income of trout hatcheries and nurseries was €18.3 million in 2020 and there were 23 companies in operation. The production of fry in fish farms consists mainly of rainbow trout fry for food fish farming. Fish farms also produce Baltic salmon, landlocked salmon, brown trout, sea trout and grayling fry. Under the DCF the fish pond producers were included in hatcheries and nurseries segment, and reported separately in EU-MAP from 2015 onwards. Therefore, there is an apparent decline in the number of enterprises in 2016. In this segment, there are also enterprises with combined production of food fish. The total income of the segment in year 2020 was €18.3 million which was a 11% increase compared to previous year, but comparing it to years 2017 and 2018 there is over €3 million decrease. Operating costs increased 6% being €16.5 million. Net profit of the segment was €1.2 million.

The cost structures for the four Finnish aquaculture segments are presented in the Figure 4.9.4. Trout Cages and Trout Tanks and Race-ways have similar cost structures where feed costs is the largest cost item and livestock costs is the second largest. In Trout Hatcheries and Nurseries segment livestock costs is the largest cost item and feed costs is the second largest. In comparison to Trout cages and Trout Tanks and race ways wages and salaries cost item forms larger proportion of the total costs. The cost structure of the Trout recirculation segment is different compared to other segments. Proportions of the Energy costs and Other operational costs are much higher compared to other segments.

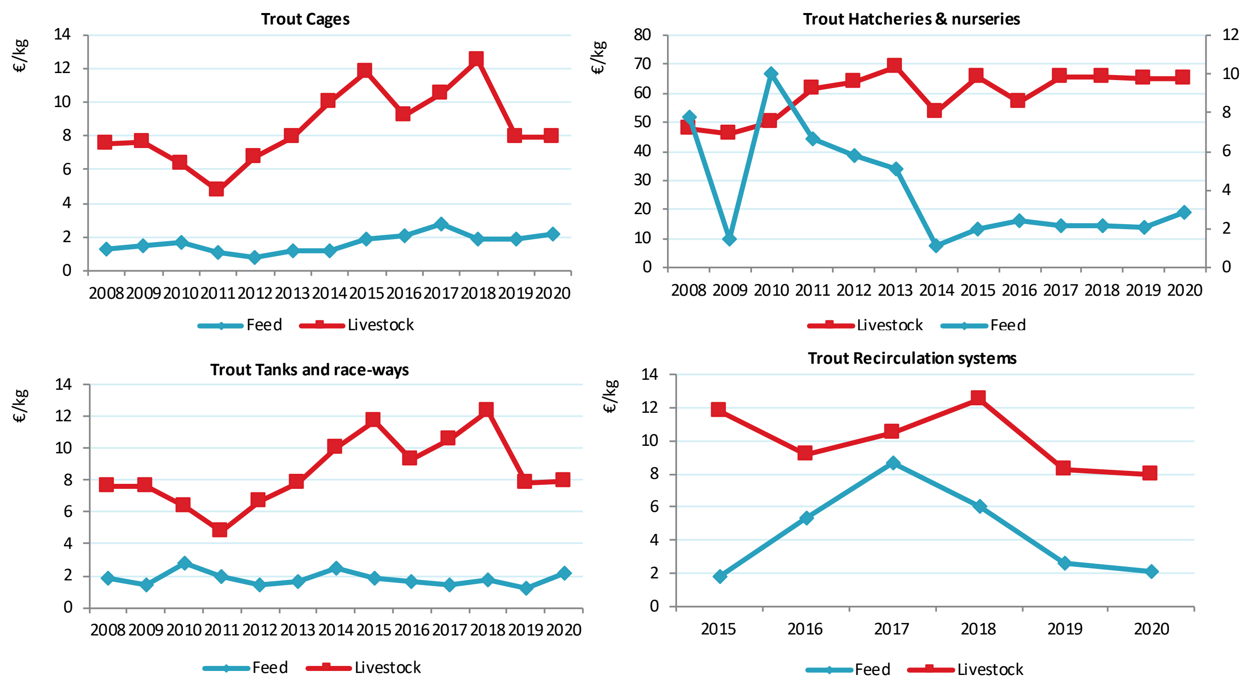
Figure 4.9.4 Cost structure of the main segments in Finland: 2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Figure 4.9.5 illustrates the development of average prices for feed and livestock. Time series for hatcheries and nurseries is affected by the segmentation change in 2015. Prior 2015 fish ponds were included in hatcheries and nurseries segment, and reported separately 2015 onwards.

Figure 4.9.5 Feed and livestock average prices €/kg for the main Finnish segments: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

4.9.5 Outlook

Nowcasts for 2021

All aquaculture companies, including both main-activity and secondary activity companies, produced approximately 14.4 thousand tonnes of food fish for sale in 2021, which was 700 tonnes less than in 2020. The production of rainbow trout was approximately 94% of the total production. The total value of fish produced for sale was €73.3 million.

Trends and triggers

The Finnish aquaculture sector is increasingly concentrated. About ten enterprises are constructing over half of the sectors turnover. The concentration benefits the sector from the benefits of mass production point of view but on the other hand it makes the industry vulnerable for example to different kind of viruses. In 2021 Infectious haematopoietic necrosis (IHN) was diagnosed at 5 fish establishments in Finland and corrective actions were needed and it had effects to the performance of the enterprises.

Prices have their obvious role for the sector. Performance of the sector is much dependent on the price of especially rainbow trout and salmon. Also feed costs are affecting on the performance.

The Finnish aquaculture sector has been strongly affected by the environmental permit policy. The environmental permits granted to fish farms practically determine the allowed volume of fish produced. The main reason for introducing the environmental permit mechanism has been the limiting nutrient loadings in the Baltic Sea.

For its part the restrictive environmental policy has restrained the aquaculture production and reduced the benefits from the economies of scale. Finland has a National spatial planning program that aims to concentrate the aquaculture production in marine areas into bigger production units and to direct the production in areas where the use of marine areas can be optimally accommodated. Transferring marine aquaculture production in big production units further offshore to the open sea has potential for increasing the production.

Because of low environmental impacts of recirculating fish farms, they are considered a good means of increasing Finnish food fish production and massive investments have been made in the technology in recent years. RAS fish farms produced approximately one 1500 tonnes of food fish, mainly rainbow trout in 2020.

The new governmental programme promoting domestic fish aims to ambitiously double fish consumption and domestic fish production in Finland by 2027. In order to achieve this, the domestic aquaculture production needs to expand. This can be achieved by taking advantage of the growth potential of new technologies (RAS, offshore/open sea farms and circular bioeconomy) while considering both the economic and environmental impacts.

COVID-19 impact

The Finnish aquaculture sector is mainly affected by the covid-19 through changes in the world markets of salmon. Together with decreased demand for fish by the restaurant businesses, lowering world market price for salmon and less continental flights, there was oversupply for salmon in 2020. This affected the price of farmed rainbow trout in Finland. Low prices for imported fish increased the imports of Norwegian salmon, while affected prices for farmed and wild fish.

High energy prices

Cost structures of the different segments in Finnish aquaculture sector are different and therefore the effects of the changes in energy prices are different too. Trout recirculation systems segment is by far the most energy intensive segment and therefore high energy prices effect to it the most. The segment is developing segment where investors have invested a lot and the rising energy prices are one more test for the investors trust. Other segments are in a verge of making profit or loss and high energy prices might turn then business into unprofitable.

4.9.6 Data Coverage and Data Quality

Data quality and availability

Economic EU data collection of aquaculture sector in Finland combines information from different data sources. Main sources are a production survey of Natural Resource Institute (Luke), structural business and financial statement statistics of Statistic Finland (SF) and account survey conducted by Natural Resource Institute. Financial statements were available for all firms in Statistical Business Register having aquaculture as the main activity.

Primary sources of financial statements data in Statistics Finland are direct inquiries and business taxation material supplemented by Business Register data. Data is based on corporate balance sheets and profit and loss account data. Statistics Finland checks for the validity of the data. Any missing data was estimated within stratum. Account data was surveyed by Natural Resource Institute by stratified survey to detect the detailed cost structure of fish farms. Cost and earnings estimates were done by design-based and model assisted regression and ratio estimation. The cost variables were estimated with ratio estimation from financial statements. A production survey was collected exhaustively from the producers. Any missing information was estimated by stratum.

The reference year of economic data collection is the preceding year. Preliminary financial statements data from Statistics Finland are available on the 4th quarter after the reference year. Data on production volume and value is available half a year after the reference year. Therefore, information of the economic situation of aquaculture sector is provided earliest one year after the period investigated.

Natural Resource Institute does not provide or publish any information about the financial statements or key indicators of individual companies. If there are less than five companies in a segment, they are clustered with other segments.

Other data issues or missing data

Natural Resources Institute Finland provides the data on aquaculture for Eurostat and the DCF, but differences in Eurostat and DCF data exist because of different data needs. Eurostat data include all aquaculture production in Finland, including also production of companies that are not main activity producers whereas DCF data includes only those companies that have aquaculture as their main economic activity. In addition, Eurostat data include only food fish production and no juvenile or fry production. Both fish produced for human consumption and fry are included in the DCF data.

4.10 France

Overview of French aquaculture

In 2020, the French aquaculture continues to be characterized by a better overall performance compared to the last five years. This trend will be confirmed in 2021 but must be nuanced according to the different French segments and the national and the international context.

Some species/segments are not included in the analysis in marine production (sea bass & sea bream hatcheries & nurseries, sea bass & sea bream cages, other marine fish on growing), in freshwater production (sturgeon (caviar) and species reared in ponds like carp, pike, pike perch, roach and burbot), in shellfish production (mussel raft, mussel long line, other shellfish long line), and in aquatic plant (macro algae, micro algae and spirulina).

4.10.1 Total Production and sales

The analyses in this chapter concern only 5 segments for which all economic data are available: Trout Tanks and Raceways (seg2.2), Mussel On-bottom (seg10.11), Oyster Rafts (seg11.9), Oyster On-bottom (seg11.11), Multispecies On-bottom (seg15.11).

With these 5 segments, French aquaculture sector represented 232 thousand tonnes of farmed product in 2020, which corresponded to an increase by 2.7% on the Olympic average 2016-2020 (225.7 thousand tonnes). The total value of production showed a very small decrease by 0.03% on the Olympic average 2016-2020 (€820.9 million) to €823.7 million in 2020 (table 4.10.1).

Table 4.10.1 Production and sales, industry structure and employment for France: 2016-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**238.2**	**203.0**	**205.0**	**180.3**	**180.5**	**188.5**	**187.1**	**195.8**	**191.0**	-2%	-3%
Marine	8.0	5.7	5.1	4.8	4.1	3.8	4.4	6.6	6.2	-6%	15%
Shellfish	186.8	153.3	159.6	135.6	131.8	140.7	144.1	148.2	144.0	-3%	-5%
Freshwater	43.5	44.0	40.4	39.9	44.6	44.0	38.5	41.0	40.8	0%	-1%
Sales value (million €)	**691.4**	**667.2**	**701.3**	**627.0**	**720.4**	**765.6**	**680.3**	**757.9**	**716.9**	-5%	4%
Marine	52.8	38.9	36.6	37.2	35.6	33.4	39.5	57.7	54.9	-5%	35%
Shellfish	501.5	491.6	547.1	462.2	538.3	578.5	497.7	543.5	508.5	-6%	-2%
Freshwater	137.1	136.6	117.7	127.5	146.5	153.6	143.2	156.7	153.5	-2%	14%

Source: EU Member States DCF data submission, 2022.

4.10.2 Industry structure and total employment

Even if the year 2020 is rather good, the shellfish sector and the freshwater sector have not experienced the same dynamics between 2019 and 2020. Indeed, the first sector has suffered a decline of 3% in volume and 9% in value between the two years. Conversely, the freshwater sector increased by 5% in volume and 1% in value over the same period.

In 2020, the total number of companies is 2 456, which represents a slight increase of 1% compared to 2019. However, this does not yet call into question the trend towards a decrease in the number of enterprises, given that this increase only concerns the number of shellfish enterprises (Table 4.10.2).

Employment in the French aquaculture sector reaches 16 269 persons for 9 219 full-time equivalents (FTE), in 2020. The shellfish sector accounts for 8 118 FTEs, or 88% of the total FTEs in the French aquaculture sector. Thus, an aquaculture enterprise employs an average of 3.8 FTE (3.7 FTE for a shellfish enterprise and 4.6 FTE for a freshwater enterprise). In both sectors, these are therefore mainly small enterprises.

Table 4.10.2 Economic performance of the French aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Number of enterprises	2,695	2,721	2,439	2,456	1%	-6%
Employment	15,187	15,249	17,186	16,269	-5%	2%
FTE	9,832	9,783	9,174	9,219	0%	-4%
Total income	854.5	909.8	943.2	908.3	-4%	1%
Total operating costs	652.4	695.7	708.3	682.3	-4%	0%
Total wages	223.8	247.6	265.8	259.0	-3%	5%
Gross Value Added	425.9	461.8	500.7	485.1	-3%	5%
Depreciation of capital	73.8	77.6	97.1	98.2	1%	19%
Earning before interest and taxes	128.3	136.6	137.8	127.8	-7%	-5%
Financial costs, net	14.1	18.1	16.8	10.3	-38%	-37%
Net profit	114.2	118.5	121.1	117.5	-3%	0%
Total value of assets	1144.1	1235.2	1486.4	1394.4	-6%	8%
Capital productivity (%)	37.2	37.4	33.7	34.8	3%	-4%
Return on Investment (%)	11.2	11.1	9.3	9.2	-1%	-13%

Source: own elaboration from EU Member States DCF data submission, 2022.

4.10.3 Overall Economic performance

For the 5 segments where all economic indicators are available, the weight of shellfish farming sector (83% of the total turnover) influenced widely the result of national economic performance. So, an average indicator can hide a disparity between different segments.

Total revenues and total operating costs were relatively stable between 2018 and 2020, reaching €908.3 million and €682.3 million (Table 4.10.2). Wages represent 38% of total operating costs. Compared to the average over the 2016-2019 period, salary costs increased by 8% and the cost item "capital depreciation" increased by 21%. Conversely, financial costs decreased by 39% (very low interest rates). Overall, the aquaculture sector achieved a positive net profit in 2020 of €117.5 million (13% of total revenues).

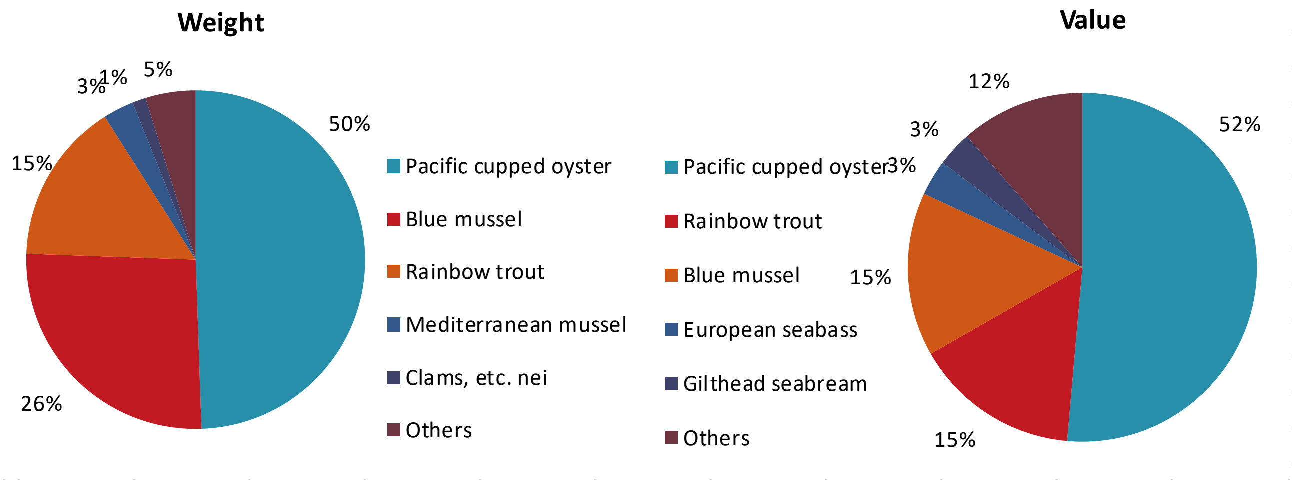
Despite the strong uncertainty on future production, subject to natural hazards, and after the COVID period which may have slowed down investment, professionals must continue to reinvest in order to renew their outdated equipment. This item has decreased significantly in 2020 (-25% compared to the reference period). As earnings before interest and taxes have decreased while total value of assets has increased, the return on Investment has decreased by 17% in 2020 over the 2016-2019 average.

4.10.4 Main species produced and economic performance by segment

The Pacific cupped oyster represents the largest share of French production with 55% of the total volume and 62% of the total value (Figure 4.10.1). Blue mussels and rainbow trout are the second and third most important species.

Since the volumes and values aggregate sales of juveniles or young adults sold to other aquaculture farms and adults sold for human consumption, the average price obtained should be considered a global indicator (Figure 4.10.2).

Figure 4.10.1 Main species in terms of weight and value in French production: 2018.



Source: EU Member States DCF data submission, 2022

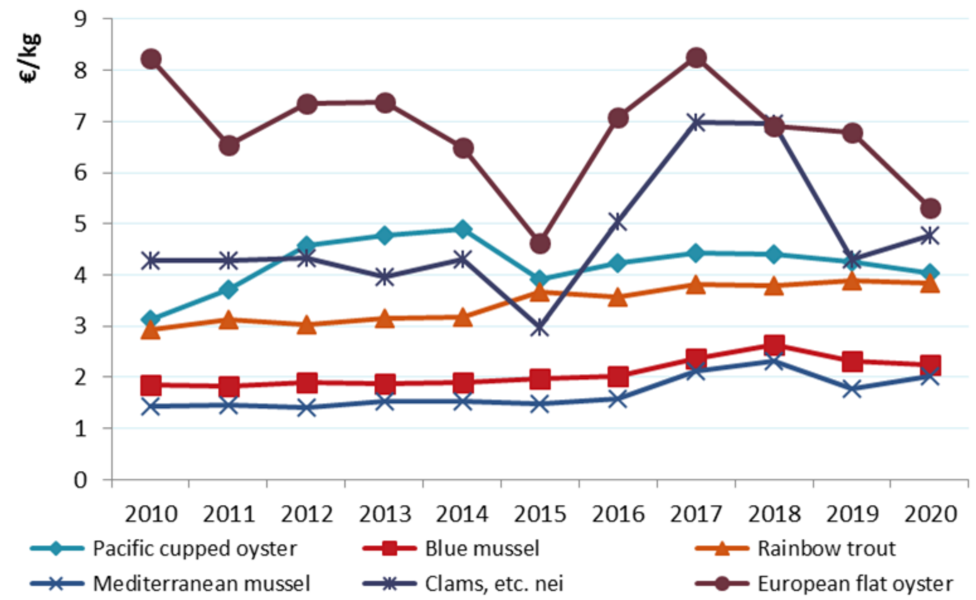
The Pacific oyster experienced a growth in valuation from 2016 to 2018 but a decline since 2019. Its selling price was €4.40/kg in 2018 but only €4.03/kg in 2020. This is partly due to higher production volumes in these years.

The price of rainbow trout has been growing slightly since 2016 with small fluctuations. However, we note a slight decline between 2019 and 2020. Indeed, its price goes from €3.90/kg to €3.85/kg. This is compensated by a higher production volume this year.

Blue and Mediterranean mussels are the least valued species with an average price of €2.31/kg and €1.96/kg over the period 2016 to 2020. Their prices are experiencing the same evolution and seem more fluctuating since 2016. It should be taken into consideration that the volumes of Mediterranean mussels have increased significantly since 2019.

The best valued species are flat oysters and clams with an average price of €6.87 and €5.61 over the period 2016-2020. As clam volumes have also increased since 2019, the price is falling over this period. The opposite is true for flat oysters.

Figure 4.10.2 Average prices €/kg for the main species produced in France: 2010-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Segment 1: Oyster bottom

This segment 'Oyster bottom' includes companies located on the Atlantic and Channel coasts which can be very heterogeneous (size, turnover, etc.), and have different strategies of production. From the supply of spat to the refining ("affinage") of oyster, these companies can focus on one stage of production (short cycle) or achieving the whole rearing cycle. Since 2008, the French oyster industry is facing mortalities of spat (shellfish less than one year) in pacific cupped oysters. To cope with these mortalities, several strategies have been implemented, which may explain the evolution of economic indicators since 2010.

In 2020, the segment consists of 1 511 enterprises and 5 871 FTE. The sales production volume was 116.1 thousand tonnes with a corresponding turnover of €515.3 million. The production volume accounts for 50% and the value accounts for 57% of the total French production.

In terms of workforce, the number of FTEs per company has been stable for the past 5 years at around 3.8 FTEs per company in 2020, while recruitment may prove increasingly difficult for companies

After 5 years of increase in the total value of assets, linked to the increase in the average size of companies, total value of assets has decreased in 2020 as well as net investment. The Gross Value Added (GVA) of EUR 260 million in 2020 is almost like 2018 and 2015 values after an increase in 2019.

Concerning the operational cost structures, Livestock is the main cost (25% of the total operating costs and depreciation of capital) as there are exchange of oysters between regions to improve shellfish growth, to supply adults to farmers specialized in "affinage" process. In 2020, wages and value of unpaid labour is a high cost (35% of the total costs).

In Table 4.10.3, the economic performance of the 4 main French segments is presented and is completed by the Figure 4.10.3 which shows a constant GVA per income in 2020 in line with previous years for the shellfish sector. For trout farms, the GVA decreased slightly in 2020 but remains at a very high level after a record year in 2019.

Segment 2: Mussel bottom

The second most important segment is the mussel bottom and consists of 278 firms and 1 138 FTE in 2020.

This segment is highly exposed to natural hazards and had to face different crises since 2010. Unfavourable weather has led to a production deficit and poor-quality mussels (2011, 2012). The deficit may also be due to a significant resurgence of predators (starfish, birds, spider crabs, etc.) in certain production areas (Channel and Atlantic coasts). Since 2014, high mussel mortality has been localised in the production areas located in the French western coast production areas (Pertuis Breton and Bourgneuf Bay). Mortalities have reached up to 100% on the long line for some professionals and 50-80% of the "bouchot" culture system. The causes of these mortalities are difficult to establish (pathological, environmental and physiological). Given the short cycle of the mussel, producers cannot reconstitute their stocks.

2020 is marked by an increase in total sales volume to 53.6 thousand tonnes (the first time since 2016) and total income (130.9 compared to 114.3 in 2019) despite the decline in the number of companies.

The Gross Value Added (GVA) in 2020 is similar to the 2014-2019 average at around €88 million, which makes it a highly profitable segment.

Concerning the operational cost structures, the most important operational cost items are wages and salaries and the imputed value of unpaid labour (38%). In the case of mussel farming, the supply of spat is exclusively from wild sources, so livestock costs are limited (8%) compared to other segments.

Segment 3: Multispecies On-bottom

This EUMAP segment corresponds to the previous DCF segment “Other shellfish Bottom” and includes companies that raise several species of shellfish (mainly oysters and mussels). Over time, the companies making up this segment can vary significantly since the indicator used to include them corresponds to a percentage of turnover (a species must not represent more than 60% of the company's total turnover).

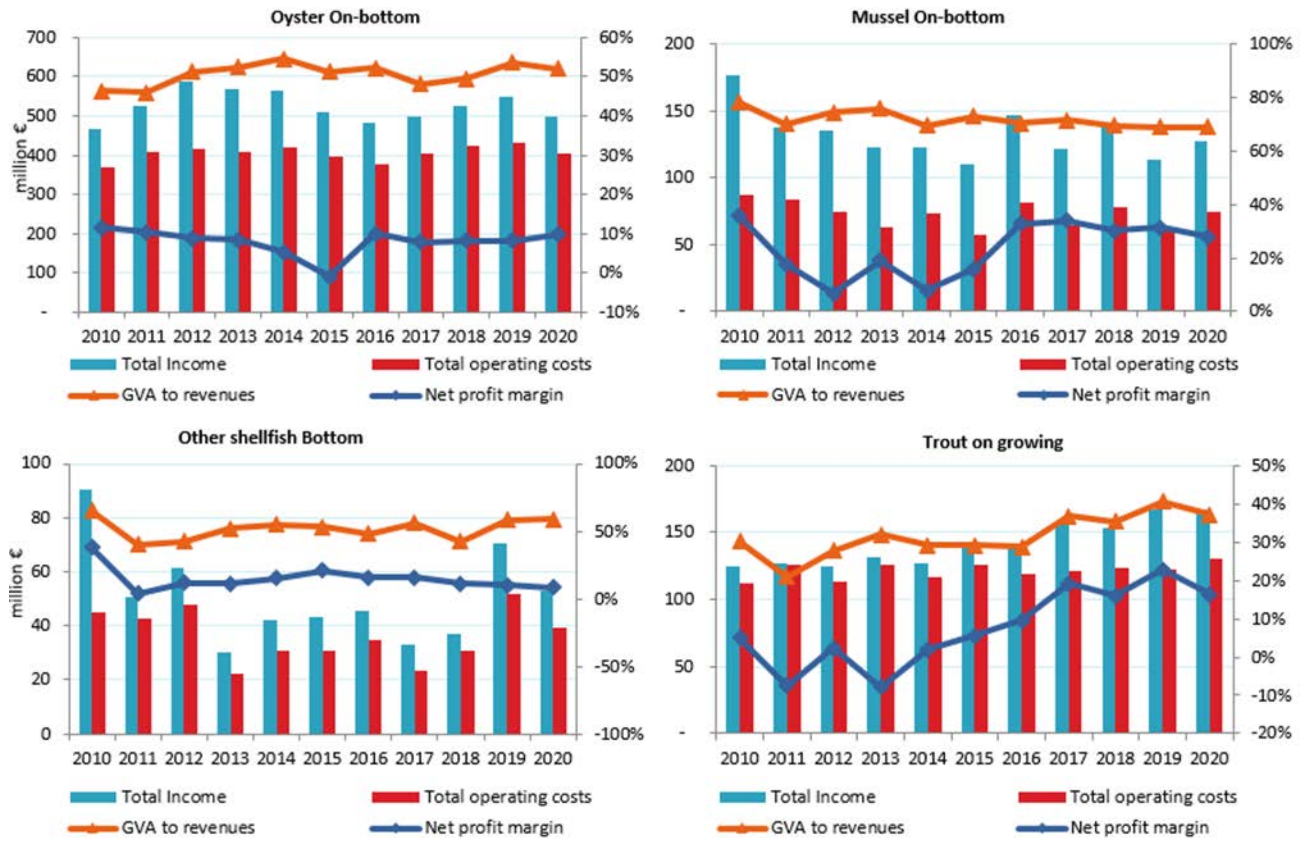
In 2020, Multispecies On-bottom segment is made up of 80 companies and 329 FTE which achieved a turnover of €53.2 million while it was €70.8 million in 2019. Thus, the strong heterogeneity of companies and its volatile composition does not allow a solid analysis of the evolution of the different indicators and results.

Table 4.10.3 Economic performance of main aquaculture segments: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Oyster On-bottom					**Mussel On-bottom**				
Number of enterprises	1667	1667	1535	1511	-2%	351	351	252	278	10%
FTE	6061	6061	5745	5871	2%	1322	1322	1015	1138	12%
Average wage (thousand €)	24.3	26.2	30.8	27.9	-9%	23.0	27.1	27.1	31.2	15%
Labour productivity (thousand €)	39.6	42.8	51.1	44.3	-13%	66.0	73.3	77.7	77.4	0%
Total sales volume (thousand tonnes)	106.8	111.3	121.5	116.1	-4%	48.4	49.6	47.3	53.6	13%
Total income (million €)	499.8	525.9	549.7	515.3	-6%	122.1	140.1	114.3	130.9	15%
Total operating costs (million €)	405.3	423.4	431.5	403.4	-6%	64.7	78.0	62.7	74.7	19%
Gross Value Added (million €)	240.0	259.2	293.4	260.2	-11%	87.3	97.0	78.8	88.0	12%
Net profit (million €)	39.0	42.7	44.6	48.2	8%	41.5	42.1	35.7	35.6	0%
Total value of assets (million €)	686.8	763.4	936.6	800.4	-15%	222.2	253.2	232.4	303.9	31%
Net investments (million €)	54.1	39.0	42.3	31.7	-25%	2.6	9.0	1.3	1.3	0%
Capital productivity (%)	34.9	34.0	31.3	32.5		39.3	38.3	33.9	29.0	
Return on Investment (%)	5.7	5.6	4.8	6.0		18.7	16.6	15.4	11.7	
Future Expectation Indicator (%)	1.0	-1.3	-2.2	-3.2		-4.8	-2.5	-4.9	-5.6	
	Multispecies On-bottom					**Trout Tanks and race-ways**				
Number of enterprises	61	61	84	80	-5%	324	327	327	313	-4%
FTE	319	319	433	329	-24%	1199	1150	1215	1102	-9%
Average wage (thousand €)	28.2	29.4	50.7	52.5	4%	18.7	21.1	19.5	23.9	23%
Labour productivity (thousand €)	58.0	49.1	95.2	95.0	0%	48.1	47.2	56.0	56.4	1%
Total sales volume (thousand tonnes)	7.7	7.5	20.1	14.0	-30%	37.8	37.4	38.0	40.0	5%
Total income (million €)	33.2	37.1	70.8	53.2	-25%	158.9	154.7	168.5	167.6	-1%
Total operating costs (million €)	23.5	30.8	51.5	39.0	-24%	121.7	123.6	122.9	130.8	6%
Gross Value Added (million €)	18.5	15.7	41.2	31.2	-24%	57.6	54.3	68.0	62.1	-9%
Net profit (million €)	5.1	4.1	7.1	4.4	-39%	30.0	24.4	38.1	27.2	-29%
Total value of assets (million €)	40.8	23.2	121.0	72.6	-40%	132.8	114.9	135.0	147.6	9%
Net investments (million €)	3.2	2.9	8.5	1.8	-79%	6.9	6.0	11.2	12.4	11%
Capital productivity (%)	45.3	67.5	34.1	43.0		43.4	47.3	50.4	42.1	
Return on Investment (%)	12.6	17.7	5.9	6.0		22.6	21.2	28.2	18.4	
Future Expectation Indicator (%)	-1.4	4.2	-1.9	-9.7		0.8	0.3	3.4	1.9	

Source: own elaboration from EU Member States DCF data submission, 2022

Figure 4.10.3 Economic performance in € million, indicators for the main French segments: 2010-2020.



Source: own elaboration from EU Member States DCF data submission, 2022

Segment 4: Trout tanks and raceways

This EUMAP segment aggregate the previous DCF segments “Trout on growing” and “trout combined”. This segment is 40 thousand tonnes bringing about a total income of €167.6 million. This segment accounts 313 enterprises for 1 102 FTE.

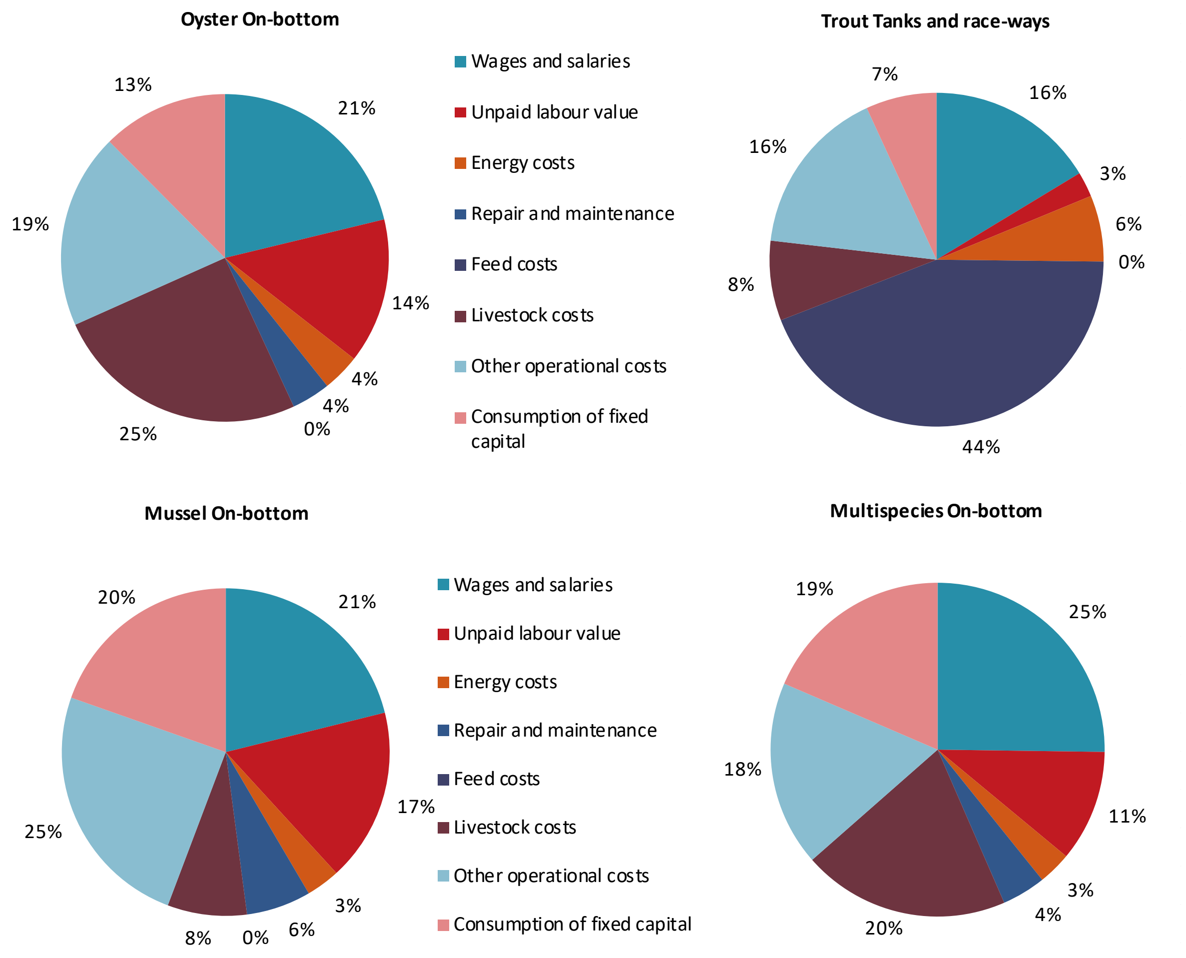
Since 2010, the economic situation in this segment had developed unfavourably. The turnover (-5%), sales volume (-38%), the total value of assets (-21%) and the total number of FTE (-12%) are decreasing between 2010 and 2016.

But since 2016, the economic performance of trout firms has been increasing. The evolution of main indicators are positive like as evidenced by the increase in total sales volume (+8% 2020/(Avg 2016-2019), gross value added (+13%). This change is due to an increase in the production of companies in connection with a dynamic market (sustained domestic demand in France) with rising prices.

As these farmers have to feed their juveniles, as well as the adults they raise for their own production, feed costs are also high (44% of total 'operational costs plus capital depreciation' in 2020). Livestock costs are around 10%. Wages and salaries are the second largest operational cost item.

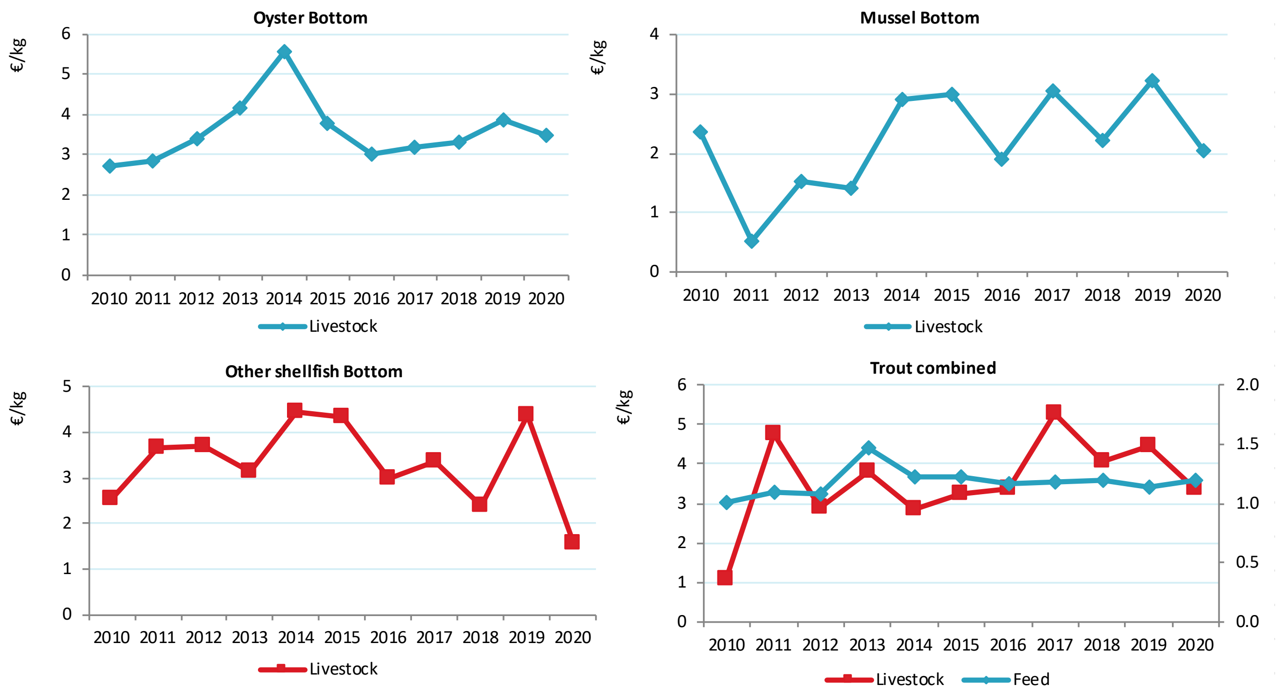
The operational cost structures for the four French segments are detailed below and in Table 4.10.4. While the costs of wages and imputed value are the most important expenditure items for shellfish enterprises, the main burden for trout enterprises is logically the feed cost.

Figure 4.10.4 Cost structure of the main segments in France: 2020.



Source: EU Member States DCF data submission, 2022

Figure 4.10.5 Feed and livestock average prices €/kg for the main French segments: 2010-2020.



Source: own elaboration from EU Member States DCF data submission, 2022

4.10.5 Outlook

Nowcasts for 2021-2022

Compared to 2020, the year 2021 is characterised by a stability in oyster and clam sectors, while the mussel sector faced an important predation by seagulls and seaspiders for a loss of 20% compared to the volume of products marketed in 2020. The number of enterprises in activity and the level of employment recovered slowly after the COVID period.

The year 2022 is very similar to 2021, with an accentuation of the mussel predation phenomenon which intensified and extended from the Channel to the Bay of Mont Saint-Michel. Employment is still on recovery (see below the sub-chapter 'COVID-19 impact).

Trends and triggers

Environmental hazards lead fluctuations of quantities and prices on the different markets. In a context of high uncertainty, the management of shellfish stocks and relations with the various customers (between shellfish farmers, with retailers or wholesalers, etc.) are at the heart of the companies' concerns.

The specific contamination by noroviruses in certain production areas (mainly South Brittany) has led professionals and health authorities to develop a specific management protocol which is giving good results. Work and tools for predicting this contamination are also underway, in conjunction with the major networks managing wastewater treatment plants.

Mass mortalities in the oyster segment is now stabilised to an average of 40% of loss on the initial quantity of spat immerged.

Predation by birds, sea-spiders, sea-stars, and sea-breme is affecting each year affect the mussel segment every year a little more, especially in the Channel and North Sea where the combination of seagulls and seaspiders create damage up to 30% of production loss. This trend should be monitored closely in the next report.

A totally Voltaic shellfish vessel, announced in the 2020 report, is now in the process of intensive testing by several professionals in southern Brittany, in a real production situation. It was developed as part of the EU post-COVID recovery fund. Another trial, on a larger scale and involving several ships, based on hydrogen, is under development in the Bay of Mont-Saint-Michel. It is developed within the framework of a call for innovative projects from EMFFA.

COVID-19 impact

The COVID forecast in the report 2020 announced a loss of 10% in production, all species combined: due to the strong resilience of the enterprises, the volume of production continues to recover a higher level between 2018 and 2019 and resist in 2020. The prices reached in 2019 a level that was previously reached in 2014. The concentration of the production in a reduced number of enterprises continues, but the employment suffered: the various confinements of the population have induced societal and behavioural changes, particularly among young people who have decided to change jobs and lifestyles. The recovery post-COVID is still ongoing but is remains difficult to re-attract young people in the coastal cities because of the low availability of housing at prices compatible with wages offered by shellfish enterprises.

High energy prices

The year 2021 is characterized by the energy impact due to the war between Russia and Ukraine. Direct impact is low, because the energy dependency in the charges structure is limited to 4% maximum among the various segments. Gasoil for vessels would not mainly impact the sector that don’t need an important volume of carburant. Electricity prices should also impact slowly by 2% of the total operating costs.

Indirect impacts should be limited in France: the Government sets up a mechanism that limits the price of electricity for people (maximum of increase limited to 20%). Another financial aid focuses on carburant prices subvention (20cent/litre until end 2022 when this report is written). So, the effects on shellfish enterprises workers should be limited as well.

General inflation could impact citizens and consumer’s budget. This could limit some consumption. However, oyster and clams’ sales, which are ‘festive’ seafood consumption only once a year, should not be affected. Mussels, which is a more often consumed seafood at a lower price, could be more affected by the consumer behaviour in the frame of the general inflation. This issue should be revised in the next report.

Social acceptance

The two main obstacles to the development of the shellfish farming in France are:

- Access to new space with a quality of water compatible with shellfish cultivation,
- Increased demand on the market for French shellfish.

These two points are closely linked to social acceptance:

- By the citizens, mainly those living on the coasts,
- By consumers, mainly those living in rural areas and cities onshore.

A few numbers of citizens are strongly opposed to the development of various activities at sea near the shoreline, not only to shellfish. Some of them are also opposed to offshore development. Two cases lodged in administrative Court of Justice have blocked for 10 years the attribution of new shellfish and algae concessions at sea in South Brittany and Charente Maritime, until the Council of

State ruled in cassation in favour of professionals recently. Only 17% of the French citizens consider the social, environmental or ethic impact of aquaculture is a problem to buy and consume seafood[25].

Professionals and their organizations, with the support of the State, are strongly committed to actions of information, awareness, communication towards the public and especially the younger generations to avoid this kind of unfounded obstruction, through the signature of a strategic document entitled "FUTURE AQUACULTURE PLAN"[26]. These actions are in addition eligible to EMFAF 2021-2027 granting in France[27].

4.10.6 Data Coverage and Data Quality

Data quality and availability

It is important to underline that the segments proposed at the European level include very heterogeneous French shellfish both in terms of their production (different techniques used) and their marketing (a multitude of outlets where the value of the shellfish in monetary terms can be very different). The interpretation of the results is therefore sometimes complicated. The sensitivity of farmer economic performance can be very different for the same contingency or, for example, in the face of the COVID crisis.

The planned sample rate is 15% overall (from 16% to 25%) and could be realised for the main segments. Some segments have been removed because of an achieved sampling rate low (e.g. mussel raft). The effort to consolidate the sample must be reinforce in the future.

In 2020, in the shellfish farms segments, the socioeconomic data of 376 enterprises segments was collected (274 in 2010) representing 19% of the population. The main segments had an appropriate sampling rate, giving a good precision.

The socioeconomic data of 63 enterprises in the trout segments was collected for year 2020, representing 20% of the population.

Decision to consider shellfish farms in "oyster" or "mussel" segments is based on the turnover ratio of one of these species group to the overall turnover; otherwise, the firm is included in "Multispecies On-bottom". This minimum ratio was fixed to 60% of the total turnover.

The economic indicators are available for 5 segments corresponding to 93% of the total turnover in 2020 and 92% of the total sold volume. Therefore, even if total data is presented for the whole French aquaculture sector, economic indicators have been calculated only using data for these main indicators where all economic data was available.

Other data issues or missing data

Some species/segments are not included in the analysis in marine production (Sea bass & Sea bream Hatcheries & nurseries, Sea bass & Sea bream cages, Other marine fish on growing), in freshwater production (species reared in ponds as carp, pike, pike perch, roach, burbot, etc.), in shellfish production (mussel Raft, mussel Long line, Other shellfish Long line), and in aquatic plant (macro and micro algae including spirulina).

[25] EU consumer habits regarding fishery and aquaculture products – EUROBAROMETER 2021.
[26] Plan d'aquacultures d'avenir : une nouvelle étape pour la filière aquacole française.
[27] Operative programme EMFFA France for 2021-2027.

4.11 Germany

Overview of German aquaculture

On-bottom production of blue mussel dominates the marine aquaculture in Germany. Due to extensive farming conditions, its harvest is highly dynamic and varies between less than 5 000 tonnes to more than 20 000 tonnes per year. Germany's freshwater aquaculture production oscillates around 19 000 tonnes (Destatis) per year. Main freshwater species are salmonids (trout and char) and common carp. Further, catfish and high value species like eel, sturgeon, crustaceans and pike perch are produced in recirculating systems (RAS). The latter group is considered in the total national volume above, but not in economic analyses in this chapter, due to limited data availability. If not indicated otherwise, the chapter only focuses on species for consumption, not for (re-)stocking.

4.11.1 Total Production and sales

Blue mussel (*Mytilus edulis*) production takes place in coastal areas of the southern and middle North Sea. The total sales volume of blue mussels comprised 22 000 tonnes in 2019 and about 12 000 tonnes in 2020. Gross sales reached about €42 million in 2019 and about €25.3 million in 2020 (Table 4.11.1). 2019 can be considered a very successful year in terms of sales volume. Nevertheless, the average price per kilo is quite low compared to 2018 and 2020. While prices for mussels reached a high level in 2020, the sales volume almost halved compared to the previous year.

In **freshwater cultures** salmonids (mainly rainbow (*Oncorhynchus mykiss*), brown (*Salmo trutta fario*), char (*Salvelinus fontinalis* and *Salvelinus alpinus × fontinalis*)) and common carp (*Cyprinus carpio*) are the most important species in German aquaculture. In 2019, about 15 100 tonnes of salmonids and carps were produced, creating a sales value of an estimated €67 million. In 2020, salmonids and carp farms produced slightly less, about 15 000 tonnes, but their estimated sales value reached €75 million (Table 4.11.1). There are further freshwater niche segments like catfish (*Clariidae* and *Siluridae*), eel (*Anguilla anguilla*), sturgeon (*Acipenseridae*) and other, mainly produced in RAS, which accounted for an additional 2 200 tonnes in 2020.

Table 4.11.1 Production and sales, industry structure and employment for Germany: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**44.0**	**40.7**	**26.4**	**26.0**	**41.8**	**36.0**	**34.2**	**40.7**	**32.2**	-21%	-9%
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	-100%
Shellfish	7.0	5.0	7.0	5.4	22.3	16.9	15.9	22.1	13.5	-39%	14%
Freshwater	37.0	35.7	19.3	20.7	19.5	19.0	18.3	18.6	18.7	0%	-20%
Sales value (million €)	**97.0**	**94.7**	**73.6**	**85.0**	**98.4**	**104.2**	**114.8**	**122.8**	**108.4**	-12%	16%
Marine	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0%	-100%
Shellfish	10.4	4.8	8.6	13.4	26.3	24.4	35.4	44.9	23.3	-48%	23%
Freshwater	86.5	89.8	64.9	71.5	72.2	79.8	79.4	77.9	85.1	9%	14%

Source: FAO, 2022.

4.11.2 Industry structure and total employment

The German aquaculture sector is small and highly diverse at the same time. Around 2 400 farms (> 0.3 ha or 200 m²) cultivate fish and seafood in Germany in fresh and marine waters. In total, around 1 800 people are employed at aquaculture facilities and it is assumed that an additional workforce of around 3 200 unpaid owners and family members are engaged here.

Blue mussel enterprises are located in the federal states of Lower-Saxony and Schleswig-Holstein holding production licenses given from the states. These licenses are valid for a restricted time. Mussel producers are obliged to form producer organisations according to Common Fisheries Policy (CFP). In consequence, the number of enterprises are stable around 9 producers. The mussel cultures in Schleswig-Holstein are much more productive and profitable than in Lower-Saxony for different reasons: better environmental frame conditions in the central North Sea on the one hand and negative impacts in the southern North Sea on the other hand. Mussel aquaculture in the Baltic Sea is only conducted on a very small scale and negligible for the overall sector in terms of the number of farms and production volume. Around 100-125 people work in the marine aquaculture in Germany in general, probably half of them in the mussel segment in particular. The statistic also includes employees from marine aquaculture research facilities.

Freshwater aquaculture in Germany is characterized by small salmonid and carp family businesses. These ~2 400 freshwater facilities often operate as additional income source and are run in part-time. According to a survey undertaken in 2020 almost 60% of the interviewed freshwater facilities (n=87) produced less than 5 tonnes per year. Only 1% of the farms had more than five employees. Overall, employment within salmonid and carp farms declined by almost 30%, from 1 691 registered employees in 2019 to 1 207 employees (FTE = 1 156) in 2020. However, the additional unpaid labour (family and owner workforce) plays a decisive role in salmonid and carp aquaculture. From a survey conducted in 2021 it can be inferred, that unpaid labour provides an additional 1 700 FTE in carp and salmonid segments. The degree of total input of unpaid labour in Germany's aquacultures might be even higher, if smaller enterprises, which have aquaculture as side business (less than 0.3 ha or 200 m²), would be considered.

Due to the high degree of unpaid labour in the sector, the number of employees is lower than the number of enterprises (Table 4.11.2).

Table 4.11.2 Structure and economic performance of the German aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Number of enterprises	2,899	2,754	2,642	2,403	-9%	-13%
Employment	5,633	5,496	5,366	4,543	-15%	-17%
FTE	3,135	3,082	3,019	2,923	-3%	-5%
Total income	113.9	137.5	114.9	105.4	-8%	-14%
Total operating costs	142.2	122.3	110.6	119.3	8%	-5%
Total wages	72.7	69.3	66.1	70.9	7%	2%
Gross Value Added	44.4	84.5	70.4	57.0	-19%	-14%
Depreciation of capital	7.6	7.0	7.2	5.2	-28%	-28%
Earning before interest and taxes	-35.9	8.3	-2.9	-19.2	-559%	-88%
Financial costs, net	1.4	0.7	0.7	0.9	30%	-2%
Net profit	-37.4	7.6	-3.6	-20.1	-457%	-81%
Total value of assets	156.1	137.7	309.6	279.2	-10%	39%
Capital productivity (%)	28.4	61.4	22.7	20.4	-10%	-46%
Return on Investment (%)	-23.0	6.0	-0.9	-6.9	-630%	-15%

Source: own elaboration from EU Member States DCF data submission, 2022.

4.11.3 Overall Economic performance

The **blue mussel** producers have experienced very good harvest for three years in a row, peaking in 2019 with an exceptional sales value of €42 million, mainly resulting from high volumes gained in Schleswig-Holstein waters. In 2020, sales volume dropped noticeably by 46% with prices for mussels increasing slightly (Table 4.11.1), which can be partly explained by the situation under COVID-19 (see also below). Regarding the fact, that blue mussel on-bottom production is highly fluctuating, these peaks of production are necessary to balance the weak economic period of the segment from 2008 to 2014, where overall production never exceeded the mark of 7 000 tonnes.

The decrease in **freshwater aquaculture** results from an ongoing concentration process, which affects small, traditional enterprises operating with carp or trout ponds first and foremost. Table 4.11.1 shows that between 2017 and 2020 the population of freshwater aquaculture farms has declined by 13%. This fact clearly illustrates the high economic pressure traditional freshwater segments face. Small-scaled farms have exited the market, due to unprofitability in mid-terms and/or the owner retiring without handing over the business to a successor. The relatively stable sales weight and sales value of freshwater farms show however, that these typically small-scaled traditional pond systems only provide a low input into the national production volume.

Beside this general trend, economic indicators should be interpreted with caution, as the German survey only started in 2017 and is still facing some shortcomings (cf. section Data Coverage and Data Quality).

4.11.4 Main species produced and economic performance by segment

Figure 4.11.1 shows the main species produced in the German aquaculture sector: Blue mussel (44% of total weight and 25% of total value), salmonids (38% of total weight and 58% of total value) and carp (18% of total weight and 17% of total value). While the blue mussel production is highly dynamic, partly depending on the availability of wild seed, salmonid and carp production is comparatively stable. The volumes of carp and salmonids combined make up more than 80% of the total freshwater fish production in Germany (Destatis, own calculations). In 2020, 10 500 tonnes of salmonids were produced, showing an increase of 100 tonnes to the previous year. Carp facilities produced 4 800 tonnes in 2020 (200 tonnes increase to 2019). In addition, 2 200 tonnes of other freshwater species were produced in 2020, 200 tonnes less than in 2019. Note the fact that high value species like eel are not considered in reported DCF data due to low volumes. They are mainly produced in RAS, which usually operate at a larger scale than the traditional pond facilities in Germany. For 2020, 8 RAS firms are listed for Germany (Destatis).

Figure 4.11.1 Main species in terms of weight and value in German production: 2020.

Source: FAO, 2022.

Blue mussels are produced in **on-bottom cultures (seg. 10.11)**. Seed mussel production plants are used to culture seed for stocking purposes and to supplement the livestock gained from fishing wild seed. The availability of seed is the crucial factor for the high fluctuation in production volumes of the segment. Due to a reduction in agricultural production grounds in Schleswig-Holstein, mussel fisheries had to adjust their systems, using seed mussel production plants. These new systems require increased efforts in terms of time and capital. Other factors like ocean dumping from the rivers Elbe, Weser and Ems *et al.* and harbours, closing fishing areas, storms and the ongoing expansion of the pacific oyster (*Crassostrea gigas*) can further affect the availability of mussel seed and later the culture itself. On-bottom cultures in Lower-Saxony tend to be more affected by the above-mentioned impacts than cultures in Schleswig-Holstein.

Table 4.11.3 Economic performance of main German aquaculture segments: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Mussel Other					**Trout Tanks and race-ways**				
Number of enterprises	8	8	9	9	0%	169	160	151	141	-7%
FTE	113	122	132	115	-13%	424	413	400	458	15%
Average wage (thousand €)	48.2	44.5	30.0	37.3	24%	28.8	31.2	31.7	32.5	2%
Labour productivity (thousand €)	84.8	143.7	253.9	147.8	-42%	60.3	85.1	49.0	53.0	8%
Total sales volume (thousand tonnes)	18.6	15.9	22.0	12.0	-46%	7.4	7.1	7.2	7.0	-3%
Total income (million €)	25.5	32.5	42.3	25.4	-40%	45.7	52.4	35.6	40.2	13%
Total operating costs (million €)	21.4	20.4	12.8	12.7	-1%	32.4	30.2	28.6	30.7	7%
Gross Value Added (million €)	9.6	17.5	33.5	17.0	-49%	25.6	35.2	19.6	24.3	24%
Net profit (million €)	2.2	10.4	27.8	11.0	-60%	10.3	19.8	4.7	8.4	79%
Total value of assets (million €)	45.9	18.0	111.7	84.6	-24%	48.6	14.2	27.4	37.2	36%
Net investments (million €)	9.0	0.5	8.5	9.5	12%	5.1	5.3	3.4	1.2	-66%
Capital productivity (%)	20.9	97.3	30.0	20.1		52.7	248.0	71.5	65.4	
Return on Investment (%)	4.9	57.6	24.8	13.0		21.2	140.0	17.0	22.5	
Future Expectation Indicator (%)	15.5	-6.7	6.0	9.3		5.7	22.9	4.9	1.4	
	Trout Ponds					**Carp Ponds**				
Number of enterprises	919	869	826	770	-7%	1803	1717	1656	1483	-10%
FTE	1288	1258	1223	1041	-15%	1310	1289	1264	1309	4%
Average wage (thousand €)	26.7	23.8	24.3	31.5	30%	15.8	16.3	15.6	14.5	-7%
Labour productivity (thousand €)	0.3	15.3	5.9	6.6	12%	5.5	6.0	5.8	4.1	-29%
Total sales volume (thousand tonnes)	3.4	3.2	3.2	3.2	-3%	5.6	4.7	4.6	4.8	3%
Total income (million €)	21.2	32.5	16.1	18.5	15%	21.4	19.8	20.9	21.2	1%
Total operating costs (million €)	55.2	43.1	38.5	44.5	16%	33.3	33.0	30.7	31.4	2%
Gross Value Added (million €)	0.3	19.3	7.2	6.9	-5%	7.2	7.8	7.3	5.3	-27%
Net profit (million €)	-36.1	-12.7	-24.8	-26.9	-9%	-13.8	-14.7	-11.3	-12.5	-11%
Total value of assets (million €)	15.7	9.9	16.2	16.8	4%	45.9	25.3	154.3	140.7	-9%
Net investments (million €)	0.8	2.2	0.8	0.3	-59%	1.2	2.9	15.3	11.5	-25%
Capital productivity (%)	2.2	193.9	44.4	40.8		15.7	30.7	4.7	3.8	
Return on Investment (%)	-229.3	-127.3	-152.6	-159.7		-30.1	-58.4	-7.3	-8.9	
Future Expectation Indicator (%)	-6.6	4.2	-7.5	-3.1		-0.7	5.7	9.0	6.7	

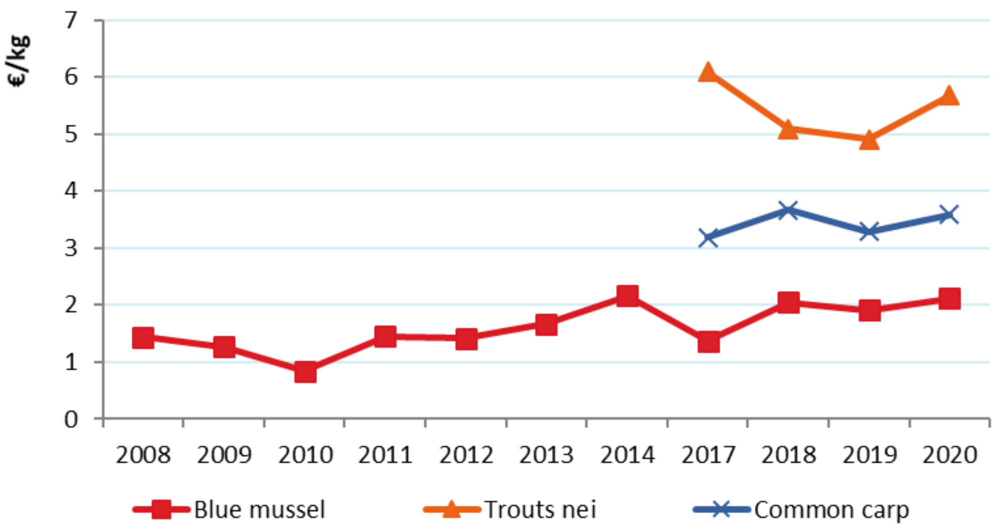
Source: own elaboration from EU Member States DCF data submission, 2022

Salmonids are produced traditionally in **trout ponds (seg. 2.1)**. It is assumed that the majority of farms (about 770 facilities in 2020) can still be classified within this segment. Trout ponds made up around 3 160 tonnes of salmonid sales weight and €18.5 million of total income in 2020 (table 4.11.3). Consisting only of approximately 150 facilities, the **trout tanks and raceways segment (seg. 2.2)** is much more productive. In 2020, they produced more than 7 000 tonnes of salmonids, which corresponds to nearly 70% of the total German salmonid production. The total income from this more mechanised segment was around €40 million (Table 4.11.3). Only very few enterprises use partly recirculating systems based on the example of Danish Model Farms. These farms are also classified as trout tanks and raceways, due to their small number. For German standards, these systems are relatively large and often produce more than 100 tonnes per year. Consequently, these few enterprises have a significant impact on the total quantities.

Carp ponds (seg. 4.1): Nearly all carp production systems in Germany are earthen ponds and polycultures. Traditional secondary species in carp ponds are sturgeon (*Acipenser ruthenus*), tench (*Tinca tinca*), pike (*Esox lucius*), perch (*Perca fluviatilis*), European catfish (*Silurus glanis*) and pike perch (*Sander lucioperca*). The volume of these species is not reported in detail in the statistics, but should amount to an additional 10% of the total carp production. Carp ponds produced 4 788 tonnes of sales in 2020, creating a total income of €17.8 million (Table 4.11.3).

German **blue mussel** enterprises are price takers in the European market. They sell their mussels either directly to Dutch wholesalers or indirectly via the central mussel auction in Yerseke in the Netherlands. The price highly depends on the quality of the mussel harvest. There are different quality classes at the blue mussel market. The bigger, the higher the flesh proportion and the brighter the flesh colour, the higher the quality class and the price payed. The quality of mussels depends on environmental conditions and faced impacts in the extensive on-bottom culture. The highest quality is distributed to the gastronomy, where Belgium, the Netherlands and France are important markets for German blue mussels. The lowest quality is distributed to discounters and can gain as little as a third of the price. In 2019, German mussel producers continued to benefit from high mortality and slowed growth of Dutch blue mussel cultures (southern North Sea), which resulted in a decreased overall supply and high prices for German blue mussels, with an average price of about €1.90 per kg (€0.10 lower that the year before). Even with a challenging situation of the sales market, due to the COVID-19 pandemic, in 2020 the price per kilo increased to €2.10 (Fig 4.11.2). This can be ascribed to lucky timing of the gastronomies re-opening coinciding with harvest season, very good quality of mussels and little competition on the market.

Figure 4.11.2 Average prices €/kg for the main species produced in Germany: 2008-2020.

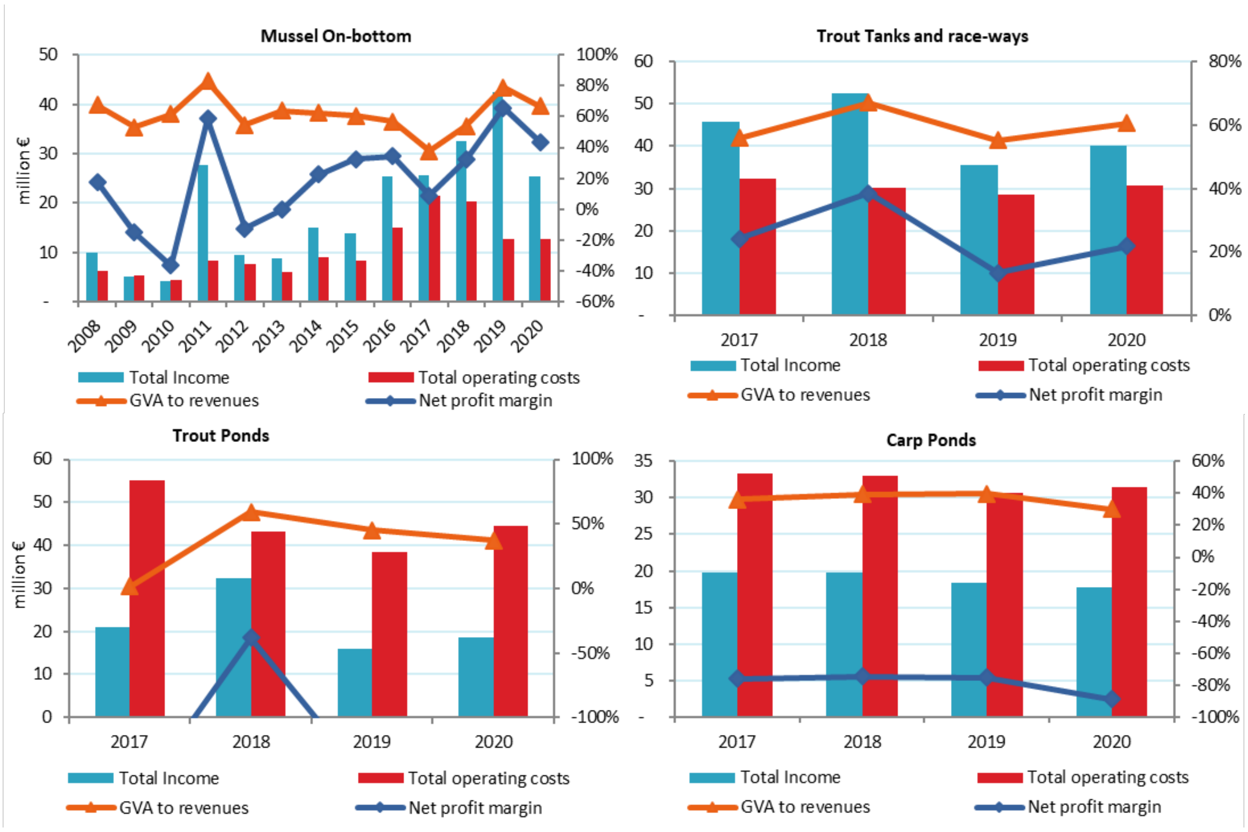


Source: own elaboration from EU Member States DCF data submission, 2022.

The prices for freshwater species strongly vary according to species, region and final product (fresh, chilled, frozen, smoked, etc.). For the majority of small-scaled **trout pond** farms direct-sales to the consumer are very important and generate the highest value. Here, point of sales are farmer markets and farm shops. Trout farms, which are classified to the **trout tanks and raceway segment**, often also have direct marketing integrated in their business models, but provide markets for fingerlings and stocking as well as fish for processing (smokeries). The retail market is not attractive for German trout entrepreneurs, because of comparably low prices and restrictions imposed by supermarkets. Notwithstanding, there is a price transmission from trout imports observed, mainly from Denmark and Turkey to domestic trout commodities, which are offered in the supermarkets. In consequence, imports from these countries indirectly influence the price development, at least on wholesale level. A mixed calculation between different sales channels, different salmonid species and the above described impacts on price development led to average trout prices between €4.90 per kg and €6.10 per kg (Fig 4.11.2).

For **carp pond** farms, carp imports from Czech Republic and Poland have a huge impact on the price development. Of course, direct marketing also plays a role here, but wholesalers have a significant market power purchasing in usual years about 50% of the total sales volumes. Another quarter of sales volume is distributed for stocking to angling clubs or other fish farms (including secondary species). The sales to restaurants and other retailers accounts for approximately 20%. In 2020, the distribution between different sale channels was shifted towards a higher share of direct marketing (see also chapter on COVID-19). Wholesaler price was €2.24 per kg, whereas direct marketing can yield prices between €4.00-12.00 per kg (Brämick and Schiewe 2020). Between 2017 and 2020 mean prices ranged from €3.20 to 3.70 per kg (survey among freshwater producers Germany).

Figure 4.11.3 Economic performance in € million, indicators for the main German segments: 2017-2020.

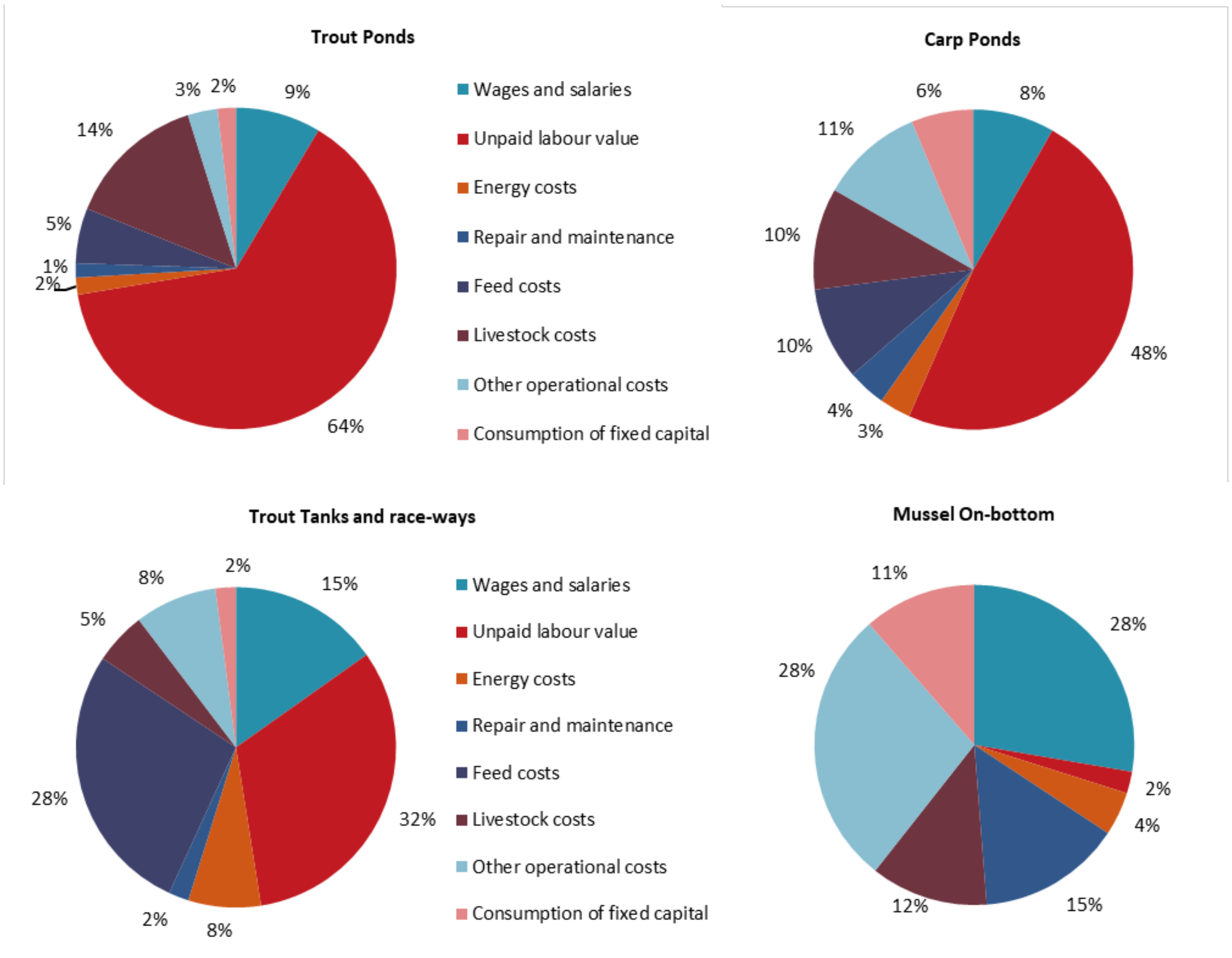


Source: own elaboration from EU Member States DCF data submission

While Mussel enterprises at least in Schleswig-Holstein and modern trout tank and raceways farms had positive net profit margins since 2017 (Fig. 4.11.3), the economic indicators in Table 4.11.3 clearly illustrate the structural change and economic pressure, which is put on traditional pond farms in salmonid and carp culture. Another indicator of a critical economic situation for a part of the sector is the decreasing number of farms. However, the relative decrease in Table 4.11.3 among the segments is misleading due to methodical reasons. Trout farms were allocated via a fixed allocation formula towards the segments trout ponds or trout tanks and raceways. In fact, the last segment is definitely not as harmed by termination of businesses as the first.

The main cost positions in the **blue mussel on-bottom segment** are fuel for the mussel vessel, wages and the purchase of imported mussel seeds (Fig. 4.11.4). Mussel seeds are gained from imports, wild catch and long-line systems. The last two are integrated in the operating costs of mussel enterprises. In a mean, the cost or effort for blue mussel seed received from imports is €0.60 per kg, from fisheries (wild catch) is €0.25 per kg and from longlines is €0.80 per kg. In years with a good catch of wild mussel seed, imports are low and vice versa.

Figure 4.11.1 Cost structure of the main segments in Germany: 2020.



Source: EU Member States DCF data submission, 2022.

As traditional extensive or semi-intensive segments, **trout and carp ponds** have a huge need of work force, which is mainly covered by unpaid labour provided by the owner himself/herself and members of his/her family. If this unpaid labour value is not considered, which is often the case in contribution margin calculations, looking at trout ponds, the costs for fry and fingerlings (livestock) are the most important ones. The reason is that small scale farms usually do not run their own hatcheries. The cost for livestock is followed by wages and salary and feed costs in third place. Carp feeds on natural food resources available in the ponds (plankton) as well as grain, which is provided as supplement by the farmers. Only large carp farms feed their stocks with compound fish feed to optimize growth rates. Average feed costs per kg produced carp were at €0.66 in 2020. Farms of the segment **trout tanks and raceways** tend to be larger scaled and more automated, on average labour costs are lower and feed costs make up almost 30% of total costs (in modern farms feed costs can have a share of more than 40%). Trout feed for grow-out production does not differ between ponds and tank/raceways and costs around 1 €/kg fish produced. However, overall feed cost for trout production in tanks and raceways is often higher per kg fish as the more expensive feed for fry and fingerling is included (average cost of feed is €1.22 per kg in 2020). Energy costs, mostly in form of oxygen is also an important part of the cost structure in salmonid farms. The low cost for livestock is caused by the fact, that farms of this segment are mostly vertically integrated. Hatchery, nursery, grow-out and (sometimes) processing are part of the farm. The effort invested into the production of own eggs, fry and fingerling is already considered in the other operational costs.

4.11.5 Outlook

Nowcasts for 2021-22

In 2021, 2 212 freshwater aquaculture facilities produced 18 246 tonnes of salmonids, carp and other freshwater species, while mussel enterprises report a production of 10 308 tonnes in 2021. 2 127 people were employed in the marine and freshwater aquaculture sector in 2021 and it can be assumed that the amount of unpaid labour, owners and family labour, is similar to 2020 with a slight decreasing trend (cf. Trends and Triggers).

Trends and triggers

- **Mussel seed:** The majority of blue mussel producers culture mussel seed with seed collectors, where natural seed finds optimal growing conditions. However, the technique is still very cost intensive compared to wild caught or the resettlement of wild cultures of young mussels from neighboring coastal areas (imports) and the technique is not exhaustively developed yet. 2020 was the first year to harvest mussels derived exclusively from mussel seed collectors in Schleswig-Holstein. Compared to 2016-2019, landings in 2020 and 2021 (SH) show reduced production. Difficulties include the identification of suitable locations for the seed collectors as well as the best time of harvest.
- **External impacts in the North Sea:** Blue mussel producers in Lower-Saxony operating in the southern North Sea suffer from climate change impacts (e.g. increased frequency of storms), increased relocation of sediments from river dredging; harbor maintenance, construction work for new offshore wind parks and the ongoing expansion of the pacific oyster (*Crassostrea gigas*) in particular. In contrast, blue mussel producers in Schleswig-Holstein located at the middle North-Sea profit from struggling competitors in the South North Sea (Lower-Saxony and Netherlands).
- **Climate change impact on-shore:** Shortage of water supply and increased water temperatures put continuous economic pressure on freshwater fish producers, with carp producers being especially dependent on weather conditions. A very dry and hot summer in 2018 was followed by another very warm year, enhancing water shortage in 2019. 2020 was a comparably more humid year. In general, new investments (e.g. pump systems, additional aeration, fish stables) will be necessary to adapt accordingly.
- **Concentration process**: Ongoing trend of decreasing number of farms. In particular, small-scaled farms have exited the market in the last decade. In contrast, the overall production does only slightly decrease, which infers that the sector get more concentrated (Destatis).
- **Investment backlog**: Small farms are much less able to arrange needed investments in up-to-date techniques to meet current challenges (e.g. climate change impact, lack of successors).
- **Predators**: In particular, carp farms suffer from fish loss due to protected wild fish predators like cormorant or otter. In addition, beaver damages can cause high additional costs for maintenance of production systems.
- **Diseases**: Over the last years increasing cases of Infectious Hematopoietic Necrosis (IHN) were detected in the trout-producing sector (mainly south of Germany), explaining also part of the reduced trout production.

- **Gender-gap**: Only a small share of farm owners is female (own survey 2020 n=84: 5%, own survey 2018 n=104: 8%). In contrast, 54% of all workforce is female in Germany's industries and services (Destatis, 2021).
- **Lack of successors**: In particular, small traditional farms struggle in finding a successor.
- **Direct marketing**: Closed restaurants and restrictions in trade due to the COVID-19 pandemic increased demand for direct marketing. But, this increase of direct marketing could not balance the overall negative economic impacts of the pandemic (decreased demand from gastronomy, cf. COVID-19 impact).

COVID-19 impact

German **blue mussel** firms could profit from very high prices in the third and fourth quarter of 2020, resulting from a demand surplus at the end of the year, which led to increased turnovers. However, part of the mussel producers also reported a decline in turnover and those with a surplus did not prepare the total harvest 2019/2020 for sale in the second half of 2020 in spring as usual (southern part of the North Sea). In spring, the pandemic situation was highly alarming. Gastronomy was closed, the mussel auction in Yerseke was closed, logistics were disturbed, mussel vessels could not ensure hygienic regulations such as social distancing on board and therefore stayed at port. In consequence, a significant part of mussels was not shifted from winter on-bottom storage cultures to shallow sale storage cultures, where ready-for-sale mussels usually get a final growth boost. Blue mussels that remain on the winter storage cultures are more exposed to e.g. winter storms. The described impacts affected the mussel firms in Lower-Saxony more than the ones in Schleswig-Holstein, which could sell their harvest earlier in the first quarter of 2020 due to better environmental conditions (for full results for 2020 please see Huber and Lasner, 2022, German Aquaculture under Covid-19 – Impacts of the pandemic on the sector during 2020. Aquatic Living Resources, in press). Mussel production in 2021 was indeed very low for Lower Saxony and amongst other reasons the exposure to storms might have contributed to this fact.

Survey results from autumn 2020 revealed that a substantial share of interviewed **freshwater aquaculture** farms (n=95) reported decreased sales and turnover for 2020. Thereby 44% of the surveyed salmonid producers and 53% of the carp producers reported sales losses. Salmonid aquacultures (angling ponds as additional enterprise included) were able to increase their sales more often than carp farms (22% of salmonid farms; 6% of the carp farmers). New regional adaptation strategies like "carp-to-go" were investigated. These initiatives have created alternative sales channels while the gastronomy was forced to close during the important Easter season. Further, the prices for carp in the winter sale season (Christmas sale peak) were unusually high, because of a demand surplus mainly caused by disturbed imports from Czech Republic and Poland. However, both facts could not balance the overall loss of the carp branch. Finally, around 41%of carp and 34% salmonid farmers did not experience any impacts on their business by the pandemic.

A dominating majority (78%) of all interviewed farmers in Germany from freshwater and blue mussel aquaculture (n=100) agreed, that the pandemic of Covid-19 is not the most important challenge for aquaculture (cf. trends and triggers) (for full results for 2020 please see Huber and Lasner, 2022, German Aquaculture under Covid-19 – Impacts of the pandemic on the sector during 2020. Aquatic Living Resources, in press).

The subsequent survey in autumn 2021 (n= 84 including valid answers from 31 companies that were part of the 2020 survey) revealed that part of the losses in 2020, described above, could be balanced by the end of the (economic) year: 58% reported a more positive development, whereas a quarter stated even more severe losses than reported the year before. In comparison, the effects of COVID-19 on turnover over the timespan 2020-2021 was more positive than 2019-2020, and here especially the carp sector recovered partly from the decline in sales (16% increase in sales, 8% decline and 76% reported no change for 2021 compared to 2020). Considering the overall timespan from 2019-2021, the German freshwater sector experienced an increase in sales for 32% of the surveyed farms, a decline for 27% and stable sales for 40%.

High energy prices

Increases in electricity and fuel prices affect both the marine as well as freshwater aquaculture sector in Germany. Electricity and diesel price developments in March-June 2022 compared to the same period in 2021 (Destatis) results in indices of 1.2 for electricity and 1.6 for fuel prices. Considering the cost structure of the German aquaculture segments (Fig. 4.11.4), freshwater producers and especially those with highly automated production systems are affected most by increased electricity prices, whereas the mussel sector is impacted by higher costs for fuel. In order to balance occurring additional costs, the Federal Government grants compensation for fisheries according to *de-minimis* aid. For mussel fisheries this allows balance up to €75 000 for vessels of more than 40 metres and up to €69 000 for vessels of less than 40 metres. For the freshwater sector a calculation model for additional costs is currently under revision.

Social acceptance

Germans perceive seafood in general as healthy food, independent of its origin (Krause et al. 2020, NASTAQ, 2020). According to Eurobarometer (2021), purchasing behaviour is mostly driven by price and quality of the fish product. However, awareness for (potential) environmental impacts of aquaculture production and fishery is increasing. Newspaper articles, documentaries and fish guides from a number of NGO's influence how sustainability is viewed. Concerns regarding aquaculture production include e.g. the use of antibiotics or fishmeal and -oil as part of fish feed and the related (potential) impacts on wild fish populations (NASTAQ, 2020). In general, consumer perception of aquaculture production is very heterogeneous. Aquaculture production is often perceived as artificial, on the other hand German consumers value the quality and safety of aquaculture products (NASTAQ, 2020). In 2021, the highest share in consumption was salmon (18%) (FIZ, 2022), which is mostly imported from Norway. At the same time, the majority of Germans stated a preference towards products from their own country or region and 27% prefer products from the EU (NSC, 2019). However, overall knowledge on origin of (national) fish products and related production systems is low.

Market opportunities for German freshwater fish products are not exhausted and in order to exploit this potential, communication on quality, regionality, ecological and social sustainability of national products will be important. A related strategy for 2021-2030 is proposed in the German National strategic plan for sustainable Aquaculture (NASTAQ, 2020). Further, initiatives, such as the Bavarian small-scale pond landscapes being acknowledged as Nationwide Inventory of Intangible Cultural Heritage (2021) could support informing consumers as well.

4.11.6 Data Coverage and Data Quality

Until 2011, aquaculture statistics were based on (partly estimated) data from the sixteen federal states' fisheries authorities (Brämick 2013 *et seq.*). Since then, the national Federal Statistical Office of Germany (Bundesamt für Statistik, Destatis) has taken over central responsibility. It collects the data directly via an annual census among fish farmers in compliance with the European Regulation EC No 762/2008. In 2015, Destatis has introduced thresholds. Since then, the statistical reports only consider farms bigger than 0.3 ha or 200m^3, thereby reducing bureaucratic effort for smallholders. At the same time, this leads to recent statistics not being comparable with the data from before 2015.

In terms of economic indicators for freshwater aquaculture, a reform of the national agricultural statistic law (Agrarstatistikgesetz) would be required. In contrast to production data requested by Eurostat data collection, the provision of economic and demographic data, collected under the DCF, is not mandatory for fish farmers. This results in four shortcomings. Firstly, the DCF data collecting organisation in Germany (Thünen Institute) does not have access to the national register of aquaculture firms and hence to the postal addresses of the population. Consequently, the conducted survey is based on an address register specifically researched for this purpose. Secondly, the response rate of fish farmers tends to be quite low in a written survey. In 2020, the answers represented only 4% of the facility population (N=2 403), but 15% of the freshwater production volume. To achieve a holistic picture of the sector's economics, data from the sample is projected onto the entire sector. In few cases, the coefficient of variation is quite appropriate (e.g. unpaid labour). In other cases, such as subsidies, coefficient of variation, it is much higher (> 0.8). Thirdly, the sample refers to the same sample frame, but does not cover the same farms in the sample. Only some of the farms responded to both surveys in 2019 and in 2020. This limits the comparability within the survey. Fourthly, the presented data originates from different sources: production volume and number of facilities are transferred from Destatis census (in case of mussels from National Sea Fishery Agency and the State Office for Agriculture, Environment and Rural Areas), data on employment is transferred from Federal Employment Agency and data on unpaid labour, demographics and the majority of economic indicators like turnover, costs, investments etc. results from the above mentioned survey of fish farmers.

In consequence, the chapter provides a holistic picture of the sector by merging all information available about the economic structure of the sector. However, this picture can only provide a good orientation, lacking precision due to the reasons mentioned above. Germany has addressed these shortcomings in its new Strategy for Aquaculture 2021-2030 (Nationaler Strategieplan Aquakultur für Deutschland) under the EMFAF.

4.11.7 References

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4.12 Greece

Overview of Greek aquaculture

In Greece, the seabass and seabream segment constitutes the largest part of aquaculture production, followed by the mussel, trout, and other freshwater fish. The sector in 2020 demonstrates 137.5 thousand tonnes and €600.8 million in sales. The sector shows a stability in terms of production and sales during the last 5 years (2016-2020).

For 2020, there are 691 enterprises with 4 074 employees, 80% of whom are employed in marine fish sector. The sector also demonstrates financial losses of €17 million in 2020, despite the 6% increase of total sales value.

4.12.1 Total Production and sales

The total aquaculture sector sales in Greece, continue the increase trend in 2019 and 2020 in both terms of volume and value. The Greek aquaculture sector, after a period of almost 10 years characterized by a financial crises and multiple company merges, managed to demonstrate increases in sales, employment, and number of enterprises during the last 5 years period (2016-2020).

Regarding the Greek aquaculture techniques, for the 5-year period of 2016-2020, marine sector shows 5.8% increase in sales volume and 2.8% increase in sales value. The freshwater sector demonstrates a respective 23% increase in comparison to 2015. However, the year 2020, showed a 34% decrease in sales volume and 37% decrease in sales value, compared to 2019, due to the exclusion of 2 companies from the sample because of licensing problems and conversion into foreign company's subsidiary.

In 2020, the mussel production sector, compared to 2016, demonstrates an 18% decrease of sales volume and 25% decrease in sales value. The same year compared to the previous one, shows significantly larger decrease in both terms (34% and 37%, respectively). This is attributed to the effect of increased water temperature in North Aegean during 2019-2020 which caused high mussel mortality rates. The specific phenomenon did not appear in the following years.

The mussel price is stabilized in the last 6 years although it is significantly lower compared to other Mediterranean countries' mussel prices. For 2019-2020 Greek mussel category continues demonstrating increased sales in the domestic market where the price is usually higher, helped by advanced marketing practices (marketed as premium delicatessen products) and by increasing availability in large supermarket chains and small fish shops in deshelled form.

4.12.2 Industry structure and total employment

Regarding the aquaculture structure in Greece, for 2020, 22% corresponds to SA and Ltd enterprises that demonstrate almost 85% of the total sector's yearly sales. The largest companies are seabass & seabream production fish farms. In Greece, most aquaculture units are not economically autonomous units and there are cases where a single company may own or rent numerous fish farms, especially in the case of seabass-seabream. For 2020, the 691 units belong to 452 companies.

In the case of mussel farms, there are numerous proprietors with registration codes for tax purposes registered as mussel farmers that often own percentage ownership in several mussel farms. The mussel farms number is stable during the 5-year period of 2016-2020 except for year 2018, in which obligatory relocation of mussel farms due to application of Areas of Organized Aquaculture Development Community directive and license renewal problems led to a decrease of operating farms.

Regarding employment in the aquaculture sector, the 2019-2020 values are almost 9% higher than 2015 in total employment and 13% in FTE terms. The freshwater sector, mainly the trout farms, demonstrate an increase of 26% in total employment and 38% in FTE terms, due to increased employment in small trout family firms, to support higher production quality. Marine sector demonstrates a continuous increase in both total and FTE employment during the 2015-2020 period. On the other hand, during the same period, shellfish sector's employment values show significant variations because of the aforementioned usual practice of mussel farmers with multiple small percentage ownership in various mussel farms appearing as employees in all of them for the years 2015 2016 and this was rectified in the next years surveys.

Table 4.12.1 Production and sales for Greece: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**115.4**	**123.6**	**114.8**	**118.0**	**135.2**	**119.6**	**130.8**	**139.2**	**137.5**	-1%	14%
Marine	90.3	102.4	95.0	89.5	107.1	98.5	105.7	111.7	113.3	1%	16%
Shellfish	21.2	18.0	17.6	21.8	25.7	17	21	23	21	-8%	11%
Freshwater	3.9	3.2	2.2	6.7	2.5	4.5	4.2	4.7	3.1	-34%	-17%
Sales value (million €)	**456.0**	**534.7**	**545.0**	**448.1**	**583.9**	**545.3**	**556.3**	**564.9**	**600.8**	6%	18%
Marine	433.8	514.6	530.5	433.4	562.6	527.9	539.0	539.7	582.7	8%	19%
Shellfish	9.0	8.6	7.1	8.6	10.3	6.1	6.5	8.7	7.7	-12%	-1%
Freshwater	13.2	11.5	7.4	6.1	11.0	11.3	10.9	16.4	10.4	-37%	-2%

Source: EU Member States DCF data submission, 2022.

4.12.3 Overall Economic performance

For the 2017-2020 period, total income of the aquaculture sector demonstrates in 2020 the highest value of €990 million, following an increasing trend with a 22% raise from the €813 million in 2019. The same increasing trend goes for the total operating cost variable with a rise of 15% comparing the last two years (from €832 million to €958 million).

Table 4.12.2 Structure and economic performance of the Greek aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Number of enterprises	659	650	691	691	0%	-9%
Employment	3,876	3,924	4,383	4,418	1%	9%
FTE	3,264	3,678	4,105	4,139	1%	13%
Total income	835.4	806.3	813.2	990.4	22%	21%
Total operating costs	710.6	805.9	832.7	958.3	15%	22%
Total wages	69.0	61.5	79.1	78.9	0%	13%
Gross Value Added	193.7	61.9	59.6	111.0	86%	6%
Depreciation of capital	24.9	26.5	27.7	26.9	-3%	2%
Earning before interest and taxes	99.9	-26.2	-47.2	5.2	111%	-42%
Financial costs, net	25.8	26.3	37.6	22.1	-41%	-26%
Net profit	74.1	-52.4	-84.8	-17.0	80%	19%
Total value of assets	1374.7	1362.5	1297.4	1485.2	14%	10%
Capital productivity (%)	14.1	4.5	4.6	7.5	63%	-3%
Return on Investment (%)	7.3	-1.9	-3.6	0.3	110%	-39%

Source: own elaboration from EU Member States DCF data submission, 2022.

The cost of wages has been increasing since 2017 demonstrating in 2019 and 2020 the highest values. However, while 2020 demonstrates the highest number of employees, (3 795 compared to 3 761 persons in 2019 in FTE terms), it produces a lower total wages value than 2019 (€78.9 million in 2020 compared to €79.1 million in 2019). This is attributed mostly to a wage subsidy policy applied by the Greek government to firms affected by the Covid-19 pandemic during late 2020.

The consolidation and companies' merging continued to a greater extend for the aquaculture sector in 2019 and especially in 2020. The significant financial losses of the dominant large seabass & seabream companies affect the financial variables of the whole sector during the 2017-2020 period. For example, in 2019, two companies of the above category demonstrated combined financial losses of €104 million. The same two companies lowered their losses to €32.5 million in 2020, justifying the drop of financial losses for the whole sector from €84.8 million in 2019 to €17 million in 2020. According to the companies, the negative financial results are attributed to the difficulties of the fish production planning that usually takes place about 18-24 months before their sale, impairing their ability to predict fish price developments. The final configuration of fish prices not only affects the value of sales but also the valuation of organic stocks, which are generally the most important asset of aquaculture companies. Consequently, in the event of a price decrease, the companies' financial status and results are negatively affected. The merging of aquaculture companies in 2020 also led to an increase of total value of assets significantly improving capital productivity and return of investment, compared to 2019 (by 63% and 110%, respectively).

4.12.4 Main species produced and economic performance by segment.

The main aquaculture species produced in Greece are seabream, seabass, mussel, and trout. For 2020, seabream production corresponds to 46% of total production weight and 51% of total production value. Additionally, seabass represents 31% of total production weight and 37% of total value. Mussel production corresponds to 15% of total production weight but only to 1% of total value. Other marine fish category corresponds to 6% of total weight and 9% of total value. Last, trout production amounts to 1% of total weight and 1% of total aquaculture value.

Figure 4.12.1 Main species in terms of weight and value in Greek production: 2020.

Source: EU Member States DCF data submission, 2022.

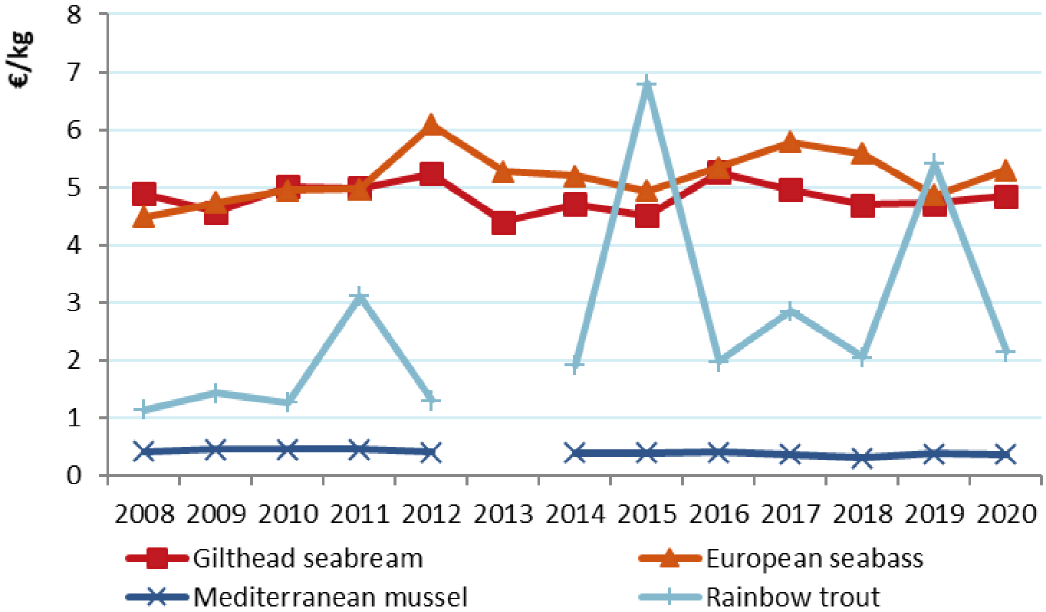
The price for seabass and seabream has been relatively stable in Greece for the 2008-2020 period. During these years seabass has demonstrated an average price of €5.2 per kg (€6.1 highest and €4.5 lowest price) and seabream average price rose to €4.8 per kg (€5.3 highest and €4.4 lowest).

For Mediterranean mussel, for the 2008-2020 period the average price was €0.4 per kilogram, same as the price of year 2020. The largest production units are located in Northern Greece, a fact that facilitates the direct transfer and sale of production to the neighboring country Italy (exports make up 80-90% of total domestic production). Since the designation of Areas of Organized

Aquaculture Development (AOAD or POAY in Greek) started in 2017, new mussel farms are expected to emerge from new mussel farm operation licenses, relocation and extension of old farms and merging.

Regarding the rainbow trout, in Greece, for the 2008-2020 period the average price reached €2.8 per kg and for the year 2020 rose to €2.9 per kg.

Figure 4.12.2 Average prices €/kg for the main species produced in Greece: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022

According to the new EUMAP segmentation, the aquaculture segments in Greece are as follows:

- Segment 1: Sea bass & Sea bream Cages
- Segment 2: Mussel Longline
- Segment 3: Trout Tanks and race-ways
- Segment 4: Other freshwater fish Ponds

Segment 1: Seabass and Seabream Cages

The seabass & seabream cages segment is the most important in Greece in terms of sales volume and value. For the year 2020, it represented 96% of total sales value and 82% of total sales volume. The industry is under a continuous consolidation and restructuring phase and 2021 or 2022 were estimated as the end of this adaptation period. For the years 2019 and 2020 the seabass seabream segment shows a stabilization in enterprises and FTE numbers. In 2020, there is a 127% increase in labour productivity mostly because of the significant rise of other income value. Average wage has stabilized on €22 thousand while total income and total operating cost for 2020 both show a raise of 24% and 16%, respectively. The seabass and seabream segment for 2019-2020 demonstrates significant net losses mainly because of lower fish prices compared to 2018, a result of strong competition from Turkish aquaculture companies that increased their supply while the international demand for aquaculture seabass and seabream remained on the previous years' level. Additionally, in 2020 Capital productivity almost doubled (6.5% from 3.3%), Return of investment improved, and FEI dropped from 1.8% in 2019 to 0.3%.

Table 4.12.3 Economic performance of main Greek aquaculture segments: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Sea bass & sea bream					**Mussel Longline**				
Number of enterprises	343	347	358	358	0%	201	193	201	201	0%
FTE	2633	3017	3187	3196	0%	368	368	512	529	3%
Average wage (thousand €)	21.7	17.4	22.0	22.0	0%	18.9	13.6	10.0	9.7	-3%
Labour productivity (thousand €)	85.1	17.6	13.1	29.8	127%	15.5	15.9	15.9	13.2	-17%
Total sales volume (thousand tonnes)	98.5	105.7	111.7	113.3	1%	16.6	20.9	22.9	21.2	-8%
Total income (million €)	815.9	784.9	783.5	968.1	24%	6.1	6.5	9.4	9.0	-4%
Total operating costs (million €)	648.9	784.3	811.9	940.0	16%	7.4	5.6	6.3	6.2	-1%
Gross Value Added (million €)	224.0	53.0	41.8	95.1	127%	5.7	5.8	8.1	7.0	-14%
Net profit (million €)	117.6	-50.6	-93.2	-20.4	78%	-1.3	0.7	2.9	2.7	-9%
Total value of assets (million €)	1359	1348	1279	1466	15%	1.0	1.2	2.5	2.4	-4%
Net investments (million €)	33.4	29.9	50.9	31.6	-38%	0.0	0.0	0.1	0.1	-5%
Capital productivity (%)	16.5	3.9	3.3	6.5		546.5	481.0	328.2	292.6	
Return on Investment (%)	8.7	-3.8	-7.3	-1.4		-122.1	54.8	118.4	111.5	
Future Expectation Indicator (%)	0.7	0.3	1.8	0.3		-0.8	0.9	0.3	0.3	
	Other freshwater fish Ponds					**Trout Tanks and race-ways**				
Number of enterprises	52	51	64	64	0%	63	59	68	68	0%
FTE	169	169	243	247	2%	94	124	163	167	2%
Average wage (thousand €)	19.0	13.8	8.6	8.6	0%	19.2	14.9	10.7	8.1	-24%
Labour productivity (thousand €)	-227.4	10.0	25.7	9.7	-62%	26.4	10.5	21.1	13.8	-35%
Total sales volume (thousand tonnes)	2.6	1.9	2.6	1.0	-62%	1.9	2.3	2.0	2.1	1%
Total income (million €)	7.5	8.6	10.9	4.4	-60%	5.9	6.2	9.4	8.8	-6%
Total operating costs (million €)	49.2	9.3	6.8	4.1	-39%	5.2	6.8	7.7	7.9	2%
Gross Value Added (million €)	-38.4	1.7	6.2	2.4	-61%	2.5	1.3	3.4	2.3	-33%
Net profit (million €)	-42.7	-1.7	4.1	0.3	-93%	0.5	-0.8	1.3	0.5	-60%
Total value of assets (million €)	9.1	9.2	2.5	2.4	-3%	5.7	4.5	13.0	14.1	9%
Net investments (million €)	0.0	0.3	0.0	0.0	0%	0.9	0.1	0.3	0.5	64%
Capital productivity (%)	-421.5	18.3	250.9	100.3		43.2	29.1	26.5	16.4	
Return on Investment (%)	-468.1	-18.4	166.3	11.8		8.2	-18.4	9.9	3.6	
Future Expectation Indicator (%)	-10.7	-7.4	-0.4	0.0		12.6	-2.3	0.3	1.5	

Source: own elaboration from EU Member States DCF data submission, 2022.

Segment 2: Mussel Longline

The mussel aquaculture activity, for the year 2020 demonstrates a drop in every variable except the FTE value due to the decrease of sales volume and value in the same year. The years 2019 and 2020 also showed significant decrease in average wages especially compared to 2017. As previously mentioned, the sector faced also environmental issues that led to loss of production volume.

Segment 3: Other freshwater fish Ponds

The segment of Other freshwater fish Ponds, despite the increase of number of enterprises for the years 2019-2020 (64 enterprises compared to 51 in 2018), and an 82% increase of FTE in 2020 compared to 2018, the rest of the variables demonstrate decrease of values. This is due to the fact that the owners, both the new ones that joined the category in 2019-2020 and old ones, are farmers/fishermen who use parallel activities to support their main income. Very few keep full records and provide full production and cost data. For 2019 and 2020, no data was provided for the variables raw material costs: livestock and fish feed costs. Because of those problems, the charts of data on livestock and fish feed costs were not used.

The segment, although important for its socio-economic value since it operates in remote areas and its companies are mostly run by families, is however small in scale regarding the whole aquaculture sector. The lack of official records also impairs the attempts to verify supplied data. The apparent low level of investments in the category is depicted in the low values of total value of assets and return of investments variables.

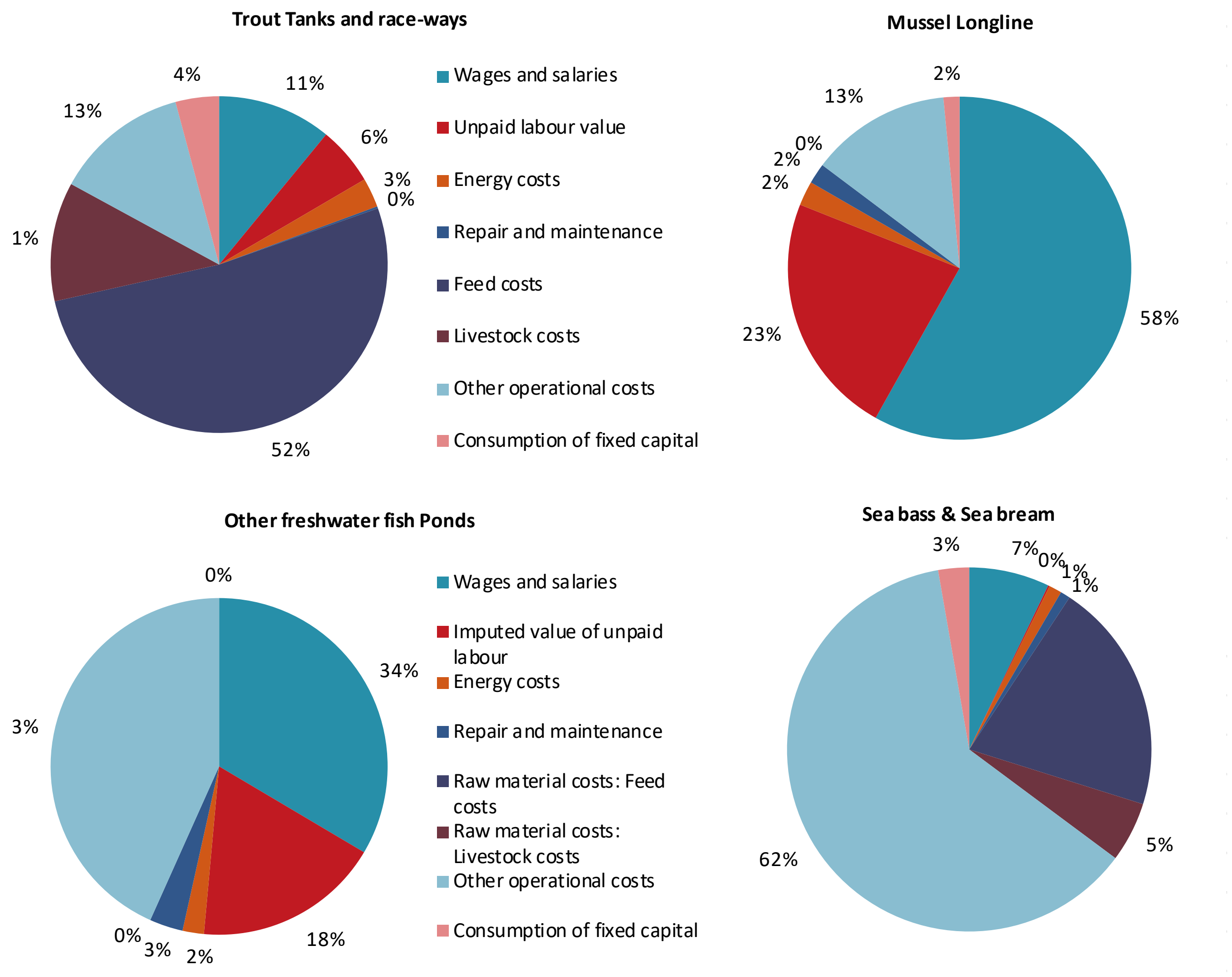
Figure 4.12.3 Economic performance indicators (in € million) for the main Greek segments: 2015-2020.

Source: own elaboration from EU Member States DCF data submission, 2022.

Segment 4: Trout Tanks and race-ways

The trout tanks and raceways for 2019 and 2020 demonstrate an increase in number of enterprises and, consequently an increase in FTE number. The decrease in average wage values was partly due to the fact that in 2020 the Greek government paid a part of the sector's employees' salary due to covid-19 lockdown measures. In the year 2020, labour productivity showed a 35% decrease compared to 2019 and net profit also decreased by 60% respectively. The newly added trout farms almost tripled the total value of assets in the category as well as an increase to net investments. Capital productivity continued to decline (from 43% in 2017 to 16.4% in 2020). Return of investment also showed a significant drop (3.6% in 2020 compared to 9.9% in 2019).

Figure 4.7.4 shows the cost structure of the four main aquaculture segments in Greece: 2020.



Source: EU Member States DCF data submission, 2022.

For the year 2020, for the seabass and seabream segment, other operational costs represent 62% of total operational cost followed by feed cost (20.6%), wages and salaries (7%), livestock cost (5.3%) and consumption of capital (2.7%).

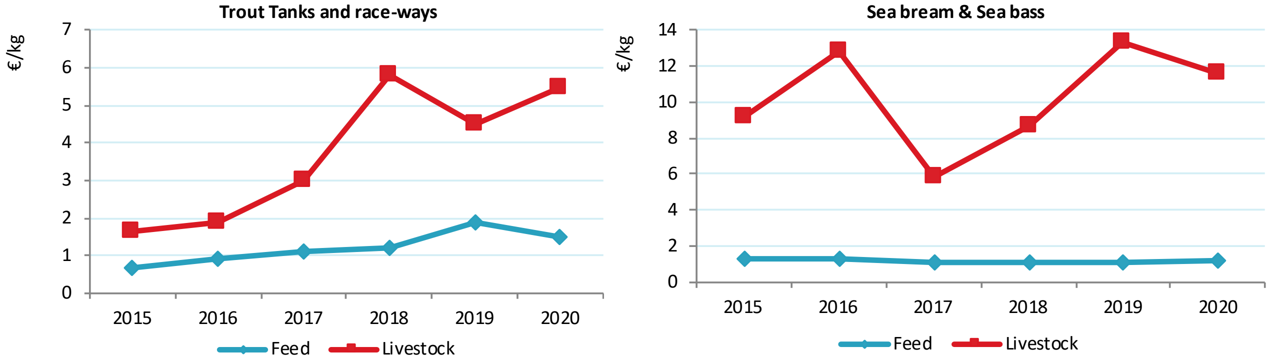
For trout tanks and raceways, the most significant costs are feed cost (52%) followed by other operational costs (13%), wages and livestock cost both at 13%, unpaid labour value (6%), consumption of capital (4%) and energy cost (3%).

The mussel longline greatest production cost is wages and salaries (61%) followed by imputed value of unpaid labor (27%), other operational costs (7%) and repair and energy costs equally at 2% each.

Last, the Other freshwater fish Other methods production cost structure consists of raw material costs (36%), other operational costs (20%), wages and salaries (16%), consumption of fixed capital and raw material cost both at 10% imputed value of unpaid labor (6%) and energy and repair costs both at 1%.

Below, in Figure 4.12.5, regarding the feed and livestock average prices, for the seabass and seabream segmentation, the relatively stable livestock cost is due to the fact that large farming companies operate their own hatcheries-nurseries units controlling the respective cost. Same goes for the feed cost, and even smaller companies without their own fish feed production units are supplied by the Greek fish feed market, ensuring a stable and lower than the imported fish feed price.

Figure 4.12.4 Feed and livestock average prices (€/kg) for the main Greek segments: 2015-2020.



Source: own elaboration from EU Member States DCF data submission

4.12.5 Outlook

Nowcasts for 2021-22

For the next two years, the nowcasts were estimated based on provisions from the two largest aquaculture bodies that initially planned a 7% production raise for 2021, which was revised to 5.5% increase for 2021 and 7% for 2022. According to the initial data collection for the 2021-2022 survey, only the very large seabass seabream farming firms will manage to achieve their goals of 5% production increase at the end of the 2-year period. Regarding the other segments, mussel farms will return to 2019 production levels since the sea water temperature rise phenomenon has ended and due to termination of covid-19 lockdown measures, foreign mussel demand will increase for the next two years.

Trends and triggers

The seabass seabream segment will benefit from the consolidation of the sector by achieving lower cost levels and favourable sales contracts.

One of the effects of the covid-19 outbreak was the increase of parallel activities in the companies, mainly processing, since the lockdown measure forced some of the producers to stock production in the form of deep-frozen products and to create products of high added value to reach new markets, like ready to cook and ready to eat products.

Due to the fact that almost all Greek aquaculture production is exported, the recently introduced label “Fish from Greece” may help in strengthening the sector’s position against lower priced non-EU imported aquaculture products.

COVID-19 impact

Despite the covid-19 lockdown measures, several large and very large seabream-seabass companies declared increased sales for year 2020 with an estimation of sales growth for the first quarter of 2021, predicting a diminishing impact by the pandemic on their activities. Many enterprises received indemnifications as subsidies on operating costs to help reduce covid-related financial impacts, in forms of salary, interest subsidies and government loans under favorable conditions. However, smaller companies with reduced contract-bargaining power and access to external funds expressed concerns on the impact of the covid measures and the consequent increase in operating expenses in coming years.

High energy prices

The rise of energy prices begun to affect the Greek aquaculture sector in 2021. The impact was more severe in 2022 immediately after the start of Russian-Ukrainian war. The land based activities of aquaculture companies than include hatcheries-nurseries, fish feed production, production of aquaculture equipment and fisheries processing activities were directly affected while the transportation and maintenance activities for the whole sector were affected on a lesser level. Also, the rise of fish feed prices is expected to greatly affect the operating costs of the companies from 2022 and onwards.

Social acceptance

Historically, social acceptability for aquaculture has been an issue in the Greek aquaculture development since circa 1990. The occupation of land and/or sea which is considered public for all the local communities was considered in many areas as unacceptable. In particular, for the local rural economies and societies, there are problems associated with their impact on the quality of the environment and an area's ecosystem and secondly - equally important though - what may be the benefit to the local community. According to the MedAID Deliverable No.73 (Pérez Agúndez et al. 2021) the issue of social acceptability is still valid and important for the local communities. However, today's situation shows that the local communities are much more mature in terms of understanding the importance of industrial development in primary production and they have more ways available to seek and obtain or passively receive information.

The positive impact of aquaculture is widely recognized: the security that it brings to food supply, the relief of pressure on other fisheries stocks, the employment opportunities it offers local communities, and the generation of support enterprises that process the aquaculture produce. The study's results show that the local communities accept that there are positive synergies with other activities (for example tourism through the sales of fresh and ready-to-consume products). However in some cases those synergies are identified both as positive and negative.

According to the same study, the negative aspects as identified from the questionnaire respondents, include constraints on the use of the shoreline for tourism-related activities, increased noise, smells, pollution, and decrease of biodiversity and landscape degradation.

The proposed solutions to the social acceptability problem are:

- The use of an integrated approach to coastal and marine management and land and sea use, under which economic, social, and environmental issues would be integrated.
- Consumer education and advertising on the value of aquaculture and its societal benefits,
- The application of corporate responsibility plans,
- Advertisement campaigns (TV, radio, press, workshops/events etc.) to increase transparency much needed and much sought by the locals
- Joined effort by local groups of fish farms to become organized and to produce corporate plans which will aim to revert any local opposition and actually make allies with the local community.

4.12.6 Data Coverage and Data Quality

Data quality and availability

The survey's collected data was provided by financial records and questionnaires as well as segmented values provided by non-probability sample survey, and supplemented with and cross checked by data from the following sources: (a) Prefectural Chambers of Commerce, Industry and Trade (e.g. brand name, location, VAT number, phone and fax numbers) (b) Prefectural Directorates of Fisheries and Veterinary Services, as well as the National Food Control Agency (EFET) and the Hellenic Ministry of Rural Development and Food (e.g. purchase of raw material, production per species, total sales in quantity and value, employment, functioning regulations), (c) Integrated Monitoring System of Fisheries Activities (OSPA) and (d) business and professional online data bases (e.g. location, phones, projected investments, sales, general economic data).

The survey was carried out by application of the census method for most variables and Non-Probability Sample Survey for certain cost variables according to Greece's "Work Plan for data collection in the fisheries and aquaculture sectors 2020-2021". The guidelines and practices agreed upon by program's partners and experts, were followed and monitored by monthly work reports and regular work meetings to guarantee proper implementation of the survey schedule.

Other data issues or missing data

The feed costs for Other freshwater fish in other methods in 2017 is considerably higher than the rest years. A check should be applied to clarify the reason for this (error in reported data, typo).

Other freshwater fish Other methods reported previously is now reported as Other freshwater fish Ponds for 2019-2020. According to Greece's National Working Plan 2020-2021, the new segmentation Other freshwater fish Ponds (seg8.1) in 2019-2020 replaces the segment Other freshwater fish Other methods (seg8.5) that was used previously. For compatibility reasons, in the next data call the years 2017-2018 should be resubmitted replacing Other freshwater fish Other methods with Other freshwater fish Ponds. Also for 2019-2020, as mentioned above, no data was provided for the variables raw material costs: livestock and fish feed costs.

In 2013, is European seabass reported as Saddled seabream, the Other marine fish segment was not reported, and all freshwater segments were reported aggregated. If it is possible to re-examine and re-process the 2013 raw data, those issues should be addressed for timeline compatibility reasons.

For 2015 and 2016, the total weight of sales, feed used and livestock used seem to be reported in tonnes rather than kg. Since the segmented categories are reported in kg, those variables (the total weight of sales, feed used and livestock) should be resubmitted.

Reference

Pérez Agúndez et al. (2021) Lessons learned from study site implementation and recommendations. MedAID Deliverable No. 7.3.

4.13 Hungary

Summary

Hungary is a landlocked country producing only freshwater aquaculture products. The data collection of freshwater aquaculture is not mandatory. Hungary submitted some initial data, but for consistency reasons it was preferred to use FAO data instead.

Production volume and value

The Hungarian aquaculture sector produced 18.4 thousand tonnes of fish in 2020. This production was valued at about €35.4 million (FAO, 2022). Hungary produces only freshwater species.

The production weight has been showed increasing trend between 2008-2020, however the production value has decreased in the last two years. The production weight in 2020 was 14% higher than previous twelve-year average; respective growth in value was 13%.

Table 4.13.1 Production and sales for Hungary: 2008-2020.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 19-20	Develop. 2020/(08-19)
Production weight (thousand tonnes)	**15,7**	**14,8**	**14,2**	**15,6**	**15,1**	**14,9**	**15,3**	**17,3**	**16,2**	**18,3**	**17,9**	**17,3**	**18,4**	***6%***	***14%***
Marine	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	15,7	14,8	14,2	15,6	15,1	14,9	15,3	17,3	16,2	18,3	17,9	17,3	18,4	6%	14%
Production value (million €)	**31,2**	**27,1**	**28,0**	**30,1**	**30,6**	**26,1**	**29,4**	**30,6**	**31,5**	**38,7**	**38,4**	**36,1**	**35,4**	***-2%***	***13%***
Marine	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	31,2	27,1	28,0	30,1	30,6	26,1	29,4	30,6	31,5	38,7	38,4	36,1	35,4	-2%	13%

Source: FAO, 2022.

Main segments

According to available FAO statistics, the common carp was the main species produced by the Hungarian aquaculture sector, representing 65% in terms of weight and 66% in terms of value of total production in 2020.

The second most important species is the North African catfish (hetero-clarias, hybrid variant) with 21% of the total weight and 18% of the total value. Silver, bighead carps represent 5% of production value and 2% in volume. There are also some relevant productions of Wels catfish and grass carp.

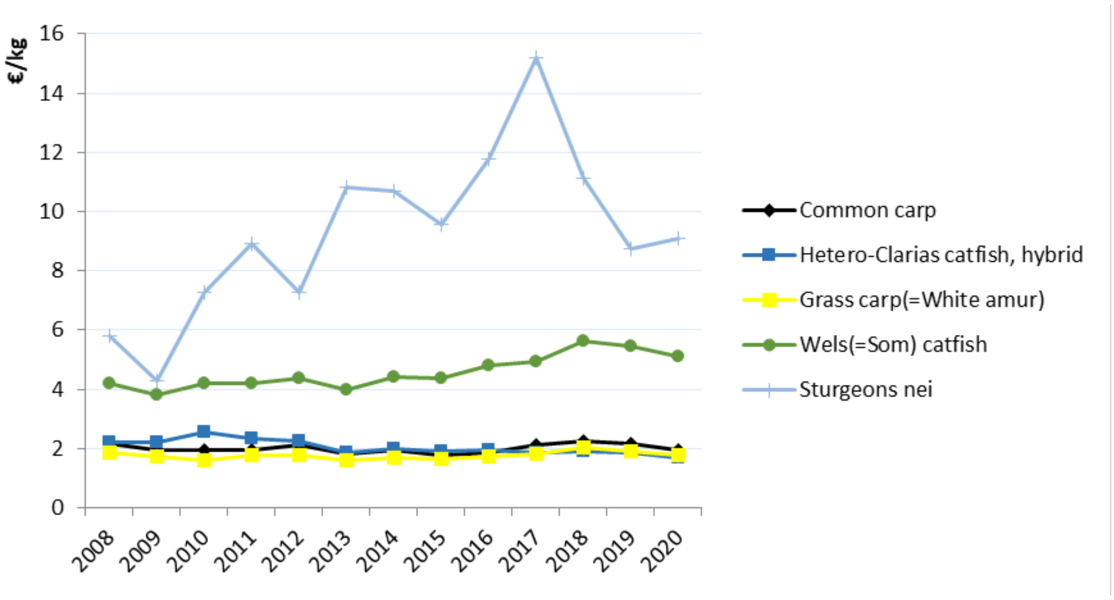
Average prices for the main species started decrease in 2019 which continued in 2020, except for sturgeons.

The common carp price in Hungary was 2 €/Kg in 2020. The price of grass carp €1.8 per Kg, and for Wels catfish was €5.1 per Kg in 2020.

Figure 4.13.1 Main species in terms of weight and value in Hungarian production: 2020.

Source: FAO, 2022.

Figure 4.13.2 Average prices for the main species produced in Hungary: 2008-2020.



Source: FAO, 2022.

Data Coverage and Data Quality

The data collection of freshwater aquaculture is not mandatory under the DCF and EU-MAP programmes of the EU data collection. So landlocked countries are not obliged to provide economic data for this report. The analysis of the Hungarian aquaculture sector is therefore based on data extracted from FAO.

4.14 Ireland

Overview of Irish aquaculture

Irish aquaculture is mainly maritime, dominated by the at-sea production of Caged or Penned Atlantic salmon (*Salmo salar*) and that of the bivalve mollusc species; Pacific Oyster (*Crassostrea gigas*) and Blue mussel (*Mytilus edulis*). Shellfish are cultured in both the subtidal and intertidal zones of sheltered bays and harbours of the western and south-eastern seaboards, using a combination of Off-bottom, suspended and seabed culture methods. The main cultures make up 4 of the 8 Irish EUMAP segments. There is, in addition to the marine cultures, a small number of land-based freshwater finfish units and shellfish hatcheries.

4.14.1 Total Production and sales

Output volume and sales value at sector level has remained steady, between 37,000 and 38,000 tonnes, worth between €175 and €180 million annually, between 2018 and 2020. The figures belie trends at segment level, in response to the Covid lockdown crisis in 2020.

The Marine category of figure 1.n.2 is the Caged salmon segment which was able to adjust to the challenging 2020 market conditions by adjusting its products. Output volume and value increased by 14% and 13% respectively from that of 2019. The shellfish segment products, mainly for live markets, lost their markets for a period and on reopening, sold at reduced unit sales values for a time. Output volume and sales value were subsequently down by 8% and 17% respectively in 2020 from 2019.

Table 4.14.1 Production and sales, industry structure and employment for Ireland: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**45.0**	**46.7**	**36.2**	**31.7**	**44.0**	**45.7**	**37.2**	**38.3**	**37.7**	-2%	-8%
Marine	9.2	15.9	12.4	9.7	16.7	18.9	12.2	11.7	13.3	14%	4%
Shellfish	34	29	23	21	26	26.2	24.4	26.0	23.8	-8%	-12%
Freshwater	1.9	1.3	1.0	1.1	0.9	0.6	0.6	0.6	0.6	-1%	-45%
Sales value (million €)	**94.3**	**122.5**	**130.3**	**116.3**	**167.7**	**200.6**	**179.5**	**175.3**	**179.8**	3%	28%
Marine	47.1	77.6	75.7	58.8	106.0	138.6	119.6	112.1	126.8	13%	49%
Shellfish	39	39	47	52	57	60.0	58.2	61.5	51.1	-17%	2%
Freshwater	8.0	6.4	7.3	5.3	4.7	2.0	1.6	1.7	1.9	12%	-63%
Number of enterprises	**304**	**302**	**279**	**277**	**289**	**282**	**281**	**292**	**316**	8%	10%
Marine	17	24	19	18	20	28	26	26	28	8%	31%
Shellfish	264	258	241	244	255	249	249	259	280	8%	11%
Freshwater	23	20	19	15	14	5	6	7	8	14%	-49%
Employment	**1,972**	**1,715**	**1,708**	**1,821**	**1,948**	**1,952**	**1,994**	**2,230**	**1,988**	-11%	5%
Marine	146	184	195	145	180	204	225	243	212	-13%	18%
Shellfish	1,706	1,454	1,448	1,620	1,719	1,734	1,749	1,965	1,754	-11%	6%
Freshwater	120	77	65	56	49	14	20	22	22	0%	-62%
FTE	**1,287**	**952**	**956**	**941**	**1,027**	**1,039**	**1,109**	**1,237**	**1,085**	-12%	5%
Marine	130	156	171	115	160	176	191	217	159	-27%	3%
Shellfish	1,065	737	738	788	829	851	901	1,003	909	-9%	8%
Freshwater	92	59	47	39	38	12	16	17	18	4%	-59%

Source: EU Member States DCF data submission, 2022.

4.14.2 Industry structure and total employment

The industry generally is made up mainly of shellfish micro-businesses, employing 5 persons or less. The finfish categories are made up of several medium sized salmon companies and one Multi-national. There are also a number of land-based Salmon smolt and Rainbow trout producing micro-businesses.

The size of the sector overall has grown slowly, year on year in terms of licenced capacity and number of businesses since 2018, reaching 316 production units in 2020, up 8% on 2018. Licenced sites were renewed and some new sites came on-stream, along with start-up production units in the expanding oyster segment. Total employment had reached a level of 1 980 persons in 2019, a 13 year high but the 2020 lockdown impact was to reduce the level by 7% to 1 848 persons or a 7% drop in FTE to 1 007 from 1 086 in 2019.

4.14.3 Overall Economic performance

Total income increased to €195.9 million or 9% in 2020, from €181.2 million in 2018. Total operating costs had been increasing to 2019 but dipped in 2020 to €148.8 million from €161.5 million. This was likely due to a reduction of operations throughout 2020, rather than a drop in actual costs per operation as units focussed on essential management through lockdown. Costs increased sharply for all segments in 2021. Total wages increased in 2019 from 2018 but dropped significantly in 2020 to €26.8 million or by 21% as emergency-level wages were paid to many.

Many businesses were unable to pay wages throughout 2020 and an emergency wage was paid to employees of these by the state. Notwithstanding disruption to production Economic indicators to 2020 are positive. GVA has increased steadily across the sector, up by 41% from 2019. Depreciation has remained steady from 2018. Net profit for the sector was estimated as €40.6 million for 2020 in Table 4.14.2, which is higher than the €32.1 million estimated in the national survey.

Total income, costs and GVA have increased by 35%, 24% and 38% respectively while wages overall have decreased by 10% for the time period 2008 to 2019.

Table 4.14.2 Economic performance of the Irish aquaculture sector: 2017-2020.

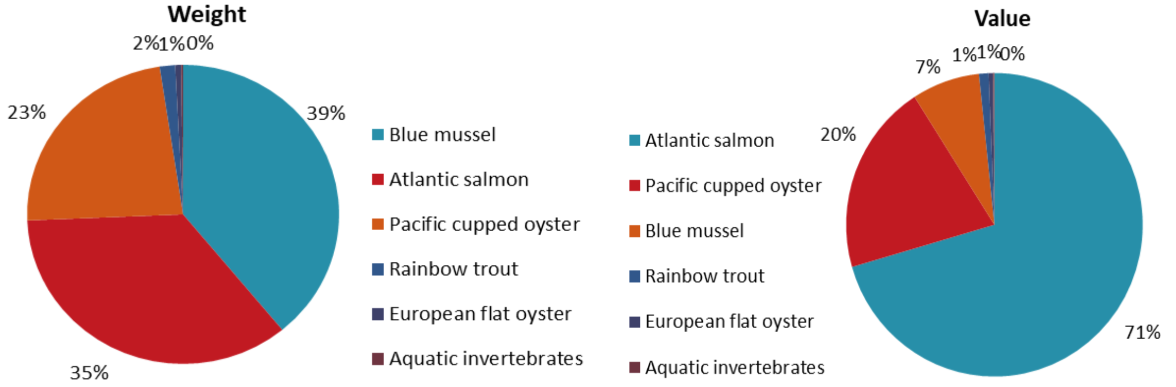
Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Total income	201.7	181.2	180.0	195.9	9%	4%
Total operating costs	137.2	148.2	161.5	148.8	-8%	0%
Total wages	27.7	31.8	34.0	26.8	-21%	-14%
Gross Value Added	92.2	64.8	52.4	73.8	41%	6%
Depreciation of capital	9.0	9.3	9.0	9.1	0%	-1%
Earning before interest and taxes	55.5	23.7	9.4	38.0	304%	29%
Financial costs, net	-25.7	0.5	0.7	-2.6	-455%	68%
Net profit	81.2	23.1	8.7	40.6	369%	8%
Total value of assets	194.0	240.5	244.3	264.2	8%	17%
Capital productivity (%)	47.6	26.9	21.4	27.9	30%	-13%
Return on Investment (%)	28.6	9.8	3.9	14.4	273%	2%

Source: own elaboration from EU Member States DCF data submission, 2022.

4.14.4 Main species produced and economic performance by segment

The main Species-cultures of Irish aquaculture are: Caged (Atlantic) salmon, Farmed Pacific cupped oyster (Oyster other), Longline cultured and Bottom cultured (Blue) mussel. The salmon production made up 35% by sales volume and 71% by sales value of 2020 output. The two mussel segments between them accounted for 39% by sales volume and 7% of sales value of 2020 output. The farmed oyster segment made up 23% by sales volume and 20% by sales value of 2020 output.

Figure 4.14.1 Main species in terms of weight and value in Irish production: 2020.

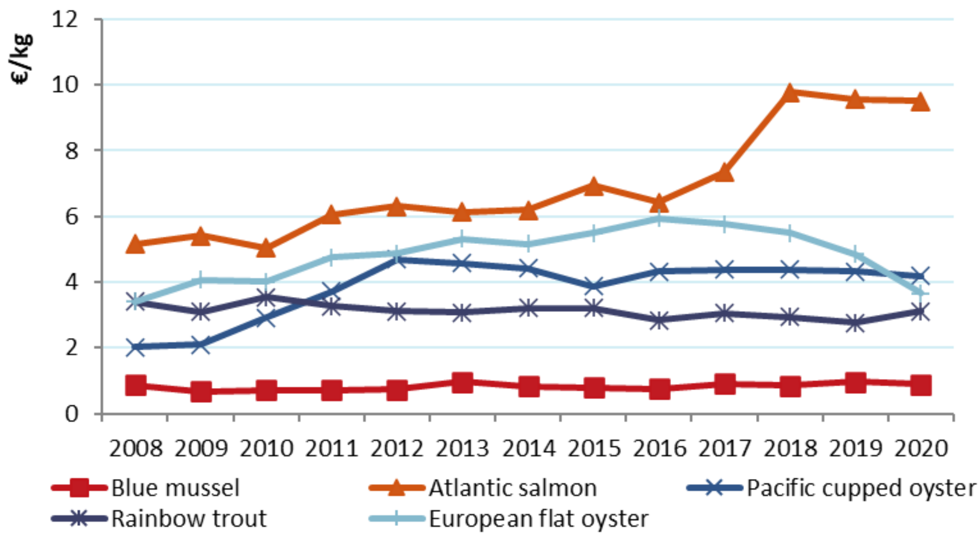


Source: EU Member States DCF data submission, 2022.

Irish Farmed salmon, produced to organic certification, has seen a steady increase in unit sales value per kilogram from €5.2 in 2008 to €9.8 in 2018. Over the last two years to 2020, the unit sales value has slipped to €9.5 as there was a shift to frozen products from fresh whole as the lockdown suppressed markets.

Similarly, unit sales value for farmed oyster rose over the same period from €2 per kg to €4.4 in 2017, then slipped to €4.2 in 2020. The unit sales value for oysters varied greatly from Bay to bay in 2020, depending on the specific oyster product desired by the market and availability of such products when it reopened. Many stocks grew out of required specification during lockdown.

Figure 4.14.2 Average prices (€/kg) for the main species produced in Ireland: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

European flat oyster unit price per kg rose from €3.4 in 2008 to €5.9 in 2016 then slipped steadily thereafter to €3.5 per kg in 2020. The scarcity of this product over recent years, caused the market to switch away to the more readily available Pacific cupped oyster products.

Blue mussel unit sales values collectively have performed relatively steadily over the time series, averaging between €0.7 to €1 per kg. Bottom cultured mussels generally fetch a value of €1 to €1.6 per kg, while Suspended mussels for live market fetch an average €0.7 per kg. Mussels for the processing market fetch somewhat less.

Rainbow trout fetched €3.1 per kg in 2020. Over the time series this has varied from €3.5 to €2.8 per kg. The average price estimated does not indicate the current precarious state of the Irish Trout segment. Its small scale necessitates niche markets and high product placings to counteract the high cost of small scale production. Product placement has lost ground in the changed market place post lockdown.

The main segments in the Irish aquaculture and their key findings are detailed below.

Salmon Caged

Caged Salmon production is on the upward swing of its regular production cycle in 2020 and although experiencing a dip in its average sales unit value, seems to have weathered the twin market and logistical challenges of pandemic lockdown and Brexit without serious disruption to the segments overall production output pattern. Volume output, whole Round in 2020 was 12 870 tonnes, up 13.6% on 2019 which generated €118.9 million at farm gate, up 9.4% on 2019. Average unit price per kilo whole round was €9.24 which is down by 3.7% on unit value in 2019.

Smolt production continued to rise from 2018 level, up 15.5% on 2019 to 462 tonnes in total, 29.4 million smolts produced. The production of stand-alone businesses was 151 tonnes, and the balance of the total production was made by auxiliary smolt units for the on-growing units of amalgamated companies.

Hatchery production mainly supplied the home on growing industry in 2019 and 2020 and a small portion was also exported to the UK. A total of 10 850 tonnes or 83.8% of the farm-gate sea-cage product, all of which was produced to Organic certification, was exported either whole-round or processed into head-on gutted, filleted or otherwise value-added products before being exported principally to France, Germany, the Middle East and North America.

Employment

Direct cage production total employment decreased by 20 persons to 170 with a sharper FTE reduction of 151 from 178. Similarly, smolt hatchery total employment dropped two persons to 47 but FTE in this segment dropped a full 20 units to 19, indicating a shift from full-time to part time employment here and in the salmon production segments generally. Notwithstanding annual fluctuations, site employment is mainly full-time and over 600 persons are employed either in direct production, processing or support services to the Salmon Seafood industry. Only 4.7% of the employed on-site were female with greater proportions employed in processing and in other parts of the value chain.

Business structure and capacity

Segment business structure and capacity has not changed significantly in 12 months. Active production unit number fluctuates with production cycle requirements, fallowing and other management strategies. Five companies operate 19 on-growing production units in Deep-water Bays from Donegal to Cork, while a mix of stand-alone businesses and auxiliary enterprises of the on-growing businesses operate 12 land-based hatchery units.

Cage salmon production has under-supplied the organic market for a number of years now. Attempts to expand production to meet demand by acquiring new production sites or to upgrade outdated licence conditions of existing ones to better facilitate improved production methods however has been frustrated. Parties hostile to production expansion have the option to stall site development through a protracted licence appeal process that can be initiated after a new site licence has been awarded. That, plus the lengthy process undergone to achieve the licence award beforehand works against the case for investment in the segment. The Scottish government meanwhile has recently announced plans to invest in expanding organic salmon production there which will likely challenge Irish product placement in the near future in shared markets.

Maximum production capacity remains therefore within an alternating 10 to 20 000 tonnes output cycle, in accordance with Organic certification fallowing requirements and within a chronic shortage of production space and facilities. In 2020, 193 pens or more, enclosing 4.3 million m^3 were used in producing 2.64 million fish, averaging 4.87 kg., whole round.

The segment is highly integrated vertically and to a lesser extent horizontally. In the latter case some units work contracts for others and smolts produced by auxiliary units are reared mainly for home production. Vertically, farm gate and processed product are marketed locally.

Inputs and costs in 2020

Feed is the biggest single cost component whereas 'Other operational costs' is a broad church of costs dominating salmon farm production. 417.3 tonnes of smolts input cost €7.55 million. About 18 822 tonnes of feed input cost over €28 million. Wages and salaries total cost came to €6.23 million. Total costs were estimated at €99.3 million and cost of producing 1 tonne of farm gate product was estimated as €7 376, down 15.3% on 2019's estimated unit cost of €8 708.

Mortalities: no major mortality event was recorded in 2020.

Table 4.14.3 Economic performance of main Irish **Error! Reference source not found.**aquaculture segments: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Salmon cages					**Oyster Other**				
Number of enterprises	20	19	18	22	22%	148	148	149	160	7%
FTE	149	171	195	156	-20%	528	583	593	560	-6%
Average wage (thousand €)	53.1	46.5	43.3	40.1	-7%	24.7	30.5	27.3	24.5	-10%
Labour productivity (thousand €)	311.9	158.3	42.1	212.9	405%	59.3	42.4	48.6	44.6	-8%
Total sales volume (thousand tonnes)	18.7	12.0	11.6	13.2	14%	9.8	10.2	10.5	8.8	-16%
Total income (million €)	135.8	116.4	109.7	125.4	14%	43.7	44.9	47.4	42.2	-11%
Total operating costs (million €)	97.3	97.3	109.8	98.5	-10%	25.5	37.9	34.8	30.9	-11%
Gross Value Added (million €)	46.3	27.0	8.2	33.1	302%	31.3	24.7	28.8	25.0	-13%
Net profit (million €)	62.5	15.4	-3.9	22.5	673%	14.5	3.1	8.9	8.9	0%
Total value of assets (million €)	75.4	106.5	118.3	128.8	9%	71.7	79.1	72.1	82.3	14%
Net investments (million €)	1.1	4.4	3.8	12.8	234%	5.8	3.0	4.8	2.2	-54%
Capital productivity (%)	61.4	25.3	7.0	25.7		43.6	31.3	40.0	30.3	
Return on Investment (%)	82.9	14.5	-3.3	17.5		20.2	4.0	12.3	10.8	
Future Expectation Indicator (%)	-2.8	0.8	0.1	6.6		3.6	-1.1	1.9	-1.0	
	Mussel Bottom					**Mussel Long line**				
Number of enterprises	25	26	32	29	-9%	57	57	56	61	9%
FTE	78	78	73	77	6%	145	136	231	187	-19%
Average wage (thousand €)	33.1	25.2	30.5	28.5	-6%	16.7	19.2	16.2	18.1	12%
Labour productivity (thousand €)	58.6	58.1	65.2	85.4	31%	32.7	25.4	23.4	32.7	40%
Total sales volume (thousand tonnes)	7.5	4.7	4.9	4.4	-11%	8.6	9.2	10.3	10.4	1%
Total income (million €)	8.9	6.3	8.0	10.2	28%	5.8	6.6	7.8	10.0	28%
Total operating costs (million €)	6.9	3.8	5.4	5.8	7%	3.5	5.7	6.1	7.2	18%
Gross Value Added (million €)	4.6	4.5	4.7	6.6	39%	4.7	3.4	5.4	6.1	13%
Net profit (million €)	0.1	0.9	1.4	6.7	364%	1.1	0.4	0.9	2.5	177%
Total value of assets (million €)	19.5	22.8	16.0	21.6	35%	17.8	22.6	26.5	17.9	-32%
Net investments (million €)	0.0	1.5	1.5	0.0	-100%	0.6	0.9	0.9	0.7	-24%
Capital productivity (%)	23.5	19.9	29.6	30.6		26.6	15.3	20.4	34.2	
Return on Investment (%)	0.7	3.9	9.0	30.9		6.2	1.6	3.4	13.9	
Future Expectation Indicator (%)	-6.4	1.1	3.7	-4.9		-1.8	1.8	0.6	1.9	

Source: own elaboration from EU Member States DCF data submission, 2022.

Farmed oysters

Output Trend

Total sales value nationally in 2020 was estimated at €36.6 million, worth 20.3% of national sales value and down 19% on 2019. Sales value was generated from a national output volume of 8 866 tonnes, down 19% on 2019. Output volume in 2020 was 23.4% of national total. Average unit sales value per kilo dipped to €4.12 from €4.38 (-5.87%). Native oyster output in 2020 was approximately 233 tonnes, worth a total of €1.55 million.

About 7 557 tonnes of Farmed oyster output tonnage were of triploid stock, with an average unit value of €4.25 per kilo. 835 tonnes output was of Diploid stock with an average unit value estimated at €3.38 per kilo. Commercially viable production per hectare nationally in 2020 averaged at 4.77 tonnes per hectare, down 8.8% on 2019.

Markets

Approximately 6 325 tonnes of total output were for the consumer market, down 16.3% on 2019. The balance produced was for farther on-growing-fattening on Irish or other EU sites. Total volume, all class sizes, exported in 2020 was 8 615 tonnes. 82.4% of this went to France, 5.2% went to the Netherlands. 3.78% went to other EU countries and 8.84% went to SE Asia, notably Singapore, S. Korea, Hong Kong and Mainland China.

The size 3 class product (66 -85g.) had the highest average unit value of €5.45 per kg., followed by Size 1 or greater (more than 110g.) at €5.22 per kg. Higher unit values were achieved locally. Half-grown product averaged €3.38 per kg. The French market still prefers the 66-85 g. class while the largest sizes, with some specialist exceptions, generally go to Asia.

Employment

The Farmed oyster segment provides the most employment in Irish aquaculture and together with the mainly seasonal work found within the Native oyster (*Ostrea Edulis*). Co-op segments, provided employment for 1 223 persons (FTE 605). While Co-op seasonal employment had decreased significantly during lockdown, employment generally on the Farmed oyster units remained stable with the help of the State Lockdown wage assistance schemes. Employment in the Farmed oyster segment was 847 or FTE 535 and in the Co-op fishery segment, totalled 376 or FTE 70. The data for employment in this latter segment is largely estimated.

Employment status in the farmed oyster segment is fairly evenly divided; 43% full-time, 32% part-time and 25% casual in 2020. 11.3% of the total were female.

Business structure and capacity.

Farmed oyster was produced by 157 businesses, operating 159 production units, located in the intertidal Bays and estuaries of the West, Southeast and Northeast coasts. The majority of these, 107 units in 2020, are small, employing up to 5 persons. 29 units employed 6-10 persons and 22 employed greater than 10 persons. 10 businesses operated 14 production units produce native oysters, 8 of whom are Co-ops employing more than 10, predominantly ageing male fishermen for short winter harvesting seasons. Farmed oyster output was produced upon approximately 439 944 trestles, within 2 000 licenced hectares. Commercially viable production output per hectare dropped from 5.23 tonnes to 4.77 tonnes as unsold stocks remain on site in some places.

There is some horizontal Integration locally though companies mainly operate independently of each other in terms of depuration, marketing and distributing their products. There is some cooperation in product marketing.

The majority of farmed oysters occurs by traditional bag and trestle though the use of alternative methods is increasing in certain bays as improvements occur with their fittings with experience. Moving parts for example between bag and frame are being made of more suitable materials, reducing wear and replacement frequency for hanging and swinging basket methods. Buoyancy in the latter method has become more fine-tuned to suit particular circumstances and to avoid dislodging supporting frames.

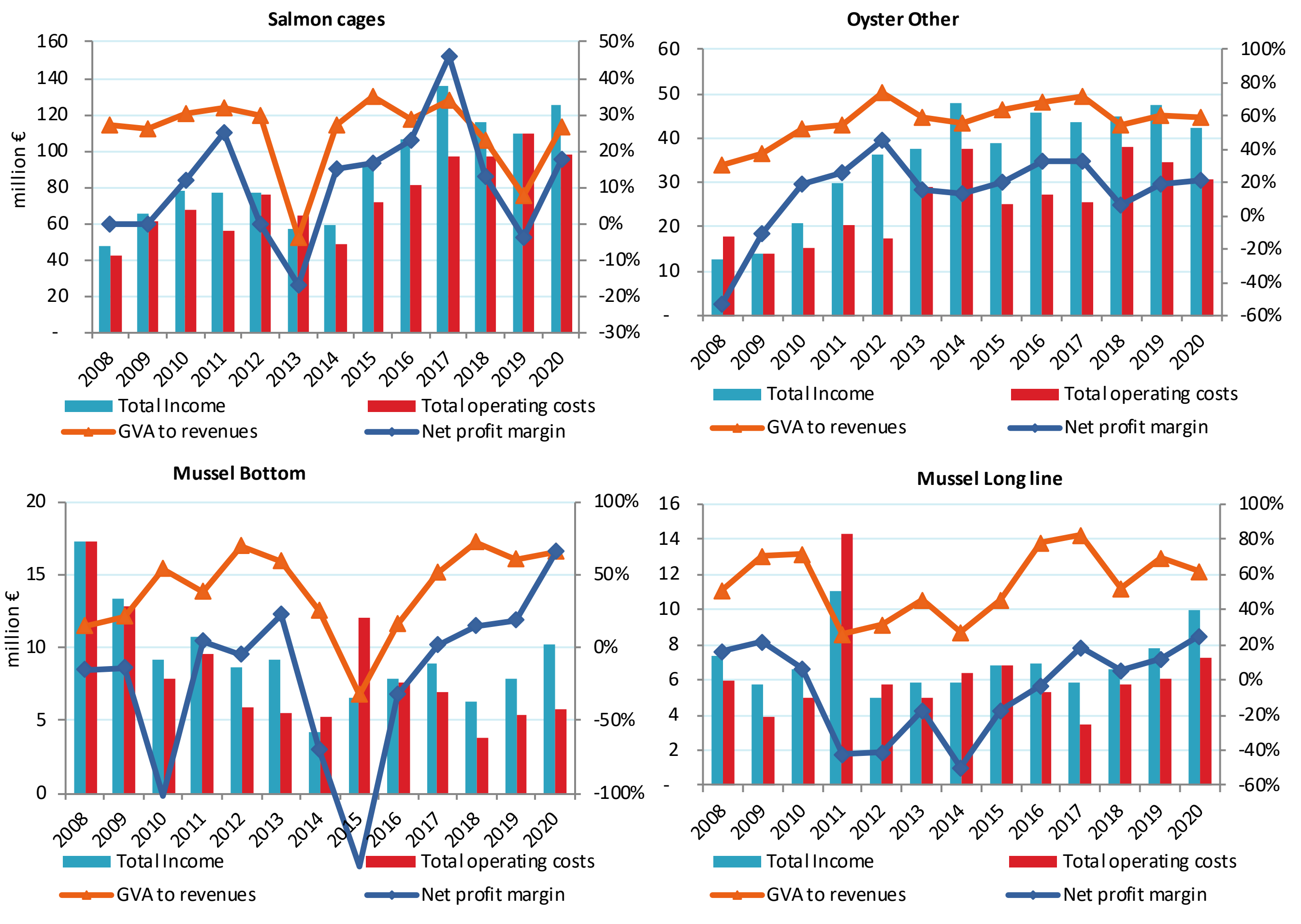
Inputs and Costs

847.6 tonnes of seed and half-grown input to production sites cost €5.34 million in 2020, down by 42.1% in quantity from 1464 tonnes costing €5.91 million in 2019. Loss of sales income, along with sites carrying unsold stock for months beyond normal clearance periods have contributed to this drop in input which will have a negative impact on output over the next several years. Seed was sourced mainly from 5 French and 1 UK hatcheries, the most popular being France Naissain and was bought in sizes G6-10, at costs ranging mainly between of €10 and €12 per 1 000 pieces. Wages and salaries cost was estimated at 13.2 million for 2020.

In 2020 the average cost of producing one tonne of farmed oysters was €3 309.

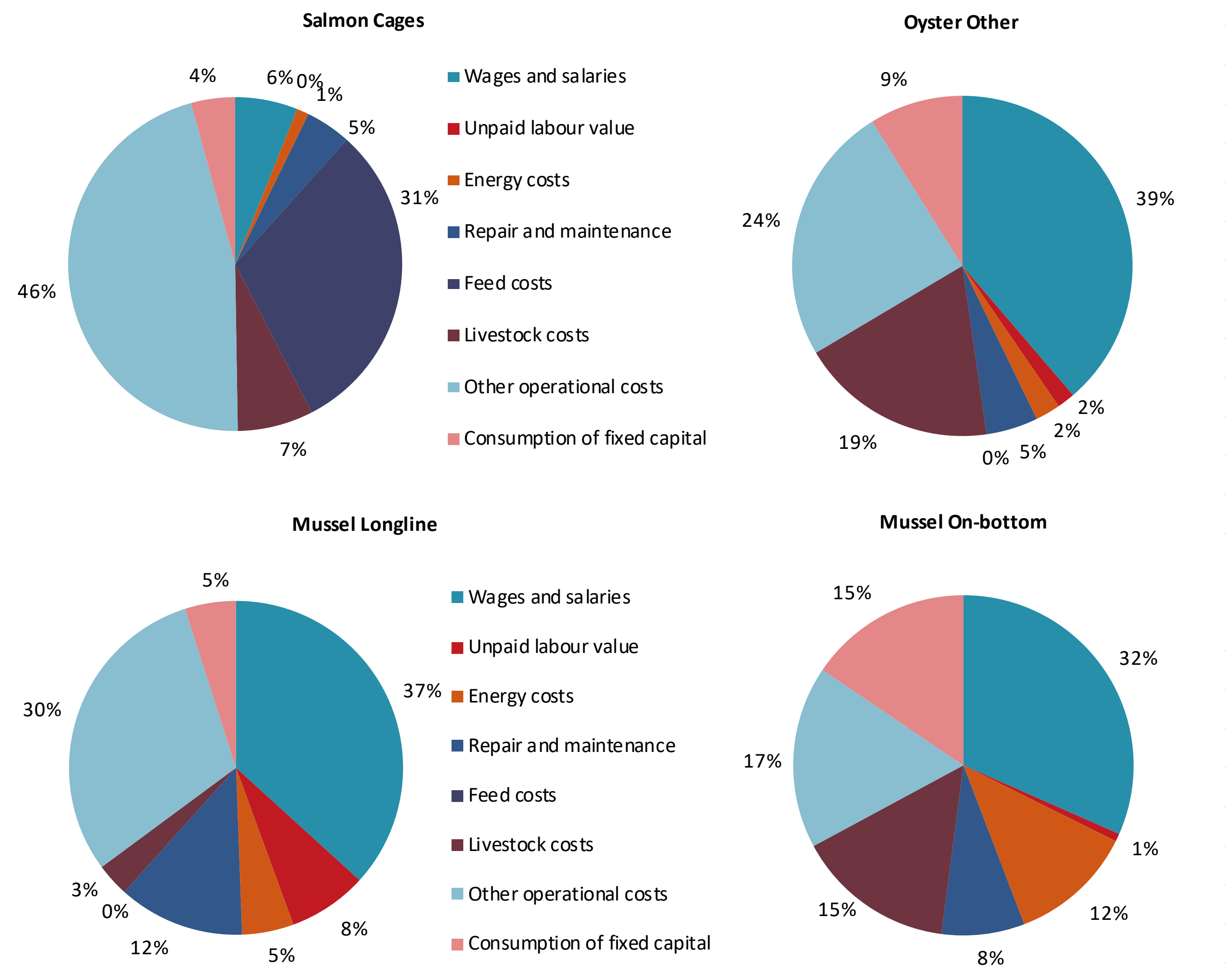
Average national mortality was 24%. Mortality rate and causes varied from bay to bay with pathogenic causes, red tides, dredging and suspected toxic discharges at different times being quoted as causative factors. A combination of some of these caused high cumulative mortality in major producing bays such as at Waterford Harbour and Donegal bay, in some cases as much as by 80-100% of seed stock. High juvenile mortalities had also occurred in 2019 in some west coast bays where the entire input stock had been lost in certain cases. In adjacent bays, production and sales has been as normal, indicating that no two production areas are the same in terms of environment and bio-dynamics and that successful sales depend on stocks reaching the correct market specifications at the right time, followed by rapid sales movement.

Figure 4.14.3 Economic performance indicators (in € million) for the main Irish segments: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Figure 4.14.4 Cost structure of the main segments in Ireland: 2020.



Source: EU Member States DCF data submission, 2022.

Suspended mussel culture

Output

Rope mussel culture in 2020 produced 10 375 tonnes of combined product which, taking into consideration the re-integration of missing businesses, meant that production volume output recovered to approximately 2019 levels after markets re-opened from the initial pandemic lockdown. Overall sales value fell to €6.2 million from €6.9 million (combined fresh and processed markets) a drop of 10.1%. Fresh market product, 7 161 tonnes had an average unit value of €697.5, ranging from €650 to €800 in most bays. The output balance of 3 214 tonnes was sent for processing for an average €624.29 and ranging between €500 to €650 per tonne. Two to three production lines per hectare produced a national average commercial yield of 10.87 tonnes in 2020.

Markets

6 945 tonnes of mainly fresh product were exported in 2020, 53.9% going to France, 26.6% to Holland, 6.2% each to Italy and the UK while the balance went to other EU destinations such as Spain and Germany. 3 218 tonnes were processed in Ireland and a proportion of this was also exported. Some hundreds of tonnes of fresh product went to the home market which had been growing steadily in Bays such as Mulroy, Killary, Kenmare and Roaringwater, before the lockdown.

Employment

Segment employment level and business structure in 2020; 248 persons, FTE 137 by 56 businesses operating 61 production units has withstood the lockdown and Brexit crises thus far, with the State assistance schemes having assisted with retaining staff. The long-term trend though is that of slowly declining employment levels as the sector continues to streamline and mechanize with specialist crews and equipment servicing a greater number of production units. Employment categories are relatively evenly split: 32.7%, 34.3% and 33% between full-time, part-time and casual. About 14.5% of the workforce were female.

Business Structure and capacity

49 of the 61 production units employ 5 people or less, 8 units employ between 6 and 10 and just 4 employ more than 10 persons. In some areas there is increasing difficulty in securing casual labour, particularly important at times of collector deployment and harvesting and a consequent increase in unpaid labour is carried out by business owners.

Production is concentrated in the deep-water bays of the Southwest; Cork and Kerry and to a lesser extent in the north-west, from Killary Harbour to Mulroy Bay. While red tide closures interrupt continuous production flow, the biggest impediment to the sectors growth remain the reliance on those markets that have a large home production stock, leading to periods of over-supply. Farther market possibilities remain limited by the short shelf life of the fresh product.

Production capacity in terms of suitable sites has been reached and maximum capacity is 15 000 tonnes, contained on 1 773 lines, upon approximately 1 000 hectares. The industry is fragmented with some horizontal integration of producer and processing units developing. Culture infrastructure are sub-tidally located, in sheltered deep-water bays, consisting of suspended, Head-Rope systems, varying in length from 100 to 200 meters. Continuous new Zeeland rope is favoured by larger operators in such locations as Bantry, Killary and Roaring water Bays, Swedish or Danish Strap is favoured in Kenmare Bay, Traditional rope is used among the smaller operators in Roaring water Bay and partially continuous, reusable rope (Recycled pergolari material) is used in Killary Harbour.

Inputs and Costs

Stock input is mainly from locally deployed seed collectors in early to late summer. Costs are tied up in the materials used and the labour of making up and deployment of the collectors. An estimate of €243 990 was made for input costs in 2020. Wages & salaries for the segment were estimated at €2 8 million. The average cost of producing 1 tonne of rope culture mussel was estimated as €642, indicating producing for the processing sector only for purely production-oriented businesses was unprofitable in 2020. Unpaid labour costs for the business owners consequently rose to an estimated €833 thousand in 2020 from €288 thousand in 2019. In 2019, the average cost, using the same parameters, of producing 1 tonne was €480.6, for an average overall unit sales value of €674 (Fresh and for Process products).

Mortality is difficult to estimate for the sector, here estimated as averaging 2.81%, with up to 38% reported in some instances. No major red tide event was reported and harvestable stocks were mainly cleared in time before their weight could pull them to the bottom with commercial loss.

Seabed cultured mussels

Output

Bottom mussel output is down nationally by 11% to 4 394 tonnes and down by 10.3% in value to €7.07 million. Unit price national average is up 0.74% to €1 623 per tonne. Production level remains at a critical low level and only scarcity driven, relatively high average unit sales value for consumer-ready product at specific points of the market season is keeping most businesses afloat.

Markets

Product is exclusively exported, mainly to Holland and France with the Dutch taking in 93.5% and the French 6.5% of exports in 2020. All product, sold fresh and mainly in bulk, was sold from between €850 to more than €3 000 per tonne, depending on time of year and whether the product was consumer-ready, and of the right size and meat yield. The Dutch market is significantly the more lucrative of the two main market destinations. The Dutch home product is derived from collector seed which seemingly produces an inferior meat yield to wild seed stock.

Employment

The segment employed 110 persons (FTE 75) directly which is slightly up on 2019 (FTE 73). Employment status within the segment has moved from mainly full-time to a more even mix with part-time as the remaining businesses structure to withstand the prolonged challenge of insufficient seed supply and drop in labour requirement. 52.7%, 23.6% and 23.6% were full-time, part-time and casual respectively in 2020. 4.5% of the total employed were female. Most employees make up the crews of dredgers which are an essential tool of the segment for seed collection, husbandry and harvest.

Business structure and Capacity

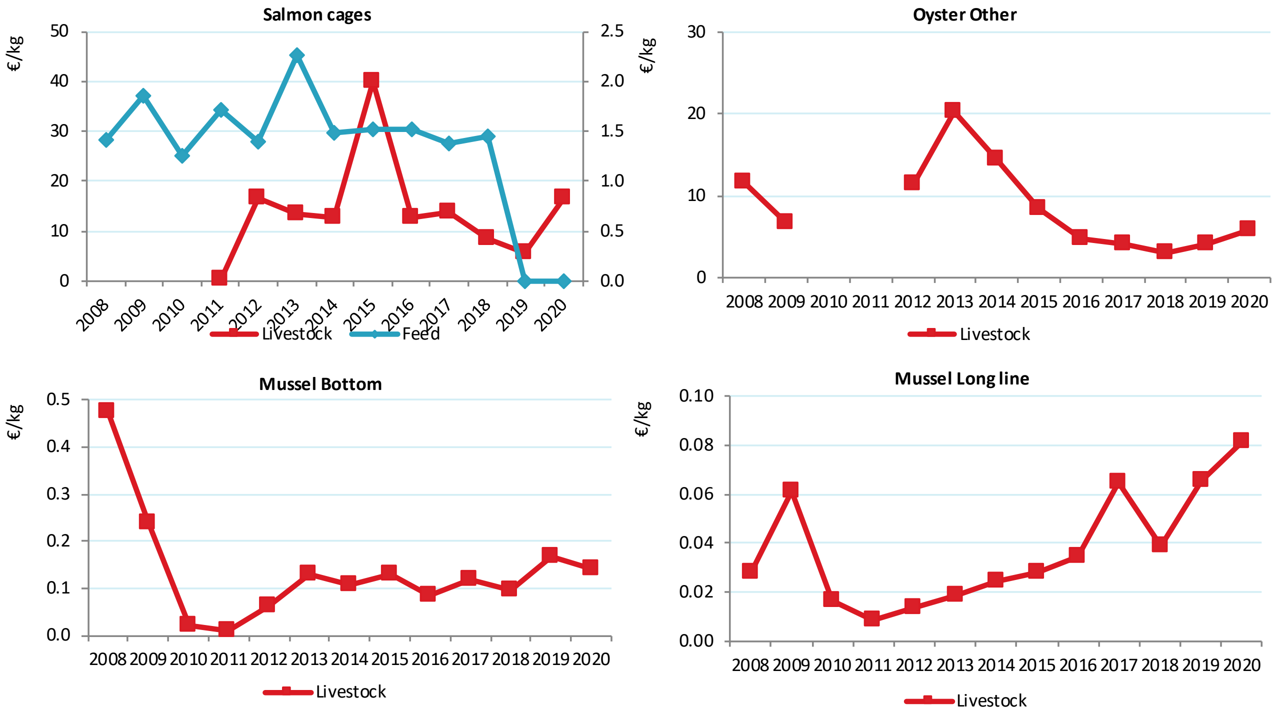
A total of 17 businesses were running 29 production units, operating in Carlingford Lough, Wexford Harbour Castlemaine Harbour and Lough Foyle in 2020. The industry is shrinking and amalgamating in the face of a continuing scarcity of seed supply. Furthermore, production capacity is threatened in Wexford Harbour, a major production location, by the reduction of licenced production area due to a re-designation of traditional sites as intertidal areas and therefore the preserve of Wild-bird conservation. A reduced area size has been licenced in another portion of the Harbour without consultation with the industry as to its suitability for bottom mussel culture.

The industry is fragmented with little or no horizontal or vertical integration. In excess of 30 000 tonnes was produced in 2003 and 2005, though production levels were mainly between 10 and 20 000 tonnes until 2012, when output dropped below 10 000 tonnes to the present. Production is limited not by space but rather by the continued almost total dependence on wild seed beds for input stock. The resource has been scarce for some years now and its management is politically and legally contentious in the aftermath of Brexit and ongoing policy pertaining to the Voisinage Agreement. Limited amounts of half-grown stock are purchased from the rope mussel segment in extremis while other sources remain technically or economically non-options.

Inputs and Costs

About 7 664 tonnes of seed were transplanted costing a total of €814.3 thousand in 2020. Seed cost is tied in closely with that of vessel, crew and fishing costs. Cost of fishing per tonne of seed averaged €106.25, ranging from €50 to €300 per tonne with distance to seedbed and fishing effort required. Market value of seed per tonne averaged €300. Wages and Salaries costs to the segment in 2020 were estimated as €2.2 million. The average cost of producing 1 tonne of mussels for sale was estimated as €1 260.

Figure 4.14.5 Feed and livestock average prices €/kg for the main Irish segments: 2008-2020



Source: own elaboration from EU Member States DCF data submission, 2022

4.14.5 Outlook

Nowcasts for 2021-22

The annual national survey of Irish aquaculture indicated a recovery of output volume and employment while the number of new businesses continued to grow in the Farmed oyster segment (EUMAP Oyster other) and also the emergence of a new Suspended culture Seaweed segment. Output volume in 2021 is estimated at 42 812 tonnes. Employment for 2021 is estimated at 1950 or FTE of 1 127. Average unit sales values across the segments continued to be less than those achieved in 2019, limiting the total sales value achieved in 2021 to €178.9 million.

Trends and triggers

The salmon segment, over the years of survey, had been caught in a cyclical trend of increasing, then declining production ranging from under 10 000 tonnes to 18 000 tonnes as a result of restraints to licenced area capacity and the fallowing requirements of organically certified production. Capacity increase is hampered by strong opposition to new licences.

Direct on-site employment levels have remained consistent at either side of 200 persons and unit sales value steadily increased until 2018. Costs of feed, stock input and a range of maintenance, supply and other services specific to the industry have increased significantly in 2021.

Up until 2021 Ireland dominated the organic market and could not fully supply it due to its capacity limits. Other larger producing States were less interested in pursuing the organic market until 2021 when the UK (Scotland) announced their intention to do so. This development represents a serious challenge to the Irish salmon segment who need the unit sales value of their product to remain high to cover the greater and increasing costs of production in Ireland, relative to their competitors in the UK. The number of on-growing businesses may remain as for 2021 (5) if the segment can meet the UK organic challenge. The number of stand-alone smolt producing hatcheries has declined from 2008 and the remainder are vulnerable to take over as auxiliary units by the better capitalised Caged salmon businesses.

The oyster segment had been steadily growing in capacity, output volume, sales value, businesses involved and employment sustained until temporarily knocked back by the lockdown period. From 2021 it has resumed growth in all areas except the average unit sales value, although this is expected to grow with a return of consumer confidence and growing market diversity. Capacity increase is also hampered in a number of bays by opposition to new licences but this depends more on the demographic make-up of local population stakeholders in an area, rather than the full-time, principled opposition directed at all times at Irish Salmon farming.

The Suspended mussel sector has also recovered its output and unit sales value for both live market and stock for processing is expected to fully recover by 2022. Under normal circumstances the segment is a steady economic performer. Sales value and volume to a limited extent is expected to gradually increase, though business number engaged and number employed may continue to decline with the amalgamation of units, increased mechanisation and emergence of roving operations crews, servicing more sites. There is little or no opportunity to increase the licenced area capacity of this segment.

The bottom mussel segment continues to be dependent on fluctuating wild seed capture, therefore its future outputs from a technical perspective would be expected to fluctuate with time. Politically the segment is under pressure to reduce its licenced capacity in the face of requirements of other intertidal stakeholders such as Wildbird conservancy agencies looking to increase feeding ground reserves. Employment and number of businesses may remain steady or decline depending on future seed and licenced ground availability and the future market requirements of France and Holland.

The Trout sector has been resilient in the face of unit sales value losses of some product lines (not obvious in average figures) during the lockdown. The sharp increases in energy costs now occurring in 2022 may prove too much for this small land-based segment to bear for protracted periods without support. The sector should otherwise recover its product placement if client spending power and confidence recovers.

COVID-19 impact.

The shellfish segments Oyster other and Suspended mussel were heavily impacted by the lockdown in terms of a lengthy freeze on sales. Most effected were those producers who primarily supplied the hospitality sector. Other markets opened intermittently and at a very reduced level over the period.

Suspended mussel normal sales volumes resumed early in the third quarter of the year and output volume recovered to over 10 000 tonnes but with lower than average sales values achieved.

The oyster segment was harder hit generally as its live products must meet particular specifications of size, weight and shape which can be achieved for a limited period before growing out of the standard. The market closed when many stocks were ready for sale at their top form and opened eventually after the most desired qualities were lost, resulting in sales at reduced prices or below cost. The experience varied from one bay to another with a few fortunate producers having sold their stock for a small size-oriented market before the lockdown set in and others having to sell below cost to clear their sites months later.

The Bottom mussel segment normally have sold their produce before March so escaped the worst of lockdown effects.

The salmon sector had a number of options to deal with the challenging market conditions such as shifting the proportion of top end product sold, towards value for money products and freeze-storing or selling frozen products.

The tiny trout sector lost its premier product placing, vital for its small-scale viability within the retail stores it supplies as cash strapped customers switched to value for money products. The closed down hospitality sector was another important client.

Many smaller employers were unable to pay themselves or their employees over the lockdown and continued employment was mainly safeguarded by several State wage assistance schemes, run over the period.

The lockdown period did not just affect the industry economically but also had detrimental social affects as many small and remote farmers felt isolated by the social distancing requirements. These requirements also hampered certain production operations, reducing employment hours. Managers were compelled in such cases to scale down to essential maintenance activity only, even when some market opportunity presented.

High energy prices

Energy price rises are literally tying up the Irish Fishing sector. For the aquaculture sector, high energy price is one of several inter-related rising costs concerns. All Irish segments export the bulk of their products using increasingly expensive transport, exacerbated by the need to avoid the delay of UK transit. The salmon, farmed oyster and bottom mussel farmers must pay for input and deed stock that is becoming increasingly expensive to produce and therefore purchase or more expensive to capture in the wild, due to increasing fuel costs. Increasing energy costs therefore is the underlying reason for the increasing cost of input stock and the feed needed to grow them. The land-based units meantime are meeting electricity price rises that coupled with diminished product placement, post lockdown, threaten their continuing viability.

Social acceptance

The level of social acceptance in Ireland towards aquaculture generally is poor, relative to those states where aquaculture has been long established and is a part of the cultural fabric such as oyster farming in Arcachon, France, mussel farming in Galicia, Spain or freshwater finfish culture in many parts of central Europe. The industry has a peripheral place at best in the national consciousness and indeed is practiced for the most part, in remoter areas of the country, its activity unnoticed in more populated areas. The industry comes to the attention of the public usually in the form of well aired objections to farther development in the form of new licenced production areas.

There is a strong, well organised and media-familiar anti-fish-farming lobby forming two groupings: Those who oppose salmon farming for alleged threats posed to wild salmon stocks and those who oppose new licences of any aquaculture that are seen to impact their environment, economy or aesthetics of the area. Objectors range from other local stakeholders directly impacted such as inshore fishermen to second home owners to distant objectors dedicated to curbing salmon farm development by default. The industry and its supporters are slowly learning to articulate its case and to partner up with other industries and interests such as tourism, hospitality, the greater food industry and educationalists but the small, fragmented, unintegrated nature of the Irish industry compared to its competitors elsewhere in the EU, restricts its ability to fight its corner.

4.14.6 Data Coverage and Data Quality

Data quality and availability

Production input and costs, output volumes and sale values, along with basic employment data tend to be of good quality with a greater than 80% participation rate in recent surveys of these variables. Such data is available for dissemination from June of the year following that under survey.

Other costs data, such as Energy, Repairs and maintenance and Other operational costs have been difficult to get by questionnaire, up to recently and nearly impossible to obtain online, due to the limited requirement for micro-businesses to submit financial data to the Company Registration Office. This data can require up to 15 months to collect as the online data becomes available over this protracted period.

Data had been collected via census questionnaire, sample questionnaire and online survey which had been time consuming for what could be extracted. A recent Covid-related financial compensation scheme for lost input stock however plus the recent inclusion of the survey as a grant application process requirement has enabled the reduction of the survey effort to a single questionnaire, backed up by an online survey. Returns for traditionally ‘unpopular’ questions on costs have improved from 2021 and are expected to continue to do so.

Data is still received by a combination of interactive return, emailed pdf, post and phone call. Data is still entered manually therefore and errors submitted and uploaded are detected as anomalies in screening tables and their graphics

There remain discrepancies between derivative data for the national report and that for this report suggesting continuing upload formatting difficulties as some figures presented in the tables of this report are incompatible either with the national report figures or knowledge on the ground. A common pool of raw data supplies both reports.

There remain raw data estimates for the salmon industry that are questionable in their significant oscillations year on year. There is a continuing difficulty in extracting certain variable data for the segment

Other data issues or missing data

There are persisting issues of insufficient data or data of insufficient quality for certain variables as mentioned for certain costs variables. There is incomplete data for the native oyster producing (Oyster-on-bottom) sector which in practice, is a type of fishery, controlled by cooperatives of fishers with little or no administrative staff available to field questionnaires.

4.15 Italy

Overview of Italian aquaculture

Italy provides data for all the main production sectors, so the performance figure covers the marine, freshwater and shellfish segments. In 2020, both the volumes and the volume of aquaculture production decreased by 5% and 8% respectively. The volumes sold were 119.5 thousand tonnes for an income exceeding €372.4 million. The first sector in terms of volumes sold is shellfish (74.8 thousand tonnes, followed by freshwater (33.8 thousand tonnes) and marine (about 11 thousand tonnes) which ensure employment for approximately 4 400 employees. The productivity of capital in 2020 was about 40% higher than in 2018 but decreased by 8% between 2019-2020. The profit in 2020 was €144.2 million, an increase of 14% compared to 2018. Net financial costs have been the lowest since 2008, equal to approximately €1.4 million, probably due to a lower recourse to investments. ROI of 2020 was over 60% higher than that of 2018 but decreased by 11% compared to 2019. In any case, the ROI of 2020, equal to 46.4%, still makes the sector a good investment able to attract new capital.

4.15.1 Total Production and sales

Italian aquaculture in 2020 provided a sale in volume of 119 460 tonnes, for a value of €372.4 million. In volume the sales in 2020, compared with average volume of sales between 2008-2019, have decreased by 34%. In 2020, the shellfish and freshwater sectors recorded the decline compared to 2019: they sold less, respectively, by 5% (shellfish segment) and 7% (freshwater segment). The marine segment kept volumes sold slightly stable in 2020: the reduction, in fact, was equal to -2% compared to 2019. Although stable between 2019-2020, the marine sector was the sector that collapsed (-80%) compared to the average sales from 2008-2020. Evaluating the average volumes sold in the long term (2009-2019), the freshwater segment also suffered a 60% contraction in sales, selling approximately 33 400 tonnes in 2020. The shellfish segment recorded the best performance and made the greatest contribution to the entire farmed seafood sector with +60% of product sold on the 2008-2020 average.

4.15.2 Industry structure and total employment

In the two-year period 2019-2020 the number of companies is stable, equal to 582 equal entities. Compared to 2018, the total number decreased by 2%, while on the average for the entire period (2008-2020) it decreased by 7%.

51% of companies are small-sized companies with <5 employees and structured mainly on non-capital forms of companies. In the freshwater and shells sector they are mainly cooperative companies or single-member family businesses. In the marine sector there is a greater presence of companies with employees up to 10 and usually the prevailing legal form is the joint stock company. In the seabream and seabass inland sector, on average, there are no companies with less than 5 employees.

In 2020, the second social data collection was carried out, and 4 378 employees. In percentage terms, the shellfish segment occupies the 79% of employees, followed by the freshwater segment which employs 12.2% of the total and the remaining part (around 9%) works in the marine species segment. From 2018 to 2020, the number of employees decreased by 8%. Compared to the average from 2008 to 2019, the number of employees has decreased by 12%.

Table 4.15.1 Production and sales, industry structure and employment for Italy: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**222.6**	**270.8**	**191.2**	**185.8**	**148.2**	**152.1**	**150.3**	**125.7**	**119.5**	-5%	-34%
Marine	112.1	80.9	70.0	56.1	11.7	14.3	13.0	11.1	10.9	-2%	-80%
Shellfish	12.6	16.2	11.7	24.0	95.6	104.7	96.2	78.5	74.8	-5%	80%
Freshwater	97.9	173.7	109.5	105.7	40.9	33.0	41.1	36.2	33.8	-7%	-60%
Sales value (million €)	**439.5**	**585.3**	**464.9**	**566.9**	**344.9**	**390.8**	**380.3**	**406.8**	**372.4**	-8%	-20%
Marine	257.6	264.0	249.6	239.2	84.6	103.2	95.4	79.8	84.4	6%	-56%
Shellfish	113.2	138.5	79.9	181.0	137.8	183.5	156.0	214.9	185.6	-14%	34%
Freshwater	68.7	182.9	135.3	146.7	122.5	104.1	128.9	112.1	102.4	-9%	-24%
Number of enterprises	**696**	**692**	**587**	**587**	**592**	**592**	**592**	**582**	**582**	0%	-7%
Marine	108	105	70	70	46	46	46	43	43	0%	-38%
Shellfish	318	323	291	291	400	400	400	398	398	0%	16%
Freshwater	270	264	226	226	146	146	146	141	141	0%	-34%
Employment	**4,357**	**5,836**	**5,159**	**5,112**	**4,546**	**4,488**	**4,761**	**4,378**	**4,378**	0%	-12%
Marine	848	999	352	630	373	411	375	389	389	0%	-26%
Shellfish	1,932	4,053	3,892	3,422	3,614	3,546	3,703	3,455	3,455	0%	-2%
Freshwater	1,577	784	915	1,060	559	531	683	534	534	0%	-42%
FTE	**3,428**	**2,839**	**1,938**	**1,695**	**1,893**	**2,128**	**1,609**	**2,042**	**2,042**	0%	-14%
Marine		176	113	141	93	100	109	128	128	0%	-33%
Shellfish	3,296	2,637	1,694	1,454	1,688	1,933	1,361	1,823	1,823	0%	-11%
Freshwater	132	26	131	100	112	95	139	91	91	0%	-46%

Source: EU Member States DCF data submission, 2022.

4.15.3 Overall Economic performance

From 2019 to 2020, total income decreased by 9%, while operating cost increased by 7%. The total wages were reduced by 14% and depreciation of capital decreased by 14%, although resulted in a positive profit of €144.2 million. This net profit was among the highest since 2008, and it scored 52% increase compared to net profits between 2008-2020. Compared to 2019, the total net profit of the three sectors decreased by 23%. The most significant loss was determined by net profit of seabass and seabream cages segment (-79% compared to 2019), equal to €4.1 million (2020).

Table 4.15.2 Economic performance of the Italian aquaculture sector: 2017-2020.

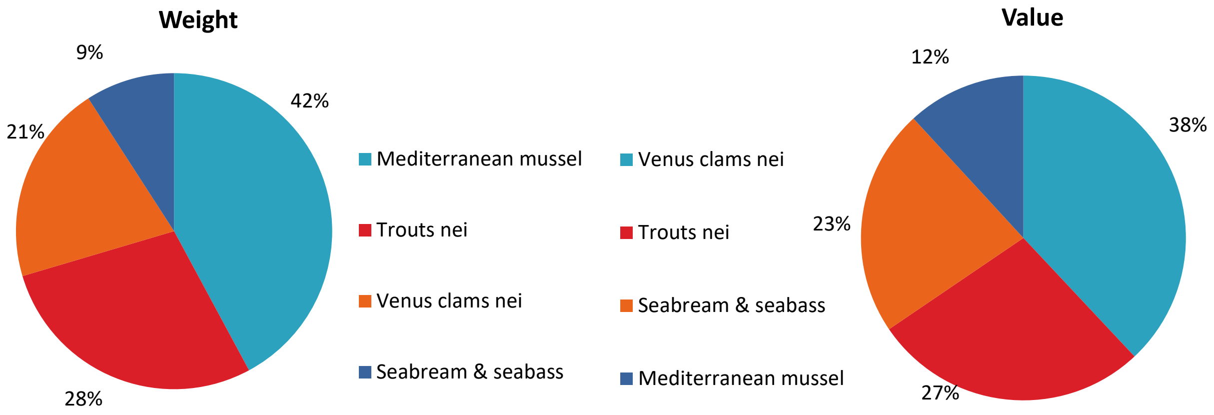
Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Total income	397.4	386.6	410.9	375.3	-9%	-4%
Total operating costs	221.2	244.4	209.7	219.8	5%	-2%
Total wages	67.9	74.6	67.3	57.8	-14%	-14%
Gross Value Added	244.0	216.7	268.5	213.4	-21%	-9%
Depreciation of capital	12.1	13.8	11.5	9.9	-14%	-16%
Earning before interest and taxes	164.0	128.4	189.7	145.7	-23%	-7%
Financial costs, net	1.9	2.2	1.8	1.4	-22%	-23%
Net profit	162.1	126.2	187.9	144.2	-23%	-7%
Total value of assets	399.0	444.8	363.4	313.7	-14%	-18%
Capital productivity (%)	61.2	48.7	73.9	68.0	-8%	8%
Return on Investment (%)	41.1	28.9	52.2	46.4	-11%	10%

Source: own elaboration from EU Member States DCF data submission, 2022.

4.15.4 Main species produced and economic performance by segment

The Italian aquaculture production is characterized by 4 main groups: shellfish, with a prevalence of mussels (42% of total volume, but 12% of total value) and clams (21% of volume and 38% of total value), freshwater, almost totally represented by trout -both white flesh and pink flesh- (28% of total volume and 27% of national total value) and marine species of seabass and seabream (9%of volume and 23% of total value).

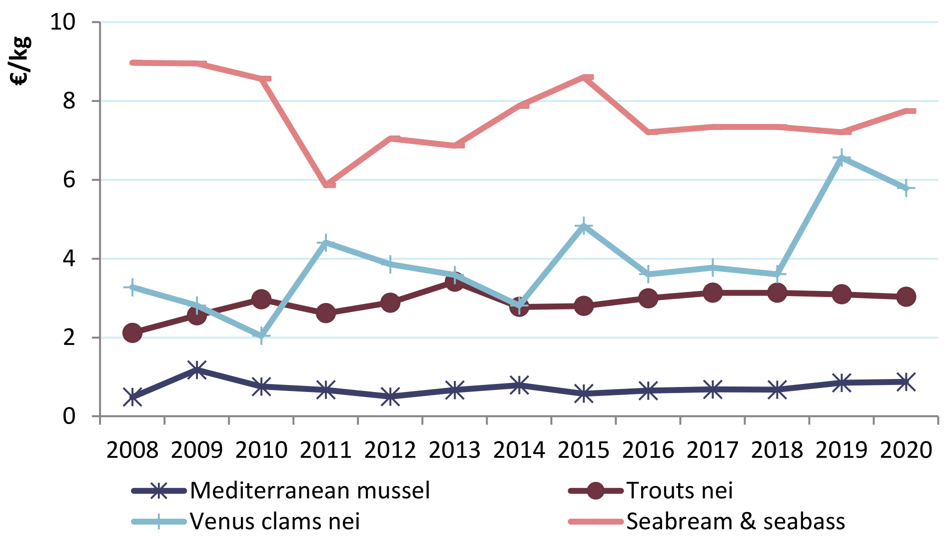
Figure 4.15.1 Main species in terms of weight and value in Italian production: 2020.



Source: EU Member States DCF data submission, 2022.

The production segment with the largest volumes of seafood supply is mussel farming. Although the mussel is very much bought and appreciated by the market, it has continued to have a more constant price trend than the other aquaculture segments. The average price of the mussel, even in the last two years, has not reached €1 per kg. The average price for trout has been rather stationary over the last 5 years, in the last two years it has been just over €3 per kg. Trout farming does not show significant price fluctuations as it provides an established end-market network that does not allow for price increases. The average price trend of the clam records peaks in periods in which the abundance contracts significantly, with a production in volume of about 25 600 tonnes in 2016, and in 2019 with a production of 25 900 thousand, compared to the average production on the five years (2016-2020) of approximately 28.6 thousand tonnes. The seabass and seabream segment represent the one that has high and on average constant prices over the last five years (€7.4 per kg), with an increase of 7% in the last year, reaching €7.7 per kg.

Figure 4.15.2 Average prices (€/kg) for the main species produced in Italy: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Below is a description of the economic performance of the three marine production segments of both shellfish and finfish. The segments within the EUMAP represent the same segments collected in the DCF. The trends for the three segments, therefore, have been available since 2008.

Table 4.15.3 Economic performance of main Italian **Error! Reference source not found.**aquaculture segments: 2017-2020.

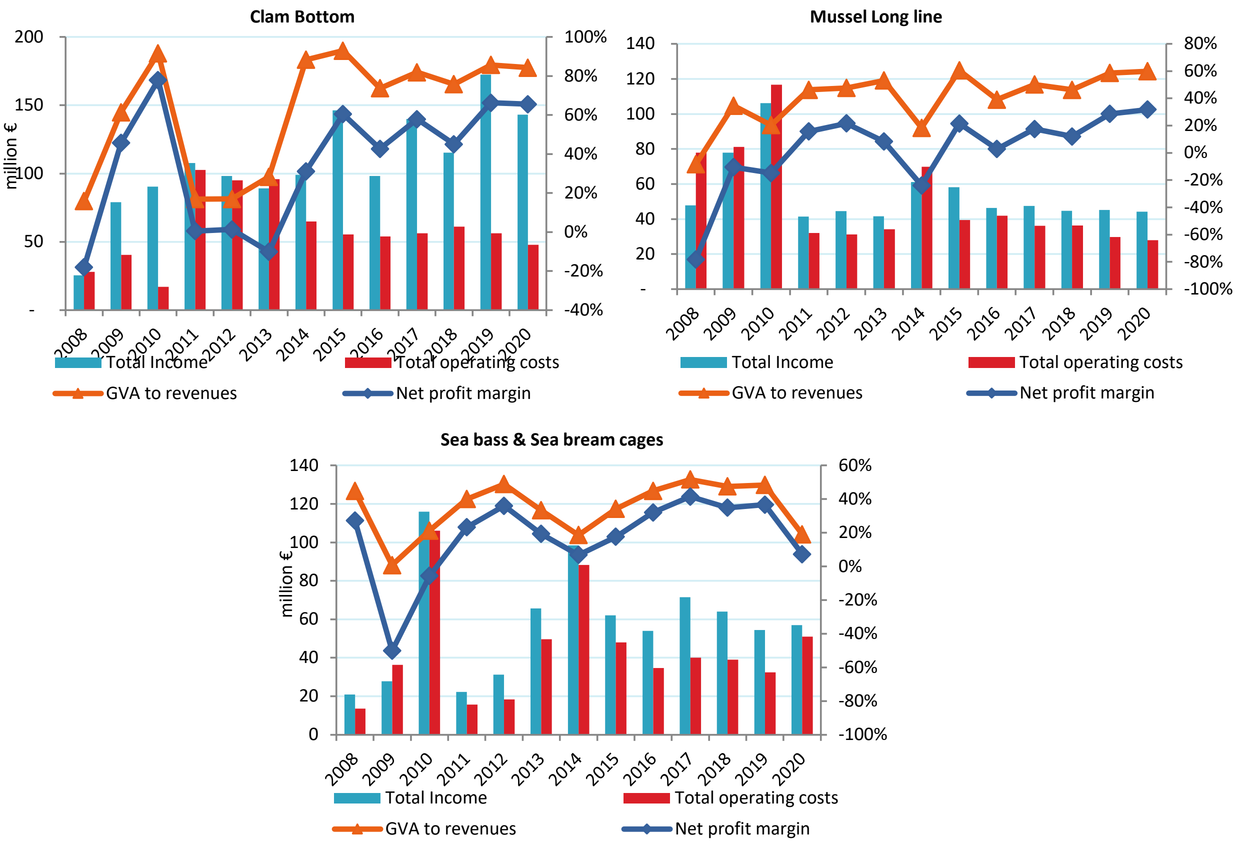
Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Clam On-bottom					**Mussel Longline**				
Number of enterprises	176	176	174	174	0%	224	224	224	224	0%
FTE	953	541	891	891	0%	980	820	932	932	0%
Average wage (thousand €)	32.5	61.4	35.4	28.3	-20%	12.8	14.9	11.9	11.0	-8%
Labour productivity (thousand €)	120.3	161.6	165.8	135.2	-18%	24.3	25.3	28.4	28.5	0%
Total sales volume (thousand tonnes)	36.2	31.1	26.0	24.5	-6%	68.5	65.1	52.5	50.3	-4%
Total income (million €)	140.0	115.3	172.4	143.0	-17%	47.5	44.8	45.2	44.3	-2%
Total operating costs (million €)	56.3	61.1	56.2	47.8	-15%	36.2	36.3	29.8	28.0	-6%
Gross Value Added (million €)	114.6	87.4	147.7	120.5	-18%	23.8	20.7	26.5	26.5	0%
Net profit (million €)	81.0	51.9	114.3	93.8	-18%	8.3	5.4	12.9	14.1	9%
Total value of assets (million €)	74.0	67.8	61.0	51.2	-16%	58.3	60.6	39.4	35.9	-9%
Net investments (million €)	22.9	19.5	17.6	14.1	-20%	18.9	21.4	14.3	11.2	-22%
Capital productivity (%)	155.0	128.9	242.2	235.1		40.9	34.2	67.2	74.0	
Return on Investment (%)	109.5	76.6	187.3	183.0		14.3	8.9	32.8	39.3	
Future Expectation Indicator (%)	27.4	25.4	25.7	24.5		27.3	30.1	30.0	25.0	
	Sea bass & Sea bream cages					**Trout Tanks and race-ways**				
Number of enterprises	24	24	22	22	0%	146	146	141	141	0%
FTE	72	79	68	68	0%	95	139	91	91	0%
Average wage (thousand €)	76.8	69.4	64.5	71.0	10%	119.5	122.3	162.6	144.6	-11%
Labour productivity (thousand €)	513.3	384.8	387.9	159.9	-59%	494.6	408.2	556.4	387.8	-30%
Total sales volume (thousand tonnes)	9.6	8.4	7.4	7.7	3%	33.0	41.1	36.2	33.8	-7%
Total income (million €)	71.6	64.0	54.5	57.1	5%	105.1	129.7	112.5	102.7	-9%
Total operating costs (million €)	40.1	39.1	32.5	51.0	57%	69.5	90.0	76.7	80.6	5%
Gross Value Added (million €)	37.0	30.4	26.4	10.9	-59%	47.0	56.7	50.6	35.3	-30%
Net profit (million €)	29.7	22.3	20.0	4.1	-79%	32.3	35.0	31.5	18.4	-42%
Total value of assets (million €)	72.8	64.2	51.4	52.9	3%	131.2	197.8	168.1	134.5	-20%
Net investments (million €)	9.9	14.7	10.3	8.8	-14%	42.3	58.6	45.1	34.3	-24%
Capital productivity (%)	50.8	47.3	51.4	20.5		35.8	28.7	30.1	26.2	
Return on Investment (%)	40.7	34.8	38.9	7.8		24.6	17.7	18.8	13.7	
Future Expectation Indicator (%)	11.2	18.8	16.1	13.0		29.7	27.2	24.3	22.8	

Source: own elaboration from EU Member States DCF data submission, 2022.

Both shellfish (mussel and clam) and marine finfish segments (seabream & seabass cages) recorded a positive net profit, although for the clam and seabream & seabass cage segments it decreased, respectively, for mussels by 18% and seabream & seabass cages by 79%. In net profit for the mussel segment in 2020 it increased by 9%. The strong contraction recorded in the net profit of the seabream & seabass cages segment, was reflected in the ROI, which fell to 7.8% for 2020, compared to 38.9% recorded in the previous year. For the three segments, net investments fell in 2020, compared to 2019. The effect of a transition year in which companies are finalizing investments made also with public aid from the EMFF, and the slowdown in investments caused by the advent of the pandemic.

The GVA of the seabream & seabass cages segment was (in 2019-2020) lower albeit positive and in absolute value indicator of a good economic performance, and equal to 19% in 2020. The most performing GVA on Revenues was marked by the clam (by 84%, 2020), as has been throughout 2008-2020. The same order of performance was achieved with respect to the net profit margin, which was 66% for clams, mussel longline by 32% and 7% for the marine fish in cages segment seabream & seabass.

Figure 4.15.3 Economic performance indicators (in € million) for the main Italian segments: 2008-2020.

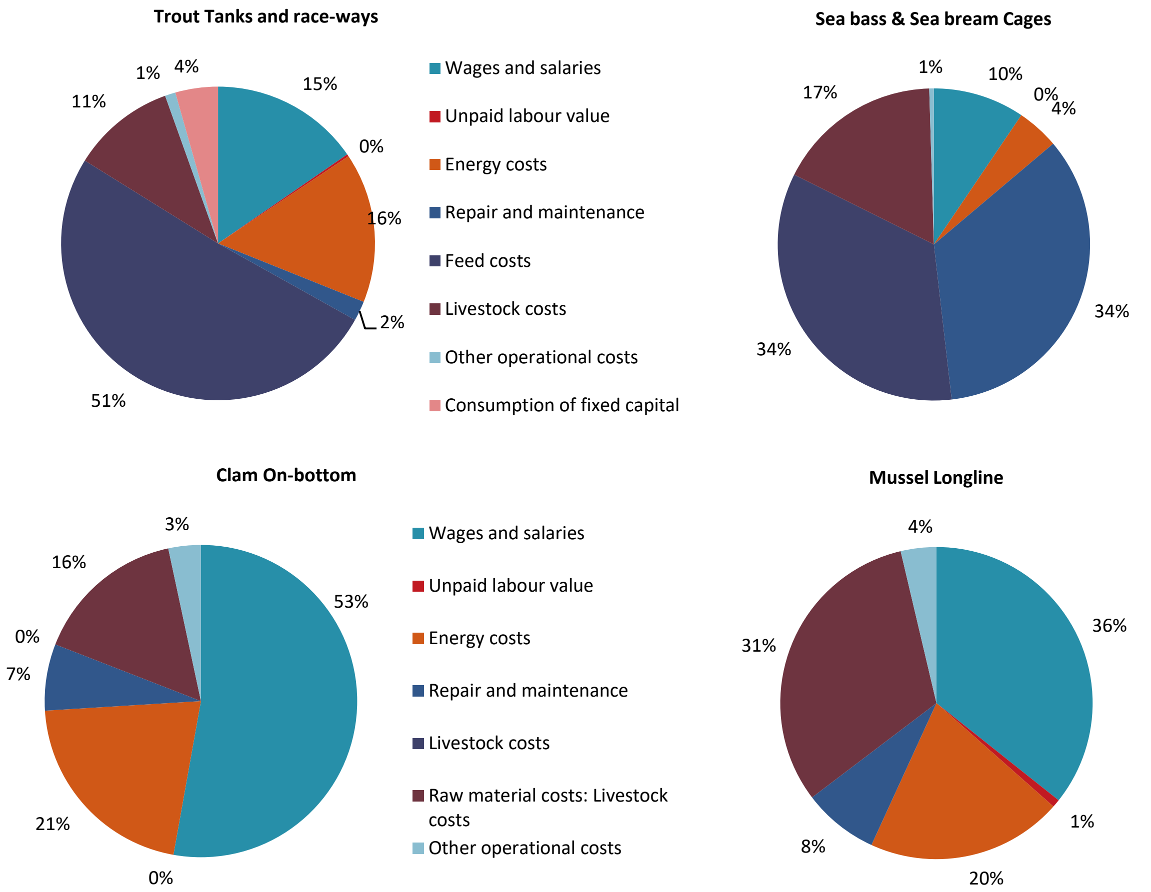


Source: own elaboration from EU Member States DCF data submission, 2022.

The cost structure is quite similar between shellfish and farm finfish. In the trout industry, in 2020, the cost of feed continues to represent the heaviest item (51%). Followed by the cost of energy (16%) and the cost of labour (15%). The strong dependence of the segment on energy costs is evident, which indirectly affect the cost of feed, too. The trout sector, although based mainly on human capital among the main production factors, has a percentage equal to 1/3 compared to the cost of feed and is also lower than the cost for energy. In the seabream & seabass cage segment, about 65% of operating costs are represented equally by feed and repair and maintenance, the latter quadrupling the weight recorded in previous periods in 2020 (in 2018 it was 8%). In the segment, the energy cost stood at the values of the previous period, and in the last year it was equal to 4% of the total operating costs.

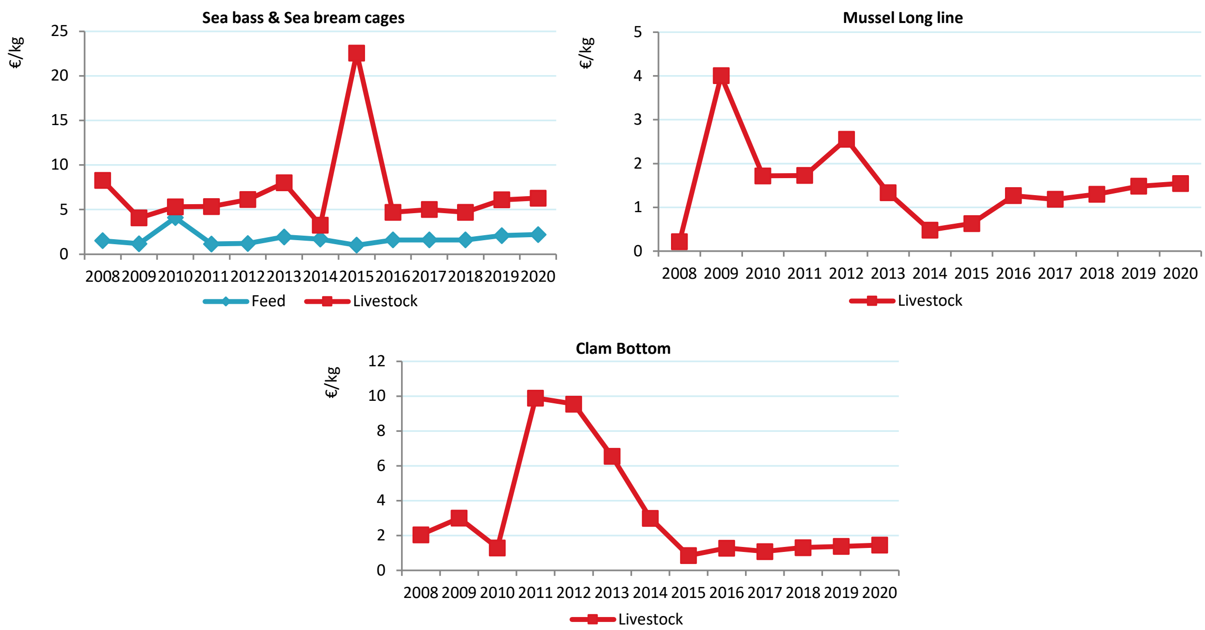
Clams, like mussels, have more than 53% and 36%, respectively, of operating costs represented by personnel costs. Although in some Italian areas exclusive nursery areas have been allocated, the price of seeds remains an item affecting operating costs: 16% for clams and 31% of total operating costs for mussels. For both segments, energy costs are 20% of the total, linked to the typical production structure of the installations, equipped with both service vessels and processing and purification vessels.

Figure 4.15.4 Cost structure of the main segments in Italy: 2020.



Source: EU Member States DCF data submission, 2022.

Figure 4.15.5 Feed and livestock average prices €/kg for the main Italian segments: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

The seabream & seabass cages sector maintains steady increases in the cost of fry and juveniles. The cost of feed, on the other hand, has started to increase since 2016: in 2020, it increased by 10% compared to 2019 and by 20% compared to 2016 (compared to a 3% increase in the volume sold in 2020/2019). The average price of a cage-seeded fry is about 0.20-0.25 per piece, with a preference for fry weighing at least more than 15 grams. The cost of the feed is around €2 per kg. For mussels, the cost of the seed is affected by availability which, due to extraordinary seasonal events, may not guarantee internal demand. In the last two years it has remained at €1.5 per kg, as well as for the clam. The cost of the clam seed appears to be constant over the last five years, while the cost of the mussel seed between 2015-2020 has more than doubled.

4.15.5 Outlook

Nowcasts for 2021-22

The data for 2021 and 2022 were estimated from the forecasts provided by the National Association of aquaculture farmed (API) and from the information received by the Association which mainly represents mussel farmers (AMA). In addition, key informant from one of the leading seabass and seabream cage companies were interviewed.

Trends and triggers

In 2022, however, starting from the first quarter, the freshwater sector suffered a severe crisis due to the difficulty of purchasing feed, due to the restrictions due to the Ukraine-Russian Federation conflict. The strong dependence on imports of fishmeal and fish oil and the poor integration of the supply chain have led to a surge in feed prices (increases of over 35-40% are estimated in 2022). Starting from spring 2022, a further crisis affected land-based aquaculture and in particular the companies operating in freshwater. The problem concerned the state of calamity due to drought associated with an anomalous increase in temperatures of up to + 2°C-+ 5 ° C on average with respect to the seasons. The two aspects caused by the effects of climate change have reversed on production costs and on the management of animal welfare. In 2022, an increase in the mortality rate in the freshwater sector is estimated. Production criticalities are affecting the availability of biomass, especially pink flesh rainbow trout. The ex-farm prices are estimated to increase by about 17-20% for the white flesh trout and up to + 25% for the pink flesh trout. Low biomass availability is impacting the trout processing industry. The market for fillets and processed products of freshwater fish is not a competitor of marine farmed fish. This in perspective represents the risk of a further increase in imported seafood based on salmonids. The weakness that revealed itself during 2021-2022 is the fragmentation and poor interaction between the players in the aquaculture supply chain. For none of the main production segments, particular increases in market shares in Italy or an increase in exported product are expected. Prices, on average, risk not covering production costs in some production segments. In this regard, in some areas of the country they are trying to discuss an ex-farm price that is the same for all producers, and which guarantees the survival of hundreds of small businesses based on a minimum number of employees, but which dot the entire production team. Similarly, the shellfish segment also expects a decrease in volumes, due to the drought which has prevented the enrichment of nutrients in the water. Although temperatures were above seasonal averages, no pathologies or abnormal increases in mortality were recorded for 2022. The Italian sector in 2022 was unable to satisfy consumer demand, and this will certainly determine an increase in seafood imports both from Croatia, a product more appreciated by Italian consumers, and mainly from Spain.

COVID-19 impact

In 2021, aquaculture recovered slightly between the first and second waves of the pandemic. The sectors that recovered greater margins on sales were the mussel and trout sectors. The marine fish segment (seabream & seabass) has maintained better stability in both volumes sold and prices even during the pandemic, as the product follows a more consolidated market mainly sales to large-scale retailers and large wholesalers. In 2021, the positive attitude of consumers towards food products improves, also favoured by the reduction of restriction measures that limited non-domestic consumption. The reopening of the restaurants and the possibility of physically returning to work, has started the phase of recovery of fish consumption and (based on the Report on food consumption of ISMEA 2022) the choice drivers linked to health, well-being, environmental sustainability and to the "conscious" purchase. For the salmonid sector, starting from the 4th quarter of 2021, the market has almost returned to the same level as in the pre-Covid period. The freshwater sector has strengthened the transformation channels of aquaculture production and initiated online sales experiences. At Christmas 2021 ISMEA[28] recorded an increase in fish consumption (both national and imported, both by catch and aquaculture) of + 21% compared to Christmas 2019. By 2022 the effects of COVID on production are totally mitigated, there is no impact on production costs due to the reorganization of the production process based on the contingent number of employees, there are no extra costs to manage the emergency. On the market side, the main threat of not being able to sell has been overcome due to restrictions of a different nature (transport, closure of collective catering, etc.) and until spring 2022 the prospects of returning to full capacity were hoped for and likely. Shellfish farming during 2020-2021 was affected by Covid which contracted both household consumption and the Ho.Re.Ca.

High energy prices

Rising energy costs have affected both marine and inland aquaculture. the increases concerned both direct increases in the cost of diesel, electricity and gas, but also increases in raw materials of fishmeal for feed, fish oil, but also the costs of service materials, such as for example, polystyrene boxes, which increased by 55% from January 2022 to July 2022. From estimates based on interviews with key informants, comparing the average costs of 1 kWh, 1m3 of gas / methane and 1 litre of diesel in 2021 and 2022, total energy costs could have increases in 2022 even higher than 40% compared to 2021. The sector does not show reaction to move towards alternative energy sources which, on the other hand, would lend themselves well to being adopted by aquaculture companies. Although investments have been earmarked for solar energy sources, few aquaculture farms have invested to date. All production segments report increases of more than 30% in the cost of energy, which also include the consumption of oxygen (raw material used in inland companies). In forecast, new materials will be considered as consumables, in particular those based on plastic (socks for mussels, ropes, buoys increased between 2021/2022 up to + 50%).

Social acceptance

In the National Strategic Plan for Aquaculture[29] (NSPA) 2021-2027, an entire chapter has been included in which the lessons learned in the previous programming regarding the social acceptability of aquaculture have been described, and what will be the commitments to achieve further goals regarding this topic. In particular, the importance of improving the acceptability of aquaculture production is recognized. For years, Italy has been dedicated to organizing events and dissemination campaigns and in the future more targeted campaigns will be carried out with national and European relevance, focusing on the initiatives envisaged by the EU. From the lessons learned in the past, the Strategic Plan intends to strengthen the process of sharing with aquaculture farmers to increase their awareness of the advantages of certification, environmental reporting, knowledge of their impacts and the introduction of reduction practices waste, by-product, and the activation of circular economy models. Social acceptability started from the levels of the public authorities that legislate and control aquaculture in Italy. In the previous Programming the process of bureaucratic and administrative simplification was started and the definition of a single framework standard for all the aquaculture production segments. To complete this process in

[28] https://www.ismeamercati.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/11547.
[29] https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/17193.

support of social acceptability, the ITAQUA Platform[30] has been established in which all stakeholder with an interest in aquaculture can make contributions of a technical and scientific scope. Other actions concern and will be further implemented, to support the Regions in sharing national strategic guidelines and to implement them through the activities of regional competence. Social acceptability among local communities takes different forms based on geographic areas. In general, the perception is considerable, where aquaculture generates income directly in local economies. This is the case with the freshwater segment or the marine farming segment. For mussels there is an increase in social acceptability, when producers come together (in consortia or in Producer Organizations) to spread knowledge about their work and the standard of fish supply. National projects have supported social acceptability by launching a series of actions to train new operators in aquaculture and to launch the database of the training offer on aquaculture.

4.15.6 Data Coverage and Data Quality

Data quality and availability

Italian data collection covered the main segment and all data referring to the segment didn't have confidentiality aspects to take in count. The Italian data for EUMAP is, in most cases, in line with value and production registered in FAO and EUROSTAT. The data are collected annually and in aggregate form by species and production technology and are disseminated by the Ministries of Agriculture and Food Sovereignty upon request.

Other data issues or missing data

In this report, the social data of the two collection campaigns have been considered. Social data on FTEs were not reported in this report because they showed significant inconsistencies with respect to the number of employees collected for all segments covered by the Italian data collection. In 2020, the social data show about gender, age, level of education and nationality, for a lower number than the total number of employees in the sector. The difference represents the percentage of unknown data estimated on a sample basis, for which the number of employed persons was acquired, but it was not possible to verify the required data. Data on seabream & seabass cages marine species revealed a significant increase in maintenance and repair costs.

[30] https://piattaformaitaqua.it/

4.16 Latvia

Overview of Latvian aquaculture

Latvian aquaculture sector cultured mainly of freshwater aquaculture species. The primary species cultured in 2020 were Common carp, Rainbow trout and Sturgeon contributing 84% and 80% respectively to the total produced volume and value. The total production volume in 2020 was 832 tonnes corresponding to the value of €4.3 million.

4.16.1 Total Production and sales

During the period from 2015 to 2020, the development of aquaculture in Latvia shows the deterioration trend mainly due to the decrease in the production capacity by 33% between 2018 and 2019 (see Table 4.16.1). However, the production capacity increases again by 21% between 2019 and 2020. The sales value remains rather stable during the same period. The annual total Gross sales of aquaculture production includes sales of fish and crustaceans', sales of juveniles and prepared aquaculture production sold during the reported year, contributing 832 tonnes in volume and value of €4.3 million in 2020.

Production amount of aquaculture products are not restricted with quota or other restrictions, thus, in comparison to fishing, the initiation of business in this sector is simpler. Nevertheless, the development of producing aquaculture is largely hindered by the high production costs of the breeding and the problems with the sales of final products. The main item offered at the market – trade size carps during relatively short summer can usually be grown only in the long three-summer.

4.16.2 Industry structure and total employment

Latvia is rich of the water resources and has a good location of inland waters and a stable, ecologically pure environment, which facilitates the development of aquaculture. The aquaculture enterprises mainly concentrated in the regions of Kurzeme and Vidzeme. A considerable number of agricultural holdings have commenced their business in aquaculture in addition to their other business activity. The main activities of the Latvian aquaculture enterprises are the following:

- Artificial breeding of young fish for restocking in coastal seawater and inland freshwater.
- Fish cultivation in freshwater open land ponds and land-based farms in special tanks and growing up for market sale.
- Short term fish cultivation in freshwater ponds for commercial angling.
- Fish cultivation in household ponds for self-consumption or hobby angling.

For Latvian countryside aquaculture is important business activity and is the employment provision field. The 78 economically active aquaculture enterprises employed 330 persons in 2020 (see Table 4.16.1). The aquaculture sector plays noticeable role in the Latvian regions development. The political and economic instability in the result having relatively little impact on changes of employment level in the aquaculture sector compared to other sectors.

The number of the economically active aquaculture enterprises decreased by 11% between 2015 and 2020. About 90% of enterprises classified as small enterprises where the number of employees is less than 5 people. The total number of persons employed in aquaculture and the number of FTE has increased by 40% and 33% between 2015 and 2020, respectively.

The data was submitted according to the EU-MAP segmentation as the segment "Other freshwater fish Other methods (seg.8.5)" due to the small number of enterprises involved in the aquaculture activity in Latvia. However, the segment includes three fish farming techniques: ponds, tanks and raceways and recirculation systems. Total number of ponds registered for fish farming and its area were 648 ponds and 4 951 ha in 2019. There were 1 194 tanks and raceways with the volume of

15 161 m^3 and 46 recirculation systems with the volume of 9 946 m^3. The use of the recirculation aquaculture systems becoming more popular in recent years.

Table 4.16.1 Production and sales for Latvia: 2015-2020

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**0.6**	**0.5**	**0.6**	**0.7**	**0.8**	**0.8**	**0.8**	**0.6**	**0.7**	18%	8%
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	0%
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	-100%
Freshwater	0.6	0.5	0.6	0.7	0.8	0.8	0.8	0.6	0.7	18%	8%
Sales value (million €)	**1.5**	**1.1**	**1.4**	**1.8**	**2.1**	**2.2**	**2.0**	**1.7**	**2.2**	33%	32%
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	0%
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	-100%
Freshwater	1.5	1.0	1.4	1.8	2.1	2.2	2.0	1.7	2.2	33%	32%

Source: FAO, 2022

4.16.3 Overall Economic performance

The total income from the aquaculture generated by the Latvian aquaculture enterprises decreased by 7% between 2015 and 2020 to €5.8 million including €4.3 million from gross sales per species, €50 thousand from the other income and €1.5 million of subsidies. In its turn, the total operating costs increased by 14% during the same period and was €6.3 million in 2020.

Table 4.16.2 Structure and economic performance of the Latvian aquaculture sector: 2015-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Number of enterprises	88	87	79	78	-1%	-8%
Employment	245	235	323	330	2%	23%
FTE	173	182	175	223	28%	26%
Total income	5.3	6.0	6.1	5.8	-4%	1%
Total operating costs	4.9	5.7	5.6	6.3	12%	17%
Total wages	2.1	2.5	2.4	2.5	7%	9%
Gross Value Added	2.5	2.8	2.8	2.0	-28%	-26%
Depreciation of capital	1.7	1.7	1.7	1.6	-7%	-9%
Earning before interest and taxes	-1.3	-1.5	-1.3	-2.1	-66%	-55%
Financial costs, net	0.0	0.1	0.3	-1.4	-620%	-1117%
Net profit	-1.3	-1.6	-1.5	-0.7	52%	51%
Total value of assets	28.1	28.2	25.7	24.0	-7%	-12%
Capital productivity (%)	8.9	10.0	10.9	8.4	-23%	-15%
Return on Investment (%)	-4.7	-5.2	-4.9	-8.7	-78%	-77%

Source: EU Member States DCF data submission

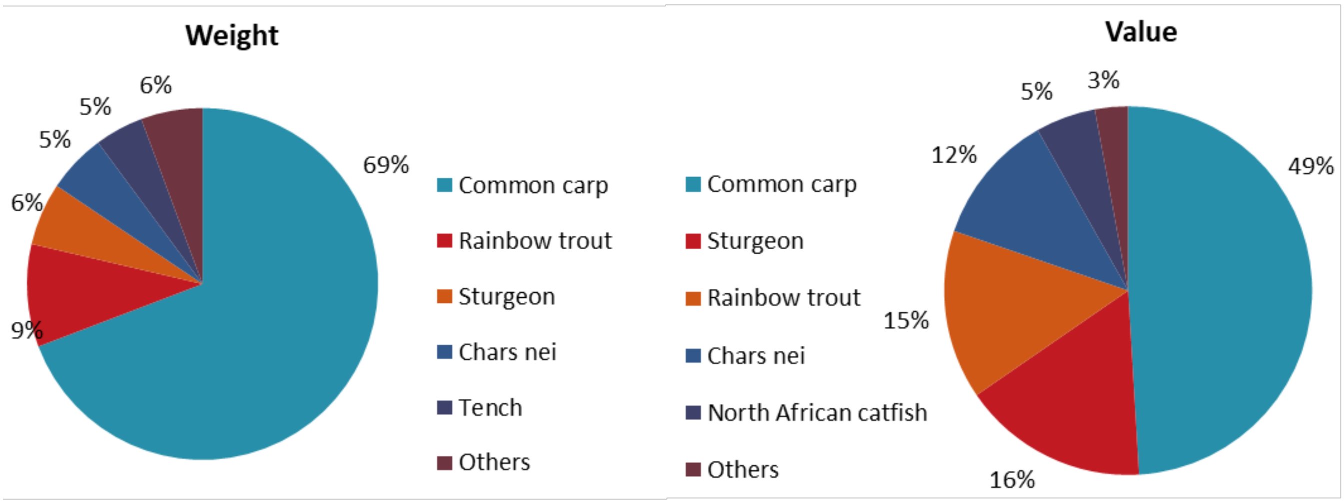
The wages and salaries contribute the largest share to the costs structure or 32%, followed by consumption of fixed capital and Livestock costs with the shares 20% and 13% respectively (Figure 4.16.4). The Energy costs contribute 11% to the total costs structure in 2020.

In terms of profitability the total amount of Gross Value Add (GVA) is €2 million and Net profit of €-0.7 million (Table 4.16.2). The sector show losses annually between 2015 and 2020. The reason could be overestimated declared values for the consumption of fixed capital. There is a possibility that firms that have other activities in addition to aquaculture will attribute all depreciation charges to aquaculture only.

4.16.4 Main species produced and economic performance by segment

Common carp was the main species produced by the Latvian aquaculture sector representing 69% in weight and 49% in value of the total production in 2020 (Figure 4.16.1). Other important species are Rainbow trout and Sturgeon covering 9% and 6% of weight respectively and 15% and 16% of value respectively in 2020.

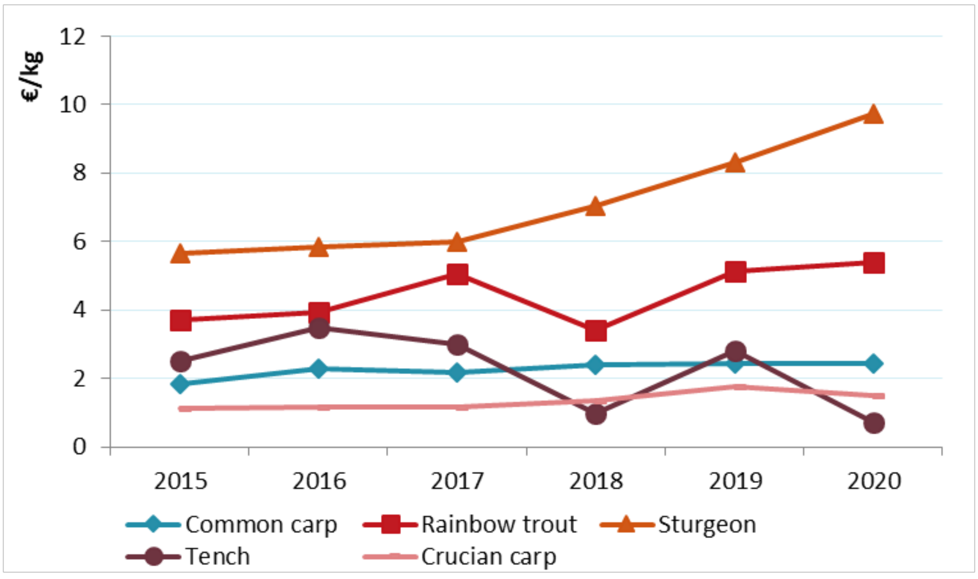
Figure 4.16.1 Main species in terms of weight and value in Latvian production: 2020



Source: EU Member States DCF data submission, 2022.

Compared to 2015, the average first-sale price for aquaculture products in Latvia has been increased from €3.2 up to €5.2 per Kg. The average price for Common carp, Rainbow trout and Sturgeon was €2.4, €5.4 and €9.7 per Kg, respectively in 2020 (see Figure 4.16.2). The average prices for Sturgeon and Rainbow trout demonstrate an increasing trend between 2015-2020.

Figure 4.16.2 Average prices €/kg for the main species produced in Latvia: 2015-2020.

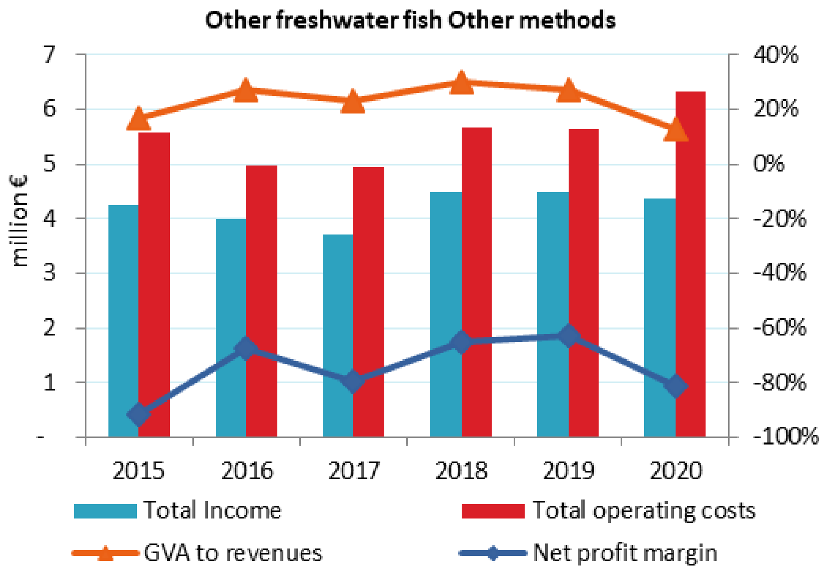


Source: EU Member States DCF data submission, 2022.

The section by the segment cannot be provided in whole detail due to the small number of enterprises in the aquaculture sector. The data was submitted according to the EU-MAP segmentation in table 9 as one segment "Other freshwater fish Other methods (seg.8.5)".

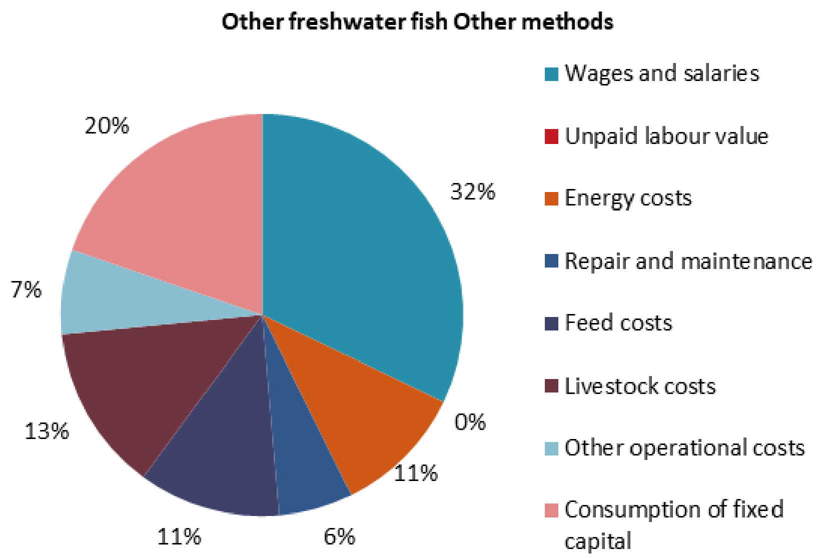
Full description and information with the relevant references to the tables and figures are provided under main section.

Figure 4.16.3 Economic performance indicators (in € million) for the main Latvian segments: 2015-2020.



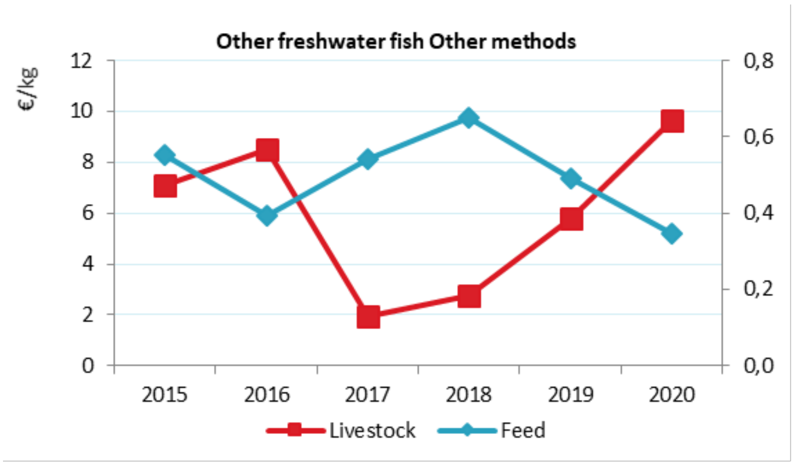
Source: EU Member States DCF data submission, 2022.

Figure 4.16.4 Cost structure of the main segments in Latvia: 2020.



Source: EU Member States DCF data submission, 2022.

Figure 4.16.5 Feed and livestock average prices €/kg for the main Latvian segments: 2015-2020.



Source: EU Member States DCF data submission, 2022.

4.16.5 Data Coverage and Data Quality

The freshwater data collection is not mandatory for Latvia under the EU-MAP because the total production in the country is less than 1% of the total Union production volume and value. However, Central Statistical Bureau of Latvia (CSB) carries out data collection for the aquaculture sector. The variables such as produced production by species in tonnes and value, total area of fishponds, volume of rearing tanks and number of employments, economic variables are included in the questionnaire form “1- Aquaculture”.

The CSB gathers also structural business statistic data extracting the information from official account reports received from enterprises (according to the EUROSTAT definition under NACE Rev. code. 0322 “Freshwater aquaculture”.

Due to the small number of aquaculture enterprises and data confidentiality protection the collected data clustered in one segment “Other freshwater fish Other methods (seg.8.5)”.

4.17 Lithuania

Overview of Lithuanian aquaculture

In 2020 Lithuanian aquaculture industry produced 4.5 thousand tonnes of freshwater fish production corresponding to €13.8 million. Compared to 2019, weight and value of production increased by 6% and 2% respectively. Total number of employees increased to 431, corresponding to 298 FTE.

4.17.1 Total Production and sales

In 2020, Lithuanian aquaculture industry produced 4.5 thousand tonnes (FAO, 2022) of freshwater fish production corresponding to €13.8 million value. Compared to 2019 total value of aquaculture production increased by 2% whereas volume was 6% higher. Total value of aquaculture production has been constantly increasing from 2010. For example, compare to 2010, weight of the total aquaculture production increased by 40.4% in 2020, whereas value improved by 131% during the same period (FAO data). The main part of aquaculture production is generated from the ponds, tanks and raceways – 84% of total quantity produced. Total weight of pond production, compare to 2019 increased by 3.3% whereas value remained unchanged with 0.1% increase. However, RAS aquaculture maintained the growth trend with 25.6% increase in weight and 25.4% increase in value compare to 2019.

Table 4.17.1 Production and sales for Lithuania: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 19-20	Develop. 2020/(08-19)
Production weight (thousand tonnes)	**3.0**	**3.2**	**3.6**	**3.8**	**4.4**	**3.7**	**3.7**	**4.2**	**4.5**	***6%***	***19%***
Marine	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	3.0	3.2	3.6	3.8	4.4	3.7	3.7	4.2	4.5	6%	19%
Production value (million €)	**6.6**	**6.1**	**7.7**	**8.9**	**12.2**	**12.2**	**12.4**	**13.5**	**13.8**	***2%***	***45%***
Marine	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	6.6	6.1	7.7	8.9	12.2	12.2	12.4	13.5	13.8	2%	45%

Source: FAO, 2022.

In 2020 from the total production, 89% was sold in the internal market. Compare to 2019, volume of exports declined by 7% to 515.3 tonnes and has a decreasing trend since 2008. Decline in exports was mainly related to the restrictions of live production exports to Poland, which is the one of the main export markets of pond aquaculture producers. In 2020, the largest export market was Latvia - 63% of total exported production.

4.17.2 Industry structure and total employment

Main segments

Lithuanian aquaculture sector consisted of 61 aquaculture units. Sector is subdivided to three main segments. The largest segment consists of freshwater species produced in ponds (including tanks and raceways) and it represents the largest share of national production – 84% of total weight and 78% of total value. It targets mainly carp, sturgeon, rainbow trout as main species and other freshwater species in less extent and contributed to the 78% of national production in terms of value. Around 24% of total pond production was certified as organically produced. In 2020, pond aquaculture enterprises generated around €105 thousand net profit with 1% net profit margin, which decreased significantly compare to 2019 when net profit margin was 5%. Decline in profitability was mostly related to the COVID-19 outbreak and pandemic control measures.

African catfish produced in RAS is the second largest segment, contributing to 11% of national aquaculture production weight and 12% of total production value in 2020. Other freshwater species produced in RAS compose third segment which contributes to the national totals with 5% of production weight and 10% of value. It supplies broader variety of high added value species, mainly rainbow trout, European eel, tilapia, Alpine char etc. RAS aquaculture units are on the growth stage with increased capital related costs. In 2020 RAS enterprises generated around €1.1 million net loss.

Total capacity of ponds consisted of 10.2 thousand ha area from which 5.8 thousand ha were used for regular production and 4.4 thousand ha were certified for organic production. Compare to 2019 total area of ponds increased by 2.2%. Pond aquaculture units also exploit tanks and raceways which in 2020 were accounted for 8.3 thousand m^3, with 7% increase from 2019. Total volume of RAS in 2020 decreased by 3.6% to 6.3 thousand m^3.

In 2020, aquaculture sector employed 431 persons corresponding to 298 FTE. Total number of employees increased by 1% compared to 2019, whereas FTE declined by 3.2%. Pond aquaculture units employed 312 persons, 6% decline compare to 2019 and 8% decrease in FTE. Decrease in the employment was resulted by COVID-19 crisis as activities were temporarily closed. Number of employees in RAS in 2020 increased by 25%, mostly due to the new entities involved in the production. The main driver of increase in the employment was establishment of new RAS aquaculture units, whereas pond aquaculture enterprises have a slightly decreasing trend in the recent years. In 2020 distribution of employment by age was dominant in 40-64 age group representing 63% of total employed. Around 23% of total employees falls to 25–39 age group, whereas 15-24 age group contributed to 6% of total employees and 8% was older than 65. Male and female gender distribution was 75% and 25% respectively. Based on the employment status survey, around 90% of total employees are involved in the activity as main employment and 10% as non-main employment including seasonal work.

In aquaculture sector labour productivity in terms of value of production per FTE increased by 8% and reached €47.4 thousand per FTE. In 2020 pond aquaculture labour productivity was €46.6 thousand per FTE with 9% annual increase, whereas RAS labour productivity was €50.6 thousand per FTE with 2% annual increase.

4.17.3 Main species produced

In 2020, carp production was predominant in terms of production weight and value accounting for 74% and 62% of national totals respectively. Compare to 2019 carp production increased by 6% to 3.31 thousand tonnes. In 2020, average first-sale price for fresh common carp for consumption decreased by 4% to €2.64 per Kg without VAT. Carps are usually grown in polyculture with other cyprinids as bighead carp, white amur, tench and other freshwater species as European pike and European catfish. Value of carp production has a tendency to increase due to the investments to fish processing in aquaculture farms and generating higher value products compare to the fresh production.

The second most important species in terms of production weight was African catfish. In 2020, Lithuanian aquaculture sector produced 478 tonnes of African catfish with 53.4% increase from 2019, whereas value increased by 43.6%. Average market price for fresh-chilled African catfish in 2020 remained stable - €2.74 per Kg without VAT. Around 25% of African catfish production from aquaculture units are sold as fresh, whereas 75% is supplied to the processing industry.

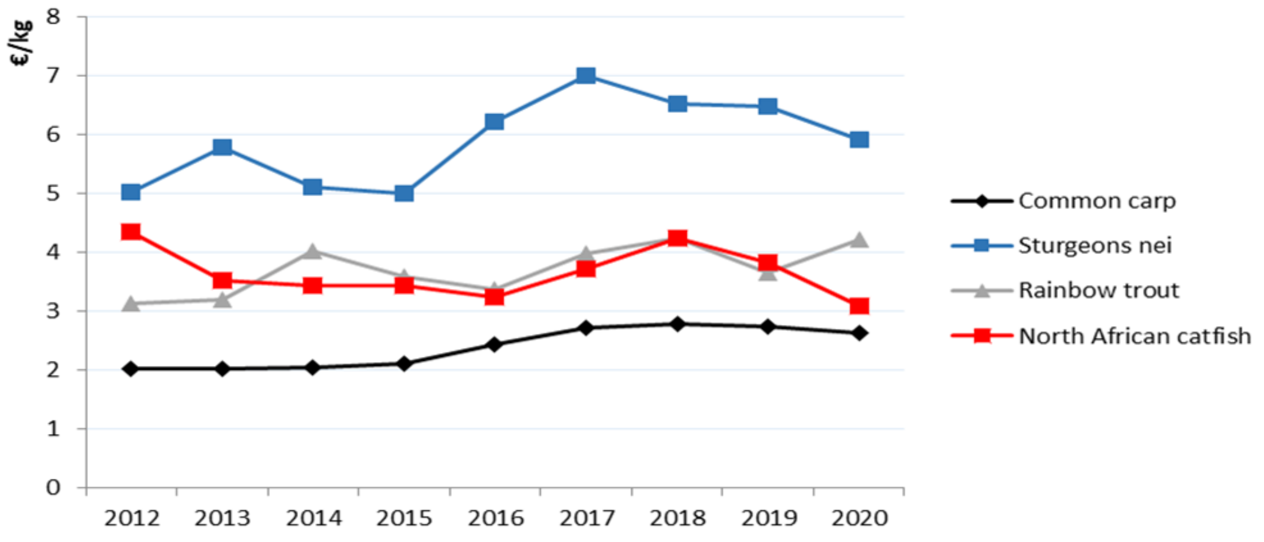
Rainbow trout was third largest species produced by aquaculture industry corresponding to 132.8 tonnes of annual production. Compare to 2019 rainbow trout production volume and value declined by 27% and 16%, respectively. In 2020 around 73% of total rainbow trout for consumption is sold in the market as fresh-chilled. Compare to 2019, average price for fresh rainbow trout increased by 18% €3.86 per Kg without VAT. From the total rainbow trout production, 63% is produced in RAS, whereas rest part comes from ponds, open raceways and tanks.

In 2020, aquaculture farms produced 98.2 tonnes of sturgeons and compared to 2019 weight and value of production dropped by 43% and 48%, respectively. In 2020, the average price for fresh-chilled sturgeon in the internal market for consumption was €5.29 per Kg without VAT and compare to 2019 it improved by 12%.

Figure 4.17.1 Main species in terms of weight and value in Lithuania production: 2020.

Source: FAO, 2022.

Figure 4.17.2 Average prices for the main species produced in Lithuania: 2012-2020.



Source: FAO, 2022.

4.17.4 Outlook

Nowcast for 2021-22

Based on official LAFPMIS statistics total aquaculture production in 2021 increased by 14.6% to 5.1 thousand tonnes corresponding to €16.4 million value with 16.4% increase compare to 2020. Weight of RAS production increased by 51% in 2021. Result was influenced by contribution of new producers as well as increase of sales in large scale RAS units. Pond aquaculture production improved by 7%. Number of employees decreased by 2%, whereas FTE declined by 5% compare to 2020. Average prices for the major species had a tendency to increase in 2021. For instance, average price (production for consumption) of carp improved by 7% to €2.83 per kg, rainbow trout by 17% to €4.9 per kg, sturgeons by 7% to €6 per kg. However, average price for African catfish after record high supply from producers decreased by 9%.

Based on primary official LAFPMIS data, weight of aquaculture production sales is tending to decrease in 2022. For example, during 2022 for the months January to June in comparison to 2021 January to June period, weight of aquaculture production decreased by 17%, whereas value of production improved by 1%. Such tendency was mostly driven by impacts of war in Ukraine on the global energy and agricultural markets. Remarkable increase in energy products, cereals and fish feed resulted in higher farm-gate prices. For example, in first half of 2022, average prices of carp increased by 30%, African catfish by 3%, sturgeons by 36% and rainbow trout by 2% compare to 2021. Based on the preliminary 2022 data, annual aquaculture production is expected to decrease by 10% in volume and 1% in value, compare to 2021. In comparison to 2020, aquaculture production volume and value in 2022 is foreseen to increase by 2% and 15%, respectively.

Trends and triggers

Lithuanian aquaculture production has a growing trend, industry adjusts to different market conditions and consumer demands. Pond aquaculture has a developed stable production capacity which results in constant production quantities with increasing diversification to processed fish production. RAS segment is developing its capacity and constantly increasing supply to market, mostly with the processed aquaculture production. RAS aquaculture has a niche segment and supplies market with fresh production of species as Alpine char, whiteleg shrimps, red claw crayfish and tilapia.

Main drivers for growth:

- Support for investments in aquaculture (EMFF, EMFAF), both for the introduction of new production capacities and for the modernization of existing capacities and the acquisition of more advanced technologies, especially with the aim of increasing the quality of produced products, increasing added value and diversifying supply.
- Higher demand of aquaculture production in the domestic market, increased consumption of fisheries products.
- Diversification of income by vertical integration through fish processing facilities, catering and direct sales to consumers.
- Development of e-marketing of aquaculture products.
- Adaptation of aquaculture technologies to the consumer needs for newly developed aquaculture products and variety of species.
- Maintenance of the cultural heritage and supply the market with traditional products.

Main challenges:

- Decreasing trend of aquaculture production export since 2010. The main export products were juveniles for on-growing and fresh aquaculture production.
- Increasing energy prices, which reduce competitiveness of production especially from RAS systems.
- Shortage of qualified employees, due to the strengthening of negative demographic trends in the country.

COVID-19 impact

Based on the 2020 and 2021 data on aquaculture production, sales of production has a tendency to increase compare to the previous years. For example compare to 2019, volume of total aquaculture production in 2020 increased by 6% and further increased by 14% in 2021. However, net profitability of pond aquaculture segment in 2020 declined remarkably to 1% of net profit margin, compare to 5% in 2019. Decline of profitability is associated with additional costs in management of COVID-19 crisis. Despite the growth of production volume and values in RAS segment during 2019-2021 period, COVID-19 control measures as closure of local markets and the restriction of the movement of buyers had a significant impact on the sales of products to smaller aquaculture farms, which mainly produce African catfish and rainbow trout in small scale RAS systems. Although the sale of food products was not banned by measures of pandemic control, the closure of local markets significantly reduced buyers' access to marketed products. Companies in this segment depend on direct consumers who buy products directly from companies or in the local markets.

4.17.5 Data Coverage and Data Quality

Aquaculture sector in Lithuania consists only of the freshwater aquaculture. For the analysis FAO data was used. Data for 2021 and 2022 is taken from Lithuanian Agricultural and Food market Information System (LAFPMIS), data is included in the Official Statistics Programme of Lithuania.

4.18 Malta

Overview of Maltese aquaculture

In 2020, the Maltese aquaculture industry produced 19.8 thousand tonnes of marine fish corresponding to €215.4 million in sales value. Compared to 2019, sales weight and value increased by 43% and 33%, respectively. The total number of employees was 410 in 2020, corresponding to 300 FTE.

4.18.1 Total Production and sales

The sector is solely dependent on marine fish aquaculture. In 2020 sales output amounted to 19.8 thousand tonnes of marine fish, a 43% increase over 2019. Output in 2019, decreased by 28%. This drop marks a break in the increasing trend observed since 2008, though figures from 2020 show a quick recovery, so much so that production in 2020 is the highest level of output recorded since 2018. Similar movements were observed in turnover as sales value increased by 43% (€215.4 million) in 2020 over 2019, further showing the rapid recovery in activity over the 2019 drop, such a figure is also 82% above the 2008-2019 average.

Table 4.18.1 Production and sales, industry structure and employment for Malta: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**6.7**	**5.4**	**7.0**	**8.6**	**13.7**	**15.7**	**19.3**	**13.8**	**19.8**	43%	98%
Marine	6.7	5.4	7.0	8.6	13.6	15.7	19.3	13.8	19.8	43%	99%
Shellfish	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	0	0	0	0	0.1	0	0	0	0	0%	-100%
Sales value (million €)	**93.6**	**54.3**	**83.2**	**97.3**	**164.0**	**180.4**	**242.7**	**161.9**	**215.4**	33%	83%
Marine	93.6	54.3	83.2	97.3	163.1	180.4	242.7	161.9	215.4	33%	84%
Shellfish	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	0	0	0	0	0.9	0	0	0	0	0%	-100%
Number of enterprises	**6**	**6**	**6**	**6**	**6**	**7**	**7**	**9**	**9**	0%	40%
Marine	6	6	6	6	5	7	7	9	9	0%	44%
Freshwater	0	0	0	0	1	0	0	0	0	0%	-100%
Employment	**221**	**227**	**167**	**179**	**224**	**256**	**320**	**341**	**410**	20%	83%
Marine	221	227	167	179	221	256	320	341	410	20%	83%
Freshwater	0	0	0	0	3	0	0	0	0	0%	-100%
FTE	**169**	**161**	**153**	**153**	**224**	**216**	**258**	**292.65**	**300**	3%	56%
Marine	169	161	153	153	221	216	258	292.65	300	3%	57%
Freshwater	0	0	0	0	3	0	0	0	0	0%	-100%

Source: EU Member States DCF data submission, 2022.

4.18.2 Industry structure and total employment

Seven aquaculture enterprises operated in both 2019 and 2020. In total one can find; 6 enterprises that operate solely in tuna caging; 1 enterprise that operates solely with Sea Bass & Sea Bream cages; and 1 enterprise that has multiple operations in tuna caging, Sea Bass & Sea Bream cages, and caging of other marine species. This structure remains the same as in 2017 and 2018 respectively.

The number of employed individuals in the sector as of 2014 has been gradually increasing each year, with 2020 marking the highest number of employed personnel in the current time series. The main driver for such an increase is the significant increase in output, as even with an ongoing global pandemic that has affected the operation, costs and trade, the enterprises still managed to increase their productivity and generate higher turnover. Furthermore, when compared to the 2008-2019 period average, employment is 83% higher. In 2020, the Maltese aquaculture sector employed 410 individuals, corresponding to 300 FTEs.

Although employment figures increased, FTE in 2020 showed only a 3% increase compared to 2019, implying a potential higher engagement of part-time/reduced-hour employees.

4.18.3 Overall Economic performance

In 2020, total income increased by 32% over the previous year, recovering quickly from the decline in income incurred in 2019 (32%) and showing that output demand and sales remained prevalent even during the peak pandemic period. Overall, the sector's operating costs decreased (30%), as decreases in energy and livestock costs were the major drivers behind the drop. Although production increased significantly major expenditure sources either remained stable or decreased to the previous year. This contrast in increase in production to a decrease in cost, particularly livestock costs, derives from the sharp decline in the local prices of Blue Fin Tuna during the pandemic. At the same time, the export prices of the international market of fattened tuna remained significantly higher than the local price and therefore allowed enterprises to increase their turnover.

Such a scenario has obviously benefited the profitability of the industry, so much so that in 2020, the aquaculture industry registered record-high net profits, a 265% increase from the previous year and an overall net loss position. Unsurprisingly, Gross value Added (GVA) and Capital productivity followed the same trends as Net Profit since they were negative in 2019 but significantly recovering in 2020 with respective increases of 413% and 165%.

Variations in expenditure, capital costs and capital value were observed when compared to previous years. These variations from year to year are probably derived from the fact that the population is very small and only a few segments are present within the sector, thus any significant change in any of the enterprises or segment may result in a large variation in data.

Table 4.18.2 Economic performance of the Maltese aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Total income	180.4	242.7	164.9	217.6	32%	11%
Total operating costs	210.2	236.2	202.3	140.8	-30%	-35%
Total wages	4.9	8.6	9.5	10.1	6%	31%
Gross Value Added	-24.8	15.1	-27.8	86.9	413%	795%
Depreciation of capital	2.0	4.2	4.7	4.4	-7%	20%
Earning before interest and taxes	-31.8	2.3	-42.0	72.4	272%	403%
Financial costs, net	0.0	0.0	0.9	1.6	72%	416%
Net profit	-31.8	2.3	-43.0	70.8	265%	393%
Total value of assets	41.5	44.9	57.4	274.0	377%	472%
Capital productivity (%)	-59.9	33.7	-48.4	31.7	165%	227%
Return on Investment (%)	-76.7	5.1	-73.3	26.4	136%	155%

Source: own elaboration from EU Member States DCF data submission, 2022.

4.18.4 Main species produced and economic performance by segment

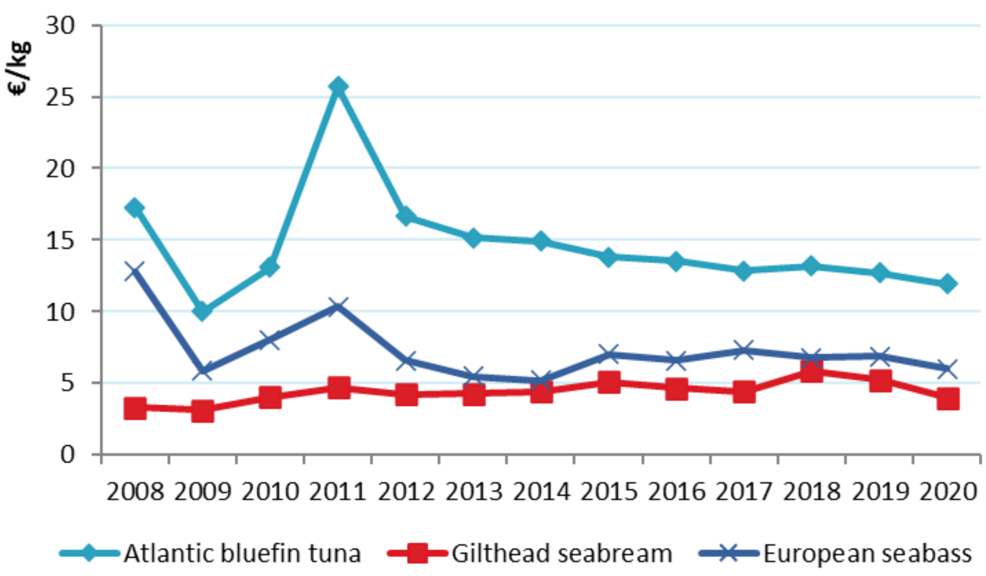
The aquaculture industry in Malta is solely marine-based. The greatest part of production volume and value is by far attributed to the capture-based aquaculture for Atlantic Bluefin tuna since it represents around 86% and 95% of the entire sector's output respectively. Following this, other important segment is Gilthead seabream, which accounts for around 14% of total production volume and 5% of the total value. Other species include the Greater amberjack and the European seabass, which all together account only for less than 1% of both total volume and total value.

On a regional scale, Malta attributes for low volumes of seabass and seabream and other species except for Bluefin tuna. Bluefin tuna fattening attributes for a significant share in the Mediterranean.

Figure 4.18.1 Main species in terms of weight and value in Malta production: 2020.

Source: EU Member States DCF data submission, 2022.

Figure 4.18.2 Average prices €/kg for the main species produced in Malta: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Bluefin tuna is the dominated species for the Maltese aquaculture. It receives very high prices especially in the Japanese and South-Korean markets, which are the main markets for this species. It is noted however, that since 2011 the average price is showing a marginal decreasing trend.

The lowest average price per kilogram remained for the Gilthead seabream, the second most important species. The trend in the prices of Gilthead seabream is practically unchanged in the entire period recorded.

The price of European seabass tends to fluctuate over the years being reported, although over since 2015 fluctuations have been of minor magnitudes.

4.18.5 Economic performance by segment

The largest segment in the Maltese aquaculture sector is the tuna caging segment with six out of the seven enterprises operating within this segment. Atlantic Bluefin Tuna is captured in the wild and fattened in the offshore cages.

In 2020, total income for this segment increased by 34% over 2019 (€206.2 million). As mentioned earlier the decrease in livestock costs for this segment pushed incurred operational costs down by 23% (€131.8 million) thus creating a profitable performance for the year over the net loss position incurred in 2019.

The GVA in 2020 amounted to €83.1 million, a significant recovery of the negative GVA recorded in the year prior. Net profits also followed a similar pattern given the variations in income and costs mentioned above. Following the significant increase in investments recorded in 2017 and 2018, investment levels have stabilised back to normal levels in both 2019 and 2020. Interestingly in 2020 the value of assets of this segment considerably increases, this may be because capital expenditure/investment in 2017 and 2018 respectively have materialised in 2020 and pushed this indicator to record highs.

Capital indicators such Capital productivity (31.9%), ROI (26.3) and the Future Expectation indicator (-1.1) have all improve over 2019.

Variations in expenditure, capital costs and capital value were observed when compared to previous years. These variations from year to year probably derived from the fact that the population is very small (only 6 enterprises in total) and thus any significant change in any of the enterprises would result in a large variation in data.

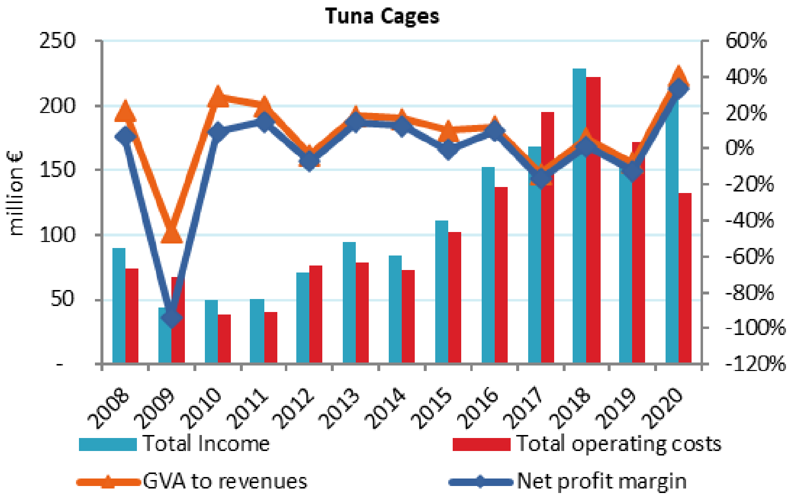
Labour productivity in terms of value of production per FTE increased by 480% in 2020 and reached €323.3 thousand per employee. Yet again the segment's very positive recovery from 2019 has pushed figures to record highs. The average wage remained relatively stable increasing by 5% (€34.2 thousand) over 2019 (€32.5 thousand).

Table 4.18.3 Economic performance of main Maltese aquaculture segments: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Tuna Cages						
Number of enterprises	6	6	6	6	0%	0%
FTE	153	198	144	257	78%	56%
Average wage (thousand €)	22.5	33.1	32.5	34.2	5%	16%
Labour productivity (thousand €)	-153.6	65.5	-85.1	323.3	480%	660%
Total sales volume (thousand tonnes)	13.1	17.3	12.0	17.1	43%	21%
Total income (million €)	168.4	228.6	154.2	206.2	34%	12%
Total operating costs (million €)	195.3	222.2	171.2	131.8	-23%	-33%
Gross Value Added (million €)	-23.5	13.0	-12.3	83.1	776%	1192%
Net profit (million €)	-28.5	2.8	-19.1	68.7	460%	560%
Total value of assets (million €)	33.4	37.8	31.8	260.8	719%	659%
Net investments (million €)	7.8	9.6	1.5	1.2	-21%	-81%
Capital productivity (%)	-70.3	34.3	-38.6	31.9		
Return on Investment (%)	-85.3	7.3	-60.0	26.3		
Future Expectation Indicator (%)	18.6	15.9	-3.4	-1.1		

Source: own elaboration from EU Member States DCF data submission, 2022.

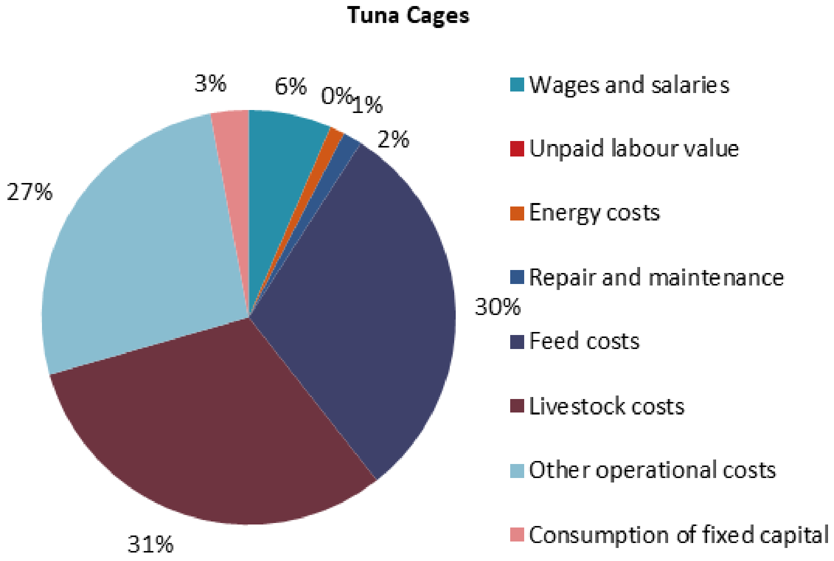
Figure 4.18.3 Economic performance indicators (in € million) for the main Maltese segment: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

The structure of operating costs for the main sector of Maltese aquaculture, the tuna cage, shows that three expenditures represent more than 85% of the total costs. The main expenditure is the livestock cost which accounts for 31% of the total costs of the sector followed by the feed costs (30%) and other operational costs (27%).

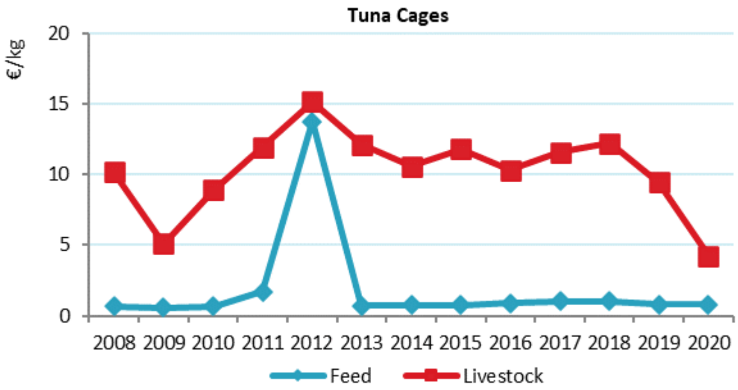
Figure 4.18.4 Cost structure of the main segment in Malta: 2020.



Source: EU Member States DCF data submission, 2022.

As note in the Fig. 4.18.5, the unit price for feed has been relatively stable since 2013, on the other hand livestock costs has been on a decreasing trend since 2018, reaching record lows in 2020 with an average price of €4.30 per kg. This sharp drop was derived by the Covid-19 pandemic and shifts in demand that occurred because of events such a border closures, closing of restaurants etc.

Figure 4.18.5 Feed and livestock average prices €/kg for the main Maltese segment: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

The second most important segment is the marine production of sea bass and seabream in cages. This sector consists only of one firm. Thus, for confidentiality reasons its economic performance shall not be provided.

4.18.6 Outlook

Based on preliminary figures, it is expected that production will slightly decrease in 2021 by circa 17%, though such figures often fluctuate based on opening stocks and livestock purchased for the year, it may be the case that in previous years stocks held were much higher than in 2021 for example. In fact, it should be noted that since 2018 output values have been following a sequential trend of increases and decreases. This implies that for 2022, should the same trend follow productions levels should relatively increase. On the other in terms of sales value, it appears that although production may have decreased in 2021, turnover remained relatively stable with only a -2% decrease. For 2022, this implies a positive foundation to maintain or further increase income, at the same time increasing costs for energy, and transport/logistics may impact the cost structure of the industry. Furthermore, given that the increases in TAC for Bluefin Tuna made in ICCAT recommendation 17-07 are still prevalent, the potential increases further support and act as a driver to increase the production capacity of the Maltese aquaculture companies operating in this segment.

With market prices of Atlantic Blue Fin Tuna recovering in 2021 post-pandemic it is expected that the costs for livestock shall increase and re-stabilise in the coming years, with the cost fluctuating mainly due to increase in livestock purchased. Since the prices of feed rarely fluctuates significantly, keeping all other factors constant expenditure should remain fairly stable. In 2022, such costs may increase due to increases in the transportation/logistics of importing feed not locally sourced, caused by the Ukraine-Russia conflict.

Furthermore, it is expected that energy cost shall increase, also because of the Ukraine-Russia conflict. Although the Maltese Government is subsidising energy for non-duty-free fuel, aquaculture operators purchase fuel that is duty-free and therefore are subjected to the changes in energy market prices which has been on an increasing trend in 2022.

In terms of employment, preliminary data for 2021 shows that the sector is looking to shift is labour force towards individual employed on a full-time basis as whilst employment decreased by 10%, the FTE increase by circa 6%. In 2022, employment may be susceptible to structural changes based on this recruitment policy and on the variations in cost structures mentioned above.

Malta has launched its Multiannual National Plan for the Development of Sustainable Aquaculture (MNPSA) for 2022-2030 period. This plan incorporates the core objectives of the: European Green Deal (EGD), the Farm to Fork Strategy, the Biodiversity Strategy, the Ecosystem Approach to Aquaculture (EAA) and the Zero-pollution ambition for a toxic-free environment. This MNPSA ‘lays out a framework of operations, to ensure that the aquaculture industry and all relevant stakeholders in Malta continue to progress and strengthen despite the existing global challenges that are affecting this sector. The vision and goals presented in Malta's plan have been devised with the international and blue economy context in mind. Achievement set by the plan in terms of sustainable growth, food security and sectoral resilience are expected to positively impact output and the overall growth of the industry'.

One of the specified objectives of the MNPSA 2022-2030 is 'Ensuring social acceptance and consumer information'. The MNPSA identifies the following challenges:

- Communication
    - Lack of consumer understanding with respect to the health and environmental benefits of aquaculture.
    - Improving public perception, building trust and address issues on food security through educational campaigns.
    - Involvement of local stakeholder in the planning of aquaculture activities.
    - More synergies are required with existing and potential ancillary services (both directly/indirectly related to aquaculture).
- Nutritional value, quality, and safety of aquaculture products
    - Lack of understanding of the quality and nutritional value of aquaculture produce and the advantages of consuming short supply chain produce on health and the environment.
    - Lack of understanding of the environmental protection, animal health and welfare involved in the industry.
- Stakeholder involvement
    - The need for more involvement of stakeholder in the sustainable development of the aquaculture industry
- Monitoring statistics and information
    - Ensure that the collection of aquaculture data (economic, environmental, operation etc.) is of the highest quality
    - The need to develop a legal framework to ensure the collection of quality data.

4.18.7 Data Coverage and Data Quality

In Malta, the aquaculture sector is divided into two main segments, these being:

- Sea bass and sea bream cages
- Other marine fish cages

However, due to the limited number of enterprises, only one, in the sea bass and sea bream cages sector, it is not possible to present data on this segment, due to confidentiality reasons.

Data quality is assured given that data collected through surveys is also cross-checked not only by the Ministry collecting the data from aquaculture operators but also by Malta's National Statistics Office (NSO). Any query raised by the Ministry/NSO with respect to the data submitted is re-checked with the aquaculture operators.

4.19 The Netherlands

Overview of Dutch aquaculture

The Dutch aquaculture sector is dominated by shellfish (blue mussel and oysters) produced in marine coastal waters. Furthermore freshwater fish is produced by a rather small group of companies growing different kind of species like eel, yellowtail kingfish, catfish and a few other species. Marine aquaculture fish (finfish) is not produced in the Netherlands. The aquaculture sector produced around 39.8 thousand tonnes of fish in 2020 and value was around €84 million including freshwater (DCF figures 2020 and FAO figures 2020). Blue mussel was by far the largest of both shellfish species with a 93% (31.5 thousand tonnes) of the total weight sales and 84% (€50.3 million) of total gross sales in 2020. After difficult years with minimal net profits of almost €5.0 million (2019), the year of 2020 resulted into a higher net profit of almost €10.0 million for the Dutch mussel sector. The net profit margin increased from 11% (2019) to 20% (2020). For 2021, it is expected that economic performance by the Dutch shellfish aquaculture will be lower, production volume, value as well as lower total costs shows a result of €8 million (-€2 million). Compared to 2020 the projected total sales value decreased as a result of lower average prices. Production is not growing, mainly due to a high mortality rate and slower growing (and therefore later readiness to harvest and market) of shellfish, compared to other MS producing similar species. In the Netherlands there is also some production of freshwater aquaculture fish. The number of companies producing aquaculture fresh fish is limited. Until now there was no data collection programme to gather economic data for this segment and it is an issue how to present performance of this subsector of aquaculture, taking into account privacy. Only a few companies are involved in this segment. In order to get a “best practice” total overview of the aquaculture sector in the Netherlands, FAO data are used to estimate production volume and value for this segment, which was approximately 5.1 thousand tonnes volume and sales are estimated at €29.1 million in 2020.

For the economic structure (cost and income indicators) only data for segment 10.11 (mussels on-bottom) were included for 2019 and 2020. The financial (operating) costs for segment 11.11 (oysters on-bottom) were lacking for these both years and therefore excluded for the economic performance indicators in this report. The segment of freshwater aquaculture is not included as this segment is not participating in the DCF for the Netherlands. Therefore, figures and tables should be interpreted with caution. The years 2017-2020 are just about shellfish, in this case only blue mussels.

4.19.1 Total Production and sales

According to FAO statistics the Dutch aquaculture sector produced a total of 39.8 thousand tonnes of shellfish and fish in 2020, which corresponded to a decrease of 14% compared to 2019. The total production value was around €82.5 million in 2020 (-2% from 2019). Compared to the annual average for the three years before, the volume of shellfish and freshwater fish production (weight) decreased by 11% in 2020. The total sales value (in euro) of shellfish decreased by 26% in 2020 compared to that three year time period.

4.19.2 Industry structure and total employment

In 2020 (Table 4.7.1), the total population of mussel and oyster aquaculture farms was 63, distributed over mussel production (42 companies) and oyster production (21 companies). The Dutch aquaculture sector is dominated by small enterprises (97%) with less than 5 employees. In total 210 persons were active within the Dutch shellfish producing companies in 2021. This was slightly less (-2%) to the previous year. Most of the persons were employed in the mussel producing companies (148 employees) in 2020. In total 12 persons were registered as unpaid labour. The other 50 employees were active in the oyster companies. Since all persons working in the shellfish are full time employed, the FTE is equal to the number of persons. Despite the dominance of individual operating shellfish companies, recently (2019-2020) there were a couple of joint ventures within the Dutch shellfish aquaculture industry. Processing companies did vertically integrate by buying out some shellfish producing or/and other shellfish processor companies. It is expected that this development of consolidation will continue in the nearby future as larger shellfish companies want to reduce risks of lacking raw materials throughout the seasons. Consolidation could also be a strategy by companies to strengthen their sales by diversifying their distribution channels and to scale (up) sales volumes.

Table 4.19.1 Production and sales, industry structure and employment for the Netherlands: 2008-2020

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**46.9**	**66.9**	**46.1**	**63.0**	**62.1**	**52.1**	**53.4**	**46.3**	**39.8**	-14%	-26%
Marine	0.1	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0%	30%
Shellfish	38.2	60.2	42.5	57.4	56.7	46.6	48.2	40.8	34.8	-15%	-27%
Freshwater	8.7	6.5	3.4	5.5	5.3	5.3	5.0	5.3	4.9	-8%	-15%
Sales value (million €)	**97.9**	**106.9**	**92.6**	**97.7**	**87.2**	**98.7**	**100.8**	**84.1**	**82.5**	-2%	-13%
Marine	0.6	2.4	1.5	0.9	1.4	1.5	1.5	2.3	2.3	0%	56%
Shellfish	67.6	73.4	72.3	73.8	60.2	65.4	66.9	52.7	53.5	1%	-20%
Freshwater	29.7	31.0	18.8	23.0	25.7	31.8	32.3	29.1	26.8	-8%	-2%

Source: EU Member States DCF data submission, 2022.

4.19.3 Overall Economic performance

For the economic performance the data of financial (operating) costs for segment 11.11 (oysters on-bottom) were lacking for 2019 and 2020. Therefore only segment 10.11 (mussels on-bottom) was included for the economic performance. The DCF data were used to analyse these results.

From 2019 to 2020, total income (excluding oysters) increased by 7% to a total of €50.3 million. Majority (94%) of this total consisted of gross sales where the rest (6%) was contributed by other income.

Table 4.19.2 Economic performance of the Dutch aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Number of enterprises	67	67	62	61	-2%	-7%
Employment	234	231	213	210	-2%	-7%
FTE	234.5	231.1	213.1	209.7	-2%	-7%
Total income	52.3	57.2	47.0	50.3	7%	-4%
Total operating costs	44.3	41.7	40.1	38.3	-4%	-9%
Total wages	15.0	14.3	13.1	12.9	-1%	-8%
Gross Value Added	23.1	29.9	19.9	24.9	25%	3%
Depreciation of capital	3.3	3.8	2.2	2.1	-1%	-31%
Earning before interest and taxes	4.7	11.8	4.7	9.9	111%	40%
Financial costs, net	2.3	2.5	1.5	1.5	-1%	-27%
Net profit	2.5	9.3	3.1	8.3	166%	68%
Total value of assets	97.4	104.3	115.2	112.8	-2%	7%
Capital productivity (%)	23.7	28.7	17.3	22.1	28%	-5%
Return on Investment (%)	4.9	11.3	4.1	8.7	115%	30%

Source: own elaboration from EU Member States DCF data submission, 2022.

The expenditures (excluding oysters) also known as total operating costs were in total €38.3 million in 2020. This was a 4% decrease from 2019 but a 9% decrease compared to the annually average expenditures from the last three years (2017-2019).

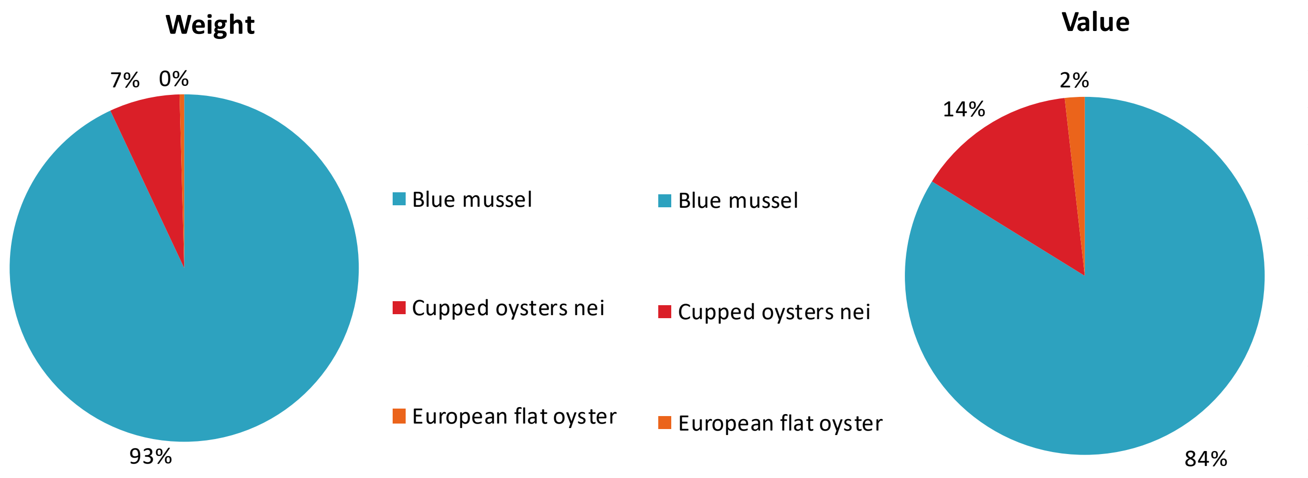
In 2020 expenditures were dominated by other operational costs (43%) and energy costs (32%). All costs decreased between 2019 and 2020 however the largest contribution of decreased total expenditure was affected by the energy costs (-35%, €-1.7 million) because of the lower fuel prices in that year. In Table 4.7.2, total wages is demonstrated with minus 1% from the last year. Total wages is the sum of two expenditure indicators: 1) imputed value and unpaid labour and 2) wages and salaries.

The gross value added (excluding oysters) increased by 25% from 2019 to 2020. This large increase could be explained by higher income (+7%, €+3.3 million) and lower repair and maintenance operating costs (-4%, €-0.2 million). Net profit was more than two and a half times higher (+166%, €10 million) in 2020 compared to the previous year. The total value of assets decreased with 2% to €112.8 million in 2020. The total level of debts decreased with 2% (to a total of €70 million) over the same period.

4.19.4 Main species produced and economic performance by segment

Dutch aquaculture is dominated by the shellfish sector as the largest in sales weight and in sales value. The cultivated shellfish species could be differentiated between mussels (*Mytilus edulis*) and oysters (*Ostrea edulis* and *Crassostrea gigas*). Production of shellfish takes place in the coastal areas with a concentration in the South-Western province of Zeeland and the Wadden Sea.

Figure 4.19.1 Main species in terms of weight and value in Dutch production: 2020.



Source: EU Member States DCF data submission, 2022.

In 2020, total sales weight of Dutch shellfish decreased (-15%) in one year to 34.8 thousand tonnes. Compared to the average from a three years period (2017-2019, 45.2 thousand tonnes) it was a 23% decrease from the average annual production weight. In terms of value, total sales increased (1%) to almost €54 million in 2020. Total sales decreased by 14% compared to the last three years average.

Aquaculture production in the Netherlands can be divided into three main segments:

- Segment 1: blue mussel on bottom cultures
- Segment 2: oysters on bottom cultures
- Segment 3: finfish, mainly European eel, yellowtail kingfish and catfish

Segment 1: Within this sector, blue mussel (Mytilus Edulis) is the most important species in total sales volume (weight) and sales (value). In 2020, the blue mussel had a share of 93% of the total shellfish weight of production and 84% of total sales (value) (Figure 4.19.1). This division was and is stable from last ten years. Due to the growing use of the mussel seed collectors, the supply of mussel seed becomes more and more stabilized. The mussel sector (31.5 thousand tonnes) is by far larger than the oyster sector (3.3 thousand tonnes) in total sales volume in 2020.

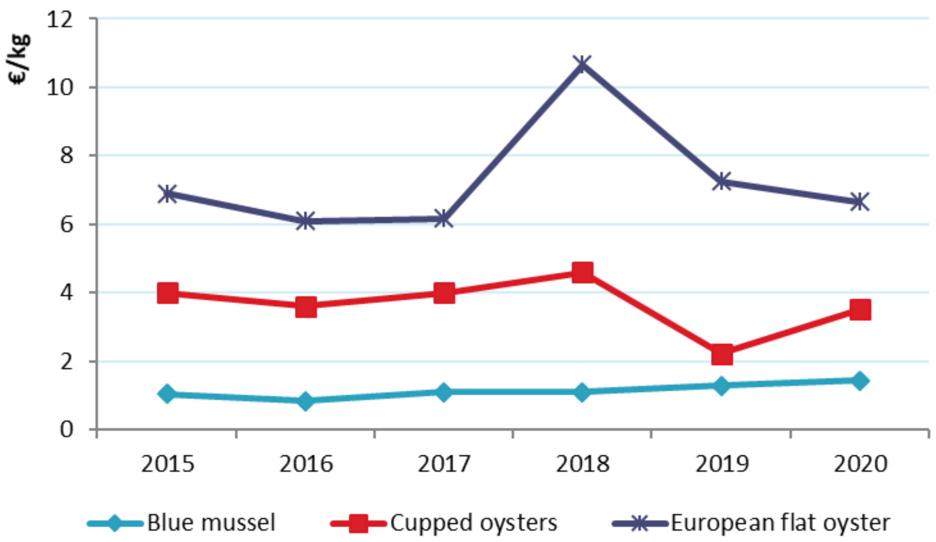
Segment 2: Oyster production had a share of 7% (3.0 thousand tonnes) of the total sales of weight in 2020 (Figure 4.7.1). The other cultivated species was the European flat oyster with a 1% (0.3 thousand tonnes) of the total shellfish weight. Total sales of all oysters were €3.4 million, around 16% of total sales.

Segment 3: From 2015, the finfish aquaculture sector (mainly European eel and catfish) is unfortunately not participating anymore in the DCF. A rough estimation could be made based on the numbers at the website of NEVEVI as the Dutch association for finfish aquaculture. In 2020, there were an estimated 25 companies active in this segment with estimated total sales volume of 5 thousand tonnes and an estimated total sales value of €30 million in 2020.

The average price for mussels in 2020 was €1.60 (+11%). The average annual price (euro/kilogram) for Dutch blue mussel fluctuated the last ten years (Figure 4.19.2). Highest average price was in 2013 with a price of €1.96 per kg, the lowest was €0.83 per kg in 2016. In 2017 and 2018, the price was stable at €1.09 per kg. The most common indicators for the price for Dutch blue mussels were the quality (mussel meat and size of shelf), time of year to be harvested (consumption ready or not in summer as high season) and competition from other MS for supply of blue mussels. While profit margin was high in 2008 (52%), it decreased to a very small profit 4% in 2016 and improved to 16% in 2018. In particular, higher costs like investments for mussel seed collectors and high mortality rate were reasons of lower profit margins.

The average price of cupped oysters is estimated at around €3 per kg, while the price of the European flat oyster is estimated at more than €6 per kg. The production volume of this flat oyster specie however is on a rather low level, in the last few years around 0.3 thousand tonnes and also in 2020. The volume of sales from other MS is far more larger than the Dutch volume. In Figure 4.19.2, we can see that prices decreased since a few years ago. Unless that oysters are more and more perceived as a premium product for out-of-home consumption and presented as an experience in restaurants and bars. It is often consumed as a raw (live and fresh) product. In contrary to aging consumers of mussels, oysters are getting more attention by young people according to the Dutch trading companies of oysters.

Figure 4.19.2 Average prices €/kg for the main species produced in the Netherlands: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Table 4.19.3 includes only segment of mussel on bottom (segment 10.11). For the year 2020 and also previous years, no data about costs were available for the segment of oysters on bottom (segment 11.11).

Segment: Mussel on bottom

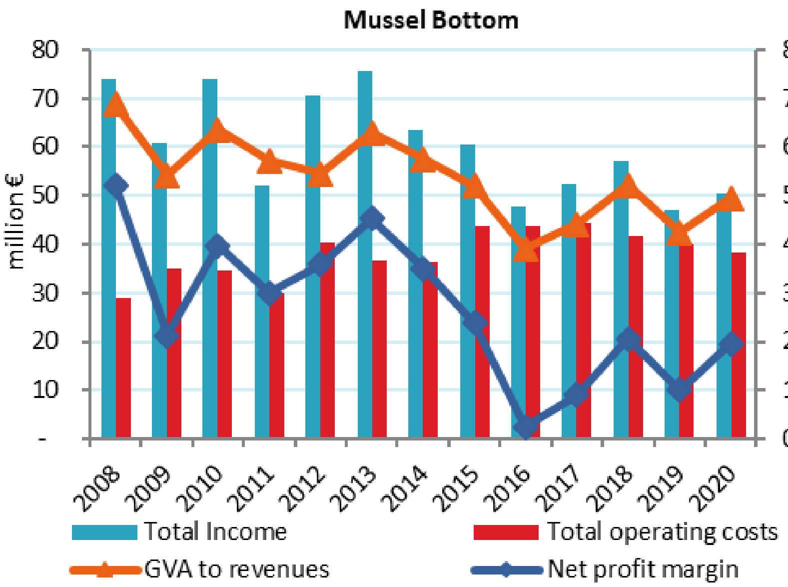
- In Table 4.19.3 it is demonstrated that there were 42 Dutch mussel enterprises in 2020. One less than in 2019. In particular single family owned companies are vulnerable to consolidation by larger companies in the sector.
- The profitability of the Dutch mussel sector improved in 2020 compared to 2019 with an increase of 111% of net profit to a total of almost €10.0 million.
- The average wage rose by 1% and net investments were at a low level (less than €0.5 million)
- Despite lower sales volume in 2020 (-5%) total income increased by 7% to €50.3 million. The average price/kg increased by 13% (Figure 4.19.2).
- In Figure 4.19.3 it is shown that the GVA to revenues increased by 25%. The net profit margin was positive and increased by 111%.
- Figure 4.19.4 provides an overview of the cost structure (including consumption of fixed capital). The main costs were other operational costs (41%) and wages and salaries (30%) in 2020. Within other operational costs, rental costs for the area where the mussels are farmed are important, as well as the costs that relate to the mussel seed collectors. In an agreement with the Dutch Ministry and environmental NGOs, the mussel sector started a transition from wild seed fisheries to sustainable alternatives (mussel seed collectors) which must be completely effective in the Waddensea in the year 2029. Although the collectors work quite well and guarantee a quite stable mussel seed production, the work requires a lot of labour. Beside that, the costs are rather high to collect the seed and innovation projects must result in cheaper alternatives to collect seed.
- No figure with feed and livestock is provided to show the average price per kg mussel seed. Since there is almost no trade in mussel seed at all. The costs that come with the mussel seed collectors are included in “other operational costs”.

Table 4.19.3 Economic performance of main Dutch aquaculture segment: 2008-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Mussel Bottom						
Number of enterprises	48	48	43	42	-2%	-9%
FTE	184	181	163	160	-2%	-9%
Average wage (thousand €)	81.4	79.2	80.1	81.0	1%	1%
Labour productivity (thousand €)	125.1	165.1	122.0	156.1	28%	14%
Total sales volume (thousand tonnes)	43.9	49.3	33.2	31.5	-5%	-25%
Total income (million €)	52.3	57.2	47.0	50.3	7%	-4%
Total operating costs (million €)	44.3	41.7	40.1	38.3	-4%	-9%
Gross Value Added (million €)	23.1	29.9	19.9	24.9	25%	3%
Net profit (million €)	4.7	11.8	4.7	9.9	111%	40%
Total value of assets (million €)	97.4	104.3	115.2	112.8	-2%	7%
Net investments (million €)	5.8	1.2	0.3	0.4	7%	-85%
Capital productivity (%)	23.7	28.7	17.3	22.1		
Return on Investment (%)	4.9	11.3	4.1	8.7		
Future Expectation Indicator (%)	2.6	-2.4	-1.6	-1.6		

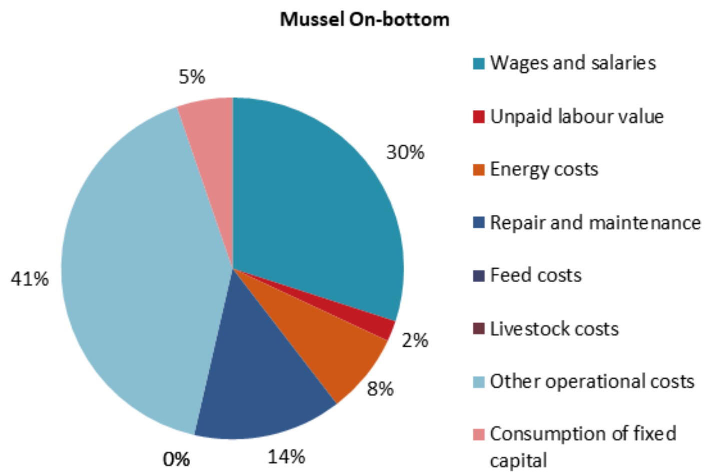
Source: own elaboration from EU Member States DCF data submission, 2022.

Figure 4.19.3 Economic performance indicators (in € million) for the main Dutch segment: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Figure 4.19.4 Cost structure of the main segment in the Netherlands: 2020.



Source: EU Member States DCF data submission, 2022.

4.19.5 Outlook

Nowcasts for 2021-22

The nowcasts are based on figures including the fresh fish aquaculture production. In 2021, the sales weight is expected to be around 37 thousand tonnes of shellfish. This means a lower production compared to the last few years. The total sales value is expected to decrease to a total of €75.3 million (-10%) in 2021. A lower average price/kg is expected (-10%). Because of some lower costs profit will be some less than €9 million, lower (-€1 million) than in 2020. The high mortality rate and slower growing (therefore smaller shells with less mussel meat) of Dutch mussels are main reasons for the expected slightly lower economic performance in 2021. For oysters the sales weight and prices will remain about the same. High mortality rates and more competition from other MS with faster growing oysters and therefore more price competitive to the EU market is stagnating the production in the Netherlands.

In 2022, the sales weight is expected to be around 5% higher compared to 2021, around 39 thousand tonnes of shellfish and fresh fish. The total sales will be around €96 million (+27%) because of much higher prices. Profit therefore will increase to an amount of around €20-25 million, depending on the development of costs.

It is expected that the combination of mussel seed collection by bottom trawling and other technologies will improve the seed supply in future. In the last 10 years production of seed by collection-technique is a growing trend and because of increasing profit in 2022, investment in new techniques is expected to be increased.

Family enterprises that are less profitable and solvable may be forced by their financial institutes (banks) to sell mussels that are not fully grown, or forced to sell in times when prices are low: that may lead to a lower sales volume as well.

The profitability of the Dutch mussel sector will be affected by the increased supply of mussels from surrounding MS. It is expected that smaller family businesses, which are not vertically integrated, will still face financial problems in the coming years. It is likely that the larger enterprises will take over the smaller family enterprises that cannot survive or which have no succeeders.

Mortality from the Japanese oyster drill and the herpes virus may be less in the near future because of a trawl is invented that removes the Japanese oyster drills. Another challenge for off bottom oyster production is to expand the area. However, some NGOs are reluctant to these expansion ambitions since off bottom oyster production needs from their perspective more ecological research about consequences for the biodiversity and the foraging function of the nature protected area to birds and other animal species. The Dutch government has to decide whether it is sustainable and acceptable to provide more permits for upscaling off bottom oyster production.

For the freshwater sector, no other data than FAO is available. It is expected that production will be around 5 000 tonnes of fish and the value will be around €30 million.

4.19.6 Trends and triggers

Current production trends and main drivers

The mussel sector is in transition towards the use of mussel seed collection technologies, rather than bottom trawling. Growing seed on mussel seed collectors is more expensive than trawling for the seeds, and will have an effect on the economic performance. However, by using mussel seed collectors, the sector is more independent from natural seed fall. The sector is facing competition from foreign competitors, which are often owned by Dutch enterprises. Where in earlier years a small harvest meant higher prices, nowadays mussels are imported from other member states, which means that prices can be under pressure.

The oyster sector has increasing problems with larvae and seed mortality due to the presence of Herpes virus and the Japanese oyster drill in the Dutch waters. To fight the Japanese oyster drill, the “oyster drill trawl” has been invented and there is research being done to grow the oysters off bottom on tables which asks for investments.

For the freshwater sector, no data is available but FAO data.

Market structure

The market structure of the mussel sector changed over the last few years. For mussel production, the number of producing companies is quite steady now because some profit is made in recent years. Smaller family companies have been taken over by (mostly) vertically integrated (family) companies. The market structure of the oyster sector has not witnessed major changes in the last years. For oyster production, the number of companies producing and trading remains stable. The mussel and oyster sector continues to have close contact with research institutes and (local) politics.

For the fresh water sector, no data is available than just FAO statistics.

Issues of special interest

A part of the total budget of the new Dutch operational program is allocated for aquaculture. The objective for aquaculture is to increase the value of aquaculture production via niche and high-value products. Beside this, the Netherlands will increase environmental and economic sustainability, by creating better cooperation, research and knowledge sharing and increased technical innovation. Recently, interest for aquaculture in combination with offshore wind energy is stimulated. This might be partly a solution to spatial conflicts in the heavily used North Sea, which will be even more used by newcomers with economic activities (windfarms), and it might come with some synergy reducing operating costs.

In the last years, academic and business interest in production of seaweeds has grown. The first commercial seaweed farms were established in 2013 and might prove to be an impulse for the aquaculture sector in the Netherlands. However, economic and ecologic values need to be proven.

Producer organisation ‘PO Mossel’ set up a knowledge/innovation agenda for coming years to improve production efficiency in terms of volume per unit area on current mussel beds. At the moment production efficiency is relatively low and could be improved.

The Dutch oyster association started with experiments for off bottom oyster farming to decrease the oysters’ mortality from the Japanese oyster drill and Herpes virus.

For most of the aquaculture companies, energy costs are a big part of total costs. Stagnation of supply of gas, especially to Europe, in 2022 caused a tremendous increase of energy prices. Prices of gas and oil (fuel) and electricity (energy) increased starting February 2022 and as a result of the rising energy prices it can be expected that costs for energy, and therefore total costs, will rise importantly, which will affect net profit in 2022. In 2021 energy prices (fuel, gas and electricity) were already rather high compared to prices in 2020 (+30%). In 2022 prices are still rising and during the first 8 months of this year energy prices increased by more than 100%.

In 2022, the mussel companies find problems with growing(speed) of mussels. It seems like mussels are not able to grow out as usual and it looks like it takes more time to become ready to harvest.

COVID-19 impact

In 2021, COVID-19 has affected the supply chain of Dutch shellfish. Prices dropped by 10% while sales did not go up. The mussel production is by far the largest aquaculture sector in terms of volume for the Netherlands. During summer season 2020 traditional distribution channels in the food service were partly closed, but the retail is with on average 70% of sales volume the dominant distribution channel for mussel producers. As retailers are always open, the COVID impact was limited for mussel sales. The effect of less tourists and the 1.5 meter distance society has affected the sales of mussels to food service. This distribution channel is in particular important for the higher profit margin compared to the more price competitive retail market.

The oyster sector is relative small in production and sales volume, however, they are more higher priced in particular in food service channels. In 2021 this sector faced a second lockdown in the Netherlands and Europe during the normally peak season for sales of oysters in December. Due to closed restaurants the producers reinvented ways and channels to sell their produced oysters directly to consumers. Oysters producers stimulated oyster sales for at-home-consumption via 'take away', 'drive through' and 'online webshops'. Despite the sales and production data of oysters are lacking at this moment (October 2022) it is expected that turnover decreased slightly in 2021 while costs were higher compared to 2020. Information and data about oyster production and sales 2022 is not available yet.

For the fresh water sector, information is not available.

4.19.7 Data Coverage and Data Quality

Data quality

The account statistic for 2020 is based on a sample of 13 aquaculture companies (shellfish), which covers 19% of the total population of around 70 farms. These 13 companies provide detailed information to Wageningen Economic Research, that is used for extrapolation to the entire sector. Additional aggregate information on sales volume and value of mussels and oysters is available from Statistics Netherlands, the Dutch Oyster Association and the Mussel Producer Organisation 'PO Mossel'.

For the freshwater sector, no data is available for 2019 and 2020. In earlier years, information on the number of freshwater companies, sales volumes and values was retrieved from the Dutch aquaculture association NEVEVI and own databases of Wageningen Economic Research. Additional aggregate information on sales volume of eel was available from Statistics Netherlands. In 2023, we hope to gather economic information by interviews and questionnaires which will be held and sent at the end of the year 2022.

Data availability

Data of land-based aquaculture is not collected as planned. Land based aquaculture in the Netherlands is a relatively small (around 25 companies/farms in 2022), reluctant, fragmented, highly competitive and dynamic part of the fish producing sector. Only information on the number of freshwater companies, production volume and value level could be obtained for this segment. This information was gathered from a desk study and information from the Dutch aquaculture association NEVEVI. Data of the mussel and oyster sector is collected in accordance with the Dutch National Plan. After collecting the information and having it checked by accountants, the companies voluntarily submit data to Wageningen Economic Research. As some companies work with financial years running from July to July, submission of this information can take place late. Once all information is collected, it is processed by Wageningen Economic Research and reported to the sector and the ministry.

Confidentiality

Obviously, the fact that such a low number of companies deliver information is a problem for confidentiality. When collecting data, Wageningen Economic Research explicitly mentions that the information will be treated confidentially. General guidelines that segments should include more than 10 enterprises would be hard to put into practice, given the low number of companies in the different aquaculture segments.

Differences in DCF data compared with other official data sources

In general, the DCF and EUROSTAT data are in line with each other. Differences between DCF and Eurostat could be explained by the extrapolation that affects total production levels.

Other data issues or missing data

For 2019 and 2020, data on oyster (11.11, oysters) and freshwater aquaculture was lacking about the cost structures. Therefore, no economic performance indicators could be calculated.

4.20 Poland

Overview of the Polish aquaculture

The total aquaculture production in Poland is approximately 44 thousand tonnes. The two main farmed species are carp and trout. The first species represents traditional extensive aquaculture (ponds) with an annual production of approximately 21 thousand tonnes. Trout production involves more intensive systems (on rivers) with a total production of about 22 thousand tonnes per year. The production of roe intended for consumption, especially the most valuable, made of sturgeon fish, has been growing dynamically for several years.

The data collection of freshwater aquaculture is not mandatory under DCF and EU-MAP. Since no data were submitted in the related data call, FAO data were used instead.

4.20.1 Total production and sales

According to FAO data, over the last 12 years production levels have increased from 36.8 thousand tonnes in 2008 to 47.7 thousand tonnes in 2020 (+29%). The value of total production have increased from €73.3 million in 2008 to €164.7 million (73%) in 2020. The total aquaculture production weight and value in 2020 were 7% higher than the production variables in 2019.

Table 4.20.1 Production and sales for Poland: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 19-20	Develop. 2020/(08-19)
Production weight (thousand tonnes)	**36.8**	**30.8**	**32.3**	**40.1**	**38.3**	**38.8**	**43.4**	**44.7**	**47.7**	***7%***	***29%***
Marine	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	36.8	30.8	32.3	40.1	38.3	38.8	43.4	44.7	47.7	7%	29%
Production value (million €)	**73.3**	**67.5**	**81.3**	**96.1**	**107.9**	**109.3**	**128.2**	**154.5**	**164.7**	***7%***	***73%***
Marine	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	73.3	67.5	81.3	96.1	107.9	109.3	128.2	154.5	164.7	7%	73%

SOURCE: FAO (2022)

4.20.2 Industry structure and total employment

Polish aquaculture produces almost exclusively fish, while crustaceans are used to keep a small number of two species of crayfish. In addition to the production of fish for consumption, Polish aquaculture produces stocking material. The rising demand noted in recent years for this type of material has provided an impetus for the development of fish farms and the modernization of hatcheries and rearing facilities. In 2020, 823.4 million fertilized eggs from 27 species of fish and 731 million juveniles of 33 species of fish and crustaceans were produced. Rainbow trout, European whitefish and pike dominated in the production of fertilized eggs, while European whitefish, pike and common carp in the production of juveniles.

Trout farms are generally distributed in the north on the Baltic Sea coast and in southern Poland in the Carpathian foothills in rich terrain with clear, cool waters. Although carp farms are distributed throughout Poland, the larger facilities are located in central and southern Poland where climatic conditions are warmer.

In 2020 the total number of people employed in aquaculture was estimated at 6 131, almost 1% lower than in 2019. A total of 5 173 people (84.4%) were employed directly in production, of which 3 341 persons were permanently employed, and 1 832 persons were seasonal. The remaining employees (not working directly in production - including office workers, warehouse workers, fishermen's guards) are 957 people (15.6%).

4.20.3 Main species produced and economic performance by segment

As in previous years, in 2020 the fish production charts were clearly dominated by the two main species of Polish freshwater aquaculture, common carp and rainbow trout. The quantitative share of carp in the total aquaculture production was 47%, while rainbow trout was 38%, while other fish species accounted for 15%.

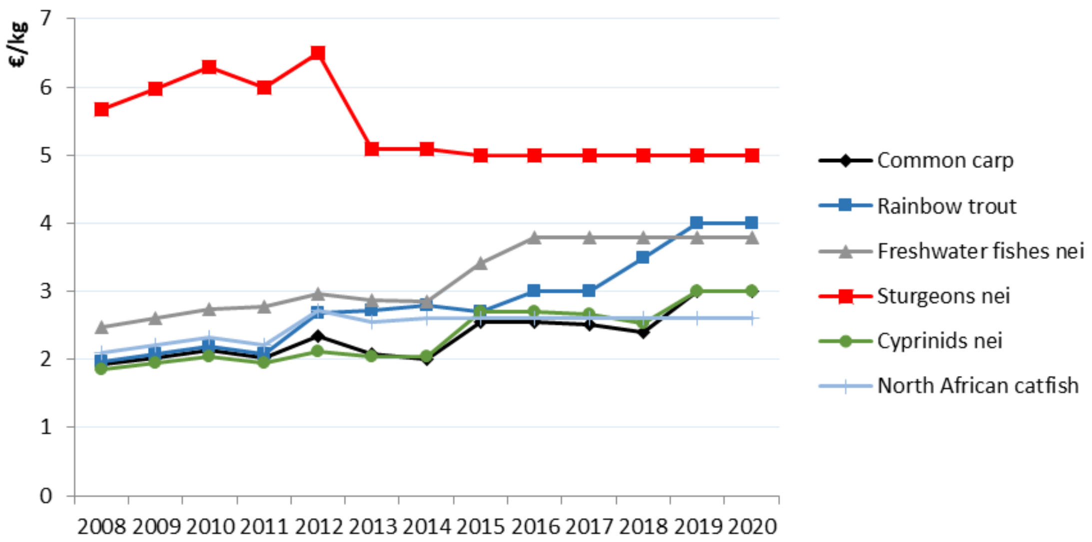
The structure of production in 2020 did not change significantly. Compared to the previous year, in 2019 the production of carp for consumption was higher by 1% point. In case of rainbow trout the production increased by 1% point and value increased by 4% points.

The enrichment of aquaculture with new fish species (mainly salmonids and sturgeons) and the increase in production in intensive farming and breeding systems mean that despite the high and relatively stable domestic carp production, the share of this species in the total fish production decreases.

Figure 4.20.1 Main species in terms of weight and value in Poland production: 2020.

Source: FAO, 2022.

Figure 4.20.2 Average prices for the main species produced in Poland: 2008-2020.



Source: FAO, 2022.

In 2020, 8 species recorded price drops compared to the previous season. The highest selling price was achieved by sturgeons with €5 per kilo. The average sales price of consumer carp in 2020 was 5.7% higher than in 2019, it amounted to €3 per kg, rainbow trout was 1.7% higher, and amounted to €4 per kg.

4.20.4 Outlook

Nowcasts for 2021-2022

Production of Polish aquaculture in 2021 decreased to 44.2 thousand tonnes and it's expected to decline even more to 43.8 thousand tonnes in 2022. This downtrend is observed because of the lower production of salmonids due to Covid-19, higher energy and feed prices.

Trends and triggers

For several years now, growing problems with the December carp market have been noticeable. The reasons are various factors, including actions by pro-animal organizations protesting against the sale of live fish, changes in consumer preferences, etc.

Consumers are clearly interested in the production of domestic aquaculture, as evidenced by the overall sales ratio (percentage share of sales in production), the value of which in 2020 amounted to 90.7% (88.8% in the previous year). The 92.3% sales rate of rainbow trout, which is one of the main species of Polish aquaculture, indicates that almost all domestic production of this species in 2020 found buyers (94.5% in 2019).

COVID-19 impact

Production in aquaculture was not strongly impacted by the COVID-19 pandemic, but in 2020, the production of caviar and roe from salmon species fell for the first time as the result of various types of restrictions caused by the Covid-19 pandemic. The decrease in caviar production was approximately 29% compared to 2019. The sale of caviar, mostly intended for export and the specific HoReCa market (hotels, restaurants, catering), was significantly reduced in 2020.

COVID's impact on aquaculture has softened through the financial programme under the State Aid Temporary Framework adopted by the Commission.

Social acceptance

According to Eurobarometer (2021), Polish consumer purchasing behaviour is mostly driven by price and the product's appearance (e.g. freshness, presentation). The environment is a purchasing determinant for every eleventh consumer. However, the vast majority of Polish consumers are concerned about the state of the environment (climate change, need to reduce CO_2 emissions) and want to change their habits to be more pro-environmental. They expect food packaging to have information about its environmental impact (including carbon footprint).

Polish consumers consider aquaculture a more environmentally friendly activity than fishing. Aquaculture campaigns organized to promote trout and carp products contributed to this trend.

4.20.5 Data Coverage and Data Quality

Data collection for freshwater aquaculture is not mandatory under the DCF and EU-MAP programmes of the EU data collection. Poland only produces freshwater aquaculture products. Thus, Poland is not obliged to provide economic data for this report. The analysis of the Polish aquaculture sector is therefore based on data extracted from FAO, Eurostat, Ministry of Agriculture and Rural Development and other sources.

4.21 Portugal

Overview of Portuguese aquaculture

The Portuguese aquaculture sector consist of freshwater, brackish and marine aquaculture, that produced and sold 13.6 thousand tonnes in 2020, which corresponds to an increase of 6% from 2019 to 2020. The total value of production was €100 million, corresponding to a 16% decrease in value over the same period.

In 2020, the Portuguese aquaculture sector was composed of 721 companies employing 1 262 workers: 489 of them worked in marine aquaculture, 740 in shellfish aquaculture and 33 in freshwater aquaculture. However, the magnitude of employment measured as FTE is lower. In total, the number of full-time employees was 987. This decrease is reflected in all three sectors, but is most evident in the shellfish sector (FTE for marine aquaculture is 481, 475 for shellfish and 31 for freshwater aquaculture).

Regarding the business structure of the aquaculture sector in Portugal, which is composed of 721 companies in 2020, this is mostly composed of small companies (≤5 employees) representing 95.5% of the sector, followed by companies with between 6 to 10 employees (2.5%), and companies with more than 10 employees (2%).

4.21.1 Total production and sales

Aquaculture production in 2020 was 13.6 thousand tonnes and generated revenues of €100 million. These results translate into a 6% increase in production, and a 16% decrease in value, compared to 2019. It corresponds to a higher production of Grooved carpet shell, the most produced species (26%), which represents 51% of the total value of Portuguese aquaculture. Turbot is the second most important species in terms of production volume (25%) and value (22%).

Production in brackish and marine waters continued to be the most important, corresponding to 97.1% of total production in 2020, which corresponds to an increase of 12% from 2019 to 2020.

Table 4.21.1 Production and sales, industry structure and employment for Portugal: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**6.9**	**6.5**	**10.4**	**8.8**	**10.2**	**10.9**	**11.8**	**12.9**	**13.6**	6%	50%
Marine	3.0	2.5	5.6	4.5	3.8	3.8	3.9	6.4	6.6	3%	67%
Shellfish	3.2	3.3	4.1	3.8	5.7	6.4	7.2	5.8	6.5	11%	42%
Freshwater	0.7	0.7	0.7	0.5	0.7	0.7	0.7	0.7	0.6	-10%	-4%
Sales value (million €)	**24.2**	**41.7**	**52.6**	**46.9**	**73.7**	**81.7**	**96.8**	**118.5**	**100.0**	-16%	64%
Marine	16.8	16.1	28.9	24.3	29.4	26.0	29.8	46.0	41.3	-10%	66%
Shellfish	22.5	24.1	21.9	20.6	42.5	53.7	65.1	70.5	56.9	-19%	59%
Freshwater	1.7	1.6	1.7	2.0	1.9	1.9	1.9	1.9	1.8	-9%	-2%
Number of enterprises	**1463**	**1459**	**1432**	**1405**	**1402**	**869**	**846**	**727**	**721**	-1%	-43%
Marine	84	79	42	40	34	15	18	50	46	-8%	-1%
Shellfish	1368	1367	1373	1358	1362	846	820	639	654	2%	-46%
Freshwater	11	13	17	7	6	8	8	38	21	-45%	69%
Employment	**2347**	**2320**	**2362**	**2247**	**2651**	**1978**	**2381**	**1731**	**1837**	6%	-19%
Marine	296	317	303	357	257	72	279	287	501	74%	81%
Shellfish	2007	1955	1995	1859	2362	1862	2058	1363	1299	-5%	-33%
Freshwater	44	48	64	31	32	44	44	80	37	-54%	-16%
FTE		**1,228**	**668**	**696**	**830**	**1167**	**1172**	**1470**	**1270**	-14%	34%
Marine		305	291	351	245	59	270	485	490	1%	75%
Shellfish		875	325	318	557	1073	866	906	749	-17%	19%
Freshwater		48	52	27	28	36	36	79	31	-61%	-22%

Source: EU Member States DCF data submission, 2022.

On the other hand, freshwater aquaculture has suffered a slight decrease of 1% in terms of production and 9% in value from 2019 to 2020. However, the negative tendency has had a greater impact on the number of companies and employees, which have decreased by 45% and 54%, respectively. This sector has a low representativeness in Portugal, which is combined with a low acceptance of this type of product in the domestic market and with difficulties of competitiveness with other countries in foreign markets.

Since 2013, sales have been increasing over the years. A peak in sales value was reached in 2019, mainly due to the increase in production of one of the highest value species (Grooved carpet shell). However, between 2008 and 2019, it is worth noting a 67% increase in weight and 66% in value in the marine sector. However, in 2020, there has been a decrease in the production of clams, oysters and mussels due to the fact that of some of their offshore production facilities ceased operations[31].

4.21.2 Industry structure and total employment

In Portugal, from 2008 to 2016, economic, social and production data were collected per production unit. From 2017 to the present, data collection for economic and social data is done per company while the collection of data production is done per production unit. The change in the way social data is collected has led to inconsistent employment data and it is now not feasible to correct the data for 2017 and beyond.

At the end of 2020, there were 712 aquaculture enterprises engaged in freshwater, brackish or marine aquaculture. This represents a reduction of 6 units compared to 2019.

Employees in the sector, in absolute values, decreased to 1 270, of which approximately 59% are employed in the shellfish sector and 39% are employed in marine aquaculture. In terms of employees, compared to the changes recorded on average between 2008/2017, the number of workers drops by 41%. This trend is due to the sharp decline in shellfish (-59%) and the freshwater sector (-24%).

A large number of these employees are low-skilled, especially in family businesses (microenterprises). However, in some small and medium-sized enterprises there are also employees with higher qualifications. A comparison of the data between the number of employees and the number of FTEs provides insight into the employment dynamics of the three macro-aggregates. Regarding the total number of FTEs, a decrease in the number of part-time jobs has been detected. This trend is led by the decrease in the total number of FTE in shellfish and freshwater aquaculture, with a decrease in this variable of 30% and 60%, respectively.

4.21.3 Overall Economic performance

For the segments where the economic indicators are available, the weight of shellfish farming sector influenced greatly the outcomes of national economic. This is, in large part, due to the high value of the Grooved carpet shell, which is also the most produced species in Portuguese aquaculture.

From 2019 to 2020, total income decreased (-7%) as well as total operating cost (-28%) and total wages (-6%). At the same time, Gross Value Added (GVA) increased (22%).

The value of depreciation of capital in 2020 decreased by 28%, compared to 2019. Assets that are not used directly in production will have their depreciations accounted for as expense. The sector has registered an improvement in the last year, with 46% increase in EBIT. The total value of assets decreased 4%, while net profit increased 52%. The return on investment also increased in order of 27%, from 2019 to 2020.

As shown in table 4.21.2, the economic-financial variables had, in general, a positive evolution. On the contrary, observing the last year-on-year variation, part of the variables shows a negative

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[31] Estatísticas de Pesca. 2020. DGRM.

trend. There are several reasons for this, among them the closure of one of the large aquaculture companies operating in Portugal, which focused on turbot production.

Table 4.21.2. Economic performance of the Portuguese aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Total income	84,5	102,4	126,3	117,4	-7%	12%
Total operating costs	40,2	48,2	83,7	60,4	-28%	5%
Total wages	10,8	14,7	18,3	17,2	-6%	18%
Gross Value Added	55,2	68,8	60,9	74,3	22%	21%
Depreciation of capital	5,4	5,8	6,8	4,9	-28%	-18%
Earning before interest and taxes	38,9	48,4	35,8	52,1	46%	27%
Financial costs, net	7,9	0,7	3,5	3,1	-11%	-23%
Net profit	31,0	47,6	32,3	49,0	52%	32%
Total value of assets	108,8	119,5	193,3	185,4	-4%	32%
Capital productivity (%)	50,7	57,6	31,5	40,1	27%	-14%
Return on Investment (%)	35,8	40,4	18,5	28,1	52%	-11%

Source: own elaboration from EU Member States DCF data submission, 2022.

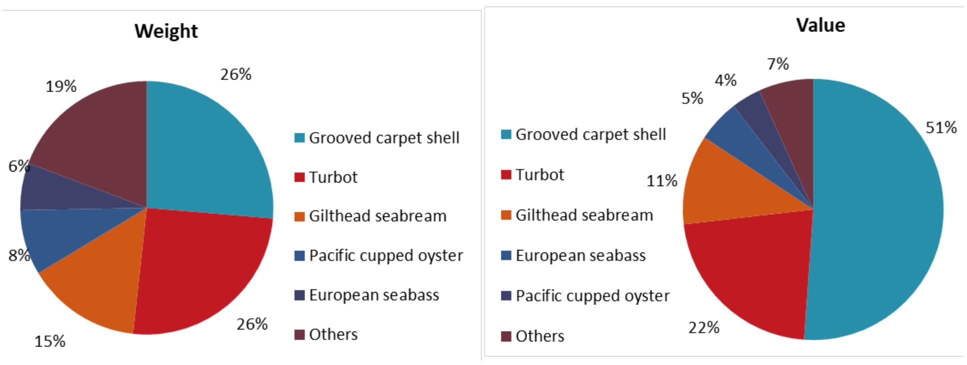
4.21.4 Main species produced and economic performance by segment

In Portugal, the aquaculture production based on bottom culture (grooved carpet shell) is mainly in estuaries areas and coastal lagoons. For other marine fish, as turbot and sole, is mainly located in the central region of Portugal. Off bottom oyster culture, also appears in estuaries, coastal lagoons and in the sea. Mussel in long line appears in south region of the mainland in open sea. The marine productions of sea bass and sea bream in ponds and cages are located both near the coast and in open sea in the Portuguese mainland coast and in the Autonomous Region of Madeira.

As shown in Figure 4.21.1, the most important segment (in terms of production weight and sales value), is the clam on bottom farms producing Grooved Carpet Shell, in small areas of land in intertidal zone, usually with less than 1 hectare. The total sales volume was 3.5 thousand tonnes with a value of €51 million, which represents 26% of the total volume and 51% of the total sales value.

The second most important segment is the marine production of other marine fish on growing (turbot and sole). The production volume was 23.6 thousand tonnes with a corresponding value of €24.2 million and represents 24.7% of total sales volume and 24.3% of the total sales value. The production techniques used are tanks and recirculation systems (RAS).

Figure 4.21.1 Main species in terms of weight and value in Portuguese production: 2020.



Source: EU Member States DCF data submission, 2022.

The third segment are seabass and seabream in ponds and cages. In 2020, 28 companies were registered as producers of these spices. Production techniques are semi-intensive and intensive in open systems. The total sales volume was 2.8 thousand tonnes with a corresponding value of €16.3 million. The segment covers 21% in volume and 16% in value of the total Portuguese production.

The forth segment is the oyster off bottom culture in intertidal zones, usually using bags and tables and in the sea using Chinese lanterns on longlines. In 2020, the production was 1.5 thousand tonnes with a corresponding value of €4.8 million. The segment has increased in last year's, and actually covers 5% of the total sales volume and 11% of the total income for the Portuguese production.

The average price of turbot has been increased since 2014 mainly from 2015 to 2016, essentially due to the decreased in the production over the last years. Nueva Pescanova S.L., the company that owned the facilities at the time, detected a major problem in the hydraulic system that captures water from the sea to supply the facilities, causing the dead of fish. In 2017, once the company was sold to the Oxy Capital fund, technical improvements were made, which led to an 18% increase in the price of turbot in 2018, due to a stabilization of the production volume and market destination. In 2020, there has been a decrease in the average price per kg of turbot (which exceeds €6) due to the increase in production.

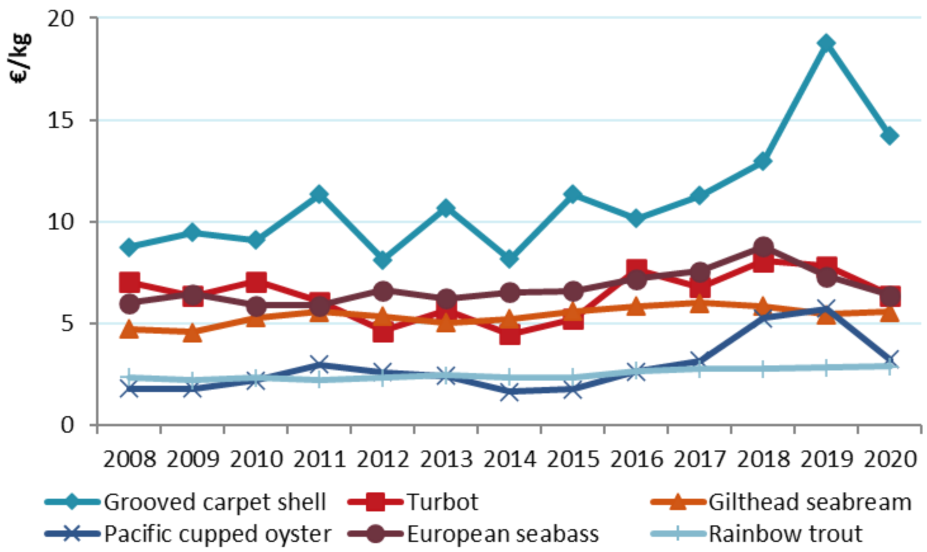
In the case of seabass, the price has decreased by 13% due to the strong increase in production. Regarding to seabream, despite the fact that in 2020 there is a greater volume of production since in 2019 several facilities started the cultivation of this species both in mainland Portugal and Madeira, the seabream price has increased by 2%.

For rainbow trout, prices have been more stable in the last two years. It should be noted that the production of intercontinental waters is almost entirely composed of trout.

Concerning the average prices for oyster, since 2014 it is verified that this value has been increasing, registering a variation of 26%.

The average price of clam presents variations over the period. This type of extensive production depends on the availability of seeds on the natural environment as well as the environmental conditions. The emergence of diseases and parasites also influence the extensive productions. In general, clams are, among shellfish, those that mainly follow a well-defined value chain.

Figure 4.21.2 Average prices €/kg for the main species produced in Portugal: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

The economic performance of the main four Portuguese segments is shown in Table 4.21.3 and the cost structure of the three main Portuguese segments are presented in Figure 4.21.3. From the table, it can be seen that in 2020 the gross value added and net profit is positive for the three out of four segments, except for the Clam.

Table 4.21.3 Economic performance of main Portuguese aquaculture segments: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Clam On-bottom					**Oyster**				
Number of enterprises	767	729	556	533	-4%	60	71	57	109	91%
FTE	864	641	598	467	-22%	145	163	122	230	89%
Average wage (thousand €)	3.4	5.5	6.4	4.7	-25%	10.0	14.4	9.9	14.4	46%
Labour productivity (thousand €)	42.0	64.8	89.0	73.8	-17%	58.4	103.1	114.1	111.8	-2%
Total sales volume (thousand tonnes)	4.1	3.4	3.0	2.5	-18%	1.9	3.1	1.8	3.0	63%
Total income (million €)	41.0	44.0	57.4	36.7	-36%	12.1	21.2	15.2	30.5	100%
Total operating costs (million €)	7.6	5.7	7.0	3.3	-52%	5.1	6.7	2.6	6.9	171%
Gross Value Added (million €)	36.3	41.5	53.2	34.5	-35%	8.5	16.8	13.9	25.8	85%
Net profit (million €)	32.2	38.5	50.4	33.4	-34%	6.7	14.1	12.3	21.0	71%
Total value of assets (million €)	9.2	9.8	19.8	1.1	-95%	7.1	15.6	6.9	25.3	265%
Net investments (million €)	2.5	1.3	2.1	0.2	-89%	0.6	3.6	0.7	1.8	156%
Capital productivity (%)	394.3	424.5	269.5	3270.9		118.3	107.8	200.3	101.7	
Return on Investment (%)	349.0	393.3	255.3	3167.7		94.3	90.6	177.1	82.8	
Future Expectation Indicator (%)	21.9	9.7	8.5	16.3		6.2	20.9	4.1	2.4	
	Other marine fish Tanks and race-ways					**Sea bass & Sea bream Ponds**				
Number of enterprises	5	5	5	3	-40%	6	8	38	36	-5%
FTE	25	145	198	168	-15%	28	33	161	168	5%
Average wage (thousand €)	119.7	19.3	20.8	20.2	-3%	17.1	20.5	20.5	18.7	-9%
Labour productivity (thousand €)	284.7	57.6	30.4	70.9	133%	75.7	19.9	-40.6	-13.2	68%
Total sales volume (thousand tonnes)	2.7	2.8	3.8	3.6	-5%	0.7	0.5	1.2	1.4	22%
Total income (million €)	19.6	23.6	31.9	24.6	-23%	4.8	3.8	9.5	11.5	20%
Total operating costs (million €)	15.4	18.0	30.0	15.9	-47%	3.2	3.8	19.3	16.8	-13%
Gross Value Added (million €)	7.3	8.4	6.0	11.9	99%	2.1	0.7	-6.5	-2.2	66%
Net profit (million €)	-4.1	3.4	-0.9	6.1	749%	1.1	-0.4	-10.8	-6.4	41%
Total value of assets (million €)	49.0	46.6	66.0	57.0	-14%	6.2	8.6	40.8	56.9	39%
Net investments (million €)	4.3	2.8	8.8	10.4	17%	2.9	2.9	11.4	8.7	-24%
Capital productivity (%)	14.8	17.9	9.1	20.9		33.5	7.6	-16.0	-3.9	
Return on Investment (%)	-8.3	7.3	-1.4	10.7		17.9	-4.6	-26.4	-11.2	
Future Expectation Indicator (%)	5.8	3.6	11.3	16.0		38.0	29.3	25.8	13.7	

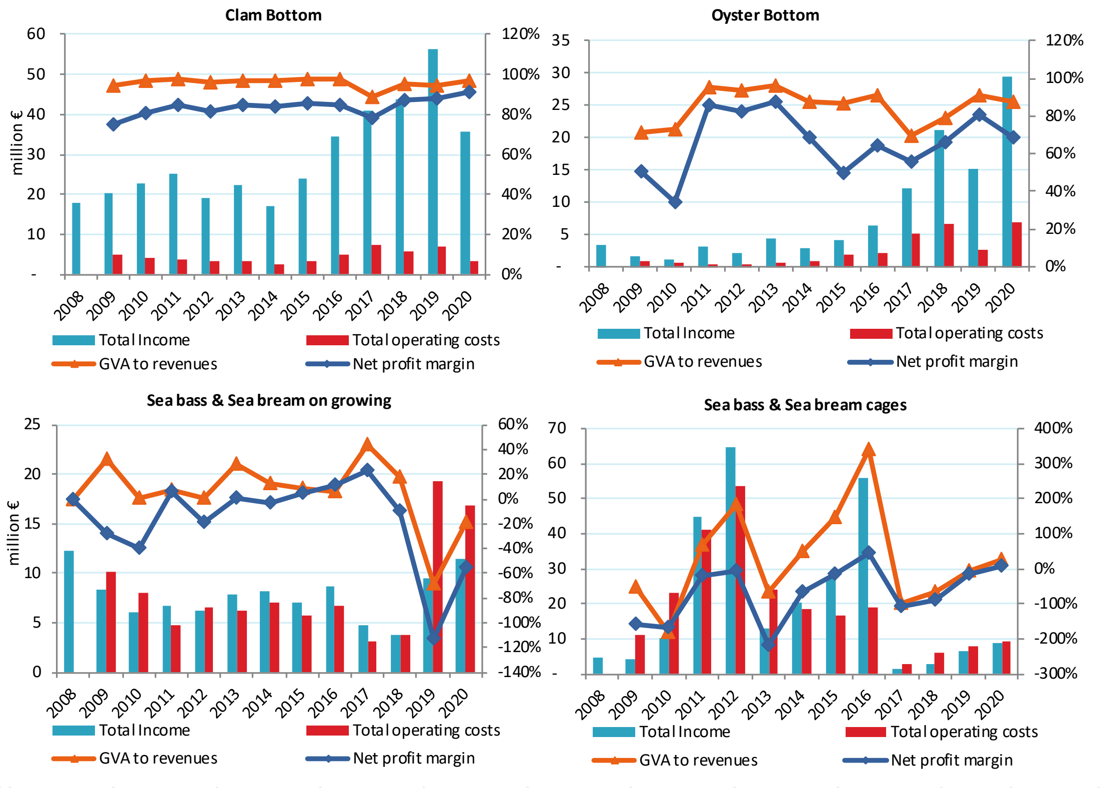
Source: own elaboration from EU Member States DCF data submission, 2022

The marine production volume of other marine fish on growing (turbot and sole) was 23.6 thousand tonnes with a corresponding value of €24.2 million, and represents 24.7% of total sales volume and 24.3% of the total sales value. The production techniques used are tanks and recirculation systems (RAS).

The increase in turbot and sole production is mainly due to two factors. The first is the improvement in the efficiency of production methods used in the turbot sector. The other factor is the recovery of the production volumes of some farming plants. This is especially significant for the turbot farming plant in Mira, in the central region. After the multinational Nueva Pescanova S.L. sold the company to the Oxy Capital fund, the company faced, and overcame, an insolvency process in 2019. Thus, in 2020, it increased its financial stability, which positively impacted the volume of production[32].

[32] Fernández-González, R., Pérez-Pérez, M. I., & Correia-da-Silva, J. Production strategies, productivity changes and innovation: An analysis of European turbot aquaculture from 2009 to 2020. *Reviews in Aquaculture*.

Figure 4.21.3 Economic performance indicators (in € million) for the main Portuguese segments: 2008-2018.



Source: own elaboration from EU Member States DCF data submission, 2022.

4.21.5 Outlook

The institutional framework of Portuguese aquaculture is governed by Decree Law No. 40/2017. This decree regulates the creation and operation of farming establishments in marine waters, estuaries and inland waters whether publicly or privately owned. Thus, it is the Portuguese state that grants the application for the attribution of an aquaculture activity and the permit for the use of waters in the public hydraulic domain.

The main axes for the development of Portuguese aquaculture are set out in the *Strategic Plan for Portuguese Aquaculture 2021-2030*, which is implemented through the *Mar2020* program financed by EMFAF for Portugal. In 2020, there were 1 272 aquaculture establishments in Portugal.

Aquaculture located in estuaries areas is the most widespread in Portugal. The use of marine salt industry facilities has given Portuguese aquaculture an option to develop at a low cost, through an easy and cheap transformation of already decommissioned salt facilities. However, the size of the tanks, the characteristics of the bottoms and the water flow rates are not adequate for the semi-intensive aquaculture production being carried out. These systems use a mixed feeding system. On the other hand, in the intertidal zones there are extensive bivalve farms, which account for a large part of the total aquaculture production.

In addition, on the coast, in recent decades, intensive installations have been built to capture seawater for the cultivation of sole and turbot. Another future objective of Portuguese aquaculture is to extend the use of floating farms along the Portuguese coast, especially along the Algarve coast, since it offers more favourable conditions than other locations. Although there is currently already a small production of fish and bivalve molluscs using this technology offshore, it is expected that, with the recent approval of Aquaculture Production Areas (APA) for the cultivation of fish, shellfish and seaweed production and its importance in the Portuguese aquaculture context will increase.

4.21.6 Trends and triggers

The Biomarine Center and bivalve mollusc hatchery in the port of Nazaré has started its activity. This centre, located in the central region of Portugal, has as its main activity the sustainable production of bivalve mollusc seeds, especially focused on the grooved carpet shell and pullet carpet shell. Portugal exports a large part of its clam seed to Spain, so this project aims to increase the independence and value chain of Portuguese aquaculture.

This project contributes to the achievement of several objectives of the Strategic Plan for Portuguese Aquaculture 2014-2020. On the one hand, this initiative increases the availability of clam seed, whose scarcity and annual fluctuations were a drawback for the sustained growth of the cultivation of this bivalve. On the other hand, it increases the percentage of skilled labour in a sector whose technological level is low.

The Strategic Plan for Portuguese Aquaculture 2014-2020 is no longer in force, but given that part of the projects approved under MAR2020 have recently started, an increase in production is expected for the coming years. It should be noted that, for this plan, strategic line of action A, which was based on facilitating administrative procedures, and strategic line of action B, focused on facilitating access to coastal space and water, have been almost entirely fulfilled.

In view of the completion of the first plan, the Strategic Plan for Portuguese Aquaculture 2021-2030 was approved in 2021. The general objective of this plan is based on four strategic intervention axes: (1) Strengthening resilience and competitiveness; (2) Participating in the energy transition; (3) Promoting social acceptance and information for consumers; (4) Increasing knowledge and innovation. These strategic intervention axes and the objectives of the plan were identified following the evaluation of the results of the previous 2014-2020 period. They are intended to provide solutions to the sector's problems and increase its robustness in the face of future challenges, such as increasing the degree of sustainability of this activity.

4.21.7 Data Coverage and Data Quality

The Portuguese Directorate General for Natural Resources, Security and Maritime Services (DGRM) has registered the total population of farms and companies engaged in aquaculture production in Portugal. It is mandatory for all aquaculture producers in Portugal to report the production in volume and value each year at the farm level. The operation of data collection was expanded in order to fulfil the needs of DCF and socio-economic data is now collected. The same operation fulfils the administrative needs for information, EUROSTAT and DCF. The data are collected at farm level in production. While production data is mandatory, economic data are provided voluntarily. Due to the low response rates, the variables are estimated to reach the whole population and quality indicators calculated.

Data for the aquaculture sector is published once a year aggregated by type of farm and species. The aquaculture statistics are published on an annual publication, “Estatísticas da Pesca”, in collaboration between DGRM and the Portuguese National Statistics Institute (INE) approximately 18 months after the end of the reference year.

Confidentiality rules are applied when the number of units in a segment is under 3. In this case, units are aggregated, when possible, to a similar segment, under the statistical evidence that both populations are homogeneous. When aggregation is not possible, data provided doesn’t include the confidential values and may not include other values if it’s possible to achieve that information by subtracting totals to the known segments.

The Portuguese data collection uses the same database to provide information to Eurostat, FAO and DCF. Differences in the data results from the aggregation requested by different data calls and the time of the year when data is provided. When data changes (new data are received or re-submission of data by some companies), new sets are compiled and disseminated to the different end users, accordingly to data revision policies. Other than this, differences between sources should not happen.

4.22 Romania

Overview of Romanian aquaculture

In 2020 Romania's aquaculture industry generated €42.4 million value of sales with 24% decrease compare to 2019. Freshwater aquaculture represents more than 99% of total production in terms of volume and value. Consequently, marine aquaculture is missing from the analysis. Number of enterprises in aquaculture sector remained at the stable level with 1% decline to 470 registered entities (mainly small farms). Compared to 2019 total number of employees and FTE declined by 10%.

4.22.1 Total Production and sales

In 2020 total value of aquaculture production in Romania decreased by 24% to €42.4 million. However, compared to 2010-2019 multiannual average, value of aquaculture production was 44% higher. Based on FAO data, weight of aquaculture production in 2020 decreased by 5% to 12.2 thousand tonnes. Aquaculture production consisted only from freshwater species, because marine aquaculture is not reported to be present.

4.22.2 Industry structure and total employment

The total population of aquaculture farms in 2020 remained stable corresponding to 470 aquaculture enterprises, only freshwater aquaculture units, producing rainbow trout carps, and other freshwater species. No marine aquaculture farms were reported in 2020.

Number of persons employed in 2020 decreased by 10% to 2 055 employees and 2 055 FTE. Employment in aquaculture industry has a tendency to decrease. For example, in 2020, compare to 2010-2019 multiannual average, number of employees and FTE was 22% and 12% lower respectively.

Table 4.22.1 Production and sales, industry structure and employment for Romania: 2010-2020.

Variable	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(10-19)
Sales weight (thousand tonnes)	**12.9**	**10.0**	**10.6**	**10.9**	**13.6**	**13.6**	**17.8**	**29.9**	68%	152%
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	-100%
Shellfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	-100%
Freshwater	12.8	10.0	10.5	10.8	13.6	13.6	17.8	29.9	68%	152%
Sales value (million €)	**31.2**	**18.1**	**19.1**	**28.9**	**30.0**	**51.8**	**55.8**	**42.4**	-24%	44%
Marine	0.0	0.1	0.1	0.1					0%	-100%
Shellfish	0.0	0.0	0.0	0.0	0.0				0%	-100%
Freshwater	31.1	18.1	19.0	28.8	30.0	51.8	55.8	42.4	-24%	45%
Number of enterprises	**444**	**430**	**430**	**355**	**440**	**456**	**474**	**470**	-1%	6%
Marine	1	2	3	2					0%	-100%
Shellfish	1	1	1	1	1				0%	-100%
Freshwater	442	427	426	352	439	456	474	470	-1%	7%
Employment	**3,933**	**2,968**	**2,542**	**1,954**	**2,230**	**1,965**	**2,295**	**2,055**	-10%	-22%
Marine	3	0	4	14					0%	-100%
Shellfish	1	1	3	4					0%	-100%
Freshwater	3,929	2967	2535	1936	2230	1965	2295	2055	-10%	-22%
FTE	**3,933**	**2523**	**2001**	**1495**	**2230**	**1965**	**2295**	**2055**	-10%	-12%
Marine	3	0	4	13					0%	-100%
Shellfish	1	1	3	4					0%	-100%
Freshwater	3,929	2,522	1,994	1,478	2,230	1,965	2,295	2,055	-10%	-12%

Source: EU Member States DCF data submission, 2022.

4.22.3 Overall Economic performance

In 2020, total income decreased by 12% to €55.8 million, but compared to 2017-2019 multiannual average, had a 4% increase. Around 76% from the total income was generated as gross sales of aquaculture production, whereas 22% from other income and rest of it from direct subsidies. The largest expenditure items in 2020 was wages and feed costs accounting for 31% and 26% of total operational costs respectively. Industry generated €24.1 million GVA, however due to the higher depreciation of capital, €-1.9 million net losses were achieved. Profitability of aquaculture sector had a tendency to decline and from 2018 were generating losses, whereas until 2017 the sector generated substantial net profits. The total value of assets in 2020 decreased by 5% to €270.7 million resulting 8.9% capital productivity. Capital productivity has a decreasing trend since 2014.

Table 4.22.2 Economic performance of the Romanian aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-18)
Total income	39.2	58.0	63.3	55.8	-12%	4%
Total operating costs	41.0	49.5		46.7		3%
Total wages	11.1	11.4	15.7	15.0	-5%	17%
Gross Value Added	9.2	19.9		24.1		65%
Depreciation of capital	8.9	8.0		10.6		26%
Earning before interest and taxes	-10.8	0.6		-1.5		71%
Financial costs, net	-51.0	0.8	1.1	0.5	-59%	103%
Net profit	40.2	-0.2		-1.9		-110%
Total value of assets	122.0	210.6		270.7		63%
Capital productivity (%)	7.6	9.5		8.9		5%
Return on Investment (%)	-8.8	0.3		-0.5		87%

Source: own elaboration from EU Member States DCF data submission

4.22.4 Main species produced and economic performance by segment

Freshwater species covers more than 99% in Romanian aquaculture production, therefore marine aquaculture is skipped from analyses. In 2020, common carp production represented 30% of total aquaculture quantities, following by 22% of trout and 18% of bighead carp. However, value of sales was predominant in trout aquaculture corresponding to 35% of total aquaculture value.

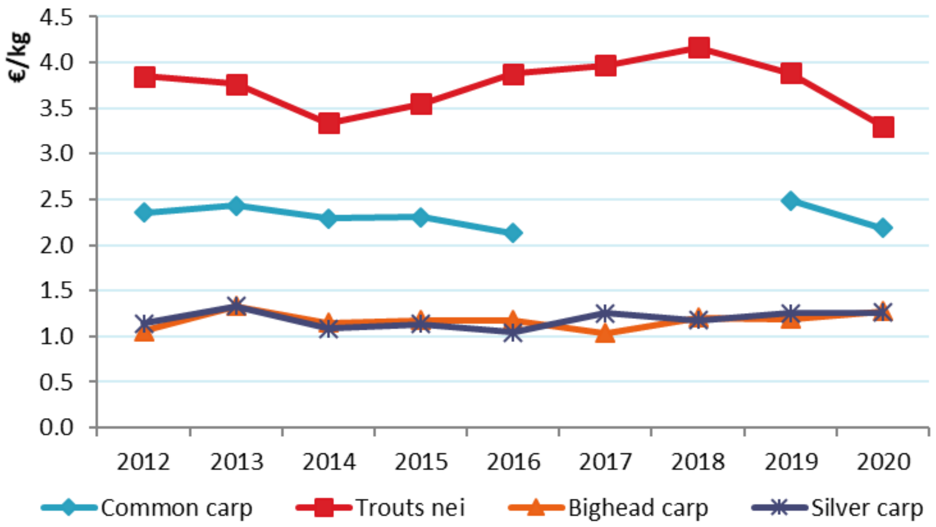
The average price for carp in 2020 decreased by 12% to €2.2 per kg and reached the lowest level since 2012. In 2020, other cyprinids as bighead carp and silver carp were supplied to the market at 7.2% and 1% increased prices respectively. Average price for trout in 2020 declined by 15% to €3.3 per kg.

Figure 4.22.1 Main species in terms of weight and value in Romanian production: 2020.

Source: EU Member States DCF data submission, 2022.

The valuable species, such as sturgeons and Poloydon spathula, including pikeperch, catfish species vary year to year. Pikeperch is very difficult to be cultured on aquaculture facilities and the quantities produced are varying pending by the cycles of production from year to year, and so the fluctuations on prices are evident.

Figure 4.22.2 Average prices €/kg for the main species produced in Romania: 2012-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

The most relevant segments in Romanian aquaculture in 2020, are the following:

- Carp polyculture
- Trout ponds
- Other freshwater fish in ponds
- Trout Recirculation systems

Segment 1: Carp polyculture

The largest segment in terms of total income is carp polyculture, representing 69% of total income generated by Romanian aquaculture sector. In 2020, it generated €15.9 million GVA and €-1.7 million net loss. In the carp polyculture, technologies used for the production are extensive. It has the lowest labour productivity in the sector with €23.2 thousand per FTE but compared to 2019 it increased by 11%. Carp polyculture provides the lowest remuneration among other segments with €6 thousand per FTE annually. Number of persons employed in the segment decreased by 18% in 2020 to 1629 employees. Segment is important in the MS aquaculture industry sector due to the fact are delivering all most fresh fish products on the market. Also, the recreational fishery allowed in this facility as very important component in total income, mainly for carp ponds.

Segment 2: Trout ponds

Trout in ponds is the second largest aquaculture segment in Romania, generating €14.2 million of total income in 2020 with 16.5% increase compare to 2019. Segment generated €6 million GVA in

2020, however it was not profitable. Trout in ponds shows the highest labour productivity in the sector with €43.1 thousand per FTE but compared to 2019 it declined by 22%. Furthermore, the highest remuneration was paid in this segment accounting for €11.2 thousand per FTE annually. Average annual wage in 2020 decreased by 16.5%, compared to 2019. Total number of employees increased by 50.7% to 330.

Table 4.21.3 Economic performance of main Romanian aquaculture segments: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Carp Polyculture					**Trout Ponds**				
Number of enterprises	94	218	323	326	1%	90	45	130	122	-6%
FTE	1340	1371	1990	1629	-18%	151	169	219	330	51%
Average wage (thousand €)	1.1	2.0	5.4	6.3	18%	16.3	2.8	14.4	11.8	-18%
Labour productivity (thousand €)	3.9	15.5		9.8		23.5	-9.9		18.2	
Total sales volume (thousand tonnes)	7.4	8.5	12.1	20.7	71%	1.7	0.1	3.6	7.8	119%
Total income (million €)	8.2	30.9	41.6	37.8	-9%	8.1	2.0	12.2	14.2	17%
Total operating costs (million €)	4.4	12.3		32.2		7.0	4.2		12.1	
Gross Value Added (million €)	5.2	21.3		15.9		3.6	-1.7		6.0	
Net profit (million €)	2.5	14.1		-1.7		-0.5	-2.4		-0.7	
Total value of assets (million €)	27.9	130.9	194.0	186.8	-4%	29.7	5.7	57.1	70.4	23%
Net investments (million €)	0.6	3.8	7.3	9.3	27%	0.9	1.4	2.1	3.5	63%
Capital productivity (%)	18.5	16.3		8.5		12.0	-29.4		8.5	
Return on Investment (%)	9.1	10.8		-0.9		-1.7	-42.3		-0.9	
Future Expectation Indicator (%)	-2.0	-0.5		1.0		-2.4	20.2		1.0	

Variable	2017	2018	2019	2020	Change 2019-20
	Carp combined				
Number of enterprises	144	218	14	17	21%
FTE	1506	1398	56	61	9%
Average wage (thousand €)	1.2	1.9	8.4	7.4	-13%
Labour productivity (thousand €)	2.6	10.8		11.3	
Total sales volume (thousand tonnes)	10.2	10.3	0.5	0.9	68%
Total income (million €)	9.1	31.3	1.8	1.6	-10%
Total operating costs (million €)	7.0	18.9	10.1	1.4	-86%
Gross Value Added (million €)	4.0	15.0		0.7	
Net profit (million €)	0.9	7.8		-0.1	
Total value of assets (million €)	35.5	132.0	8.6	8.1	-5%
Net investments (million €)	1.1	3.8		0.4	
Capital productivity (%)	11.2	11.4		8.5	
Return on Investment (%)	2.4	5.9		-0.9	
Future Expectation Indicator (%)	-2.3	61.1		339.3	

Source: own elaboration from EU Member States DCF data submission, 2022.

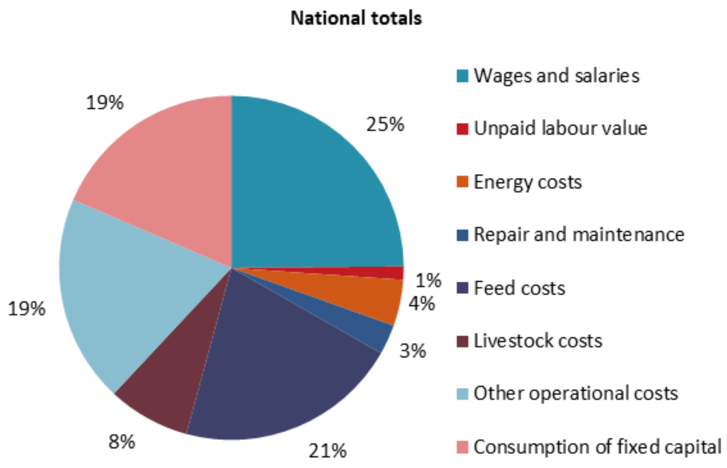
Segment 3: Other freshwater fish in ponds

Segment Other freshwater fish in ponds generated €1.6 million total income in 2020 and compared to 2019 decreased by 10%. Segment provided €0.5 million GVA, but was unprofitable in 2020. Labour productivity was slightly higher compared to carps polyculture and was estimated at €27 thousand per FTE. Compared to 2019, labour productivity declined by 17.7%. Segment offered €7 thousand per FTE annual remuneration in 2020, but it was 11% less compare to 2019. Total number of employees increased by 9% to 61 persons.

Segment 4: Trout Recirculation systems

This segment is the lowest in terms of total income, which decreased by 80% in 2020 to €1.1 million. GVA generated by trout aquaculture in recirculation systems increased to €0.5 million. Segment was unprofitable in 2020. Number of persons employed increased by16.7% to 35 employees, but labour productivity declined to €31 thousand per FTE. Annual average wage paid in the segment was €8 thousand per FTE annually.

Figure 4.22.3 Cost structure of the main segment in Romania: 2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

4.22.5 Outlook

Trends and triggers

As mentioned above are three main group species are mostly cultured on Romania industry carp, Asiatic cyprinids and trout, marine aquaculture is still missing, and some other species not for importance in total volume and value production. The sector doesn't improve the number and variety of species, as well the production methods, as example the farmers are still applying extensive method as a large scale, and not accessing new technology. For this reason, innovation is all most absent and, efforts have to be done in this respect.

No allocated zones for marine aquaculture are established, only starting within 2021 there are some works on place in this respect, starting with improvements on national legislation being expected.

The trend on increasing the production is observed in the last year but still far to the potential of the total surface available for aquaculture along the country, mainly to the old technology, and a late increase of investments for.

Market structure

The market structure in Romania is still unchanged, we are referring here to the same supermarket chains dominating the market. Only the big farms are able to sign contracts with it, and the small producers facing a lot of difficulties on it, also the huge quantity imported of marine fish and see food, as per changed demand of consumers, are discouraging them. Just the reduced number of processing units are still buying from the internal farmers but not in a constant base. In the attempt to offer other products, just few farms are producing small quantities of sturgeon, and catfish.

COVID-19 impact

The COVID crisis influenced last year the aquaculture Romanian industry and the main impacts were caused by the lockdown, replaced by less strong measures alert situation, but the sales decreased in the first part of the year, mainly, when some popular holidays, not official, reduced the volume of its, due to the restrictions on traveling, so less access to traditional markets was registered. Sales of production decreased by 24% in 2020. Average prices for main cultivated species as common carp and trout remarkably declined compare to 2019. Employment in terms of FTE has also a tendency to decrease in 2020 with 10% compared to 2019 and -22% compare to 2010-2019 multiannual average.

4.22.6 Data Coverage and Data Quality

Data quality and availability

Time series between DCF and EUMAP data at segment level was not available to analyse because segments do not match. Economic performance indicators for the main Romania segments during 2008-2020 cannot be done, because DCF and EUMAP segments do not match.

There were unexplained huge deviations for average carp price in 2016 and 2018, therefore data was removed from figure on average prices for the main species produced in Romania during 2012-2020.

Volume of 2020 aquaculture production in EUMAP data significantly deviates from FAO. Furthermore, EUMAP weight of aquaculture production is disproportionately high compare to the time series and is not compatible to 2020 aquaculture value.

Cost structure for all segments were reported identical which is unlikely as different aquaculture techniques has different cost structures. For example energy costs for intensive trout RAS is completely different from extensive pond aquaculture. Therefore figure on the cost structure of the main segments in Romania is not provided and commented.

4.23 Slovakia

Overview of Slovakian aquaculture

Slovakia is a landlocked country producing only freshwater aquaculture products. The data collection of freshwater aquaculture is not mandatory. Considering no data were submitted in the related data call, FAO data were used instead.

Despite the aquaculture sector's relatively small contribution to the national economy, aquaculture has important non-production functions that are instrumental to environmental protection and enhancement. Examples are water management, flood control, landscaping, biodiversity preservation and recreational fishing. There are around 80 Slovak aquaculture enterprises, predominantly small and medium-sized enterprises (SMEs). A particular feature of these enterprises is that aquaculture is not their primary business activity; they engage in fish farming alongside other activities. Aquaculture in Slovakia can be split into two groups: farming of salmonids (e.g. trout and grayling) and of lowland fish species (e.g. carp, pike, tench and catfish). Fish are produced in fish farming facilities (tanks, cages, nurseries, hatcheries and recirculation systems) with a capacity of 140 503 m^3 and in 485 fish ponds, covering an area of about 2 000 ha. (STECF, 2021).

4.23.1 Production volume and value

The Slovakian aquaculture sector produced 2.3 thousand tonnes in 2020, valued at almost €5.6 million, solely from freshwater species.

The total weight of production in 2020 decreased by 15% compared to 2019. The same trend for value of production is observed, with a drop of 22% from the year before. Despite this drop in 2020, the production weight and value has been increasing during the past ten years. The production weight in 2020 is 52% higher than the 10 previous years' average. Respective growth in value was 45%.

Table 4.23.1 Production and sales for Slovakia: 2008-2020.

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 19-20	Develop. 2020/(08-19)
Production weight (thousand tonnes)	**1.1**	**0.8**	**0.7**	**0.8**	**1.3**	**1.1**	**1.2**	**1.3**	**2.2**	**2.6**	**2.2**	**2.7**	**2.3**	***-15%***	***52%***
Marine	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	1.1	0.8	0.7	0.8	1.3	1.1	1.2	1.3	2.2	2.6	2.2	2.7	2.3	-15%	52%
Production value (million €)	**2.8**	**1.8**	**1.9**	**2.3**	**3.3**	**3.1**	**3.3**	**3.8**	**5.0**	**6.1**	**5.5**	**7.2**	**5.6**	***-22%***	***45%***
Marine	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Shellfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%
Freshwater	2.8	1.8	1.9	2.3	3.3	3.1	3.3	3.8	5.0	6.1	5.5	7.2	5.6	-22%	45%

Source: FAO, 2022.

4.23.2 Main segments

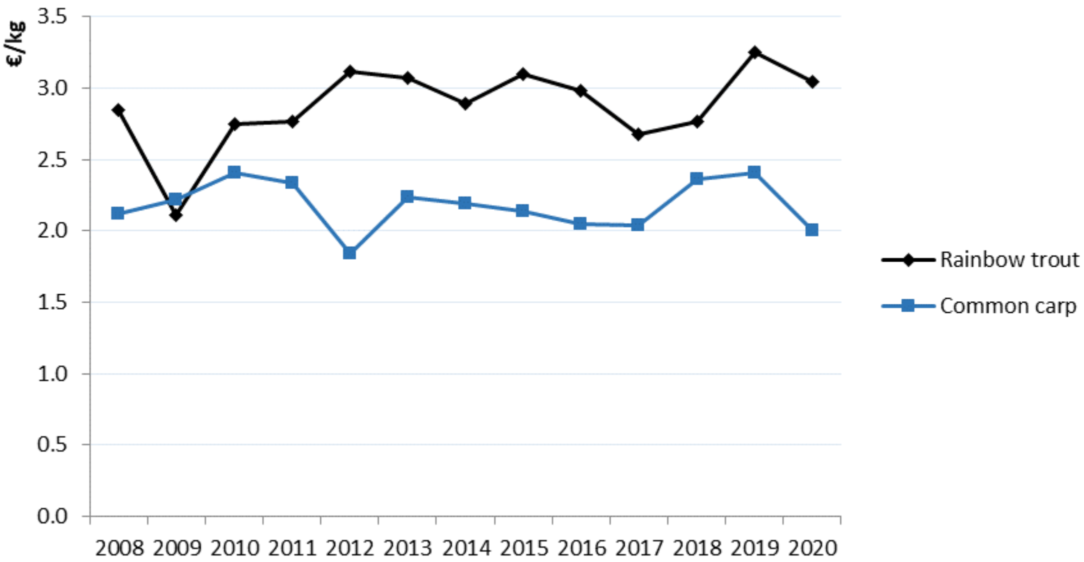
Rainbow trout remains the main species produced by the Slovakian aquaculture sector, representing 34% in total weight and 42% in terms of value of total production in 2020. North African catfish and Common carp account for the second highest share in terms of weight, with 30% of overall production each, and 27% and 25% of the total value respectively.

Average prices for aquaculture products have been stable during the period 2008 to 2020. Rainbow trout average first-sale prices in Slovakia were €3 per kg in 2020, while common carp price was €2 per kg.

Figure 4.23.1 Main species in terms of weight and value in Slovakian production: 2020.

Source: FAO, 2022.

Figure 4.23.2 Average prices for the main species produced in Slovakia: 2008-2020.



Source: FAO, 2022.

According to the previous report (STECF, 2021), the Slovakian aquaculture sector generated €8.6 million of gross value added in 2019, resulting in a GVA margin of 18%. The sector employed about 827 persons in 2019, with and FTE of 256, showing the importance of aquaculture as a part time activity.

4.23.3 Data Coverage and Data Quality

The data collection of freshwater aquaculture is not mandatory under the DCF and EU-MAP programmes of the EU data collection. So landlocked countries are not obliged to provide economic data for this report.

Since Slovakia did not submit data in the latest related data call, the analysis of the Slovakian aquaculture sector is therefore based on data extracted from FAO.

4.24 Slovenia

Overview of Slovenian aquaculture

Data on the Slovenian aquaculture were collected only for the marine fish species and shellfish, so economic data in the report are presented only for marine aquaculture. The data collection of freshwater aquaculture is not mandatory under the DCF and EU-MAP programmes of the EU data collection, therefore, regarding freshwater aquaculture, the data from FAO were used.

The main segments in the Slovenian marine aquaculture sector are Sea bass & Sea bream cages (seg3.6) and Mussel rafts (seg10.9).

In 2019, the marine aquaculture turnover was €1.4 million, in 2020 the same turnover decreased by 11% and amounted €1.2 million. The total sales volume, on the other hand, decrease by 32% from 2019 to 2020 and it was 804 tonnes in 2019 and 551 tonnes in 2020.

In 2019, the freshwater aquaculture turnover was €5.1 million, in 2020 the same turnover decreased by 7% and amounted €4.8 million (FAO data). The total sales volume, on the other hand, decrease by 5% from 2019 to 2020 and it was 1230 tonnes in 2019 and 1169 tonnes in 2020, according to FAO data.

The amount of GVA, EBIT and Net profit generated by the Slovenian aquaculture sector in 2020 was €0.3 million, €-0.9 million and €-0.9 million, respectively.

4.24.1 Total Production and sales

In 2020, there were five companies in Slovenia dealing with shellfish farming, primarily with mussel farming (Mediterranean mussel). The shellfish are farmed using hanging ropes that are attached to rafts.

In the same year, there was only one company that was engaged in breeding of fish. A main species for breeding is sea bass. Main farming techniques is breeding in cages.

In 2019, the marine aquaculture turnover was €1.4 million, in 2020 the same turnover decreased by 11% and amounted €1.2 million. The total sales volume, on the other hand, decrease by 32% from 2019 to 2020 and it was 804 tonnes in 2019 and 551 tonnes in 2020.

Table 4.24.1 Production and sales for Slovenia: 2008-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(08-19)
Sales weight (thousand tonnes)	**1.3**	**0.8**	**1.2**	**1.4**	**1.9**	**1.8**	**1.9**	**2.1**	**1.7**	-22%	12%
Marine	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	25%	58%
Shellfish	0.2	0.1	0.3	0.4	0.6	0.7	0.6	0.8	0.4	-52%	-11%
Freshwater	1.0	0.7	0.8	0.9	1.2	1.0	1.3	1.2	1.2	-5%	20%
Sales value (million €)	**3.5**	**2.2**	**3.1**	**3.6**	**5.2**	**4.7**	**6.4**	**6.5**	**5.7**	-12%	39%
Marine	0.8	0.2	0.3	0.4	0.4	0.5	0.5	0.4	0.5	25%	17%
Shellfish	0.1	0.0	0.2	0.3	0.5	0.6	0.7	1.0	0.5	-52%	23%
Freshwater	2.6	1.9	2.6	2.9	4.2	3.6	5.2	5.1	4.8	-7%	43%

Source: EU Member States DCF data submission and FAO data, 2022.

In 2019, the freshwater aquaculture turnover was €5.1 million, in 2020 the same turnover decreased by 7% and amounted €4.8 million (FAO data). The total sales volume, on the other hand, decrease by 5% from 2019 to 2020 and it was 1 230 tonnes in 2019 and 1 169 tonnes in 2020, according to FAO data.

The main reason for negative impact on the Slovenian aquaculture sector are loss of domestic market, mainly due to closure in touristic sector and loss of international markets, all caused by the COVID-19 situation.

The main segments in the Slovenian marine aquaculture sector are Sea bass & Sea bream cages (seg3.6) and Mussel rafts (seg10.9).

4.24.2 Industry structure and total employment

Aquaculture in Slovenia comprises freshwater aquaculture (cold-water fish farming of salmonids and warm-water fish farming of cyprinids) and mariculture (fish and shellfish farming). Warm-water and cold-water fish farming has been practiced since the end of nineteenth century, while mariculture has a shorter history: it started at the end of the twentieth century. The major species contributing most of the production value in freshwater fish farming are rainbow trout (*Oncorhynchus mykiss*) and common carp (*Cyprinus carpio*), whilst in mariculture it is Mediterranean mussel (*Mytilus galloprovincialis*) and European seabass (*Dicentrarchus labrax*).

Mariculture practice is traditional. Fish farming takes place in cages submerged into the sea, while mussel farming takes place in a standard manner in lines of floating buoys linked together, with longline nets hung from them. In 2007, three larger areas were designated for marine aquaculture in Slovenian territorial waters that were subsequently separated into 22 plots, for which concessions were granted for the use of marine water in 2009. It is expected that these plots will not be able to expand, due to the use of Slovenian territorial waters for other purposes. Currently, all the concessions for using marine water for the breeding of marine organisms have been granted, two of them for breeding marine fish and 20 for breeding shellfish. The total area for breeding fish at sea (excluding shellfish farming) in 2020 was 5 663 m2 (two plots). The area of the 20 plots at sea that are used for shellfish farming was 45.1 ha.

Due to natural circumstances, the development of marine fish farming in Slovenia is limited. Mariculture takes place in the Bay of Strunjan, the Bay of Debeli rtič (shellfish farming) and in the Bay of Piran (fish and shellfish farming).

Mariculture shellfish farming is more important than fish farming regarding the total volume of sales. Shellfish farming accounts for 81% of total mariculture production in 2020.

Since the early eighties (1982) the production of the Mediterranean mussel (*Mytilus galloprovincialis*) has been increasing and in 1988 it reached a maximum of 703 tonnes. After that year a significant decline was due to the fact that exports to Italy ceased. In 1995, the production of mussels reached a minimum of 12 tonnes. In recent years, there are increases in production, particularly due to the resolution of the status of shellfish production facilities through the granting of concessions for the use of marine water: first in 2001 and then in 2003, when production reached 135 tonnes, the highest since 1992. There was also a peak in production in 2019, with 690 tonnes of Mediterranean mussels produced. Current production covers mainly the needs of the domestic market. In recent years, especially in 2010, considerable difficulties occurred in the production of shellfish due to the frequent closures of sales because of the occurrence of biotoxins, which prevents shellfish farms to be used to their full production capacity. Damage on shellfish farms caused by wild fish, especially by sea bream, also presents major problems in the last few years. The damage caused by sea bream is estimated at 550 tonnes per year, so almost as much as the total sales volume in 2002.

In 2011, also with the help of EMFF funds, Slovenian mussel sector commenced with production of Warty Venus. In the year 2012, sales volume of Warty Venus amounted 5.83 tonnes, while in 2020 sales volume increase to 22 tonnes.

From 1991 onwards, intensification was carried out especially with farming European seabass and seabream in the Bay of Piran. A first result of seabass production in 1992 was 5.7 tonnes. In subsequent years, annual variations in production (growth and decline) were noted. In 2001, production reached its maximum with 59 tonnes, and very similar amounts were noted in 2003. Here, there was a peak in production in 2018, with 76 tonnes of seabass.

The first results of seabream production in 1992 were 4 tonnes. In the following years, there was a growth in production, with some variations, until 1997 when production reached a maximum of

61 tonnes. After that year, production declined and reached a minimum of 6 tonnes in 2001. In 2003, production was 16 tonnes. From 2010 to 2018, there was no production of seabream.

Slovenia is a net importer of fish and fish products. In 2020, imports were approximately five times larger than exports. There is a continuous import of fresh farmed species: seabream, seabass and salmon. The majority of the imported fish products come mainly from the European Union and are frozen, dried or processed.

In 2020, Slovenia had four companies with five or less employees, one company with six to ten employees and also one company with more than ten employees. The status in employment reflects the situation in the aquaculture sector whereby the majority of small family farms operates with self-employed people, mostly one employee. Total employment in 2020 was estimated at 30 jobs, corresponding to 25.6 FTEs. The level of employment increased between 2008 and 2020, with total employed increasing by 6% while the numbers of FTEs increase by 2% over the period. Average salary per FTE employees in 2008 was €21.5 thousand. In 2020 average salary per FTE employees decrease for approximately 3% regarding 2008 and amounted €20.9 thousand.

The number of enterprises decreased from 2008 to 2020, but the average number of FTE per enterprise has been rather constant over the period. In the period 2012-2020 Slovenian aquaculture sector underwent major structural changes. Some of the larger companies that are dealing with different types of activities, separated aquaculture from other activities formed new smaller companies, which are exclusively engaged in aquaculture. Consequently, the share of other income in total income has decreased in the period 2012-2020 for 14%. This had impact on lower labour productivity in the period mentioned.

4.24.3 Overall Economic performance

The total amount of income generated by the Slovenian aquaculture sector in 2020 was €3.9 million. This consisted of €1.2 million in turnover and €2.7 million in other income. The total income of the Slovenian aquaculture sector decreased by 6% between 2019 and 2020, while turnover decreased by 11% in the same period.

Table 4.24.2 Economic performance, industry structure and employment of the Slovenian aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Number of enterprises	7	7	6	6	0%	-10%
Employment	27	29	29	30	3%	6%
FTE	22.8	26.1	25.3	25.6	1%	4%
Total income	2.4	2.7	4.2	3.9	-6%	26%
Total operating costs	2.7	3.2	3.5	4.3	23%	38%
Total wages	0.5	0.5	0.5	0.6	19%	22%
Gross Value Added	0.2	0.1	1.2	0.3	-78%	-48%
Depreciation of capital	1.0	0.8	0.7	0.5	-24%	-40%
Earning before interest and taxes	-1.2	-1.3	0.0	-0.9	-13882%	-3%
Financial costs, net	0.0	0.0	0.0	0.0	-7%	-3%
Net profit	-1.3	-1.3	0.0	-0.9	-2777%	-3%
Total value of assets	7.3	6.8	6.7	6.6	-1%	-4%
Capital productivity (%)	3.2	1.5	17.7	3.9	-78%	-47%
Return on Investment (%)	-16.9	-19.1	0.1	-13.0	-14079%	-9%

Source: own elaboration from EU Member States DCF data submission, 2022.

All the firms in Slovenian aquaculture sector are registered to practice aquaculture and aquaculture should be their main source of income, however large part of the income still gain from carrying out other activities, such as scuba diving, underwater work, marketing, etc.

Total operating costs by the Slovenian aquaculture sector in 2020 was €4.3 million. The largest expenditure items were other operational costs (€2.8 million) and Wages and salaries (€0.6 million). The total operating costs increased for 166% from 2008-2020, mainly because of increased other operational costs in that period.

In terms of economic indicators, the amount of GVA, EBIT and Net profit generated by the Slovenian aquaculture sector in 2020 was €0.3 million, €-0.9 million and €-0.9 million respectively. Values of all economic indicators decreased from 2019, namely due increased value of total operating costs in 2020.

4.24.4 Main species produced and economic performance by segment

The most relevant segments in the Slovenian marine aquaculture are:

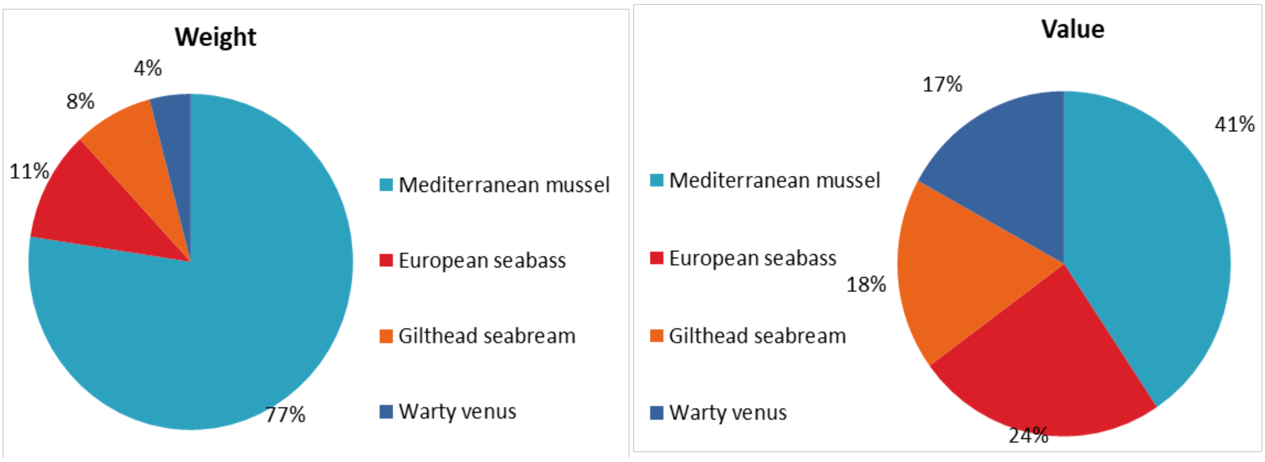
- Segment 1: Sea bass & Sea bream cages (seg3.6);
- Segment 2: Mussel rafts (seg10.9).

They are two main segments in the Slovenian marine aquaculture sector; Sea bass & Sea bream cages (seg3.6) and Mussel rafts (seg10.9). The most important species are Mediterranean mussel and European seabass.

In terms of sales volume mariculture shellfish farming are more important than fish farming. The major cultured shellfish species, Mediterranean mussel, accounts for 77% (426 tonnes) of total sales volume in 2020. The production of European seabass is more important than the production of gilthead seabream. It contributes around 10% (59 tonnes) to total mariculture production in 2020.

In terms of sales volume, sales volume of the Mussel rafts segment represents 81% of the total sales volume of Slovenian aquaculture sector in 2020 (449 tonnes). Turnover from this sector represent 58% of the total turnover in the same year (0.69 millions). In the Mussel rafts sector were 13.6 FTE employees in 2020, which represent 53% of all FTE employees in Slovenian aquaculture sector in the same year.

Figure 4.24.1 Main species in terms of weight and value in Slovenian production: 2020.

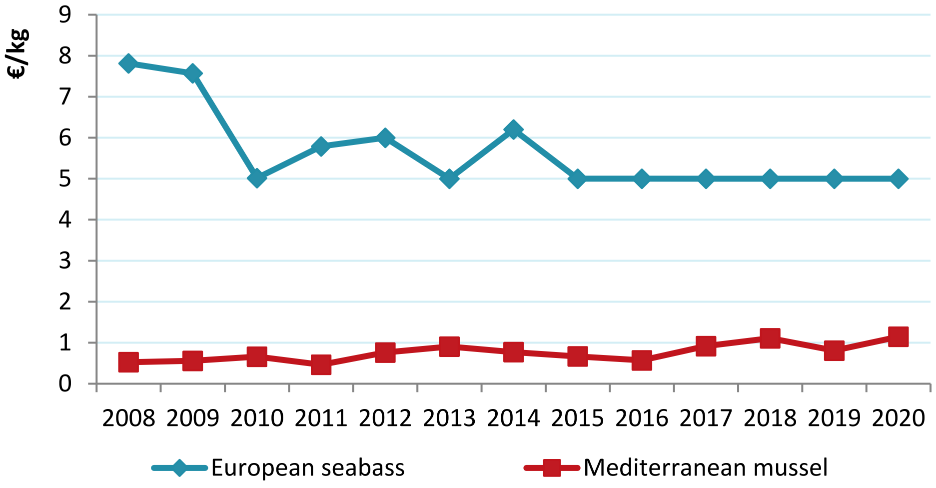


Source: EU Member States DCF data submission, 2022.

In 2011, also with the help of EMFF funds, Slovenian mussel sector commenced with production of Warty Venus. In the year 2012, sales volume of Warty Venus amounted 5.83 tonnes, while in 2020 sales volume increase to almost 23 tonnes. Income of Warty Venus represent, because of very high first sales price of around €9 per kg, around 30% of all income from Mussels sector in 2020 (0.2 millions). On the other hand, sales volume of Warty Venus represent 5% of all sales volume from Mussels sector in the same year (23 tonnes).

The highest average price on the market achieves Warty venus with amount of €9.1 per kg. The average price of European seabass was €7.8 per kg in 2008. In 2020, average price decrease by 36% regarding 2008 and amounted €5.0 per kg. The main reason for decreased price of seabass is increased imports of seabass, mainly from Greece and Croatia, where the first-sales price is lower than in Slovenia. The average price of Mediterranean mussel was €1.1 per kg in 2020, an increase of more than 100% regarding 2008. The price increase is mainly due to new sales channels in shellfish sales, where more and more shellfish are being sold to the end customers.

Figure 4.24.2 Average prices (€/kg) for the main species produced in Slovenia: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Because of the confidentiality issues, only the economic performance of the Mussel rafts segments is analysed. From the Table 4.7.3 it can be seen that the gross value added is positive in the period from 2008 to 2020, while net profit is negative in the last few years, with exemption of 2019. One of the reasons for negative net profit can be also high values of depreciation costs over a past few years. Slovenian Mussel rafts sector has over the past few years, with the help of EU Funds, invested significantly in the new equipment and production facilities. So this new investments are the main reason for increased value of Depreciation of capital.

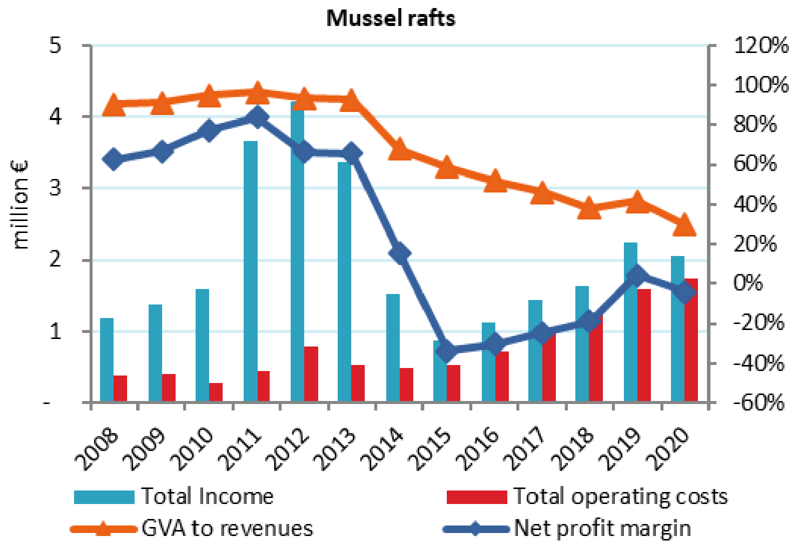
Table 4.24.3 Economic performance of main Slovenian aquaculture segment: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Mussel rafts						
Number of enterprises	6	6	5	5	0%	-12%
FTE	13	14	13	14	2%	1%
Average wage (thousand €)	16.1	16.5	21.1	20.6	-2%	15%
Labour productivity (thousand €)	51.8	43.4	70.1	45.1	-36%	-18%
Total sales volume (thousand tonnes)	0.7	0.6	0.7	0.4	-38%	-34%
Total income (million €)	1.4	1.6	2.2	2.1	-8%	17%
Total operating costs (million €)	1.0	1.2	1.6	1.7	9%	36%
Gross Value Added (million €)	0.7	0.6	0.9	0.6	-34%	-17%
Net profit (million €)	-0.4	-0.3	0.1	-0.1	-187%	57%
Total value of assets (million €)	4.7	4.4	4.2	4.3	2%	-3%
Net investments (million €)	0.0	0.2	0.0	0.0	0%	-100%
Capital productivity (%)	14.2	14.0	22.0	14.2		
Return on Investment (%)	-7.6	-7.0	2.2	-1.9		
Future Expectation Indicator (%)	-16.8	-10.2	-12.7	-9.2		

Source: own elaboration from EU Member States DCF data submission, 2022.

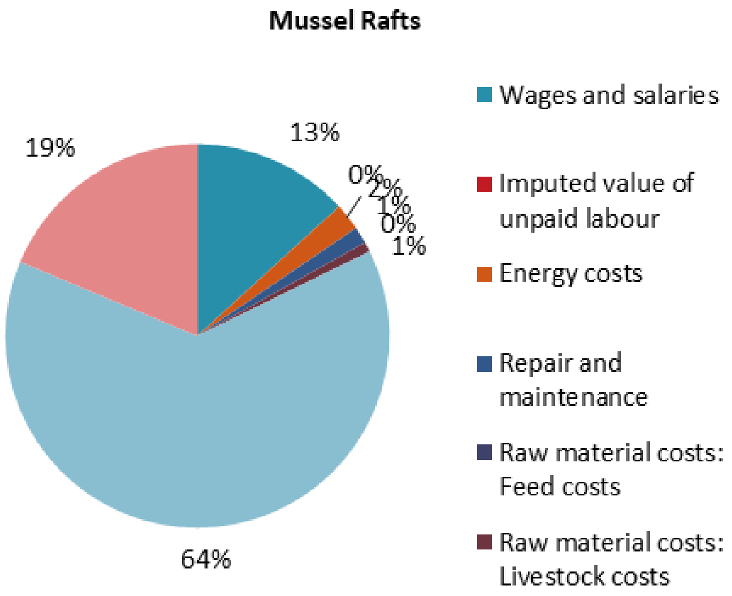
In terms of sales volume, sales volume of the Mussel rafts segment represents 81% of the total sales volume of Slovenian aquaculture sector in 2020. Turnover from this sector represent 58% of the total turnover in the same year. In terms of other economic indicators, the amount of GVA and Net profit generated by the Slovenian Mussel rafts sector in 2020 was €0.6 million and €-0.1 million respectively. Despite increased productions of Mediterranean mussel as the most important species in this segment, the values of all economic indicators in Mussel rafts sector are decreased substantially from 2008. Main reason for decreasing of economic indicators is decreased in other income due major structural changes in the sector. In terms of sales volume and value, Mediterranean mussel represents 77% and 70% of the total sales volume and value of the Mussel rafts segment.

Figure 4.24.3 Economic performance indicators (in € million) for the main Slovenian segment: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Figure 4.24.4 Cost structure of the main segment in Slovenia: 2020.



Source: EU Member States DCF data submission

The largest cost item of Mussel rafts sector in 2020 were other operation costs, accounted for 64% of the total operational costs. Depreciation of the capital made up 19% of all operational costs. In 2020, Depreciation of the capital increases by more than 500% regarding 2008. Slovenian Mussel rafts sector has over the past few years, with the help of EU Funds, invested significantly in the new equipment and production facilities. So this new investments are the main reason for increased value of Depreciation of capital.

4.24.5 Outlook

Nowcasts for 2021-22

The preliminary data for 2021 shows a decrease of 7% and 15% in terms of production volume and value, while, for employment, a stable trend is indicated. The main reason for decrease in production is the COVID–19 situation.

In 2022, because of the extremely high cost of energy, we can also expect a drop in production and significant decreased values of all economic performance indicators. According to current information, production could fall by more than 10% regarding 2020. The drop will be more noticeable in the mussel raft sector, as it is an activity with a lower added value.

4.24.6 Trends and triggers

Market structure

Slovenian market for marine products is fragmented and disorganized. A large number of producers and dealers are unorganized and acting individually. For all these reasons, they achieve a lower first sales price and higher operating costs and are therefore non-competitive with foreign suppliers.

The Slovenian seafood trade balance is relatively stable over the years and it presents a negative balance. Slovenia is a net importer of fish and fish products. In 2020, imports were approximately five times larger than export and amounted to 10 879 tonnes (EUR 61 million) of fish and other fish product (source; https://pxweb.stat.si/SiStatData/pxweb/sl/Data/-/2490101S.px). On the other hand, exports amounted to 2 210 tonnes (EUR 13 million) in the same year. The majority of the imported fish and fish products come mainly from the EU. The largest Slovenian seafood import partners are Italy, Spain and Croatia. Concerning exports, the largest partners are Austria, Croatia and Bosnia and Herzegovina.

There is a continuous import of fresh farmed species: seabream, seabass and salmon. The majority of the imported fish products come mainly from the European Union and are frozen, dried or processed.

Issues of special interest

The Ministry of Agriculture, Forestry and Food (MAFF) is responsible for fisheries and aquaculture in Slovenia. Fisheries comprise capture fisheries, aquaculture of fish and other water animals and trade in fisheries products. Inland fisheries, fish farming and fish health are managed by three main Acts: the Freshwater Fishery Act, the Livestock-breeding Act (ZŽiv) and the Veterinary Service Act (Zvet) and their regulations, ordinance, etc. Marine fisheries, fish and mussel farming are regulated by Marine Fisheries Act (ZMR-2). In fisheries and aquaculture it is necessary to take into consideration the Environment Protection Act (ZVO), the Nature Conservation Act (ZON), and the Water Act (ZV).

The main leading government agency in fisheries and aquaculture is the Directorate of Forestry, Hunting and Fisheries within the Ministry of Agriculture Forestry and Food. The main task of the Directorate is to provide overall administrative control of aquaculture and fisheries, to ensure an adequate legislative framework for aquaculture and fisheries, and to carry out related legislative tasks. The Directorate is directly involved in controlling the operation of fish farms, licensing procedure of alien species or hybrids and is also responsible for the maintenance of fish stocks in natural waters. The concessions for the use of water, which are the prerequisite for setting up a fish farm in Slovenia, are, however, granted by the Ministry of Environment and Spatial Planning. The Directorate manages that part of the state budget which is designed for fisheries and aquaculture. The funds are used for a variety of purposes, including the financing of the setting up and the management of fisheries information systems; financing of performing public service in fisheries by the Fisheries research institute of Slovenia; for the protection of natural resources Development in the Republic of Slovenia 2007-2013; as well as for the collection of data in and monitoring in fisheries. Ecological, biological research and the breeding of some indigenous species (Danube salmon, grayling, nase) are conducted in the Fisheries Research Institute of Slovenia. The Marine Biology Station of the National Institute for Biology deals with interdisciplinary research of the sea.

There has been a dynamic change in the fish production sector due to economic changes in the period from the independence of Slovenia to its accession to the European Union and after the accession. In the future, it would be reasonable to support research projects such as: analysis of potential possibilities in fish farming development in Slovenia with regards to spatial and hydrological circumstances and research into the possibility of economic farming of new species. It would also be reasonable to continue with investment in the modernization of older fish farms, especially the improvement of hygienic conditions and the construction of new fish farms which comply with EU legislation technologically and ecologically. It would also be necessary to adopt all outstanding fisheries legislation and encourage the establishment of aquaculture producer organisations with a view to the development of fish farming in terms of small and medium sized family fish husbandry. These measures would facilitate the more competitive position of Slovenian fish farming. Natural circumstances and conservation requirements in Slovenia do not allow the development of large industrial farms. The establishment of producer organisations would make it easier to obtain knowledge, new technology and reduce market costs.

Typical Slovenian maritime enterprise is small family fish/shell farm with self-employed persons, mostly one employee and some unpaid assistance from family workers. Regarding techniques and species all Slovenian marine segments are very homogeneous. Marine fish farming practice is normally intensive and takes place in floating platforms where the cages are submerged into the sea. They produced mostly European seabass. Shellfish farming practice is extensive and takes place in lines of floating buoys linked together, where longlines with mussels are suspended. The major and the only cultured shellfish species is Mediterranean mussel.

Outlook for future production trends

In the Slovenian Operational Programme for 2014-2020 the emphasis is primarily on freshwater aquaculture. The main objectives in marine aquaculture are to increase the production of shellfish to 1 000 tonnes and production of marine fish to 120 tonnes. Future development of Slovenian marine aquaculture is strongly conditioned by the small size of the Slovenian Sea. In 2007, three larger areas were designated for marine aquaculture in Slovenian territorial waters that were subsequently separated into 22 plots, for which concessions were granted for the use of marine water in 2009. It is expected that these plots will not be able to expand, due to the use of Slovenian territorial waters for other purposes. All Slovenian maritime fish and shellfish farms are currently operating at about 60% of their capacity. In the future we can expect increasing production to maximum capacity and then stagnation of Slovenian marine aquaculture. The production volume of marine fish and shellfish in 2018 was 76 tonnes and 620 tonnes respectively, so it can be assumed that the objectives of Slovenian OP are realistically achievable.

On the other hand, because of the good quality and quantity of inland water, Slovenia has a good chance to increase freshwater aquaculture, particularly salmonid rearing such as rainbow trout, Huchen (*Hucho hucho*) and brown trout. Today is in Slovenia about 60 trout farms, with a total production of only about 800 tonnes per year.

Fish farming is a sector that promises growth, in particular through an intelligent approach to quality and value adding that is integrated with environmental protection. Main aim of Slovenian OP are Technological development, innovation and knowledge transfer, competitiveness and viability of aquaculture small and medium-sized enterprises (SMEs) including improvement of safety or working conditions, protecting and restoring aquatic biodiversity, enhancing aquaculture-related ecosystems, promoting resource-efficient aquaculture, providing professional training and lifelong learning.

Key objective of Slovenian OP for fresh water aquaculture;

- Increase volume, value and net profit of aquaculture production; in cold water volume to a 1 000 tonnes per year, warm water volume 300 tonnes per year, increased GVA per employee to a €25 000 per year, total value of production to a €1.8 million per year and net profit to a €180 000;
- Increase organic aquaculture and recirculation systems; five fish farms with capacity more than 10 tonnes per year, total production of 500 tonnes per year;
- Support environmental services;
- Create and maintain employment; increase number of total employees to 180.

Slovenia collecting the economic and social data just for the marine aquaculture so in the future will not be able fully assess whether the objectives have been achieved or not.

COVID-19 impact

Covid-19 had a very large negative impact on the Slovenian aquaculture sector. The main reason for negative impact on the Slovenian aquaculture sector are loss of domestic market, mainly due to closure in touristic sector and loss of international markets. According to initial estimates, the number of employees is not expected to decrease.

Due to the coronavirus outbreak, Slovenia implemented various measures to help businesses face these challenging times. The public support took the form of direct grants, wage subsidies, exemption from paying social security contributions, reduction of certain taxes and water fees, bank guarantees, deferred payment of certain credits and compensatory payments.

High energy prices

In 2022, because of the extremely high cost of energy accompanied by increased labour costs as well as repair and maintenance costs, we can expect a drop in production and significant decreased values of all economic performance indicators. Deterioration of the economic situation will be slightly mitigated by the increase in first sale prices, which have increased by 100% in the last period. According to current information, production could fall by more than 10% regarding 2020. The drop will be more noticeable in the mussel raft sector, as it is an activity with a lower added value.

Social acceptance

In terms of fish and seafood production, Slovenia's greatest potential undoubtedly lies in aquaculture: sea bass and shellfish are farmed at the coast, while in the hinterland, trout (cold water) and carp (warm water) dominate farmed species. An interesting aspect is the increase of fish consumption among Slovenians (whose fish consumption has previously been low), and the intention to satisfy higher domestic demand with their own production. According to the ''EU Consumer Habits Regarding Fishery and Aquaculture Products'' survey (https://europa.eu/eurobarometer/surveys/detail/2271), most respondents in Slovenia have no preference if the fish is caught or farmed, although there are still many respondents who prefer to consume wild fish. According to the aforementioned survey, the most important factor for Slovenian buyers when purchasing fish is freshness and price, while the origin of the product comes third. However, in order for aquaculture to be well received by the local population and customers, a number of factors must be taken into account. Mariculture areas should be located in areas where the environmental conditions are suitable for the cultivation of individual types of marine organisms and where there are no conflicts with other uses of the sea. Mariculture areas should be outside protected areas, areas of important marine habitats and waterways. They should also be located at a suitable distance from touristic areas, swimming pools and underwater discharges. Last but not least, the determination and operation of areas for mariculture should also take place in cooperation with local authorities.

4.24.7 Data Coverage and Data Quality

Data were collected only for the marine species.

Regards to the data base “The central register of aquaculture and commercial ponds” from MAFF, in 2020, there were five operators in Slovenia dealing with shellfish farming and one subject that was engaged in breeding of fish. The data for the operators mentioned were collected from multiple sources (The Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES), questionnaire, MAFF)), allowing for cross checking. The accounting data, which are collected by the AJPES public agency, are already checked and verified. The data were collected for all six subjects.

In June 2021 the questionnaires for 2020 were sent to all operators and all of them also returned the questionnaire. Therefore, the response was 100%.

Economic data on the aquaculture sector were collected from accounting records – AJPES and through questionnaires. The national program for collection of economic data for the aquaculture sector combines information from three main resources:

1. Questionnaire information returned from the aquaculture sector on a voluntary basis,
2. Data base: ‘The central register of aquaculture and commercial ponds’ from MAFF,
3. The annual accounts of business enterprises.

The data collected from all sources are combined in such a way that a complete set of accounting items is compared for each business enterprise.

In cases where a questionnaire, as the only source, was used the response rate was 100%. In cases where the data from annual accounts of business enterprises was used the response rate was also 100%, because we have economic reports for all investigated companies.

The economic variables were collected on the basis of Council Regulation (EC) No 199/2008 and the Appendix X to the Commission Decision (EC) 949/2008. Slovenia has uploaded the complete set of requested data to the JRC server before the deadline.

While due to confidentiality issues because of the low number of marine fish farms, we are only presenting Mussel rafts segment in the chapter; ‘’Main species produced and economic performance by segment’’.

In case of Slovenian data, there are differences between Eurostat/FAO and DCF data. The difference is because the Eurostat data also contain data from freshwater aquaculture and also because of better coverage of DCF data for marine sector.

List of acronyms and abbreviations;

AJPES - The Agency of the Republic of Slovenia for Public Legal Records and Related Services.

MAFF - The Ministry of Agriculture, Forestry and Food of the Republic of Slovenia.

VARS - Veterinary Administration of the Republic of Slovenia.

4.25 Spain

Overview of Spanish aquaculture

The Spanish aquaculture sector produced 276.6 thousand tonnes in 2020 generating a turnover of €517.4 million. Moreover, employment has dropped to 12 478 workers and 5 656 FTEs, a decrease of 21.2% and 18.8% compared to 2019[33]. Considering no data were submitted in the related data call, FAO data were used for the whole data series.

4.25.1 Total production and sales

In Spain, the production of aquaculture as well as the value of its products, experienced a decreasing tendency in the last period. The total production of the aquaculture sector as a whole, according to FAO data, was 276.6 thousand tonnes in 2020, meaning a decrease of 11% compared to 2019.

The value of the Spanish aquaculture industry has grown continuously from 2017 to 2019 but, in 2020 the positive trend has been interrupted due to the effects of the Covid-19 pandemic and various adverse natural phenomena. Therefore, the value of Spanish production in 2020 is €517 million, with a 10% negative variation in turnover compared to 2019, and represents 6% less in the value of production than the average for the period 2017-2019. For 2020, the negative trend is common to all aquaculture subsectors in Spain, with freshwater aquaculture production having the sharpest decline in turnover (-21%). In fact, from 2017 to 2019, while all groups have increased the value of their productions, freshwater production has consolidated its loss of importance in the aquaculture industry in Spain.

The production in 2020 corresponds mainly to marine aquaculture (fish and shellfish), which together represent more than 94% of the quantities produced, while only 6% is freshwater aquaculture.

Marine aquaculture is mainly represented by shellfish and around 18% of the total production is marine fish. Shellfish production relevance on total production has remained stable around 75-81% along the period considered (2017-2020). Marine fish production has not followed a positive trend. In 2020, the marine fish aquaculture sector, in addition to suffering the consequences of the COVID-19 pandemic, was also negatively affected by epidemiological and climatic events that caused a considerable loss in the culture.

Table 4.25.1 Production and sales, industry structure and employment for Spain: 2017-2020.

Variable	2008	2010	2012	2014	2016	2017	2018	2019	2020	Change 19-20	Develop. 2020/(08-19)
Production weight (thousand tonnes)	**255.3**	**256.8**	**269.6**	**288.0**	**290.5**	**318.1**	**356.9**	**311.0**	**276.6**	***-11%***	***-3%***
Marine	44.68	42.89	42.89	46.75	49.94	53.32	55.68	59.56	50.28	-16%	4%
Shellfish	188	196	210	226	223	247	290	234	210	-10%	-4%
Freshwater	22.3	18.0	16.8	15.5	17.8	17.4	10.9	17.5	16.3	-7%	-5%
Production value (million €)	**355.7**	**363.9**	**381.5**	**429.6**	**507.8**	**527.7**	**541.1**	**577.0**	**517.4**	***-10%***	***17%***
Marine	238.34	239.82	261.14	302.43	362.19	376.26	377.86	438.00	390.71	-11%	26%
Shellfish	117	124	120	127	145	151	163	139	127	-9%	-4%
Freshwater	0.3	0.4	0.0	0.4	0.5	0.4	0.4	0.1	0.1	-21%	-77%

Source: FAO, 2022.

[33] Estadísticas pesqueras: Encuesta Económica de Acuicultura, 2021. Ministerio de Agricultura, Pesca y Alimentación.

The main species in marine fish production were sea bass, sea bream and turbot. While the production of sea bass and sea bream is concentrated in the Mediterranean area, that of turbot is only located in Galicia, since the turbot aquaculture companies in Cantabria and Asturias ceased their activity in previous years.

Within the shellfish aquaculture, there is the species with the greatest activity in Spanish aquaculture in terms of production: the mussel (*Mytilus galloprovincialis*). Its production, which is very stable, is around 225 thousand tonnes produced per year in the period studied. The slight variations in the production of this molluscs are due to the red tides that do not allow the production to be harvested. Although more than 95% of Spanish mussel production is located in Galicia, there are four other producing regions (Catalonia, Andalusia, Valencia and the Balearic Islands).

The second most relevant species in shellfish aquaculture is the oyster. Mainly two types of oysters are cultivated, the flat oyster (*Ostrea edulis*) and the Japanese oyster (*Crassostrea gigas* also called *Magallana gigas*). Although their production is much lower than that of mussels, this species represents an important group of molluscs in economic terms.

In addition to the others, clam culture is also representative group within shellfish production. The most cultivated species are the fine clam (*Ruditapes decussatus*), the slimy clam (V*enerupis pullastra*) and the Japanese clam (*Ruditapes philippinarum*), which can be cultivated in cultivation parks or in natural beds. On the Spanish Mediterranean coast, the natural banks and shellfish parks have seen a total reduction in the production of clams and other shellfish due to the presence of the blue crab (*Callinectes sapidus*), a very voracious invasive species.

Regarding to aquatic plants, production has stagnated between 9-11 tonnes between 2017 and 2020. In Spain, production is evenly distributed between microalgae and macroalgae cultivation. Regarding microalgae cultivation, its production is carried out in companies, spread throughout the Spanish geography, dedicated to its production mainly using fotobiorreactors. The most cultivated species are *Nannochloropsis gaditana*, *Tetraselmis chuii*, *Isochrysis galbana* and *Phaeodactylum tricornutum*. They are marketed for various purposes, such as human nutrition, animal feed, biofuels or cosmetics. Macroalgae are mainly produced in two Spanish regions: Galicia (83%) and Andalusia (17%). The species that account for most of the production are *Saccharina latissima*, *Ulva spp*. and *Gracilariopsis spp*., which are used for human food or as a source of bioactive compounds. In recent years there have been several successful experiences of *Spirulina* and *Chorella* cultivation, but in spite of being a product of excellent quality, it is difficult to compete with products from third countries, such as China.

In freshwater production, the main species is rainbow trout with more than 95% of the production in this segment. Its production is spread over a large number of Spanish regions (Castilla y León, Galicia, Andalucía, Cataluña, La Rioja, Castilla la Mancha, Asturias and Aragón). Other species produced are tench or doctor fish (*Tinca tinca*), followed by sturgeon (both *Acipenser baerii* and *Acipenser naccarii*). Production of both trout and sturgeon caviar are also an important income for some of the freshwater aquaculture companies. Freshwater fishes' production is experiencing a negative trend since 2017 to the present.

4.25.2 Industry structure and total employment

Considering official data from Spanish Government (MAPA), in 2020, 5 102 aquaculture establishments were in operation in Spain, meaning a reduction of 160 establishments compared to 2019, and a decrease of 1% compared to the average of the 2017-2019 period.

The total number of employees in the Spanish aquaculture industry was 12 478 in 2020. The figure shows a drop of 18% with respect to 2019, but a decrease of 25% if the last four years observed are considered. Regarding the FTE figures the decline is very similar to that of the number of employees, as the variation over 2019 is 16%, and 14% compared to the average for the period. 2017-2019[34].

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[34] Estadísticas pesqueras: Encuesta Económica de Acuicultura, 2021. Ministerio de agricultura, pesca y alimentación.

In 2020, many people working in aquaculture were non-paid, mainly in the mussel sector. Furthermore, there was 3 030 were skilled workers, 1 846 unskilled workers, 639 technicians with higher or medium degrees, 263 administrative staff and 118 people with other professional categories. As for the distribution of work by gender, in 2020 the trend whereby men (74%) occupy most jobs and FTE (81%) continues.

4.25.3 Economic performance

The economic performance of the aquaculture sector in Spain has improved from 2012 to 2018. However, the results in 2019 (€791 million) and especially 2020 (€727 million), show a decrease in the operating income of the sector. The variation between 2019 and 2020 of the items that form the operating income shows that, despite the 11% increase in subsidies and 26% increase in other operating income, the decrease is marked by the decrease in the net turnover of 11%, to €640 million. Despite this negative development, total revenues have declined by less than the quantities produced, indicating a higher average value of the products.

Despite the decline in revenues, operating costs during 2019 and 2020 dropped. Principally a decrease is observed in production costs such as those directed to the purchase of food and feed and in labour costs. In addition, the negative trend in the sector was also shown in gross value added, which decreased by 21% in 2020 compared to 2019.

4.25.4 Main species produced and economic performance by segment

The four main species in Spanish aquaculture in terms of value (European seabass, Atlantic Bluefin Tuna, Mussels, and Rainbow trout) represented 91% and 75% of the total industry quantities and value in 2020, respectively.

By far Mussels is the main harvested species in Spain, with a production in 2020 of 204 466 tonnes, which represents nearly three of each four kilograms of total production in Spain. This species is mainly produced in Galicia in mussel rafts, but it is also cultivated in Catalonia, and in a smaller proportion in Valencia and the Balearic Islands in rafts, and in Andalusia in longlines. However, the value of mussel production represented 25% of the aquaculture industry in the country. Mussel is a species whose production depends on the changes of environmental conditions, suffering big fluctuations into different years in the past.

When talking about marine fish, seabass is the main harvested species in Spain, with 22 765 tonnes in 2020, with a total value of €144.1 million. Seabream is the fourth marine fish cultivated in Spain, 6 458 tonnes in 2020, valued €12.5 million. These two species represented more than 31% of the total aquaculture production value in 2020. Seabream and seabass production is concentrated in Mediterranean coast, but these species are also produced in the Canary Islands and in the Atlantic coast of Andalusia.

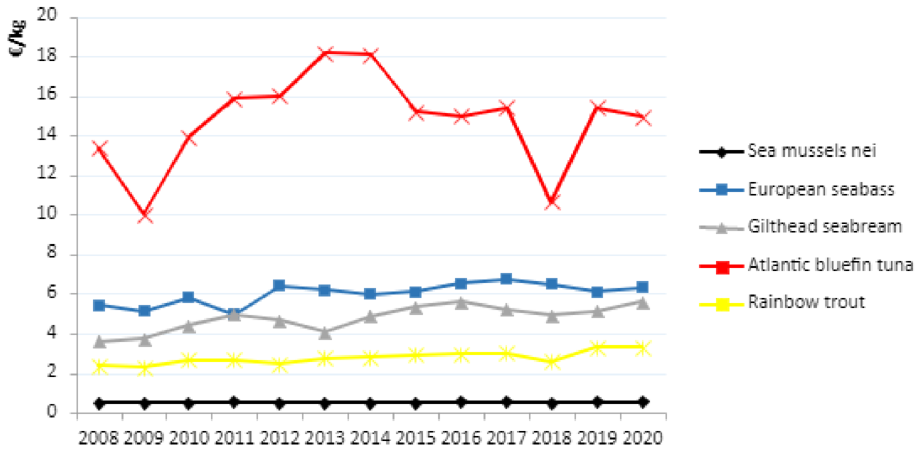
The second important species is Atlantic bluefin tuna, with a total production in 2020 of 8 913 tonnes, valued €133 million. This species has experienced a 73% growth in production between 2017 and 2020. Moreover, this is one of the species with the highest price per unit, representing 3% of the total volume of the total production of the industry, but accounting for 23% of the total value of production. Turbot, with 6 963 tonnes is the third most important species for marine aquaculture in Spain. The impact of covid-19 has been negative on this species, which has decreased its production by 15% with respect to 2019, after presenting a sustained trend in its production during the last four years.

The rainbow trout is the main freshwater species in Spain. Its production takes place inland around mostly all the regions of the country. Total production achieved 15 806 tonnes in 2020 with a value of €52 million. In the group of molluscs in Spain there are also traditional ways of aquaculture, like the clams cultivated in the intertidal areas. Their production is dominated by *Ruditapes philippinarum*. These are a kind of aquaculture with a high social value in the areas in which it is concentrated, in particular in Galicia.

Figure 4.25.1 Main species in terms of weight and value in Spanish production: 2020.

SOURCE: FAO (2022)

Figure 4.25.2 Average prices (€/kg) for the main species produced in Spain: 2008-2020.



SOURCE: FAO (2022)

Analysis of evolution of the average prices for the main species in Spanish aquaculture indicates different evolutions according to the diversity of species. Sea bream recovered the positive trend started in 2014, after a price decrease in 2018, to have an average price of €5.6 per kg in 2020.

In the case of sea bass, average prices in 2020 (€6.3 per kg) after the slight decrease occurred in 2019. Trout prices have followed an increasing trend since 2013. The average price in 2020 was €3.3 per kg, matching the 2019 price, which was the highest price record in the last 10 years. In the case of mussels, prices have remained stable since 2010, oscillating between a price range of €0.47-0.54 per kg. In 2020, following this trend, the average price was €0.51 per kg. The most significant aspect in the evolution of prices is the decrease experienced by the price of Atlantic bluefin tuna in 2018. This fact may be related to the loss of consumer confidence in this species after, in 2018, a police action was activated in Spain against the sale of illegal bluefin tuna.

The most relevant segments in the Spanish aquaculture are presented below.

- Segment 1: Seabass and seabream cages
- Segment 2: Tuna cages
- Segment 3: Mussel rafts
- Segment 4: Trout tanks and race-ways
- Segment 5: Turbot tanks

Segment 1: Seabass and Seabream cages

Sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*) are the most important species of finfish aquaculture in Spain in terms of production volume (29 233 tonnes) and together they are the most important species of the entire industry in terms of value (€180 million). Traditionally, seabream used to be the most important of the two species but, since 2015, the decline in the production of seabream together with the positive evolution of seabass has positioned this species as the most valuable in the Spanish aquaculture sector. For its part, the production of gilthead seabream in 2018 was 6 458 tonnes valued at €36 million.

These species are cultivated in warm waters, in the Mediterranean Sea, but also in the Spanish Atlantic coast and Canary Islands. There are productions in Andalusia, Canary Islands, Valencia, Murcia, Balearic Islands and Catalonia. In spite of the hatcheries located in Spain, there are not enough juveniles for domestic production so, they must be imported from other countries.

Although apart from some production developed in brackish waters in southern Spain, most of the domestic seabass and seabream production is grown in cages. The production in cages is valued almost €182 million in 2020. A part from production in cages, there are other systems such as hatcheries and nurseries (€41 million in 2020)[35].

Segment 2: Tuna cages

As a capture-based activity, the economic performance of tuna aquaculture is strongly dependent on the availability of livestock from the wild fishery. Thus, any change in the quotas for bluefin tuna catches in the Mediterranean will be transferred to most of the performance indicators of the Spanish tuna ranching companies. The corresponding TACs were significantly decreased by ICCAT in 2010, matching the figures of the scientific advice. Such a decision reduced the supply of juveniles and causing the subsequent increase in the prices of the final product. Since demand, especially in Japan, is quite inelastic, the increase in the price favoured the profitability of the industry (Fernández Polanco & Llorente, 2016)[36]. In 2017, ICCAT recommended a quota increase, which has led to an increase in the quota between 2017 and 2020 of 49%, reaching 6 107 tonnes in 2020[37].

Segment 3: Mussel rafts

The mussel aquaculture sector in Spain is concentrated, for the most part, in Galicia (97%). This mollusk represented 74% of the total Spanish aquaculture production in terms of quantities and 18.4% of the value in 2020, considering that the average price of this product is significantly lower than that of the main farmed fish in Spain. Being a species, which is strongly dependent on natural conditions, its annual production could reflect high fluctuations over time. In 2020, production was 204 466 tonnes, which represented a decrease in production of 11% compared to 2019 and 18% compared to 2017-2019. Likewise, turnover was down to €105 million, being 12% lower than in 2019 and 23% lower than in the 2017-2019 period.

In the last two years, 2019 and 2020, there has been a negative trend in mussel production. In the Mediterranean area, the effects of the Gloria storm decreased mussel production about 65%, as it affected the supply of infrastructures, equipment and production facilities. In the Atlantic area, in Galicia, the causes of the decrease in production are based on several of the mussel production links. Firstly, producers have had difficulty in obtaining seed, as there has been a shortage of seed on the catching ropes and on the stones on which they are usually collected. Secondly, in the first quarter of the year, as a result of a cause yet to be determined, the growing mussels were falling off the ropes, starting from the lower part and moving up to the upper part. Due to this fact and the uncertainty generated, the producers marketed their product early, with smaller and poorer quality mussels reaching the market. Thirdly, the growth rate of mussels has been lower than in other years. The lack of plankton and other nutrients are the causes of this phenomenon. Fourthly

[35] Estadísticas pesqueras: Encuesta Económica de Acuicultura, 2020. Ministerio de Agricultura, Pesca y Alimentación.

[36] Fernandez-Polanco, J., & Llorente, I. (2016). Tuna economics and markets. In Advances in Tuna Aquaculture (pp. 333-350). Academic Press.

[37] Control de Cuota, 2021. Ministerio de Agricultura, Pesca y Alimentación.

and lastly, in the last decade there has been a change in the marketing of mussels that affects their production and turnover. Producers are focusing on cultivating small and medium-sized mussels, as they are the most demanded by the processing industry. This has reduced the cultivation of large mussels, which have a higher price. Therefore, at the end of the production process, instead of weighing 200-220 kg, the mussel ropes weigh between 150 and 165 kg[38].

Segment 4: Trout tanks and race-ways

Rainbow trout are raised in a monoculture system, in cement tanks, and it is the main species of continental aquaculture in Spain. For its cultivation, a high-quality water supply is required throughout the year. In Spain, production is spread among several regions, but the one with the highest production is Castilla y León.

In 2020, production amounted to 15 805 tonnes, resulting in a turnover of €52 million. In terms of production and value, these figures are 7% lower than in 2019. But, despite this decline due to the Covid-19 pandemic, the trout segment seems to be consolidating the recovery trend in production and sales of the previous years, after a long decline since the end of the last Century. Since 2015, tariffs imposed by the European Commission on trout imported from Turkey at low prices have caused domestic production to rebound.

Segment 5: Turbot tanks

Turbot production in 2020 is 6 963 tonnes, resulting in a value of €48 million. These figures were lower than in the previous 5 years, with a decrease in production of 25% and 23% of the value compared to the period 2017-2019. Galicia is currently the only producing region, after turbot production in Cantabria ceased in 2019 and previously in Asturias in 2007 (Fernández-González et al., 2021)[39].

The Covid-19 pandemic has had a strong impact on the production of this species. Turbot is mainly marketed through the HORECA channel (Hotels, Restaurants and Cafes). In the first quarter of the year, when restrictions in Spain were the hardest, the main turbot production company, responsible for about 40% of the production, had an operating loss of €9 million. As a solution, the two big companies in the market (Stolt Sea Farm S.A. and Nueva Pescanova S.L.) introduced new ways of marketing turbot, such as the sale of frozen turbot. These innovations in production have lasted until today.

4.25.5 Outlook

Nowcasts for 2021-2022

Aquaculture production in Spain in 2021 increased by 7% to 327.7 thousand tonnes, with a value of almost €610 million. Freshwater production, led by rainbow trout, grew by 13% up to 15.5 thousand tonnes valued €43 million. Marine production increased by 7% and 10% in quantity and value respectively to 311 thousand tonnes with a value close to €565 million. Fish production grew by 4% to a yearly record of 66.5 thousand tonnes, but decreased its value by 13% to €429 million due to the context of lower prices. The production of crustaceans, mainly mussels, grew by 7% to 259 thousand tonnes. For its part, seaweed cultivation seems to be consolidating in Spain. However, in 2020, production and value fell by 14% and 26%, respectively, to 9 tonnes and €2 million.

The production of gilthead seabream, the second species in finfish marine aquaculture, continues its downward trend in favour of seabass, which is growing and consolidating its position as the main finfish marine aquaculture species in Spain, both in terms of quantity and value. Turbot, despite

[38] Mexillón de Galicia, 2022. Consello regulador do mexillón.
[39] Fernández-González, R., Pérez-Pérez, M. I., & Garza-Gil, M. D. (2021). Main issues and key factors for development of turbot aquaculture in Spanish regions: A social-ecological perspective. *Aquaculture*, *544*, 737140.

the stagnation of its production, has become the third most important species in production with 7 629 tonnes in 2021.

Trends and triggers

In Spain, the approval of the Spanish Constitution in 1978 led to a scenario in which administrative competences were progressively transferred to the regions. This trend was also applied to aquaculture where, at present, it is a multilevel governance. Thus, while the central government grants concessions for the use of the public maritime-terrestrial domain, each region approves the activity license. These competences derive mainly from two national laws: the Marine Cultivation Law (1984) and the Coastal Law (1988).

This year, in August 2022, the modification of the Coastal Law was approved. Among the most important changes are the new limits for the different types of concessions which, including all extensions, cannot exceed 75 years in the case of marine cultivation facilities, are limited to 50 years for public service properties, and must not exceed 30 years for the rest of the constructions dedicated to other activities, such as purification or canning companies.

This change in the criteria defining the maximum duration of concessions for the occupation of the maritime-terrestrial public domain in Spain has created uncertainty in the aquaculture sector. The regional government of Galicia, the leading Spanish region in aquaculture production, has announced its intention to appeal to the Spanish Supreme Court against the reform of the Coastal Law. This decision was taken after a series of meetings between representatives of the regional government and a representation of the affected stakeholders, which own some 4 000 buildings, including 232 companies, 59 fish markets and 24 purification plants.

In addition, another change in the institutional framework for aquaculture is expected in Spain. The documents on Spain's *Contribution to the Strategic Guidelines for a more sustainable and competitive EU Aquaculture 2021-2030* and its *Work Plan* are pending immediate approval. The main purpose of these documents are to be a tool to promote aquaculture activity in the country so that it grows and consolidates as a safe, healthy and sustainable food and product production system.

In recent years, in accordance with European guidelines, the cultivation of micro and macroalgae is being promoted. The increase in production must be accompanied by awareness campaigns at all levels on the consumption of algae. As cultivation projects are scaled up, work should also be done to improve post-production processes, such as drying and packaging.

Moreover, in some areas of the Spanish Mediterranean, such as the bays of the Ebro Delta, the tendency to have high water temperatures of more than 28ºC for prolonged periods is leading the Mediterranean mussel farming sector to shorten the production cycle to avoid production losses due to mussel death.

These high temperatures of the water cause the death of the mussel seed and push the sector to bring in the new year's brood stock from other countries. So far, Italy and Greece have been supplying seed to Spanish Mediterranean producers, but now these countries may also be affected in the production of mussel seed.

On the Spanish Mediterranean coast, the natural banks and shellfish parks have seen a total reduction in the production of clams and other shellfish due to the presence of the blue crab (*Callinectes sapidus*), a very voracious invasive species. The presence of this species impedes the recovery of natural banks of bivalve molluscs.

COVID-19 impact

In Spain, the aquaculture food system was particularly vulnerable to the COVID-19 pandemic. However, depending on the degree of internationalization and the habitual commercialization routes of the product, there were different levels of affectation.

Before analysing the degree of impact that these factors caused, it is important to highlight that, in Spain, there were different phases in the management of the COVID-19 pandemic. These stages resulted in different levels of confinement for the population that have had an effect on consumption and, consequently, on aquaculture production. The first period of institutional management of the pandemic is between March 14 and June 15, 2020, when the population is totally confined and non-essential economic activities are paralyzed. In the second period, from June 16 to October 25, 2020, the confinement of the population ended, non-essential sectoral activities resumed and, therefore, the HORECA channel was opened. From October 25 until the end of 2020, the authority to stop the activity of non-essential sectors was transferred to the regions. In this way, the HORECA channel again closed its activity in a discriminate manner in different areas of the country.

Throughout the pandemic, aquaculture was declared an "essential activity" and therefore, the sector has never experienced a national shutdown. However, some sub-sectors, such as the shellfish farming sector, voluntarily decided to stop their activity when seafood prices fell as a consequence of the closure of the HORECA channel.

In fact, those aquaculture crops for which a significant percentage of their production was distributed through the HORECA channel have seen their income levels affected. These aquaculture species, for the most part, are the ones with the highest market value. Thus, in general, it can be stated that there is a positive correlation between product price and the impact of the pandemic. This effect was especially significant in the first period of the pandemic when the HORECA channel was disconnected. Although in the central months of 2020 the HORECA channel was active, the levels of marketing of aquaculture products in the market of previous years were not recovered.

Confinement led to a change in consumption habits. Processed foods increased and fresh foods decreased. Faced with the increase in consumption of frozen or canned fish and shellfish, producers of some species began to look to the processing industry as an alternative for marketing their products, but, in the best of cases, they were only able to channel a small part of their production.

In addition, in the first months of the pandemic, foreign trade, both exports and imports, was severely restricted. Thus, aquaculture products traded abroad were adversely affected.

Social acceptance

Poor social acceptance of aquaculture is often identified with poor spatial planning, associated with top-down consultation mechanisms.

The administrative concession or authorization of an aquaculture project can be greatly delayed if the various stakeholders concerned are not taken into account.

To improve the social acceptance of aquaculture, producers and the public must be informed from the outset of the project to be developed. These actors must also collaborate to develop national and regional strategies under a more integrated perspective, taking into consideration environmental, economic, social and governance aspects.

This is why the Spanish government, together with the EU, is carrying out outreach campaigns to improve the social acceptance of aquaculture in the country.

At the regional level, there are very successful examples of co-governance in small-scale fisheries, where government, scientists, industry and NGOs are involved at the same level in decision making to manage marine resources. The benefits of down-top management are evident. Aquaculture roundtables are promoted to achieve similar results.

4.25.6 Data Coverage and Data Quality

Spain did not submit any data in the related data call. FAO data were used to prepare this chapter and official national sources were consulted.

4.26 Sweden

Overview of Swedish aquaculture

In 2020, the Swedish aquaculture sector produced 12.9 thousand tonnes of aquaculture products valued at €48.6 million. The majority of production is carried out in freshwater and the main specie produced is rainbow trout. The industry consists of 98 enterprises employing 543 people. The sales value of production is growing slowly and saw an increase of €3.4 million for 2020 compared to the previous year.

4.26.1 Total Production and sales

Over the years 2008 to 2020, production levels have increased from 6 300 tonnes in 2008 to 12 900 tonnes in 2020 and the value of total production have increased from €14.5 million in 2016 to €48.6 million in 2020. The change in production levels between 2019 and 2020 is an increase of 21%, and the sales value as a whole increased by 7% (Table 4.7.1).

4.26.2 Industry structure and total employment

In 2020, the total number of aquaculture sites were 154, distributed on 98 enterprises. The Swedish aquaculture sector is dominated by small enterprises, and in 2020, 77% of the Swedish enterprises had less than 5 employees.

Table 4.26.1 Production and sales, industry structure and employment for Sweden: 2008-2020.

Variable	2009	2011	2013	2015	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(09-19)
Sales weight (thousand tonnes)	**10.4**	**14.5**	**14.4**	**13.4**	**15.8**	**13.8**	**12.1**	**12.8**	6%	-7%
Marine	0	0	0	0	0	0	0	0	0%	0%
Shellfish	2.1	1.5	1.7	1.5	2.0	2.0	2.0	2.3	16%	29%
Freshwater	8.2	13.0	12.7	11.8	13.8	11.8	10.2	10.5	4%	-12%
Sales value (million €)	**29.4**	**47.5**	**50.3**	**53.3**	**63.1**	**63.5**	**45.2**	**48.6**	7%	-5%
Marine	0	0	0	0	0	0	0	0	0%	0%
Shellfish	1.1	1.0	1.3	1.1	1.3	0.6	1.7	1.9	8%	60%
Freshwater	28.3	46.5	49.0	52.2	61.8	62.9	43.5	46.7	7%	-6%
Number of enterprises	**192**	**153**	**144**	**126**	**105**	**93**	**85**	**98**	15%	-28%
Marine		9					0	0	0%	-100%
Shellfish	48	29	30	31	18	14	14	19	36%	-32%
Freshwater	144	115	114	95	87	79	71	79	11%	-25%
Employment	**424**	**392**	**420**	**411**	**559**	**478**	**444**	**639**	44%	40%
Marine		0	0		0	0	0	0	0%	0%
Shellfish	85	54	59	67	72	37	65	78	20%	22%
Freshwater	339	338	361	344	487	441	379	561	48%	43%
FTE	**222**	**263**	**304**	**268**	**362**	**286**	**325**	**348**	7%	23%
Marine		0	0		0	0	0	0	0%	0%
Shellfish	22	22	24	22	28	21	57	53	-7%	107%
Freshwater	200	241	280	247	334	264	268	295	10%	14%

Source: EU Member States DCF data submission, 2022.

4.26.3 Overall Economic performance

The Swedish aquaculture sector has performed fairly well during the 2008-2020 period. Total income has been rising while operating costs have fallen. During 2010, the sector had very negative results however the sector has since recovered and has showed continual growth (Table 4.26.2).

Table 4.26.2 Economic performance indicators (in € million) of the Swedish aquaculture sector: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	Develop. 2020/(17-19)
Total income	64.3	58.9	50.5	53.6	-14%	-13%
Total operating costs	56.1	33.8	42.3	48.6	25%	-4%
Total wages	10.6	9.6	9.6	8.8	0%	-3%
Gross Value Added	18.8	34.7	17.8	13.9	-49%	-25%
Depreciation of capital	3.6	3.5	3.5	3.4	-1%	-2%
Earning before interest and taxes	4.5	21.5	4.7	1.6	-78%	-54%
Financial costs, net	0.9	0.4	0.3	-1.5	-22%	-40%
Net profit	3.6	21.1	4.4	3.1	-79%	-55%
Total value of assets	76.3	74.6	76.2	87.1	2%	1%
Capital productivity (%)	24.6	46.4	23.4	15.9	-50%	-26%
Return on Investment (%)	5.9	28.8	6.2	1.9	-79%	-55%

Source: own elaboration from EU Member States DCF data submission, 2022.

4.26.4 Main species produced and economic performance by segment

Since 2016 the Swedish aquaculture industry is divided into seven segments according to EUMAP

1. Other freshwater fish – Cages
2. Other freshwater fish – Tanks and race-ways
3. Other freshwater fish – Ponds
4. Other freshwater fish – Recirculation systems
5. Other freshwater fish – Hatcheries and nurseries
6. Crustaceans – Other
7. Mussel – Other

However due to confidentiality issues segment 8.2 tanks and raceways and 8.4 recirculation systems have been aggregated for most variables.

The largest segment in Swedish aquaculture, in terms of both value and volume of production, is freshwater fish grown in cages. The second most important segment is Mussels Other (blue mussels and oysters). The third largest segment is Other freshwater fish tanks and raceways. There are five main species produced in Sweden, rainbow trout, blue mussel, arctic char, Atlantic salmon and European eel as well as a group of other freshwater fish (Figure 4.26.1).

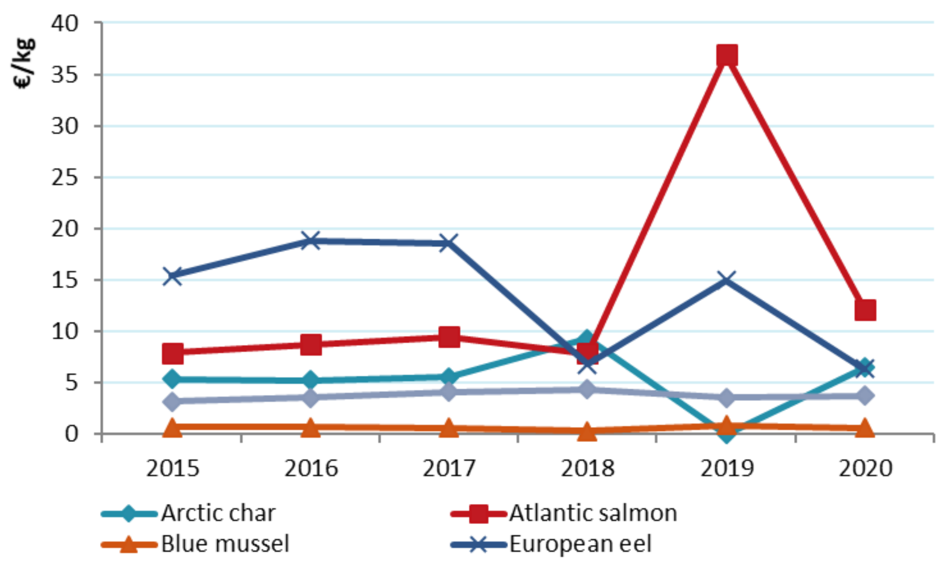
Aquaculture cages in freshwater dominate in Sweden – both in production and value. Other methods for aquaculture in Sweden are ponds, tanks and raceways. Rarer are recirculating aquaculture systems but more and more are being established. Rainbow trout is the most important specie in Sweden and is produced in most geographical regions.

In 2020, Swedish aquaculture yielded 12.9 thousand tonnes, out of which 10.7 thousand tonnes were fish (in fresh weight). The amount of fish that was produced for human consumption was 9 900 tonnes. The dominating species was Rainbow trout, with 71% of the total production and 76% of the value. The production of blue mussel yielded the second highest production volume while yielding the third largest production value after arctic char. The total value of aquaculture production amounted to €48.6 million, an increase by €3.4 million compared to 2019.

Figure 4.26.1 Main species in terms of weight and value in production, Sweden: 2020.

Source: EU Member States DCF data submission, 2022.

Figure 4.26.2 Average prices (€/kg) for the main species produced in Sweden: 2015-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Rainbow trout is the most important specie both in terms of weight and total production value while it only carries the fourth highest value per kilo. European eel yielded the highest value per kilo in Sweden prior to 2018 however, the production of European eel is less than 1% of the total aquaculture production. Atlantic salmon production in Sweden is almost exclusively for stocking purposes hence the high value per kilo (Figure 4.26.2).

The prices of the main species produced by Swedish aquaculture have been fairly stable during the period of 2015 to 2020 for most species. Price data for Atlantic salmon is incorrect for 2019 and 2020 due to confidentiality in the data the same is true for arctic char for the year 2019. The price of European eel saw a drastic decrease in 2018 and 2020 while the price of arctic char increased, the cause for these price fluctuations is however unknown. (Figure 4.26.2).

The most relevant segments in the Swedish aquaculture are analysed below.

Table 4.26.3 Economic performance of main aquaculture segments: 2017-2020.

Variable	2017	2018	2019	2020	Change 2019-20	2017	2018	2019	2020	Change 2019-20
	Other freshwater fish cages					**Mussel Other**				
Number of enterprises	37	36	37	37	0%	9	7	7	10	43%
FTE	199	180	188	182	-4%	25	20	55	53	-4%
Average wage (thousand €)	37.5	43.9	32.2	32.4	1%	23.1	17.7	136.0	84.5	-38%
Labour productivity (thousand €)	79.9	194.1	58.2	47.7	-18%	43.2	39.9	49.3	107.6	118%
Total sales volume (thousand tonnes)	13.0	11.1	10.1	10.1	0%	2.0	2.0	0.0	2.3	
Total income (million €)	55.8	55.5	41.2	42.1	2%	1.2	0.8	3.2	5.8	83%
Total operating costs (million €)	47.3	28.5	36.3	39.3	8%	0.7	0.4	7.9	4.6	-42%
Gross Value Added (million €)	15.9	34.9	11.0	8.7	-21%	1.1	0.8	2.7	5.7	110%
Net profit (million €)	5.3	24.0	2.6	2.4	-6%	-0.6	-0.2	-8.5	-0.9	89%
Total value of assets (million €)	62.5	65.6	55.5	57.3	3%	4.7	3.8	41.1	46.4	13%
Net investments (million €)	0.9	2.2	1.5	0.0	-97%	2.1	3.3	0.3	0.2	-43%
Capital productivity (%)	25.4	53.2	19.8	15.1		22.9	21.0	6.6	12.3	
Return on Investment (%)	8.4	36.6	4.6	4.2		-12.4	-6.0	-20.7	-1.9	
Future Expectation Indicator (%)	-2.2	-0.6	-1.3	-3.3		22.9	70.2	-4.8	-4.0	
	Other freshwater fish Tanks and race-ways					**Other freshwater fish Ponds**				
Number of enterprises	29	22	15	21	40%	15	18	13	14	8%
FTE	103	68	42	92	120%	17	17	22	21	-4%
Average wage (thousand €)	20.0	33.5	19.4	10.5	-46%	24.8	20.2	13.9	9.5	-32%
Labour productivity (thousand €)	9.0	32.1	-25.8	1.8	107%	60.6	47.5	38.0	41.6	9%
Total sales volume (thousand tonnes)	0.6	0.5	0.0	0.5		0.2	0.2	0.1	0.0	-100%
Total income (million €)	5.9	4.1	0.6	3.7	504%	1.4	1.6	1.0	1.1	18%
Total operating costs (million €)	7.0	4.2	2.5	4.5	80%	0.9	1.1	0.4	0.5	7%
Gross Value Added (million €)	0.9	2.2	-1.1	0.2	115%	1.0	0.8	0.8	0.9	5%
Net profit (million €)	-1.3	-0.8	-2.0	-1.1	44%	0.5	0.4	0.6	0.6	12%
Total value of assets (million €)	6.7	7.5	2.8	6.2	119%	2.2	2.2	1.1	1.6	46%
Net investments (million €)	3.7	2.0	0.1	0.2	202%	0.0	0.0	0.2	0.0	-97%
Capital productivity (%)	13.8	29.1	-38.5	2.7		47.4	36.1	77.1	55.6	
Return on Investment (%)	-18.8	-11.3	-69.9	-17.9		21.0	19.5	51.5	39.6	
Future Expectation Indicator (%)	51.6	17.2	-3.1	-0.7		-2.5	-4.3	14.2	-2.4	

Source: own elaboration from EU Member States DCF data submission, 2022.

Other freshwater fish cages

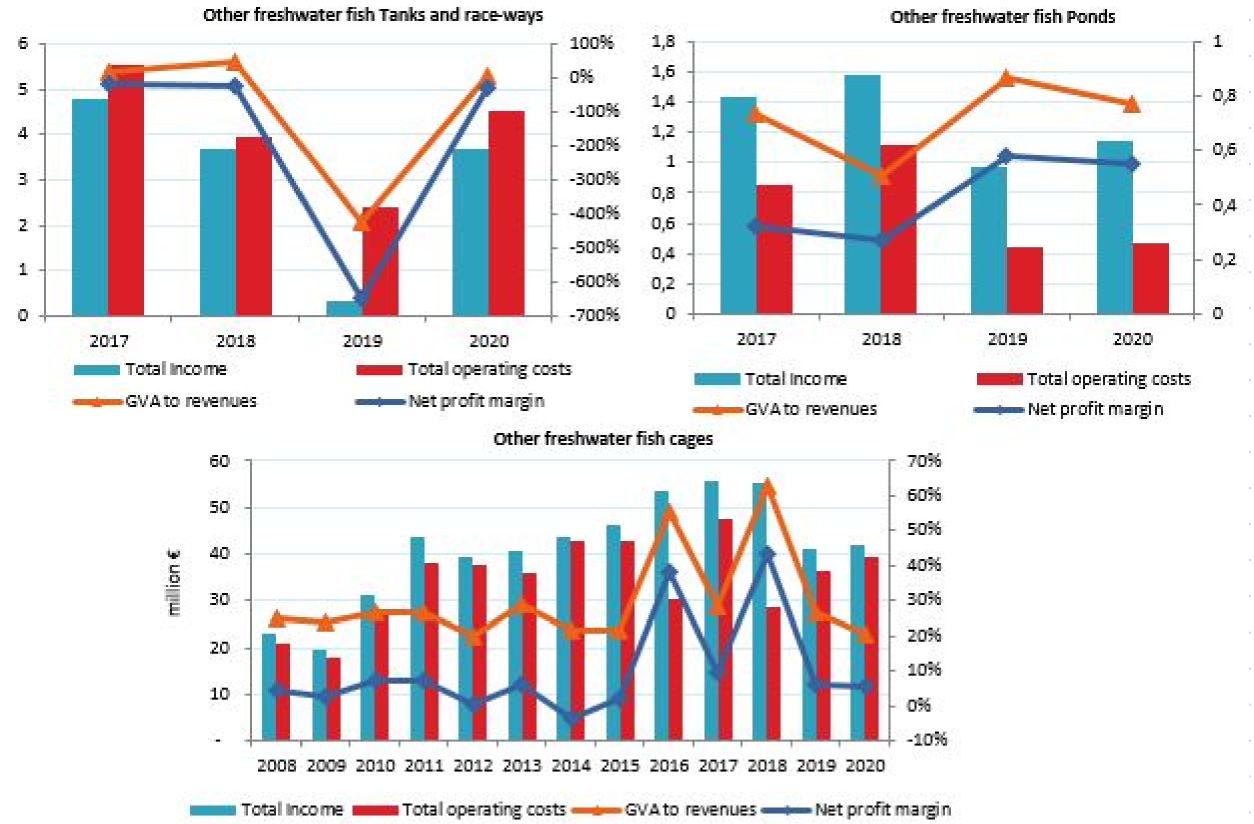
The value and volume of production of freshwater fish in cages has decreased between 2017 and 2020 and the figures indicated that the segment was experiencing challenges in the economic indicators. The segment produced 71% of aquaculture production in 2020 and the total income accounted for 90% (€42.1 million) of total income. Total sales volume in segment has decreased with 22% during 2017-2020 from 13 to 10.1 thousand tonnes and gross value added decreased from €15.9 million to €8.7 million.

In 2020, the feed costs were the main cost component with 39% of total operating costs in this segment. Other operational costs amounted for 26% of the total costs in 2020 and wages and salaries amounted 14%. The energy costs are of minor importance, 2% of total operational costs are due to energy costs.

Mussel other

The segment *Mussel other* consists of enterprises producing mussels and oysters. Previously (until 2015), enterprises producing freshwater crayfish was also included. This segment represents 19% (2 300 tonnes) of Sweden's total aquaculture production in terms of weight and 36% (€5.7 million) in terms of gross value added. The income and production have been growing for this sector during the 2017-2020 period.

Figure 4.26.3 Economic performance indicators (in € million) for the main segments: 2008-2020.



Source: own elaboration from EU Member States DCF data submission, 2022.

Other freshwater fish Tanks and raceways

This segment contains species of freshwater fish and aquaculture production both for stocking as well as consumption. In 2020, the segment produced 1.5% (5 000 tonnes) of total production and the total income accounted for 7% (€3.7 million). The production volume has been fairly stable during the 2017-2020 period.

In this segment, the cost of energy dominated with 24% of the total costs. The other main costs associated with this segment were wages and salaries, feed, livestock, and other repair and maintenance making up 67% of the total costs.

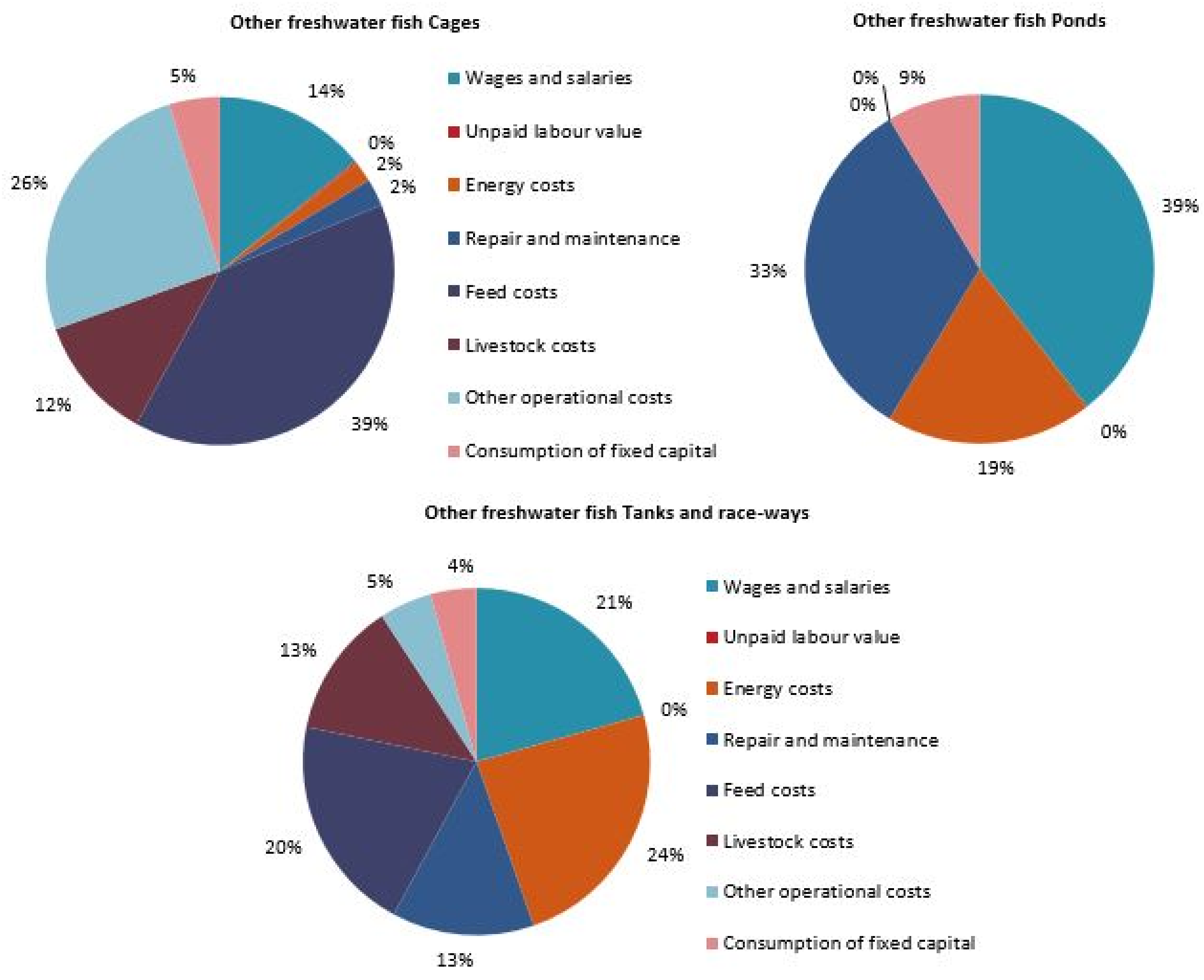
Other freshwater fish Ponds

This is the smallest segment raising freshwater fish in Sweden. In 2020, the segment produced 0.8% (1 000 tonnes) of total production and the total income accounted for 2% (€1.1 million). The production volume has declined during the 2017-2020 period.

In 2020, the GVA to revenue showed a decrease in the segment Other freshwater fish cages. The segment Other freshwater fish tanks and raceways showed an increase in 2020 with a percentage higher than previous year. The segment Other freshwater fish ponds have been relatively steady for the last three years. The net profit follows the same trend as GVA to revenues for segment Other freshwater fish cages and Other freshwater fish ponds but for segment Other freshwater fish tanks and raceways it fluctuates over the years with a sharp decrease in 2019. Operating costs have been declining for segment other freshwater fish ponds and total income peaked in 2018. Also, in segment other freshwater fish cages there are similar reports with higher income compared to operating costs and the opposite was observed in segment other freshwater fish tanks and raceways (Figure 4.7.3).

The segment Other freshwater fish ponds reported a cost of wages and salaries that presented a majority (39%) of the total costs. Another major cost in this segment was feed costs (33%) whereas unpaid labour, energy, repair and maintenance and other operational costs only represented a minor part of the costs.

Figure 4.26.4 Cost structure of the main segments in Sweden: 2020.



Source: EU Member States DCF data submission, 2022.

The operational cost structures for the main Swedish freshwater fish segments are presented in Figure 4.7.4 using EUMAP segmentation. Due to low number of enterprises and response rate, the segment *Other freshwater fish Recirculation systems* cannot be presented.

4.26.5 Outlook

Nowcasts for 2021-22

In 2021 and 2022, the Swedish aquaculture sector is predicted to keep developing at a rate somewhat similar to previous years. The Swedish government has made it clear that there is a desire for the sector to have greater growth. Actions to facilitate that development are being taken in the form of additional funds to facilitate development as well as conducting an analysis on how to adapt regulations and simplify the administration of the aquaculture sector. While the sector is recovering from the Covid-19 pandemic the war in Ukraine with higher energy and feed costs as a result has a potential to affect the growth of the Swedish aquaculture sector in a negative way.

Market structure, current production trends and main drivers

The Swedish aquaculture sector has experienced an increase in volume of production. Over the last decades production levels have increased from 6.3 thousand tonnes (2008) to 12.9 thousand tonnes (2020). One explanation for the observed growth in production is likely related to structural changes in the aquaculture sector, where enterprises merge into larger units to benefit from economies of scale. Data since 2008 show that the number of enterprises has decreased, at the same time average production volumes has steadily been increasing.

Between 2016 and 2020, the increase in production stalled and a decrease was seen these years. However, in 2016 the production was higher than any previously reported year. The downturn in 2017 and 2018 is most likely the result of permits expiring for a few enterprises coupled with disease outbreaks that had a negative impact on production. The continued decline in 2019 and 2020 may have similar causes as 2017 and 2018 coupled with the effects of the Covid-19 pandemic. Most of the Swedish aquaculture production comes from a few large enterprises, there are however many small enterprises with a limited production.

Issues of special interest

The national strategy document (Svenskt vattenbruk - en grön näring på blå åkrar, in Swedish) with the objective to identify how the Swedish aquaculture sector can grow in the direction of economic and environmental sustainability to 2020 was revised during 2021. The goal of the revision was to create a common strategy for the fishery and aquaculture sectors. As part of the revision, the action plan for Swedish aquaculture was evaluated and updated to better suit the future needs of the sector. The new national strategy for Swedish fisheries and aquaculture will constitute the main foundation for constructing a national action plan for sustainable development of Swedish aquaculture.

In 2021 the European Maritime Fisheries and Aquaculture Fund (EMFAF) entered into force with the purpose of supporting the EU common fisheries policy (CFP), the EU maritime policy and the EU agenda for international ocean governance. The Swedish government decided to provide additional co-founding to the national programme that was adopted in 2022 with the aim of supporting the development of sustainable aquaculture in Sweden.

Outlook for 2021 and 2022

Sweden's net imports of fish, crustaceans and molluscs were considerably higher than the production in 2020. Swedish aquaculture could gain a larger share of the domestic market, where demand for cultivated fish products is high.

There is an increasing demand for sustainably produced seafood from the public in Sweden. There are also political initiatives that aims at developing and increasing the Swedish aquaculture production. In 2017, the Government put forward an action plan stemming from “A National Food Strategy for Sweden – more jobs and sustainable growth throughout the country. 2016/17:104”. The strategy lifts the potential of future aquaculture and concludes that “seafood and marine resources have the potential to meet increased demands. Areas of water should be made available for sustainable aquaculture, such as fish, shellfish, oyster and mussel farms, so as to strengthen the Swedish aquaculture industry”. Aquaculture is included in the action plan and funds that will contribute to a sustainable development has been allocated. Funds have not been granted to enterprise investments but to projects that will help the whole industry to develop.

The Swedish aquaculture industry has received some major setbacks in 2019 and 2020 that will likely affect the future production in Sweden. Several farms have been denied new or increased environmental licenses due to new interpretations of the environmental legislation. Some were given the opportunity to change techniques to more environmentally friendly techniques but others are forced to close down. Due to these new verdicts in the Land and Environmental Court of Appeal, the largest production segment in Sweden (freshwater fish in cages) needs to change to more environmentally friendly techniques. This will require large investments and in the European Maritime and Fisheries Fund (EMFAF) funds have been allocated to support environmental investments for aquaculture.

The Swedish aquaculture sector also face difficulties related to regulations and implementing new production techniques at a commercial scale. There is an ambition to increase aquaculture production using new sustainable production techniques, however, most of this work is still on project levels and has not reached commercial scales. The production of marine shellfish products is currently small in relation to freshwater production, although Sweden has significant production of organic mussels (KRAV).

An analysis of the impact of administrative burdens and governance has been conducted, as the results show a high burden for enterprises. Also, an investigation on how to adapt regulations and simplify administration was conducted during 2019 and the results were published in late 2020. The investigation identified multiple areas of improvement and the work is set to continue in 2021. In 2022 the state’s public inquiry was given the task of reviewing legislation connected to Swedish fisheries and aquaculture with the aim of presenting areas of improvement, the results will be presented to the Swedish government in 2023.

The sector also also faced setbacks to its development in 2020 and beyond due to the Covid-19 pandemic and the war between Russia and Ukraine in February 2022.

COVID-19 impact

The outbreak of Covid-19 resulted in the supply chains being exposed to great strain both nationally and internationally. In both Sweden and the EU, the Hotel Restaurant and Catering (Horeca) segment largely closed down at the beginning of the year. This also happened during late 2020 into early 2021. This has meant that industries with large exposure to Horeca have been affected very negatively, this includes the Swedish aquaculture sector.

For Swedish aquaculture, the closure meant a reduction in sales that varied in intensity during the year. During the spring, the decrease was about 30%, but improved gradually to a decrease of 15–25%. Then came the second wave of infection, which again generated a decrease. Since the impact of Covid-19 is global, the decrease in sales has also affected other countries. This has meant an increased supply of seafood products from abroad to the Swedish market. Increased supply has put pressure on prices and affected companies negatively. Despite low prices and an increase of seafood in general, both farmed and wild-caught, the loss within Horeca is not covered by increased retail sales, i.e., sales to retail companies have not increased in the corresponding volume that has decreased to Horeca. The problem of oversupply and the consequent lower prices risks remaining for a longer period even if the pandemic were to end as the recovery in demand from HoReCa can be expected to take time. Sweden also has no significant production of fish feed, which makes the industry vulnerable to restrictions concerning imports. Internationally, Swedish aquaculture companies state that they are still competitive in terms of both quality and production costs.

4.26.6 Data Coverage and Data Quality

Since 2011, the Swedish Board of Agriculture is responsible for compiling and reporting statistics on the aquaculture sector for the reported period together with the Swedish Agency for Marine Water Management. The Swedish Board of Agriculture in cooperation with Statistics Sweden conducted a questionnaire and a tax declaration survey for each year. Data was collected from both income tax declarations, administrative records and the questionnaire sent to all aquaculture enterprises. In order to identify the segments, companies using more than one farming technique or growing more than one species, all production, incomes and costs were transferred to the main technique and main species based on turnover.

The questionnaire is sent out to all aquaculture enterprises. For each enterprise, the value of sales from the questionnaire is compared to income as reported in the income tax declarations. Enterprises that have aquaculture as their main activity more than 50% (income from tax declarations) are considered to have their primary activity in aquaculture. The questionnaire is used to create a cost allocation key for costs that are not specified in income tax declarations, since production year 2016 (collected in 2018), it also includes social variables according to EUMAP.

Data quality and availability

Data for the aquaculture sector is published once a year, in August the same year as the census.

Confidentiality

To avoid problems with confidentiality, segments should in general include more than 10 enterprises. Due to confidentiality problems the segment Other freshwater fish Recirculation systems is not reported in total since the response rate was too low

Differences in DCF data compared with other official data sources

Since data on aquaculture production is reported from the Statistics Sweden to Eurostat, there should be minor deviations in the production volumes as reported by Eurostat. Furthermore, since FAO, EUROSTAT data and DCF report data on production based on first sales the definition should not be an issue. Disparities may also arise due to updates in the data mainly due to changes in the number of active enterprises.

5 IMPACTS OF THE ENERGY CRISIS ON AQUACULTURE COSTS

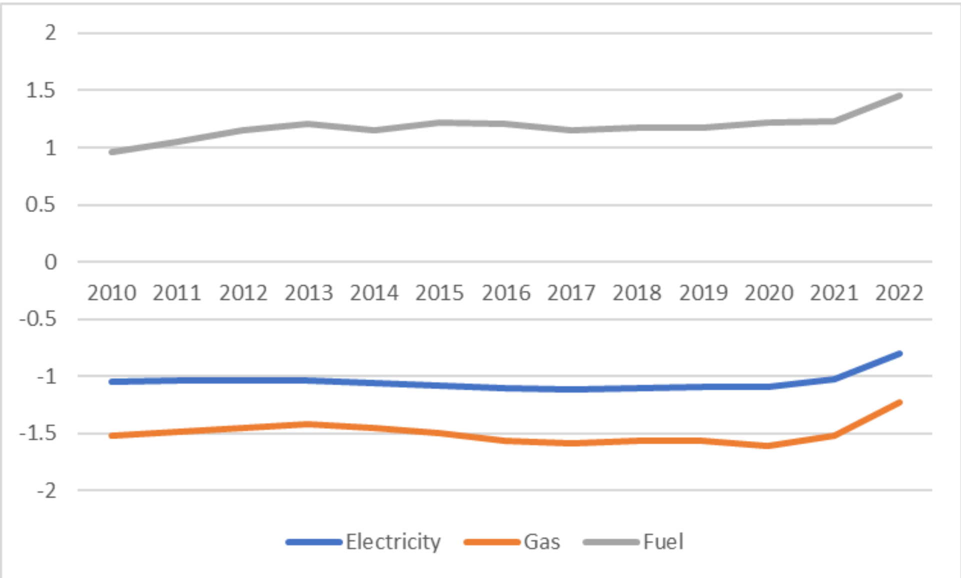
Energy is a critical resource for any industry activity and any change in its cost will have an impact on the profitability of the business. Aquaculture performance is affected by the evolution of the energy costs in several ways with different intensity of the impacts depending on the segment and species. The direct impact comes from the increase of prices for energy and fuels that are directly connected to the production costs. However, the shocks of the energy prices also indirectly affect the costs of other critical inputs for the aquaculture production such as feed and fingerlings. In general, sea and land-based fish farming is more sensitive to changes in energy prices than shellfish. Furthermore, extensive or semi-intensive fish farming is less dependent on energy than intensive fish farming.

Considering the limitations in the availability of data, this section is an attempt to provide some insight on and quantify the potential impacts of the current energy crisis on the production costs of EU aquaculture, exacerbated after the aggression upon Ukraine by Russia. In order to do so, the evolution of the energy prices is first discussed in relation to the interrelation between electricity, fuel and gas. Secondly, the direct impacts on the cost structure are derived from the increase of the energy prices. Finally, some indirect impacts is assessed based on the availability of data.

5.1 Energy prices

The evolution of the energy prices is observed through the cost of electricity and other sources of energy such as gas and fuel oil. Like any other commodity, the price of electricity is dependent on the different technologies and materials involved in its production, from which gas has been a critical element in the EU. Using the Eurostat data of gas and electricity prices in the EU industry, the results of a linear regression model indicates that the changes in the price of gas explains about 96% of the changes in the price of electricity.

Figure 5.1 Evolution of energy prices 2010-22. Log scale.



Gas price fluctuated around €30 per MWh between 2010 and 2021. However, the trend shifted in the first semester of 2022, rising by 95% up to €58 per MWh. The increase on the price of gas caused a similar shift in the prices of electricity. The price of electricity moved around and average of €84.6 per MWh between 2010 and 2020. The trend starts changing in 2021, when the price of electricity in the EU increased 15%. However, the main raise came in 2022, reaching a maximum EU average of €160 per MWh in August after increasing 69.5% during the year. The evolution of fuel oil prices shows a more erratic trend with alternating increases and decreases along the observed decade. Nevertheless, a 60.3% increase in the import price in 2022 is also a relevant contribution. Although the price of fuel also has a significant impact on the price of electricity, this is much less important than the impact of gas, as shown in Figure 5.1.

Considering the many forms of aquaculture production technology electricity is more important in the case of land-based fish farming. This is especially the case for species raised in inland production facilities where energy is used for aerating the water in traditional ponds or for recirculation systems for both juvenile and grow-out production. The effects of the increasing electricity prices is of course most severe on production techniques for the more closed and highly intensive farms using recirculation and bio-filters to purify water before discharged. In contrast, shellfish and marine aquaculture is less dependent on electricity, but fuel prices become more relevant as boats are used for transporting feed, maintenance and harvesting.

5.2 Estimating indirect impacts

The estimation of indirect impacts is not an easy task due to the lack of specific data on the main specific cost items of many aquaculture production inputs. Feed and fingerlings are the two most important operational costs in the case of fish farming, where labor and fuel are more relevant in the case of shellfish farming. Unfortunately, accurate data on these items is not available for all EU countries, making the need of adequate proxies critical for any attempt of analyzing the corresponding impacts.

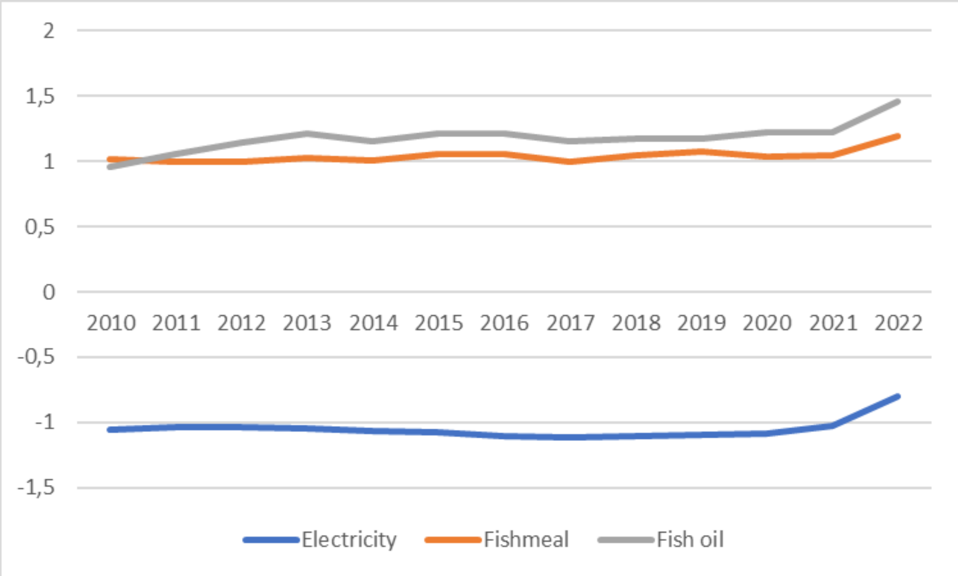
Labor cost depend on political and economic decisions of every country and enterprise and so, the impact of the rise of energy costs on salaries may differ across cases, making it more difficult for estimation in case there would be a significant correlation across the involved variables. Furthermore, the transition of energy prices into labor cost may also have a longer lag before becoming evident. Thus, labor cost is not considered significant in this analysis.

In an attempt to access energy price influence on fingerling and feed, trade data of some of these important inputs commodities or their most critical components can be used as a proxy when accessing impact on fingerlings and feed.

The data on trade of alive fish, where fingerlings should be included, are unfortunately too aggregated. Thus, it is not possible to distinguish between fingerlings and adult fish. This results in inconsistent price series, which means that the inaccuracy for using these data are too high to be used as a proxy for fingerlings trade. However, import prices of fishmeal and fish oil can be used as a reliable proxy of the changes in feed price, since both are critical components in the production of feed for aquaculture. This must however also be based on the assumption of price transmission in the value chain of feed in aquaculture.

The production of fishmeal and fish oil is an energy intensive process where the raw product is chopped up, heated up and divided into the meal and oil, where the meal is finally dried. Import price of fishmeal and fish oil is therefore highly dependent on the changes in the prices of electricity. Regression analysis shows predictive ability of 72% in the case of fishmeal and 90% for fish oil (Figure 5.2). In both case prices have been already rising significantly before 2021. Thus, fishmeal imports increased their price by 51.5% between 2010 and 2021. However, the prices follow a new 40.5% increasing trend along 2022. The price of fish oil imports, on the other hand, increased 69.5%.

Figure 5.2 Prices of electricity, fishmeal, and fish oil (2010-22). Log scale.



5.3 Estimating the impacts on cost structures

Using these estimates, the following price increase for 2022 is derived: The price for electricity increase 70%, 60% in the case of fuel, and 55% in feed if using the average increase of the prices of fishmeal and fish oil.

Using these estimations, and making the assumption that the rest of the cost items remain constant, the changes in the cost structures for different segments can be obtained.

In the following, an extrapolation has been made for the following EU aquaculture segment:

- Seabass and seabream produced in sea cages,
- Mussel's production,
- Trout produced in high intensive open RAS facilities in Denmark.

In Figures 5.3 to 5.5 below, the cost structure breakdowns for the segments based on 2020 data is first shown and then the cost structure based on the new estimated price components showing the 2022 cost structure. In Tables 5.1 to 5.3, the cost of energy and feed is shown for 2020 and the estimated values for 2022 in euro. The difference between the value in 2020 and the estimated value for 2022 is then shown in the last column.

Seabream and seabass

Seabream and seabass is produced in open marine sea cages. The cost structure for seabream and seabass is presented in Figure 5.3.

It should be noted that new cost shares in Figure 5.3, show the increase of direct and indirect cost simultaneously. The new levels of energy costs for seabream and seabass show an increase of 0.7% point in the direct energy use. However, in monetary terms this correspond to an increase in energy cost of 70%. The indirect effect of the increasing energy prices are shown in the feed cost, which increases 9.1% points. In monetary terms, this respond to an increased cost of €167 million or 56% for the seabream and seabass segment.

Figure 5.3 Estimated cost structure of the seabass and seabream segment in 2020 and 2022.

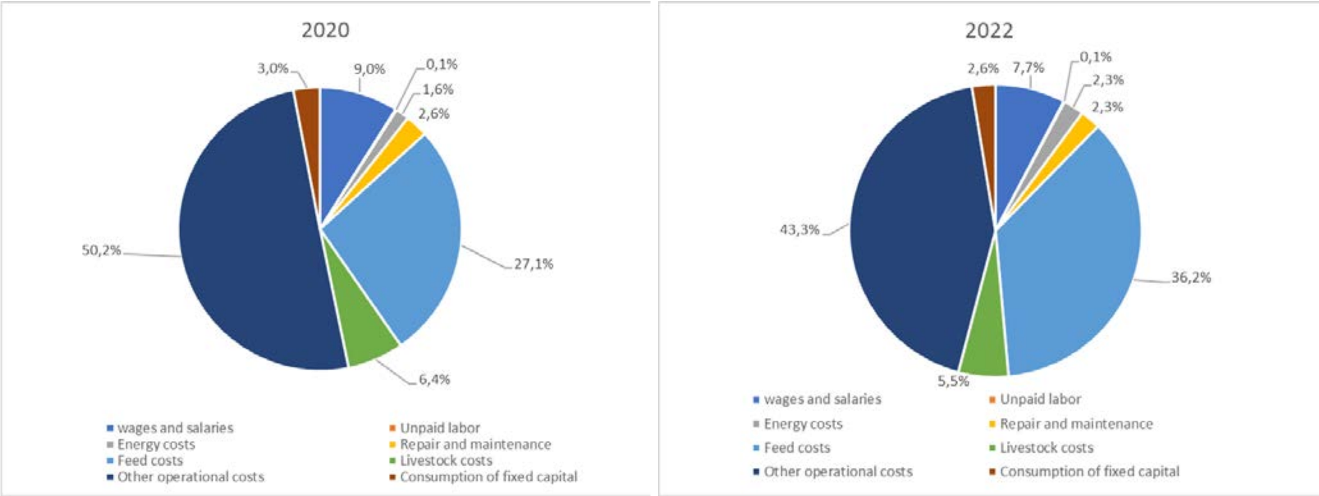


Table 5.1. Seabass and seabream. Difference in costs 2020 - 2022

Cost in €	2020	2022	2022 - 2020
Energy costs	16,192,950	27,447,050	11,254,100
Raw material costs: Feed costs	282,563,127	438,357,331	155,794,204
Total	298,758,097	465,806,403	167,048,306

Mussels

The mussel segment contains several different production techniques. However, all have in common that feed is not an input factor in the production process. The cost structure for mussels are presented in Figure 5.4.

Figure 5.4 Estimated cost structure of the mussel segment in 2020 and 2022.

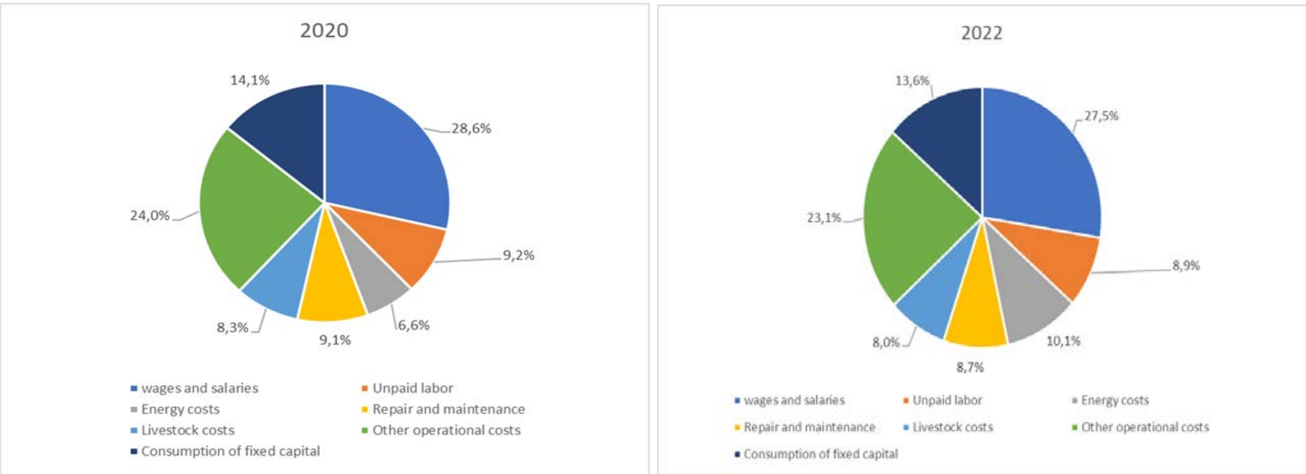


Table 5.2. Mussels. Difference in costs 2020 - 2022

Cost in €	2020	2022	2022 - 2020
Energy costs	14,181,148	22,732,380	8,551,232

The rise of direct fuel costs increases the share of energy in the cost structure of mussel production with 3.5% points, but the rest of the structure remains almost unchanged. In monetary terms, this corresponds to an increased cost of €8.6 million or an increase of 60% for the Mussel segment.

Trout RAS systems

Recirculation systems is one of the segments where the impacts are expected to be more pronounced, given the high energy consumption in this farming system. The RAS trout industry in Denmark is therefore used here for illustrating the potential impacts on these systems (Figure 5.5).

Figure 5.5. Estimated cost structure of the Danish RAS trout segment in 2020 and 2022.

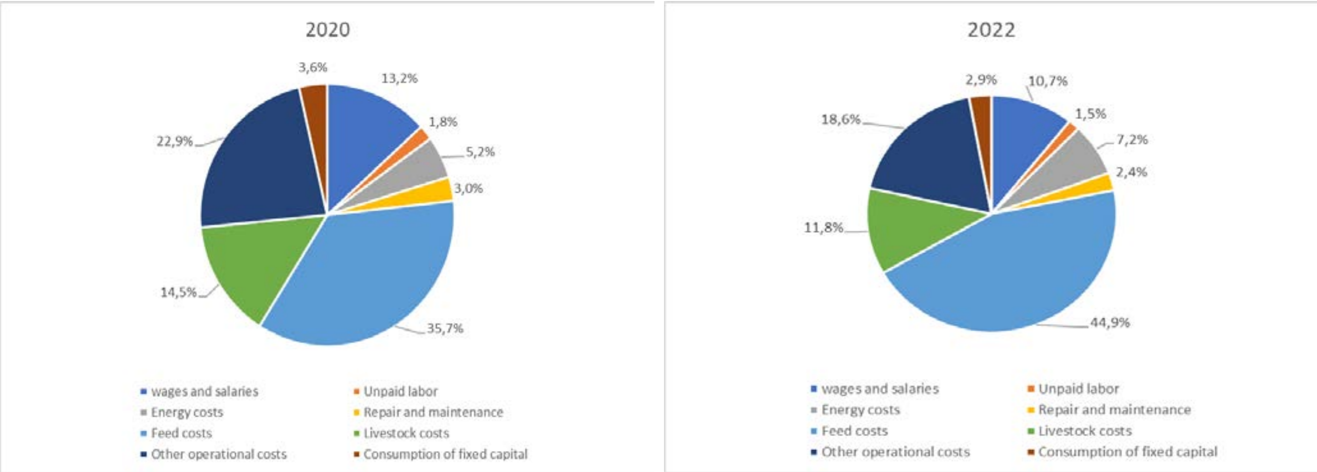


Table 2. Trout in RAS (Denmark). Difference in costs 2020 - 2022

Cost in €	2020	2022	2022 - 2020
Energy costs	2,453,837	4,159,254	1,705,417
Raw material costs: Feed costs	16,784,162	26,038,289	9,254,127
Total	19,240,019	30,199,565	10,959,546

In the case of land based trout farms using RAS technology, the direct energy costs increase by 2.0% points, while the indirect effect on feed cost increase 9.2% points. In monetary terms, this corresponds to an increase of 70% in the direct energy use costs and 55% in the indirect feed costs for the trout RAS segment.

The impacts on the cost structure in this segment is, thus, both high on direct and indirect costs. The impact of more traditional land based farming systems is considered to be in between the sea cage farming and the intensive RAS farming systems.

5.4 Summary and conclusions

Despite the lack of detailed data on specific input cost items for the industry and prices on these critical inputs for many aquaculture activities, some impacts of the increases in the costs of energy can be deducted besides the direct impact. The direct impacts depend on the consumption of energy (electricity, fuel and gas) of each segment and will vary according to the required energy needs for the running of the aquaculture operations. These increases appear to be relatively higher in the case of mussel farming, due to the higher consumption in fuel from mainly boats (and limited input of other factors), than in the RAS trout farms and sea cage farming of seabass and seabream. Overall, the increase of the direct energy cost in the presented cost structure in the three segments is; 3.5% points for mussels, 2% points for RAS trout, and 0.7% point for seabass and seabream.

The largest increase in the operational costs due to the energy crisis is estimated to come from the indirect impacts. Unfortunately, only the impacts on feed could be estimated in this chapter, but it is expected that the prices of other critical inputs such as fingerlings and labor in the longer run would also increase. With regard to the cost shares of feed, the share in the cost structure may increase 9% points in the case of seabass and seabream in sea cage, and 9.2% points in the case of trout produced in Danish RAS facilities. When looking at the different segments it should also be taken into account that the different segments have different size in terms of number of firms, income and costs on which the increasing prices of energy should be distributed on.

6 NOWCAST ESTIMATION OF A SELECTION OF INDICATORS TO 2021 AND 2022

6.1 Background

For the second time in the report on the economics of aquaculture in Europe, a nowcast exercise is to be conducted. Carrying out the nowcast for aquaculture is a considerable challenge, considering that the availability of official statistics on aquaculture at the European level and in other supranational organizations and global databases is lower than in other activities such as fisheries or fish processing.

The availability of EUMAP data for the year 2019 has made it possible to analyse the quality of the first nowcast exercise developed during the previous report. The comparison of the estimated values for 2019 and the actual values for 2019 shows negative deviations of only 2% in turnover and total employment, 5% in FTE and 6% in total sales value.

On this occasion, the results of the estimates for 2021, despite their limitations, will be especially useful, considering the economic situation caused by COVID-19 during 2020 and 2021.

6.2 Scope

The scope of the nowcast is limited to estimate the production in volume (Total weight of sales), the production in value (Gross sales), and the employment (both persons employed and persons employed FTE) at national level for EU aggregate series.

This exercise is inspired in what has already been done for the report on fleet economics, and follows the recommendations and principles for estimation of the main variables for EU aggregates approved by the STECF plenary in 2019. In addition, as far as possible, we try to apply the same estimation principles defined for imputation on missing data.

6.3 Nowcast relations in economic indicators

The exercise of updating the nowcasting methodology to analyse the economic activity of aquaculture in the EU has started with the search for possible variables for the estimation in 2021 and 2022.

- First of all, it has been confirmed that the explanatory variables used in the imputation methodology only have information available until 2020.
- Secondly, the variables to be nowcasted (production in quantity and value and employment) have been searched in alternative sources, or a proxy (closely connected) of them, without positive results.

This first stage has highlighted the challenge posed by nowcasting in aquaculture. Availability of the variables under analysis for 2021 and 2022. Different from the previous report, this time no production data was available for the nowcasted years (2021 and 2022) in Eurostat or FAO. The most recent data available in Eurostat and FAO at the time of preparing this report corresponded to the year 2020. This time the nowcast depends entirely on the availability of data from national sources and the contributions of experts. Neither alternative variables whose evolution can approximate the evolution of the nowcasted variables have been located.

In the case of aquaculture, the number of aquaculture farms is not available in an official register updated to 2021 and 2022. Even if such a registry existed, it would not be as effective alternative variable as in the case of the number of vessels in fishing, given the differences in terms of number of productions units, size, production scale, production technology, etc., which may exist between companies within the same aquaculture segment, even within the same company.

In this context, estimates for 2021 and 2022 are based on the evolution of EUMAP and national public bodies' data and estimates. The estimations are qualified by experts attending the EWG meeting. The nowcasting is completed with qualitative information from different secondary sources (industry reports, producer organizations, etc.) provided by experts and from experts' own experience. This qualitative information is especially useful for the nowcasting in 2022, for which there is still very little final or estimated official information available, and to understand what is the evolution of the situation.

The methodology developed for the nowcast is described in Annex II.

6.4 Nowcast output and coverage

The information obtained during the EWG has allowed a quantitative nowcast at national level in 2021, based on data from EUMAP and final and estimated data from national public bodies provided by the experts. Then, nowcasted national totals for 2021 have been distributed by environments (finfish marine, finfish freshwater and shellfish) considering countries distribution by environments in 2018. In the case of the weight of sales we have been able to estimate all the countries with the exception of Austria, Belgium, Czech Republic, Hungary, Latvia, Portugal, Romania and Slovakia. In the case of gross value there are no nowcasts for the following countries; Austria, Belgium, Cyprus, Czech Republic, Estonia, Germany, Hungary, Latvia, Portugal, Romania and Slovakia. This means that the nowcasting coverage for 2021 is equivalent to 92% and 85% of the production volume and value in 2020, respectively. In the case of employment, the availability of data has been lower and the nowcast coverage decreases to 67% and 39% in the case of employees and FTE, respectively.

In the case of 2022, the data obtained are mainly estimates, and for a very small number of countries, which does not allow for a quantitative nowcast like the one carried out in 2021. In this case, the qualitative information provided by the experts are essential for the nowcast.

6.5 Nowcast results

The results of the nowcast for national totals in 2021 are included and analysed in the EU overview chapter. The results of the nowcast for 2022 are analysed in the corresponding section about nowcast in each national chapter produced by the experts.

Below are the quantitative results of the estimates made for 2021, as well as the sources of information used to determine the imputation factors. The first two tables represent total sales in volume results (tonnes) and the sources of information to estimators' calculations.

Country	2020	2021	2022
AUT	4.527	Nonowcast	Nonowcast
BEL	209	Nonowcast	Nonowcast
BGR	9.796	10.726	Nonowcast
HRV	21.740	26.926	Nonowcast
CYP	7.428	8.000	Nonowcast
CZE	20.083	Nonowcast	Nonowcast
DNK	54.099	51.613	51.613
EST	966	753	Nonowcast
FIN	13.108	14.409	Nonowcast
FRA	238.215	236.706	232.177
DEU	26.958	23.535	Nonowcast
GRC	137.505	144.705	Nonowcast
HUN	18.373	Nonowcast	Nonowcast
IRL	37.735	42.623	Nonowcast
ITA	119.459	137.790	123.590
LVA	832	Nonowcast	Nonowcast
LTU	4.477	5.133	4.586
MLT	19.829	16.410	Nonowcast
NLD	38.895	36.900	Nonowcast
POL	47.700	41.606	Nonowcast
PRT	13.648	Nonowcast	Nonowcast
ROU	29.947	Nonowcast	Nonowcast
SVK	2.296	Nonowcast	Nonowcast
SVN	551	515	Nonowcast
ESP	276.562	297.465	Nonowcast
SWE	12.824	15.251	Nonowcast

Country	2020	2021	2022
AUT		Nonowcast	Nonowcast
BEL		Nonowcast	Nonowcast
BGR	EUMAP	EUMAP	Nonowcast
HRV	EUMAP	National Sources	Nonowcast
CYP	FAO	National Sources	Nonowcast
CZE		Nonowcast	Nonowcast
DNK	EUMAP	National Sources	Experts
EST	FAO	National Sources	Nonowcast
FIN	EUMAP	National Sources	Nonowcast
FRA	National Sources	Experts	Experts
DEU	EUROSTAT	National Sources	Nonowcast
GRC	EUMAP	National Sources	Nonowcast
HUN		Nonowcast	Nonowcast
IRL	EUMAP	FAO	Nonowcast
ITA	EUMAP	National Sources	National Sources
LVA		Nonowcast	Nonowcast
LTU	National Sources	National Sources	National Sources
MLT	EUMAP	EUMAP	Nonowcast
NLD	National Sources	National Sources	Nonowcast
POL	National Sources	National Sources	Nonowcast
PRT		Nonowcast	Nonowcast
ROU		Nonowcast	Nonowcast
SVK		Nonowcast	Nonowcast
SVN	EUMAP	EUMAP	Nonowcast
ESP	National Sources	National Sources	Nonowcast
SWE	National Sources	National Sources	Nonowcast

The following two tables below present the results of the nowcasting for the gross sales in 2021 and 2022 and the information sources used to calculate the estimation factors in 2021 and 2022.

Country	2020	2021	2022
AUT	30.254.594	Nonowcast	Nonowcast
BEL	1.394.034	Nonowcast	Nonowcast
BGR	27.033.567	30.987.371	Nonowcast
HRV	133.013.161	158.003.923	Nonowcast
CYP	43.053.811	Nonowcast	Nonowcast
CZE	36.447.600	Nonowcast	Nonowcast
DNK	180.753.293	174.293.651	174.293.652
EST	3.803.611	Nonowcast	Nonowcast
FIN	73.324.130	73.625.462	Nonowcast
FRA	878.620.885	875.028.417	863.604.369
DEU	100.313.711	Nonowcast	Nonowcast
GRC	600.763.396	623.138.396	Nonowcast
HUN	35.437.391	Nonowcast	Nonowcast
IRL	179.784.263	178.742.668	Nonowcast
ITA	372.407.475	399.220.814	398.611.581
LVA	4.308.858	Nonowcast	Nonowcast
LTU	13.779.035	16.040.117	15.867.720
MLT	215.446.769	210.438.308	Nonowcast
NLD	83.019.520	75.000.000	Nonowcast
POL	164.692.217	168.168.978	Nonowcast
PRT	99.992.142	Nonowcast	Nonowcast
ROU	42.370.021	Nonowcast	Nonowcast
SVK	5.579.270	Nonowcast	Nonowcast
SVN	1.201.953	1.016.935	Nonowcast
ESP	573.202.128	536.833.377	Nonowcast
SWE	48.595.858	49.860.737	Nonowcast

Country	2020	2021	2022
AUT		Nonowcast	Nonowcast
BEL		Nonowcast	Nonowcast
BGR	EUMAP	EUMAP	Nonowcast
HRV	EUMAP	National Sources	Nonowcast
CYP		Nonowcast	Nonowcast
CZE		Nonowcast	Nonowcast
DNK	EUMAP	National Sources	174.293.652
EST		Nonowcast	Nonowcast
FIN	EUMAP	National Sources	Nonowcast
FRA	National Sources	Experts	863.604.369
DEU		Nonowcast	Nonowcast
GRC	EUMAP	National Sources	Nonowcast
HUN		Nonowcast	Nonowcast
IRL	EUMAP	FAO	Nonowcast
ITA	EUMAP	National Sources	398.611.581
LVA		Nonowcast	Nonowcast
LTU	National Sources	National Sources	15.867.720
MLT	EUMAP	EUMAP	Nonowcast
NLD	National Sources	National Sources	Nonowcast
POL	National Sources	National Sources	Nonowcast
PRT		Nonowcast	Nonowcast
ROU		Nonowcast	Nonowcast
SVK		Nonowcast	Nonowcast
SVN	EUMAP	EUMAP	Nonowcast
ESP	National Sources	National Sources	Nonowcast
SWE	National Sources	National Sources	Nonowcast

The following tables below present the results of the nowcasting for the persons employed in 2021 and 2020 and the information sources used to calculate the estimation factors in 2021 and 2022.

Country	2020	2021	2022
AUT	333	Nonowcast	Nonowcast
BEL	15	Nonowcast	Nonowcast
BGR	1.072	Nonowcast	Nonowcast
HRV	1.283	1.190	Nonowcast
CYP	466	Nonowcast	Nonowcast
CZE	1.433	Nonowcast	Nonowcast
DNK	585	544	544
EST	62	Nonowcast	Nonowcast
FIN	485	Nonowcast	Nonowcast
FRA	12.897	12.129	12.050
DEU	1.328	1.377	Nonowcast
GRC	4.074	4.111	Nonowcast
HUN	1.415	Nonowcast	Nonowcast
IRL	1.848	1.943	Nonowcast
ITA	4.378	4.378	4.378
LVA	330	Nonowcast	Nonowcast
LTU	446	438	449
MLT	410	370	Nonowcast
NLD	291	Nonowcast	Nonowcast
POL	6.131	6.405	Nonowcast
PRT	1.262	Nonowcast	Nonowcast
ROU	2.055	Nonowcast	Nonowcast
SVK	943	Nonowcast	Nonowcast
SVN	30	Nonowcast	Nonowcast
ESP	12.478	12.478	Nonowcast
SWE	543	531	Nonowcast

Country	2020	2021	2022
AUT		Nonowcast	Nonowcast
BEL		Nonowcast	Nonowcast
BGR		Nonowcast	Nonowcast
HRV	EUMAP	National Sources	Nonowcast
CYP		Nonowcast	Nonowcast
CZE		Nonowcast	Nonowcast
DNK	EUMAP	National Sources	Experts
EST		Nonowcast	Nonowcast
FIN		Nonowcast	Nonowcast
FRA	EUMAP	Experts	Experts
DEU	National Sources	National Sources	Nonowcast
GRC	EUMAP	National Sources	Nonowcast
HUN		Nonowcast	Nonowcast
IRL	EUMAP	FAO	Nonowcast
ITA	EUMAP	EUMAP	Experts
LVA		Nonowcast	Nonowcast
LTU	National Sources	National Sources	National Sources
MLT	EUMAP	EUMAP	Nonowcast
NLD		Nonowcast	Nonowcast
POL	National Sources	National Sources	Nonowcast
PRT		Nonowcast	Nonowcast
ROU		Nonowcast	Nonowcast
SVK		Nonowcast	Nonowcast
SVN		Nonowcast	Nonowcast
ESP	National Sources	Experts	Nonowcast
SWE	National Sources	National Sources	Nonowcast

The following tables below present the results of the nowcasting for the persons employed in 2021 and 2022 and the information sources used to calculate the estimation factors in 2021 and 2022.

Country	2020	2021	2022
AUT	200	Nonowcast	Nonowcast
BEL	9	Nonowcast	Nonowcast
BGR	930	Nonowcast	Nonowcast
HRV	1.105	Nonowcast	Nonowcast
CYP	388	Nonowcast	Nonowcast
CZE	860	Nonowcast	Nonowcast
DNK	425	399	399
EST	51	Nonowcast	Nonowcast
FIN	370	Nonowcast	Nonowcast
FRA	6.185	6.574	6.373
DEU	1.263	1.306	Nonowcast
GRC	3.795	3.804	Nonowcast
HUN	1.309	Nonowcast	Nonowcast
IRL	1.007	1.107	Nonowcast
ITA	2.042	2.042	2.042
LVA	223	Nonowcast	Nonowcast
LTU	268	254	269
MLT	300	319	Nonowcast
NLD	258	Nonowcast	Nonowcast
POL	3.678	Nonowcast	Nonowcast
PRT	987	Nonowcast	Nonowcast
ROU	2.055	Nonowcast	Nonowcast
SVK	566	Nonowcast	Nonowcast
SVN	26	Nonowcast	Nonowcast
ESP	5.934	Nonowcast	Nonowcast
SWE	348	364	Nonowcast

Country	2020	2021	2022
AUT		Nonowcast	Nonowcast
BEL		Nonowcast	Nonowcast
BGR	EUMAP	Nonowcast	Nonowcast
HRV	EUMAP	Nonowcast	Nonowcast
CYP		Nonowcast	Nonowcast
CZE	EUMAP	Nonowcast	Nonowcast
DNK	EUMAP	National Sources	Experts
EST		Nonowcast	Nonowcast
FIN	EUMAP	Nonowcast	Nonowcast
FRA	EUMAP	Experts	Experts
DEU	National Sources	National Sources	Nonowcast
GRC	EUMAP	National Sources	Nonowcast
HUN		Nonowcast	Nonowcast
IRL	EUMAP	FAO	Nonowcast
ITA	EUMAP	EUMAP	Experts
LVA		Nonowcast	Nonowcast
LTU	National Sources	National Sources	National Sources
MLT	EUMAP	EUMAP	Nonowcast
NLD	National Sources	Nonowcast	Nonowcast
POL		Nonowcast	Nonowcast
PRT		Nonowcast	Nonowcast
ROU		Nonowcast	Nonowcast
SVK		Nonowcast	Nonowcast
SVN	EUMAP	Nonowcast	Nonowcast
ESP	National Sources	Nonowcast	Nonowcast
SWE	National Sources	National Sources	Nonowcast

6.6 Nowcast methodology development for Aquaculture economic indicators

In the case of aquaculture, the results of the first nowcast show the usefulness of this exercise to increase the information provided to policy makers and the rest of the end users of the report.

The work to carry out for the second nowcast has highlighted the importance of experts work to obtain quantitative information for the nowcast at t+1, and the difficulty of making a quantitative nowcast based on secondary sources for the period t+2.

In order to provide information for the management of aquaculture in the EU, future reports should improve the nowcasting methodology and information collection to support the nowcast analysis.

In future EWGs, the results of the nowcast would improve if the nowcast had a preparatory work. This preparatory work would allow to obtain from experts final and estimated quantitative and qualitative data for t+1 and t+2.

7 SOCIO-DEMOGRAPHICS OF THE EU AQUACULTURE SECTOR

The social variables that should be collected for the aquaculture enterprises are listed in table 6 - Social variables for the fishing and aquaculture sectors from the COMMISSION DELEGATED DECISION (EU) 2019/910, establishing the multiannual Union programme for the collection and management of biological, environmental, technical and socioeconomic data in the fisheries and aquaculture sectors.

According to Art. 6 (b) from the COMMISSION DELEGATED DECISION (EU) 2019/910 Social data shall be collected every three years starting in 2018 by collecting data for 2017. In order not to leave space for interpretation, which should be the first year for collection of data, PGECON 2019 agreed that social data should be collected every three years starting in 2018 when the first data was collected covering year 2017 until further experience has been gained from both end users and experts. The first attempt to describe and interpret data is also published in Nicheva et al. 2021.

This Report contains data from the second social data collection of the year 2020. Most member states have provided social data for 2020 (Table 1). Due to the relative stability of social data, the EWG 22-17 agreed to impute the social data for 2020 based on data provided by Spain for 2017 and by France and Romania for 2018 regardless of the reference year in order to enhance the basis of data (see Table 2). The present report concentrates on describing the current socio-demographics in the EU aquaculture sector and does not examine trends.

The social variables that should be collected are: Employment by gender, FTE by gender, Unpaid labour by gender, Employment by age, Employment by education level, Employment by nationality and Employment by employment status and FTE National. Furthermore, under the economic data collection the following employment variables are collected, which are listed in table 7 - Economic variables for the aquaculture sector in the regulation: Number of persons employed, Unpaid labour and Number of hours worked by employees and unpaid workers.

The Commission Decision does not require stratified data or combined variables, however PGECON recognised that reporting social variables at more disaggregated levels rather than at national totals and the reporting combined variables would add value to the social analysis. PGECON workshop reports from Vilnius (2017) and Athens (2018) provide recommendations on how the social data could be reported at a more disaggregated level.

The following categories for social variables were recommended:

- Age categories: <=14, 15-24, 25-39, 40-64, >=65, unknown.
- Education categories: High, Low, Medium, unknown.
- Gender categories: Female, Male, unknown.
- Nationality categories: national, EEA, EU, non-EU/EEA, unknown.
- Employment status: Employee (which can be disaggregated into Employee full time, Employee part time), Owner, unknown.

PGECON recommended that social data should be reported for the total population and that the sampling strategy and sampling size should be reported. RCG ECON 2022 recommends that age classes should be further disaggregated by splitting the age category 40-64 into two groups (40-54 and 55-64). Further, the variables Gender, Education and Nationality should be distributed according to these age classes.

The 2022 data call included the recommendation for additional disaggregation of age classes. However, only one MS reported social data split into the additional age classes as suggested above (Bulgaria) and especially for the first and last age classes the data was not reported correctly in a number of cases (<=14; >=65). EWG 22-17 observes that the social template should include the additional age classes, to facilitate the disaggregation.

The analysis for 2020 includes data provided by 18 countries under the 2022 EU-MAP data call – Belgium, Bulgaria, Croatia, Czech Republic, Germany, Greece, Denmark, Finland, France, Italy, Ireland, Latvia, Malta, Netherlands, Portugal, Romania, Slovenia, and Sweden.

Member states collected social data at different levels. Some member states collected data at enterprise level and they were able to report the total numbers for each variable, others at employee level, which led to the possibility to report combined variables. Similar to the economic data collection under DCF, member states used different sampling strategies (e.g. census, probability sample survey, non-probability sample survey or combination between the strategies).

Table 7.1 MS providing social data for 2020 aquaculture enterprises during 2022

Country	Gender	Age	Education	Nationality	Employment status
BEL	Y		Y		
BGR	Y	Y	Y	Y	Y
CZE	Y	Y	Y	Y	Y
DEU	Y	Y*	Y*	Y	Y
DNK	Y	Y	Y	Y	Y
ESP					
FIN	Y	Y	Y	Y	Y
FRA	Y				
GRC	Y	Y	Y	Y	Y
HRV	Y	Y	Y	Y	Y
IRL	Y	Y*	Y	Y	Y
ITA	Y	Y	Y	Y	Y
LVA	Y	Y	Y	Y	Y
MLT	Y	Y	Y	Y	Y
NLD	Y	Y	Y	Y	Y
PRT	Y	Y	Y	Y	Y
ROU	Y*		Y*		Y*
SVN	Y	Y	Y	Y	Y
SWE	Y	Y	Y	Y	Y

Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG.

*Data was in different format and was excluded from EU overview.

Table 7.2 Reference year of the social data used in this analysis

Country	Gender	Age	Education	Nationality	Employment status
BEL	2020		2020		
BGR	2020	2020	2020	2020	2020
CZE	2020	2020	2020	2020	2020
DEU	2020	2020*	2020*	2020	2020*
DNK	2020	2020	2020	2020	2020
ESP	2017	2017	2017	2017	2017
FIN	2020	2020	2020	2020	2020
FRA	2020	2018	2018	2018	2018
GRC	2020	2020	2020	2020	2020
HRV	2020	2020	2020	2020	2020
IRL	2020	2020*	2020	2020	2020
ITA	2020	2020	2020	2020	2020
LVA	2020	2020	2020	2020	2020
MLT	2020	2020	2020	2020	2020
NLD	2020	2020	2020	2020	2020
PRT	2020	2020	2020	2020	2020
ROU	2018	2018	2018	2018	2018
SVN	2020	2020	2020	2020	2020
SWE	2020	2020	2020	2020	2020

Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG.

*Data was in different format and was excluded from EU overview.

EWG 22-17 noticed the following discrepancies:

- Romania reported 2020 social data for Gender, Education and Employment status, but all variables were in a format that is not consistent with the rest of the MS. The data was excluded from the EU overview and MS comparison. Instead, 2018 data from Romania was included in the report.
- Ireland provided age categories that are incompatible with the agreed age classes, this data was therefore excluded from the EU overview and MS comparison.
- Belgium did not report any data for Age, Nationality and Employment status; France did not report data for Age, Education, Nationality and Employment status.
- Germany reported data for Age and Education in a different format that could not be included in the report.
- Different MSs have different understanding of the variable employment status, consequently a comparison between all MSs was not possible. The definition of this variable does not clearly state if unpaid labour should be included or not. This issue should be clarified during EWG 22-14 (Social data in EU fisheries).

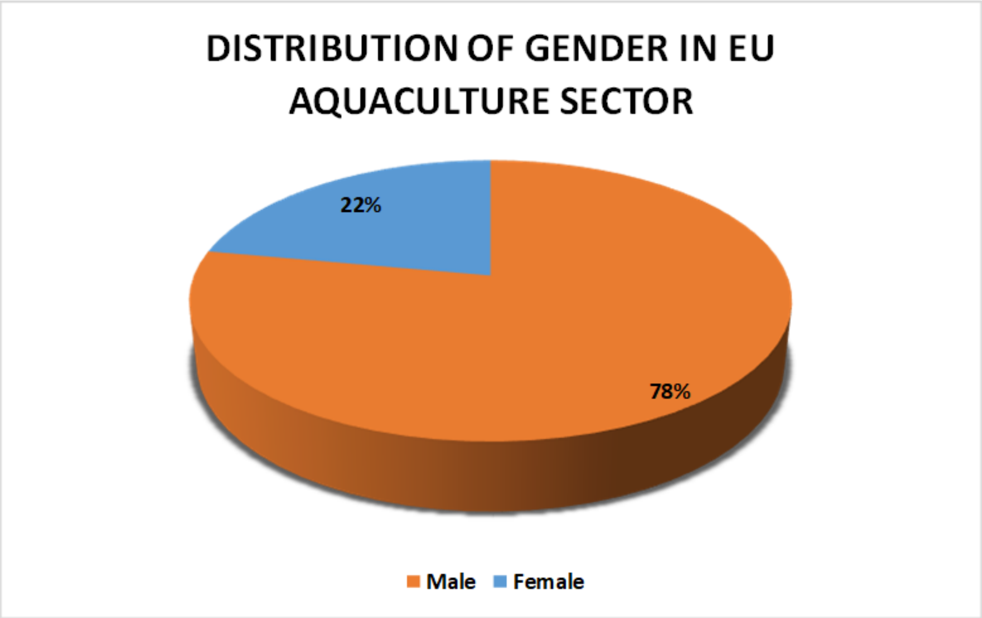
In the following, the social data from the data call is analysed and commented.

7.1 Gender

The proportion of male in the aquaculture enterprises was 78%, while the female proportion was 22%.

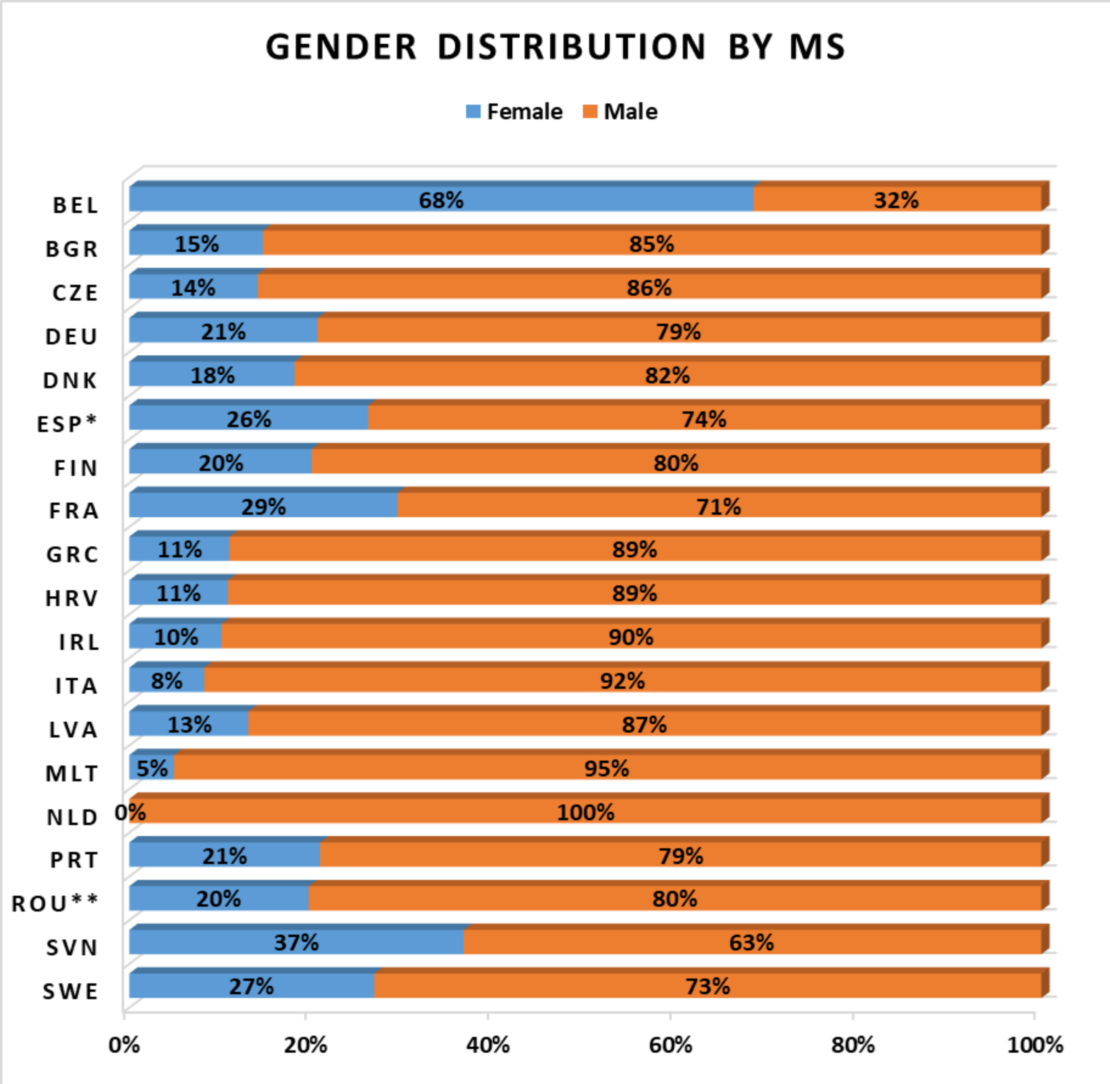
Seventeen countries provided data for the gender variable. The percentage of female employees in the different MSs varied between 0% in the Netherlands and up to 68% in Belgium.

Figure 7.1.1: Gender distribution in EU, 2020



Source: MS data submissions under the 2022 aquaculture data call and elaboration by the EWG.

Figure 7.1.2: Gender distribution by MS, 2020



Source: MS data submissions under the 2022 aquaculture data call and elaboration by the EWG.

*Data refers to 2017.

**Data refers to 2018.

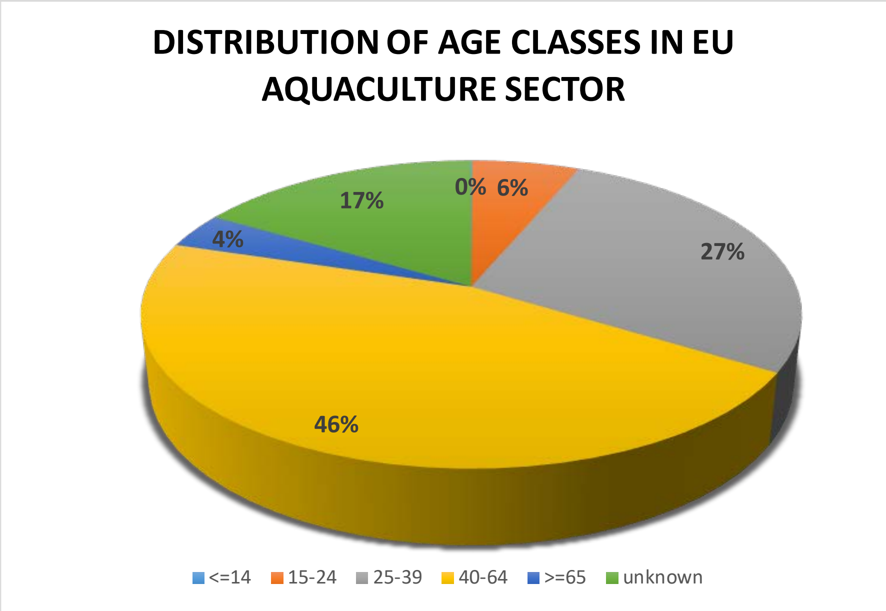
7.2 Age

As mentioned above, most member states collected age-data based on the proposed age categories provided by PGECON. However, some member states used their own age categories.

The 40-64 age class made up the largest proportion (46%) of people employed in the EU aquaculture sector, followed by the 25-39 age class (27%). A further 6% were apportioned to the 15-24 age class, 4% to the over 65 years category, 0.1% to the 14 or less age category and 17% were unknown.

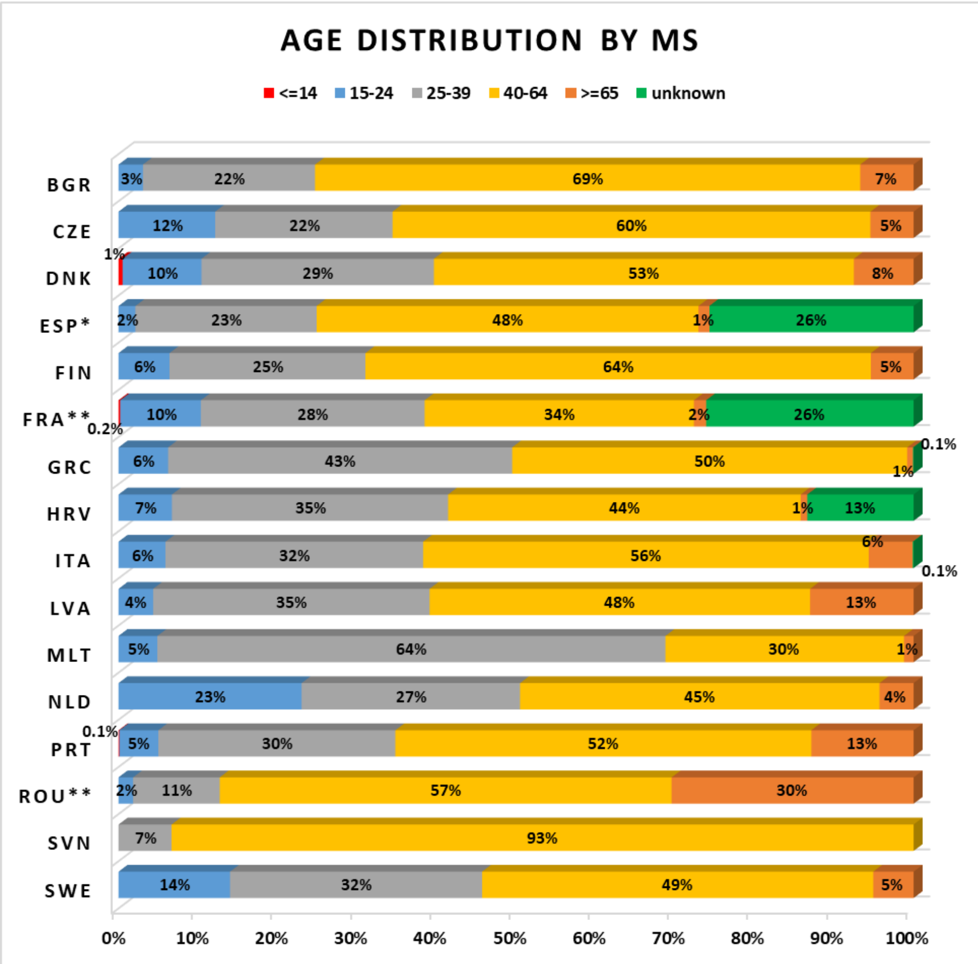
It should be noted, that in comparison with the fisheries and the fish-processing sector the percentage of people in the 40-64 age class is lowest in the aquaculture sector. The 40-64 age class made up the largest proportion (58%) of people employed in the EU fishing fleet (STECF-19-03) and made up the largest proportion (50.5%) of people employed in the processing industry (STECF-21-14). However, in order to keep the consistency between the requirements for the three sectors, EWG 22-17 recommends, to split the age group 40-64 into smaller groups, which will ensure a more detailed analysis of the age class variable.

Figure 7.2.1: Age distribution in EU, 2020



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG.

Figure 7.2.2: Age distribution by MS, 2020



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG.

*Data refers to 2017.

**Data refers to 2018.

The percentage of the age group 40-64 is highest in Slovenia (93%), Bulgaria (69%) and Finland (64%). 64% of the employees in Malta were in the age class 25-39, followed by 43% in Greece and 35% in Latvia. The highest percentage of employees over 65 years is in Romania, Latvia and Portugal – 30%, 13% and 13%, respectively.

7.3 Education

Member states were required to report education by categories low, medium, high, and unknown.

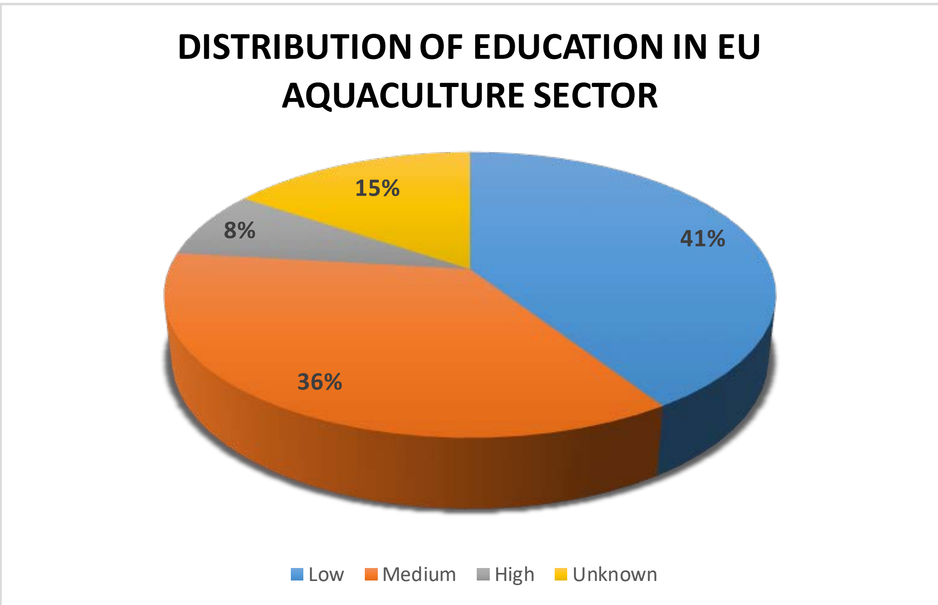
The education level categories required were based on the International Standard Classification of Education (ISCED) academic qualification classifications. For more information on the ISCED levels included in the age, categories see the Table 7.3.1.

Table 7.3.1: ISCED Academic qualification categories

ISCED code	ISCED Educational attainment levels	Education Level
1 2	Primary Lower Secondary School	Low
3 4	Upper Secondary School Post-secondary non-tertiary education	Medium
5 6 7 8	Short-cycle tertiary education Bachelor's or equivalent level Master's or equivalent level Doctoral or equivalent level	High

Overall, the data analysed demonstrates that 41% of people employed in the EU aquaculture sector only had a low level of education, followed by 36%, which had a medium level education. Only 8% had a higher-level education and 15% of the education level was reported as unknown.

Figure 7.3.1: Education distribution in EU, 2020



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

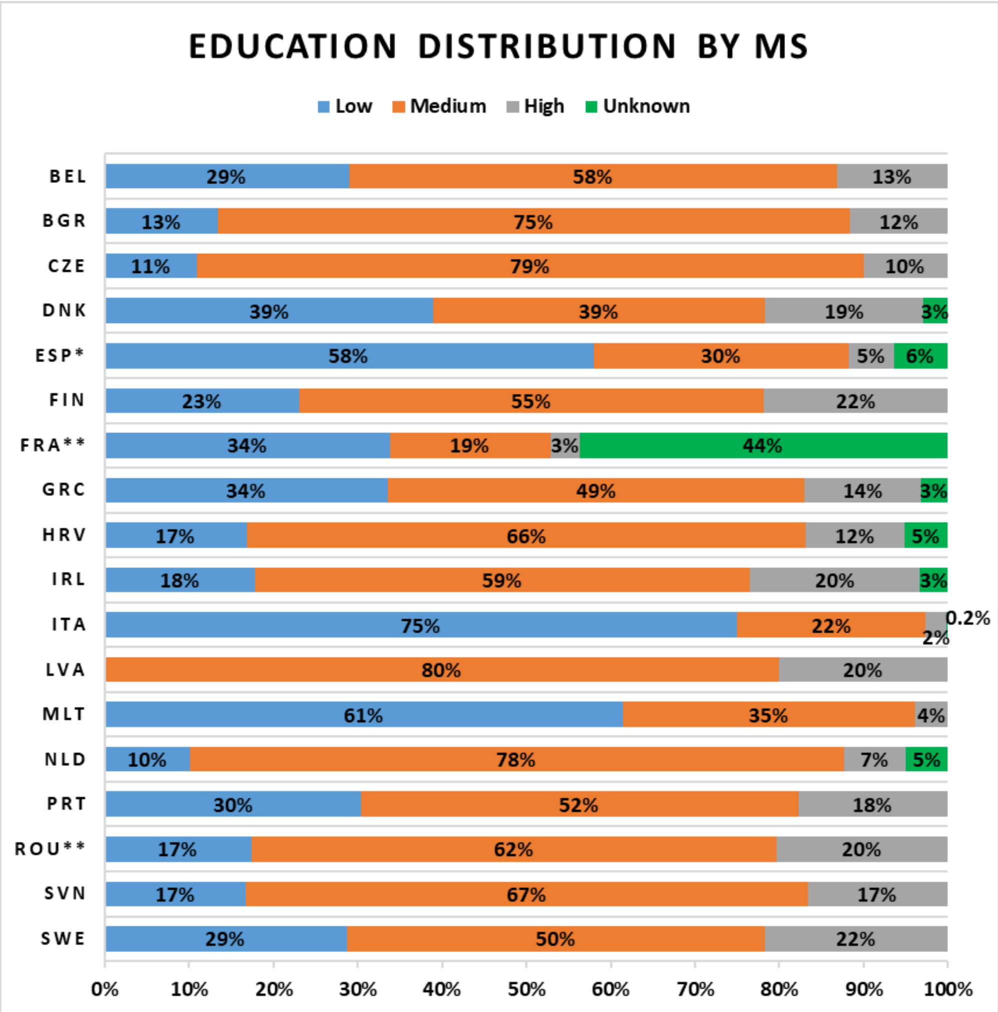
During the 2022 Aquaculture data call, 16 MSs provided the data regarding the education level.

Romania provided the distribution by education level but the classes do not correspond to data submitted by other MS, so they were excluded from the analysis. Germany also provided data that was not reliable and was excluded from the EU overview.

The percentage of the higher education group is highest in Finland and Sweden (22%), followed by Latvia (20%), Denmark (19%) and Portugal (18%). 75% of the employees in Italy, 61% of Maltese and 58% of Spanish employees had a low education level.

The largest percentage distribution is for the medium education level. With medium education are 80% of the employees in Latvia, 79% in the Czech Republic, 78% in the Netherlands, and 75% in Bulgaria. The comparison with the processing industry for this variable shows that the percentage of low educated people was much higher in the aquaculture enterprises than those in the processing industry.

Figure 7.3.2: Education distribution by MS, 2020



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

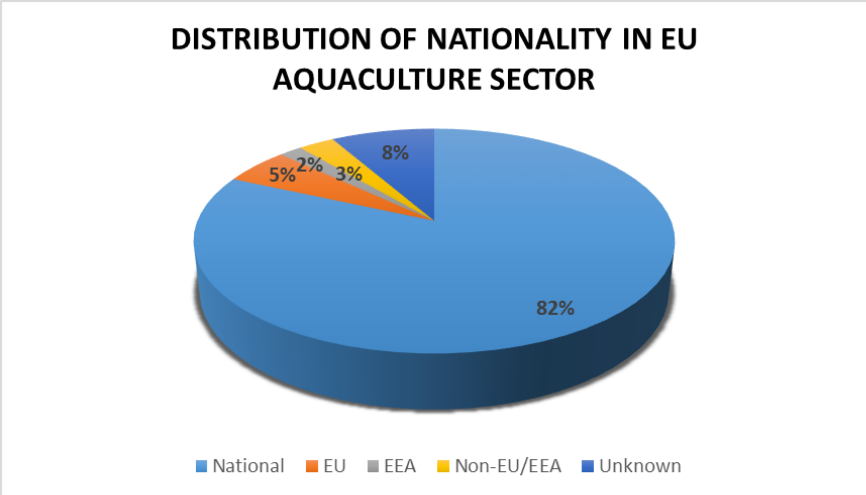
*Data refers to 2017.

**Data refers to 2018.

7.4 Nationality

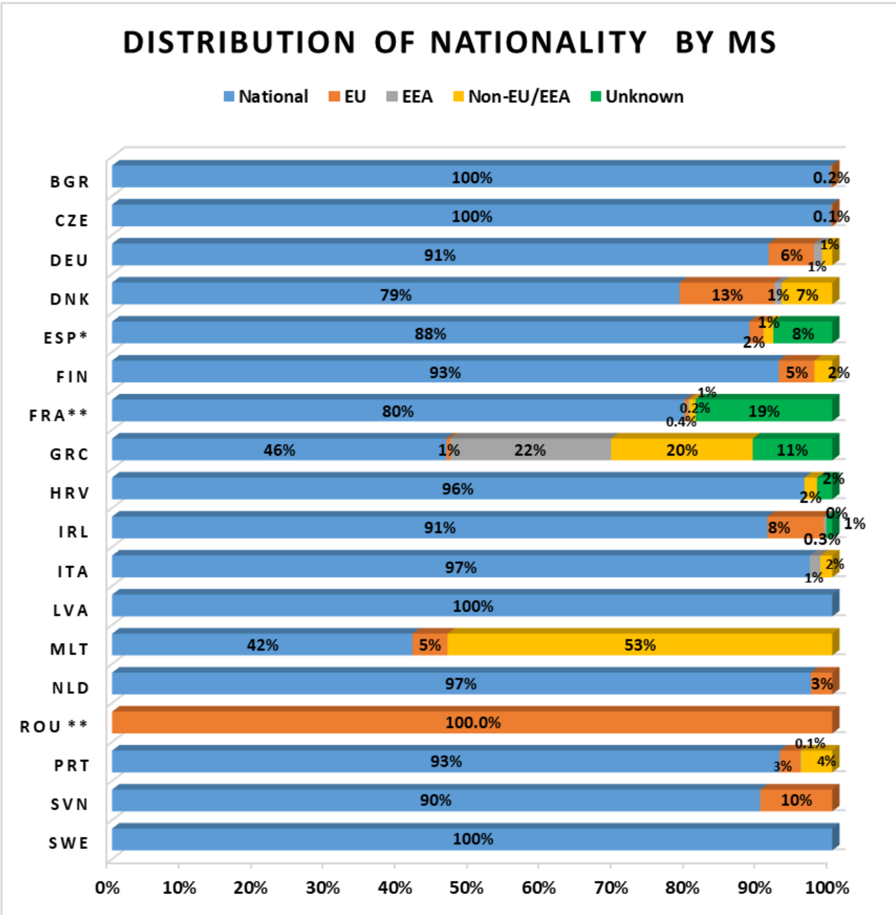
For all member states, it was required to report social data by nationality group. The nationality groups used were: Nationals, EU, EEA, non-EU/EEA and unknown.

Figure 7.4.1: Nationality distribution in EU, 2020



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

Figure 7.4.2: Nationality distribution by MS, 2020



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

*Data refers to 2017.

**Data refers to 2018.

The majority (82%) of people employed in the EU aquaculture sector were nationals of their own country, followed 5% from EU, 3% from non-EU/EEA nations, 2% from EEA and 8% of the employees were with unknown nationality.

In all the MS, the national employees are the main employees. The proportion of nationals varied from 100% in Sweden and Latvia to 42% in Malta. The other workers are mainly from non-EU/EEA as the main representatives are in Malta with 53% of the employees. The percentage of the unknown in MS was always less than 20%.

7.5 Socio-demographics by production technology

Aquaculture is not a homogeneous industry but uses a wide set of production technologies. Different technologies might for example require employees with different educational levels. To highlight such differences, the social data is provided by technology.

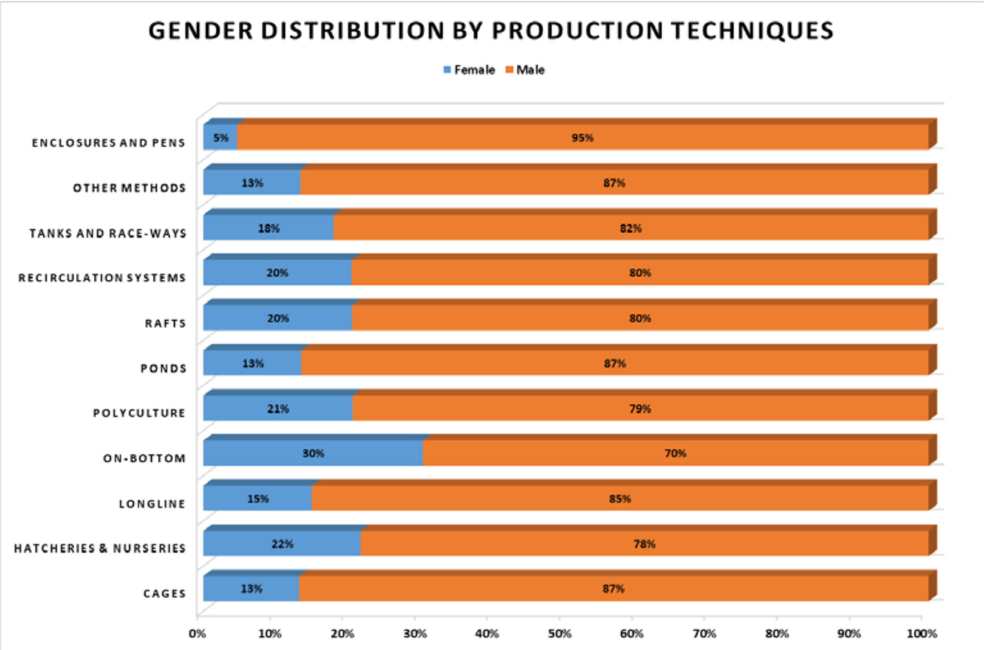
The following countries have provided data divided according to production technologies for 2020: Bulgaria (BGR), Croatia (HRV), Czech Republic (CZE), Greece (GRC), Denmark (DNK), Finland (FIN), France (FRA), Italy (ITA), Ireland (IRL), Latvia (LVA), Malta (MLT), Netherlands (NLD), Portugal (PRT), Romania (ROU), Slovenia (SVN), and Sweden (SWE). For Spain, social data from 2017 was included. For some countries only part of the data was reported according to production technologies, for others no differentiation could be provided. Possible causes here are for example reasons of confidentiality.

Gender

Starting with gender, the sector on average employs 78% male and 22% female. The male domination is consistent overall production technologies although differences occur. The technology with highest share of female is "On bottom mussel production" with 30% female and 70% male employees. On bottom is a commonly used technology with over 5 000 employed persons primarily located in Spain.

The gender distribution by production technology is provided in figure 7.5.1 below.

Figure 7.5.1. Gender distribution by production technology



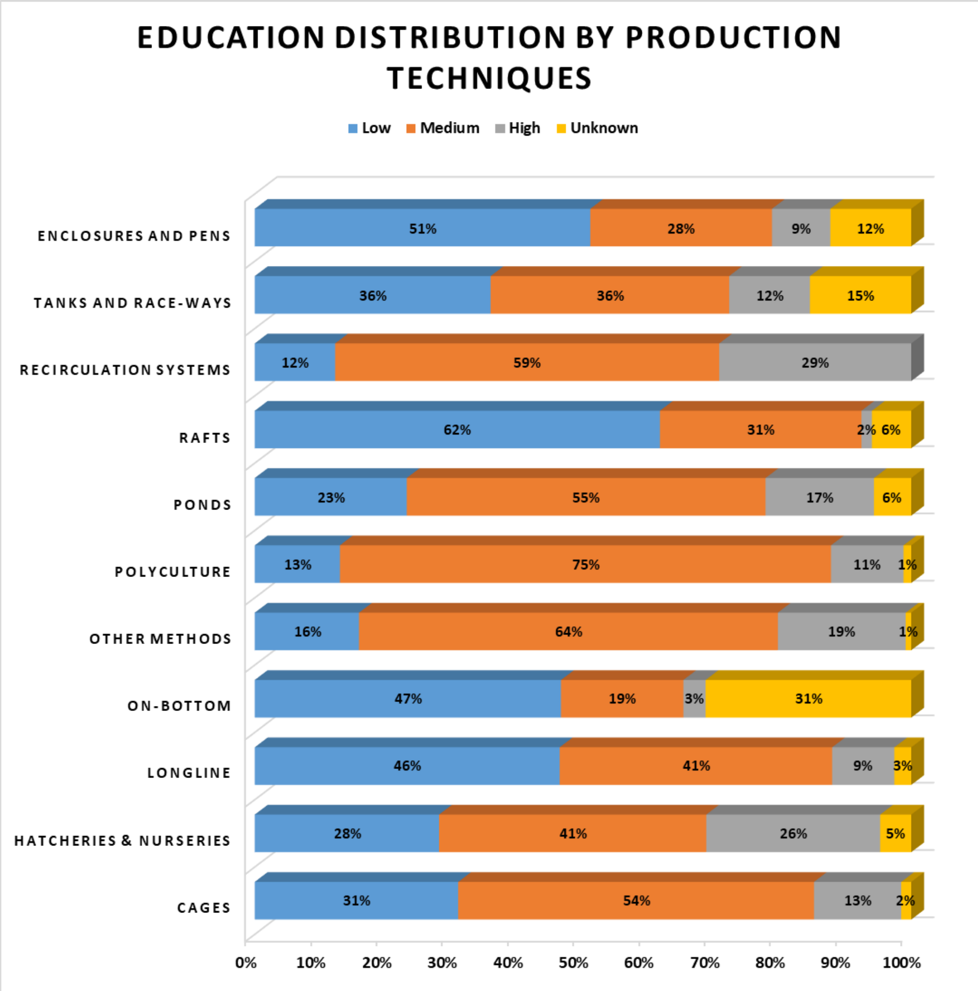
Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

Education level

On average, 41% of the employees in the aquaculture industry have low education and 8% have a high education. However, the educational level differs among production technologies. Four technologies (“rafts”, “enclosures and pens”, ”on bottom” and “longline”) are primarily employing persons with low education. “Enclosures and pens” include only production within one country.

On the other hand, “recirculation systems” and “hatcheries and nurseries” employ more highly educated workers than all other production technologies. It should, however, be noted that these two production system categories present rather a small segment. Other technologies with a low share of low educated employees are “ponds” (23%), “polyculture” (13%), “other methods” (16%).

Figure 7.5.2. Educational level by production technology



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

Age

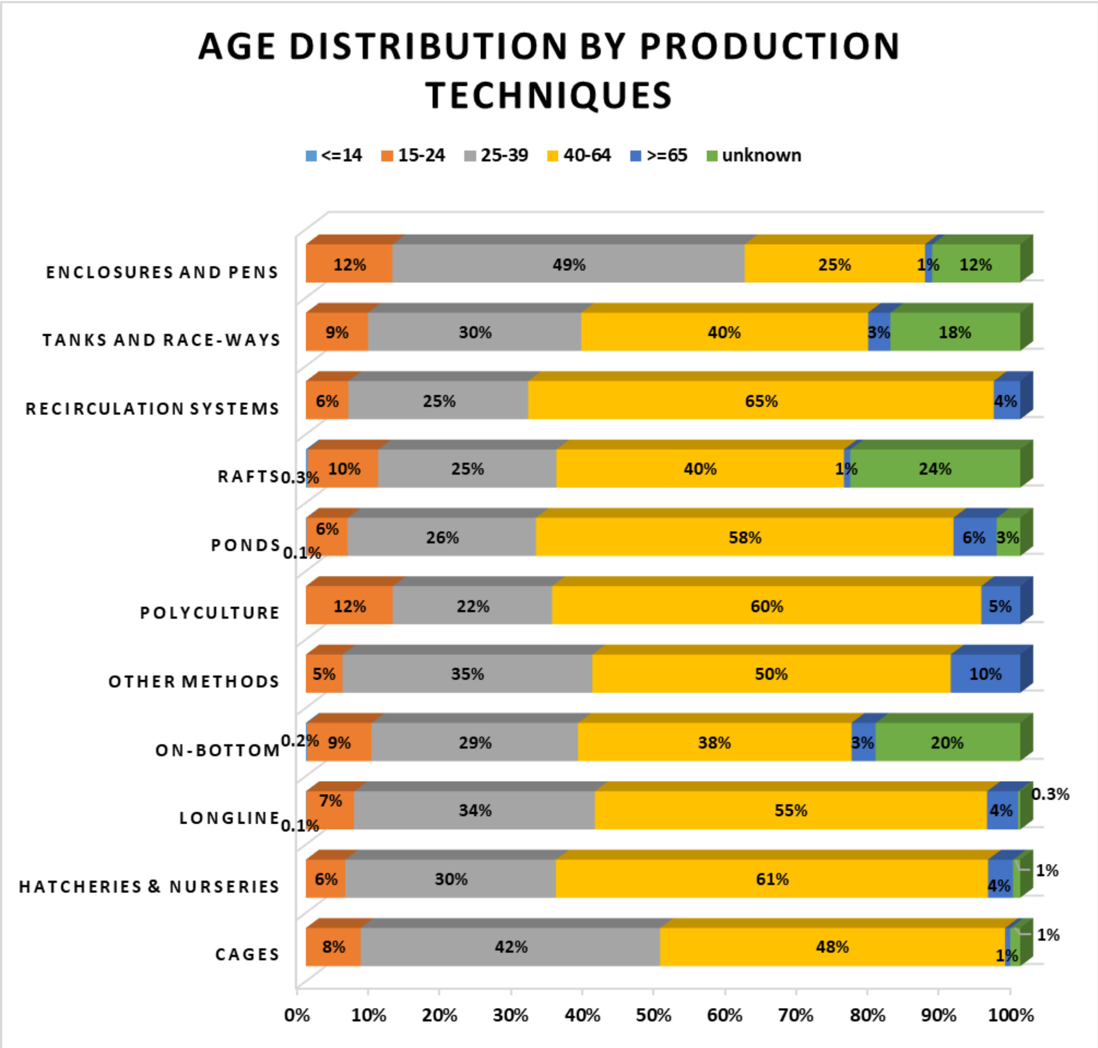
The most common age category is 40-64 years and this is the case for most production technologies as well. That is not surprising, since this is the category with the widest age range (25 years).

The technologies with highest share in this age category as presented below are “recirculation systems” (65%), “hatcheries and nurseries” (61%) and “polyculture” (60%). However, these present rather small shares of the aquaculture production techniques in the EU, or are only represented by few countries as e.g. polyculture.

Especially “enclosures and pens”, “cages”, “longline” and “other methods” are examples of production technologies that have high shares of young people. For “enclosures and pens” it has to be kept in mind, that this production technology represents only production of one country.

The age distribution by technology is presented in figure 7.5.3.

Figure 7.5.3. Age distribution by production technology.



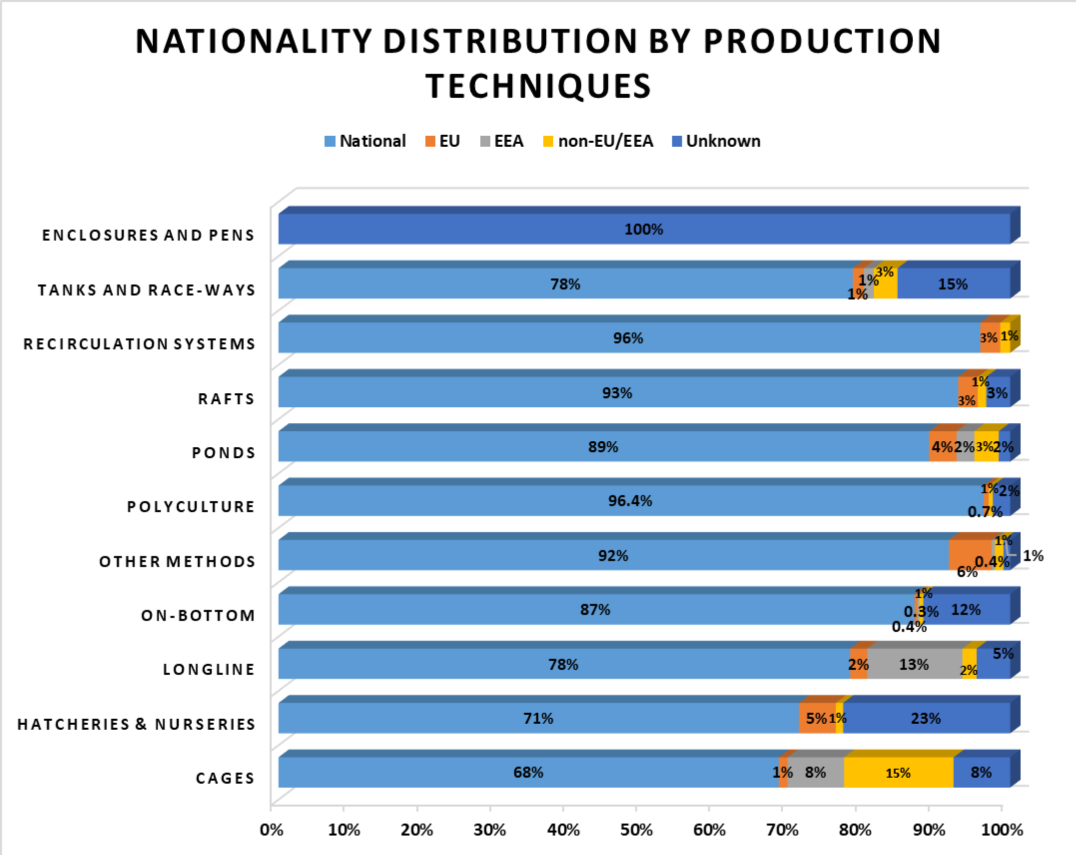
Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

Nationality

Persons from their respective home nations dominate employment in all production technologies. Most technologies employ only a few percentages from outside the nation. An exception is the production category “cages”, where in total 24% of employees were not born in the production country and “longline” production, where 17% of the employees originate from EEA countries.

In figure 7.5.4 below, the nationality is provided by production technology.

Figure 7.5.4. Nationality by production technology.

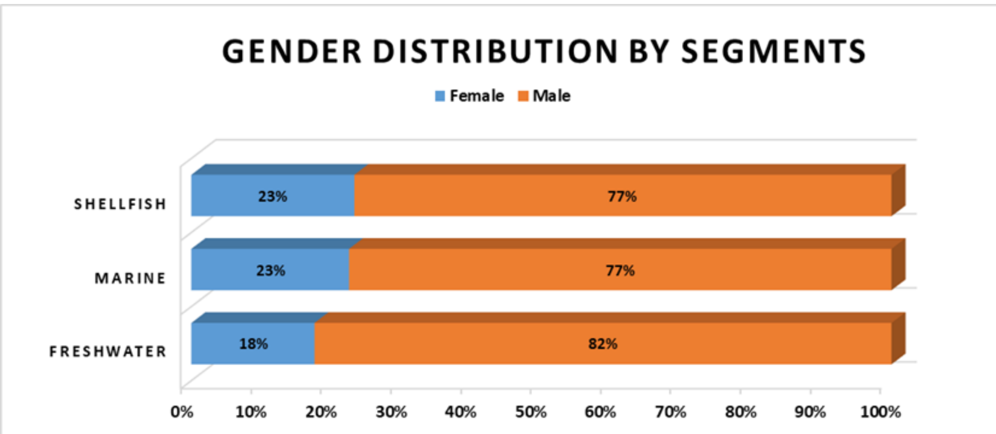


Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

7.6 Socio-demographics by production sector

The socioeconomic variables are further presented by production sectors or main species groups, in other words if production is of freshwater finfish, marine finfish or shellfish. The following countries have reported data on the production sector: Belgium (BEL),Bulgaria (BGR), Denmark (DNK), the Czech Republic (CZE), Finland (FIN), France (FRA),Greece (GRC), Croatia (HRV), Ireland (IRL), Italy (ITA), Latvia (LVA), Malta (MLT), Portugal (PRT), Romania (ROU), the Netherlands (NLD), Sweden (SWE), and Slovenia (SVN).

Figure 7.6.1. Gender distribution by production sector.



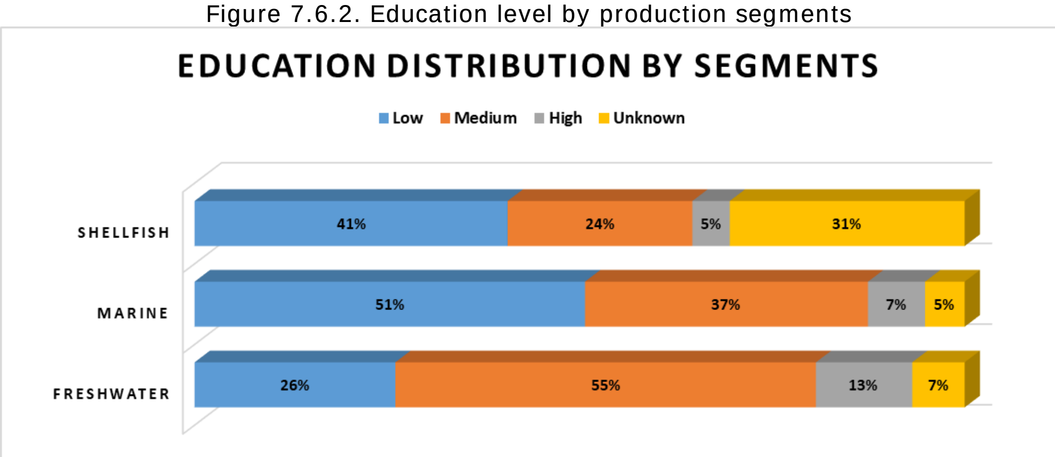
Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

Employment by gender and production sector presented in figure 7.6.1, show that females are representing between 18% and 23% of the employees in EU aquaculture enterprises. Male employees are dominating in the three sectors, representing 82% in freshwater enterprises, followed by 77% in marine production and 77% in the shellfish segment.

From all the social variables, collected under the 2022 Aquaculture data call, the education is the one showing highest fluctuations between the different production sectors. While in the freshwater the employees with low education are 26%, the percentage of lower educated persons in the marine water is 41% and in the shellfish is almost double (51%). The medium educated employees are mainly represented in freshwater enterprises (55%), followed by marine (37%) and the shellfish segment with 24%. Highly educated employees are covering almost the same percentage in shellfish and marine production – 5% and 7% respectively, while in the freshwater segment they cover 13%. The level of unknown education level is relatively high in the shellfish segment 31%, while for freshwater it is 7% and only 5% in marine production.

The education level by production sector is presented in figure 7.6.2 below.

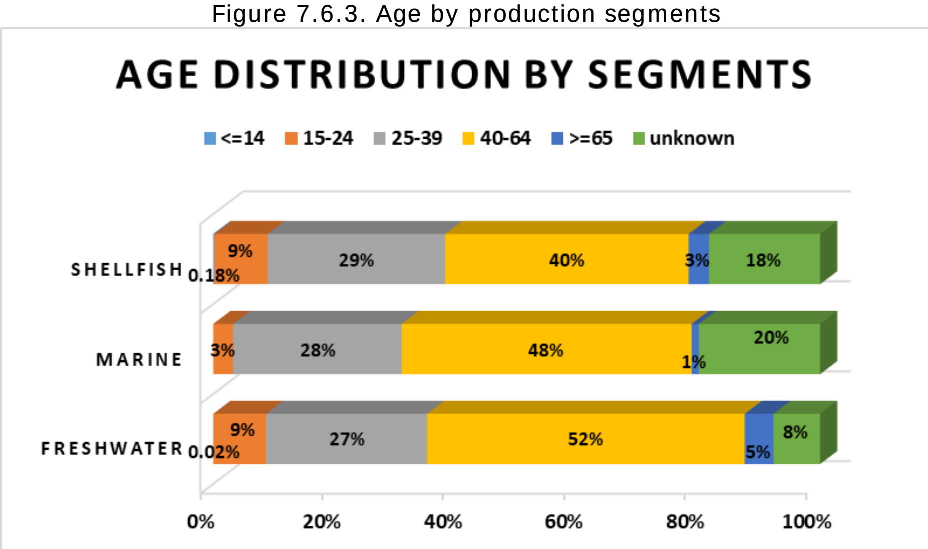
Figure 7.6.2. Education level by production segments



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

The major share of the employees in all sectors is between 40 and 64 years old. In the freshwater sector and in marine enterprises, they represent 52% and 48% of the employees respectively. The same age category is represented by 40% in the shellfish sector. 18% in the shellfish sector are with unknown age, followed by 8% for the freshwater segment and only 1% for the marine water farms.

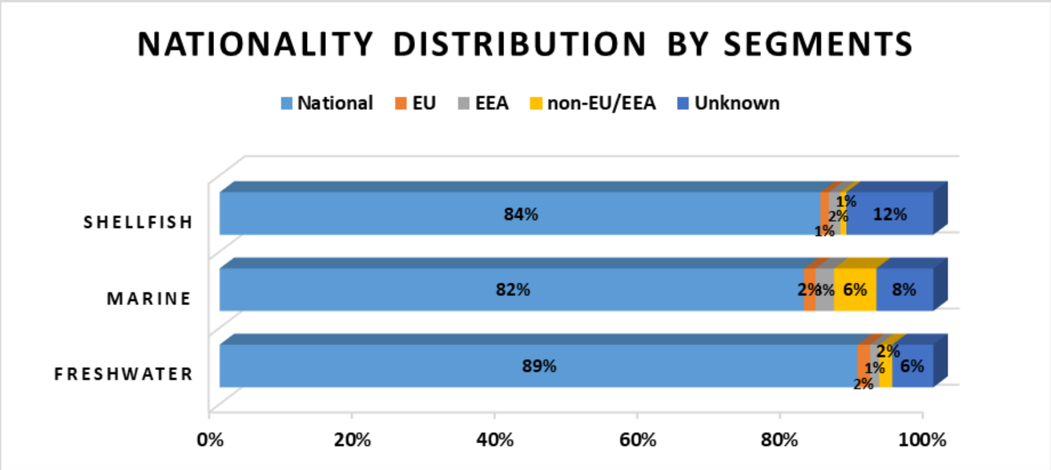
Figure 7.6.3. Age by production segments



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

In all production sectors, nationals from the respective MS are the main employees. The percentage of nationals is highest for the freshwater sector (89%), followed by shellfish (84%). The rest of the categories (EU, EEA and non-EU/EEA) are modestly presented, except for non-EU/EEA employees in the marine water sector (6%). The percent of unknown nationality is under 12% for all three sectors. The nationality of the employees is presented by production segments in figure 7.6.4.

Figure 7.6.4. Nationality by production segments



Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG

7.7 Main conclusions

The main conclusions and issues identified by the EWG 22-17 during the analysis of the second social data submitted for the aquaculture sector under EU-MAP are:

- Gender: 78% of the persons employed in the sector are male, and thus European aquaculture is clearly gender biased. This differs from the processing industry, which shows an equal gender distribution. The large share of male is prevalent in all member states and in all production technologies, however, the shellfish segment employs a higher percentage of female workers.
- Age: The age class 40-65 constitutes about 46% of total employment, which is similar to the results based on data for 2017 (43%). It is the largest age class for most member states, as well as for both marine and freshwater production. The 25-39 age class covered 27%, whereas the 15-24 age class only covered 6%. Furthermore, 17% was reported as unknown.
- Education: Overall, the data analysed showed that 41% of people employed in the EU aquaculture sector had a low-level degree of education. 36% had a medium level education, whereas only 8% had a higher-level degree of education. For the education indicator, 15% of the education level was reported as unknown.
- Nationality: The vast majority (82%) of people employed in the sector are EU nationals of their own country, the rest mainly being workers from other EU MS's. This is true for all technologies and production segments as well.

7.8 Data issues

- Spain did not provide social data, which creates a gap bearing in mind that Spain is the main aquaculture producer with an important share of employees in the EU aquaculture sector.
- Ireland provided the age classes in different segmentation than the one recommended by PGECON/RCG ECON and, for this, their data were not included in the EU overview. In order

to provide an accurate EU analysis and comparison among MSs, EWG 22-17 concludes that it would be advisable that all MSs will submit data according to the age classes recommended by PGECON/RCG ECON.

- France did not provide data for Employment by age, Employment by education level, Employment by nationality and Employment status.
- Belgium did not provide data for Employment by age, Employment by nationality and employment status.
- Germany reported data for Age and Education in a different format that could not be included in the analysis.
- Romania did not provide data for Employment by age and Employment by nationality. The provided social data was in a wrong format and the group could not include it in the analysis.

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9 ANNEXES

9.1 Annex I: Methodology for construction of overall EU trends - Imputation

Background

The EWG 18-19 report (STECF, 2018) was the first time that an exercise of imputation was undertaken in the economic report of the EU aquaculture sector, with the conviction that the methodology would be further applied and developed in future reports. The EWG 20-12 TORs stated that "*the data for EU total should reflect an estimation of the actual evolution and should not be distorted by the inclusion (or exclusion) of Member States throughout the analysed period. The compilation of EU aggregates may require the use of imputation in some Member States*". In this context, prior to EWG 20 12, it was developed a preparatory work in order to define a methodology of imputation with the purpose of facilitate that even with some missing values, the EWG is able to analyse aggregate figures at the EU level. The EWG 22-17 TORs highlights again that "imputation of missing values may be required to obtained coherent time series and indicators that reflect a robust estimate of EU aggregates."

Imputations techniques are employed to address issues with data gaps for particular years and/or indicators in Member State data submissions, and Member States that, due to their small aquaculture sector, are not required to submit data under the data collection framework. Specifically, it was necessary to estimate certain values at national level for EU aggregate series.

This section describes the methodology used to do the necessary imputations in the EU overview chapter in the EWG 22 17, that is based on the methodologies applied for the construction of the overall EU trends in the previous EU Aquaculture Sector reports (STECF, 2018 and 2020), the last edition of the fish processing report (STECF 19-15), and the principles for using alternative sources to address major data gaps in the estimation of the main variables for EU aggregates approved by the STECF plenary in 2019 for the fish processing sector (STECF, 2019). Missing data are imputed at environment level (Finfish marine, finfish freshwater, shellfish), and then aggregated at national totals.

The indicators of the EU overview covered by the imputation methodology are: total sales volume, turnover, number of enterprises, employment and FTE.

Other economic performance indicators (labour productivity, capital productivity, average wage, GVA, EBIT, ROI) proved in the previous Economic Aquaculture EWG (STECF 18-19) to be too difficult to provide a reliable time series for, as there are significant data gaps in input costs for major aquaculture producing Member States. The last Fish Processing Sector Economic Report (STECF-19-15) also developed a gaps imputation exercise to build EU aggregated indicators based in the same protocol approved by the STECF 19-02. In the case of the fish processing industry, the EWG was able to develop estimations on several input cost such as energy, wages and salaries or gross investments. This was possible because fish processing is an industrial activity that is included in the Eurostat´s Structural Business Statistics (SBS). Unfortunately, aquaculture is not included in SBS, so in the case of these other economic performance indicators, it is recommended to follow the recommendations given by the previous group of experts.

In order to produce a time series of the EU aquaculture sector for some key economic indicators, a number of steps needed to be taken, considering the principles described above and the availability of data. These steps are described for each indicator below.

9.1.1 Total sales volume

The main data source for total sales volume is the submission of data by Member States through the DCF or EUMAP. Where there are data gaps, the most recent reporting year was adjusted based on the percentage change in FAO production data.

$$(1) \qquad TSV_{est}^{n} = TSV_{DCF}^{n-1} \cdot \left(\frac{Production_{FAO}^{n}}{Production_{FAO}^{n-1}}\right)$$

Where:

TSV = Total sales volume

Production = Total production in quantities

n = year n

n-1 = year n-1

est = estimated value

DCF = data from DCF/EUMAP

FAO = data from FAO

For Member States that do not report data on total sales volume through the data collection framework for any year, FAO production data was taken directly.

$$(2) \qquad TSV_{est}^{n} = Production_{FAO}^{n}$$

Where:

TSV = Total sales volume

Production = Total production in quantities

n = year n

est = estimated

FAO = data from FAO

9.1.2 Turnover

The main data source for turnover is the submission of data by Member States through the DCF or EU MAP. Where there are data gaps, the most recent reporting year was adjusted based on the percentage change in FAO value of production data.

$$(3) \qquad Turnover_{est}^{n} = Turnover_{DCF}^{n-1} \cdot \left(\frac{Value_{FAO}^{n}}{Value_{FAO}^{n-1}}\right)$$

Where:

Turnover = Turnover

Value = Value of production

n = year n

n-1 = year n-1

est = estimated value

DCF = data from DCF/EUMAP

FAO = data from FAO

For Member States that did not report turnover through the data collection framework, FAO data on value of production was taken directly. The data are converted from USD dollar to Euro using the European Central Bank average annual exchange rate.

$$(4) \qquad Turnover_{est}^{n} = Value_{FAO}^{n}$$

Where:

Turnover = Turnover

Value = Value of production

n = year n

est = estimated

FAO = data from FAO

9.1.3 Number of enterprises

The main data source for the number of enterprises is the submission of data by Member States through the DCF or EU MAP. Where there are data gaps, the most recent reporting year was used as the number of enterprises is very stable and does not change significantly when there are changes in production volume or value.

$$Enterprise_{est}^{n} = Enterprise_{DCF}^{n-1} \quad (5)$$

Where:

Enterprise = Number of enterprises

n = year n

n-1 = year n-1

est = estimated value

DCF = data from DCF/EU MAP

For Member States that do not report any data on the number of enterprises through the data collection framework, the number of enterprises is estimated by applying the ratio of turnover per enterprise calculated for DCF reporting Member States to the turnover for the Member States without data on the number of enterprises. This has been the criterion applied in previous reports, so which provides consistency to the data series.

9.1.4 Total employees

The main data source for employment is the submission of data by Member States through the DCF or EU MAP. Where there are data gaps, the most recent reporting year is adjusted based on half the percentage change in turnover. This estimation methodology was selected and applied in the 2018 aquaculture economic report based on an analysis of standard errors for the Member States, where changes in employment and changes in production volume and value could be analysed. That half the percentage change in turnover was the strongest estimation of employment and it makes some sense as production weight can fluctuate significantly with shellfish production (particularly mussels) and also that employment has a slow and often more muted response to changes in economic performance ('employment stickiness').

$$Employment_{est}^{n} = Employment_{DCF}^{n-1} * (1 + \frac{\left(\frac{Turnover_{DCF}^{n}}{Turnover_{DCF}^{n-1}} - 1\right)}{2}) \quad (6)$$

Where:

Employment = Total number of employees

Turnover = Turnover

n = year n

n-1 = year n-1

est = estimated

DCF = data from DCF/EUMAP

For Member States that do not report total employment through the data collection framework, employment data from the OECD is used wherever available. For the remaining Member States, employment is estimated by applying the ratio of turnover per employee for DCF reporting Member States to the turnover for the Member States without employment data.

9.1.5 FTE

An employment time series is also reported for FTEs. Again, the main data source is the submission of data by Member States through the DCF or EU MAP. Where there are data gaps the most recent reporting year is adjusted based on half the percentage change in turnover (as previously described). For Member States that do not report total employment through the data collection framework, a factor is applied to total employment as calculated from those Member States reporting both total employment and FTE employment.

$$FTE_{est}^{n} = Employment_{est}^{n} \cdot \left(\frac{FTE_{MS}^{n}}{Employment_{MS}^{n}}\right) \quad (7)$$

Where:

Employment = Total number of employees,

FTE = FTE,

n = year n,

est = estimated value,

MS = total MS data from DCF/EU MAP

9.2 Annex II: Nowcast methodology

The nowcast methodology for the EWG on The EU Aquaculture Sector is inspired in what has already been done for the report on fleet economics, and follows the recommendations and principles for estimation of the main variables for EU aggregates approved by the STECF plenary in 2019. In addition, we try to apply the estimation principles defined for imputation on missing data.

The indicators included in this second nowcast exercise for EU Aquaculture Sector report are "Total weight of sales", "Gross sales", and employment measured both through the "Persons employed" and "Persons employed FTE".

The scope of the nowcast exercise is finally conditioned by the availability of information. This section describes the methodology used for the analysis of the quantitative information available for 2020 and 2021.

9.2.1 General methodology

At the time of conducting the economic analysis, the data lag is usually two years, so the projection is made for years t + 1 and t + 2, being "t" the last year requested in the EU-MAP data call. In the present case, t = 2020, t+1= 2021 and t+2 = 2022.

In the general case of the nowcasting methodology, a variable "A" in year t+1 is estimated by the same variable "A" in year t and the change in variable "B" between year t and t+1, when the value for variable "B" in year t+1 is known (STECF, 2020[40]). Unless otherwise noted, the relationship between t + 2 and t + 1 is the same as between t + 1 and t. Therefore, the following general formulation is used:

$$A_{est}^{t+1} = A_{EUMAP}^{t} * \left(1 + \left(\frac{B^{t+1} - B^{t}}{B^{t}}\right)\right)$$

$$A_{est}^{t+2} = A_{est}^{t+1} * \left(1 + \left(\frac{B^{t+2} - B^{t+1}}{B^{t+1}}\right)\right)$$

Where:

A = explained variable

B = explanatory variable

t = year t

t+1 = year t+1

t+2 = year t+2

est = estimated value

EUMAP = data from EU-MAP

Where data for variable "A" is already reported in the EU-MAP for t+1, this data is automatically selected rather than the nowcasting estimation. The variable "B" can be the same indicator, for example, an estimation of the "Gross sales", but also a proxy of it, such as the value of the production from aquaculture excluding hatcheries and nurseries from Eurostat (fish_aq2a).

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[40] Scientific, Technical and Economic Committee for Fisheries (STECF): The 2020 Annual Economic Report on the EU Fishing Fleet (STECF 20-06) Annex. Publications Office of the European Union, Luxembourg, 2020a, doi:10.2760/597156, JRC123089.

9.2.2 Total weight of sales

The total weight of sales (TWS) in 2021 is estimated by adjusting the 2020 EU-MAP data with the grow rate experimented by sales (volume) between 2020 and 2021 according to the variable B. Total sales in 2022 is estimated by adjusting the TWS estimated in 2021 with the increase/decrease experimented by sales (volume) between 2021 and 2022 according to indicator B. If any country has provided their data for 2021 in the EUMAP, this data is used instead of the estimate described below.

$$TWS_{est}^{t+1} = TWS_{EUMAP}^{t} * \left(1 + \left(\frac{B^{t+1} - B^{t}}{B^{t}}\right)\right)$$

$$TWS_{est}^{t+2} = TWS_{est}^{t+1} * \left(1 + \left(\frac{B^{t+2} - B^{t+1}}{B^{t+1}}\right)\right)$$

Where:

TWS = Total weight of sales

est = estimated value

EUMAP = data from EU MAP

B= proxy variable selected

9.2.3 Gross sales

Gross sales in 2021 is estimated by adjusting the 2020 EUMAP data with the grow rate experimented by variable B between 2020 and 2021. The value of the production in 2022 is estimated by adjusting the gross sales estimated in 2021 with the increase/decrease experimented by variable B between 2021 and 2022. If any country has provided their data for 2021 in the EUMAP, this data is used instead of the estimate described below.

$$GS_{est}^{t+1} = GS_{EUMAP}^{t} * \left(1 + \left(\frac{B^{t+1} - B^{t}}{B^{t}}\right)\right)$$

$$GS_{est}^{t+2} = GS_{est}^{t+1} * \left(1 + \left(\frac{B^{t+2} - B^{t+1}}{B^{t+1}}\right)\right)$$

Where:

GS = Gross sales

est = estimated value

EUMAP = data from EU MAP

B= proxy variable selected

9.2.4 Employment

Employment in 2021 is estimated by adjusting the 2020 EUMAP data with the grow rate experimented by Persons employed between 2020 and 2021 according to the explanatory variable B. Employment in 2022 is estimated by adjusting the employment estimated in 2021 with the increase/decrease experimented by B between 2021 and 2022. If any country has provided their employment data for 2021 in the EUMAP, this data is used instead of the estimate described below.

$$PE_{est}^{t+1} = PE_{EUMAP}^{t} * \left(1 + \left(\frac{B^{t+1} - B^{t}}{B^{t}}\right)\right)$$

$$PE_{est}^{t+2} = PE_{est}^{t+1} * \left(1 + \left(\frac{B^{t+2} - B^{t+1}}{B^{t+1}}\right)\right)$$

$$FTE_{est}^{t+1} = FTE_{EUMAP}^{t} \; * \; \left(1 + \left(\frac{B^{t+1} - B^{t}}{B^{t}}\right)\right)$$

$$FTE_{est}^{t+2} = FTE_{est}^{t+1} * \left(1 + \left(\frac{B^{t+2} - B^{t+1}}{B^{t+1}}\right)\right)$$

Where:

PE = Persons employed

FTE = Persons employed FTE

est = estimated value

EUMAP = data from EU MAP

B= proxy variable selected

9.3 Annex VI: Data collected under DCF and EU-MAP

In this year's data call Member States reported data under the EU-MAP. However, this report contains data from the former DCF program and the most recently implemented EU-MAP. Below the requested variable and segmentations for both programs are listed.

9.3.1 Parameters requested under the DCF

The economic variables to be collected for the aquaculture industry sector under the Data Collection are specified in section A of the Chapter IV and in Appendix X of Commission Decision 2010/93/EC of the 18th of December 2010, on Adopting a multiannual Community programme pursuant to Council Regulation (EC) No 199/2008 establishing a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy.

Table 7.4.1: DCF data requirements

Variable Group	Variable	Unit
Income	Turnover	Euro
	Subsidies	Euro
	Other Income	Euro
	Total Income	Euro
Personnel Costs	Wages and salaries	Euro
	Imputed value of unpaid labour	Euro
Energy Costs	Energy Costs	Euro
Raw Material Costs	Livestock costs	Euro
	Feed costs	Euro
Repair and maintenance Costs	Repair and maintenance	Euro
Other operational Costs	Other operational costs	Euro
Capital Costs	Depreciation of capital	Euro
	Financial Costs, net	Euro
Extraordinary Costs	Extraordinary Costs, net	Euro
Capital Value	Total Value of Assets	Euro
Investments	Net Investments	Euro
Debt	Debt	Euro
Raw Material Volume	Livestock	Tonne
	Fish Feed	Tonne
Total volume	Total sales volume	Tonne
Employment	Male employees	Number
	Female employees	Number
	Total employees	Number
	Male FTE	Number
	Female FTE	Number
	Total FTE	Number
Number of enterprises	less or equal than 5 employees	Number

	6-10 employees	Number
	more or equal than 11 employees	Number

Following DCF the statistical unit for the aquaculture data collection is defined as enterprise, which is the lowest legal entity for accounting purposes. The population refers to enterprises whose primary activity is defined according to the EUROSTAT definition under NACE Code 05.02: 'Fish Farming'. More detailed definitions of parameters can be found in the glossary (section 8.2). Data is requested to be reported by segment and in National totals. Segments are defined as a combination of the main species cultured and the technology used for their production.

9.3.2 Parameters requested under the EUMAP

Under the provisions of Council Regulation 2017/1004, there are requested the economic variables for the aquaculture sector detailed in Table 7 of the Commission Decision (EU) 2016/1251. Member States are invited to submit listed data following the segmentation set out in Table 9 of the Commission implementing decision (EU) 2016/1251.

Table 7.4.2: EUMAP data requirements

Variable Group	**Variable**	**Unit**
Income	Gross sales (total)	Euro
	Operating Subsidies	Euro
	Other Income	Euro
Personnel Costs	Wages and salaries	Euro
	Imputed value of unpaid labour	Euro
Energy Costs	Energy Costs	Euro
Raw Material Costs	Livestock costs	Euro
	Feed costs	Euro
Repair and maintenance Costs	Repair and maintenance	Euro
Other operational Costs	Other operational costs	Euro
Capital Costs	Consumption of fixed capital	Euro
	Financial Income	Euro
	Financial Expenditure	Euro
Capital Value	Total Value of Assets	Euro
Investments	Net Investments	Euro
	Subsidies in investments	Euro
Debt	Debt	Euro
Raw Material Weight	Livestock used	Kg
	Fish Feed used	Kg
Total volume	Total weight of sales	Kg
Employment	Persons employed	Number
	Persons employed FTE	Number
	Number of hours worked by employees and unpaid labour	Number
	Unpaid labour	Number
	Unpaid labour FTE	Number

Number of enterprises	Less or equal than 5 employees	Number
	6-10 employees	Number
	More or equal than 11 employees	Number

9.4 Annex IV: Glossary of variables and indicators reported under the DCF and EUMAP

9.4.1 Parameters requested under the DCF

Turnover:

"Turnover" comprises the totals invoiced by the observation unit during the reference period, and this corresponds to market sales of goods or services supplied to third parties.

Turnover includes all duties and taxes on the goods or services invoiced by the unit with the exception of the VAT invoiced by the unit vis-à-vis its customer and other similar deductible taxes directly linked to turnover.

It also includes all other charges (transport, packaging, etc.) passed on to the customer, even if these charges are listed separately in the invoice. Reduction in prices, rebates and discounts as well as the value of returned packing must be deducted. Income classified as other operating income, financial income and extraordinary income in company accounts is excluded from turnover. Operating subsidies received from public authorities or the institutions of the European Union are also excluded (Structural Business Statistics (SBS) Code 12 11 0, Commission Regulation (EC) No 2700/98).

Subsidies:

"Subsidies" are the financial assistance received from public authorities or the institutions of the European Union which are excluded from turnover.

It includes direct payments, e.g. compensation for stopping trading, refunds of fuel duties or similar lump sum compensation payments; excludes social benefit payments and indirect subsidies, e.g. reduced duty on inputs such as fuel or investment subsidies.

Other income:

"Other income" refers to other operating income included in company accounts which are excluded from turnover; income coming from other activities than aquaculture, e.g. the licensing of ponds for recreational fishery purposes.

Wages and salaries:

"Wages and salaries" is equivalent to "Personnel costs" on the Structural Business Statistics.

"Personnel costs" are defined as the total remuneration, in cash or in kind, payable by an employer to an employee (regular and temporary employees as well as home workers) in return for work done by the latter during the reference period. Personnel costs also include taxes and employees' social security contributions retained by the unit as well as the employer's compulsory and voluntary social contributions.

Personnel costs are made up of:

- wages and salaries
- employers' social security costs

All remuneration paid during the reference period is included, regardless of whether it is paid on the basis of working time, output or piecework, and whether it is paid regularly or not. Included are all gratuities, workplace and performance bonuses, ex gratia payments, thirteenth month pay (and similar fixed bonuses), payments made to employees in consideration of dismissal, lodging, transport, cost of living and family allowances, commissions, attendance fees, overtime, night work etc. as well as taxes, social security contributions and other amounts owed by the employees and retained at source by the employers. Also included are the social security costs for the employer. These include employer's social security contributions to schemes for retirement pensions, sickness, maternity, disability, unemployment, occupational accidents and diseases, family allowances as well as other schemes. These costs are included regardless of whether they are statutory, collectively agreed, contractual or voluntary in nature. Payments for agency workers are not included in personnel costs. (Structural Business Statistics (SBS) Code 13 31 0, Commission Regulation (EC) No 2700/98).

Wages and salaries: Wages and salaries are defined as "the total remuneration, in cash or in kind, payable to all persons counted on the payroll (including homeworkers), in return for work done during the accounting period." regardless of whether it is paid on the basis of working time, output or piecework and whether it is paid regularly or not. Wages and salaries include the values of any social contributions, income taxes, etc. payable by the employee even if they are actually withheld by the employer and paid directly to social insurance schemes, tax authorities, etc. on behalf of the employee. Wages and salaries do not include social contributions payable by the employer. Wages and salaries include: all gratuities, bonuses, ex gratia payments, "thirteenth month payments", severance payments, lodging, transport, cost-of-living, and family allowances, tips, commission, attendance fees, etc. received by employees, as well as taxes, social security contributions and other amounts payable by employees and withheld at source by the employer. Wages and salaries which the employer continues to pay in the event of illness, occupational accident, maternity leave or short-time working may be recorded here or under social security costs, depending upon the unit's accounting practices. Payments for agency workers are not included in wages and salaries. (Structural Business Statistics (SBS) Code 13 32 0, Commission Regulation (EC) No 2700/98).

Social security costs: Employers' social security costs correspond to an amount equal to the value of the social contributions incurred by employers in order to secure for their employees the entitlement to social benefits. Social security costs for the employer include the employer's social security contributions to schemes for retirement pensions, sickness, maternity, disability, unemployment, occupational accidents and diseases, family allowances as well as other schemes. Included are the costs for all employees including homeworkers and apprentices. Charges are included for all schemes, regardless of whether they are statutory, collectively agreed, contractual or voluntary in nature. Wages and salaries which the employer continues to pay in the event of illness, occupational accident, maternity leave or short-time working may be recorded here or under wages and salaries, dependent upon the unit's accounting practices. (Structural Business Statistics (SBS) Code 13 33 0, Commission Regulation (EC) No 2700/98).

Imputed value of unpaid labour:

Unpaid workers normally refer to persons who live with the proprietor of the unit and work regularly for the unit, but do not have a contract of service and do not receive a fixed sum for the work they perform. This is limited to persons who are not included on the payroll of another unit as their principal occupation.

Thus, imputed value of unpaid labour estimates the value of the salaries that these unpaid workers would have received if their work was remunerated.

The chosen methodology to estimate this imputed value of unpaid labour should be explained by the Member State in their national programme.

Energy costs:

“Energy costs” corresponds to the “Purchases of energy products (in value)” on the Structural Business Statistics.

Purchases of all energy products during the reference period should be included in this variable only if they are purchased to be used as fuel. Energy products purchased as a raw material or for resale without transformation should be excluded. This figure should be given in value only. (Structural Business Statistics (SBS) Code 20 11 0, Commission Regulation (EC) No 2700/98).

Livestock costs:

Livestock costs should correspond to the variable livestock volume.

In the Structural Business Statistics, it is included inside 13 11 0 “Total purchases of goods and services”.

Feed costs:

Feed costs include the purchasing costs of the feed during the reference period. The feed costs should correspond to feed volume.

In the Structural Business Statistics, it is included inside 13 11 0 “Total purchases of goods and services”.

Repair and maintenance:

Under repair and maintenance there should be included the costs incurred to bring an asset back to its earlier condition or to keep the asset operating at its present condition (as opposed to improving the asset).

On the Structural Business Statistics is included inside 13 11 0 “Total purchases of goods and services”.

Other operational costs:

Other operating costs should comprise outsourcing costs, property or equipment rental charges, the cost of raw materials and supplies that cannot be held in the inventory and have not been already specified (i.e. water, small items of equipment, administrative supplies, etc.), insurance premiums, studies and research costs, external personnel charges, fees payable to intermediaries and professional expenses, advertising costs, transportation charges, travel expenses, the costs of meetings and receptions, postal charges, bank charges (but not interest on bank loans) and other items of expenditure.

On the Structural Business Statistics is included inside 13 11 0 “Total purchases of goods and services”.

Depreciation of capital:

Depreciation refers to the decline in value of the assets. In accounting, it is used as the allocation of the cost of tangible assets to periods in which the assets are used, in order to reflect this decline in their value.

The chosen methodology to allocate these costs over periods should be explained in the national programme. ESA (6) 6.02 to 6.05 European System of Accounts 1995 (Regulation (EC) No 2223/96, Regulation (EC) No 1267/2003, Eurostat ESA 1995 manual).

Financial costs, net:

“Financial costs, net” should be calculated as costs, coming from financial activity of the enterprise, minus the financial income.

Extraordinary costs, net:

“Extraordinary costs, net” is the difference between “Extraordinary charges” and “Extraordinary income”.

“Extraordinary income” and “Extraordinary charges” are the income and costs that arise otherwise than in the course of the company's ordinary activities (Article 29 of the Fourth Council Directive 78/660/EEC of 25 July 1978).

Total value of assets:

This parameter corresponds to the Balance sheet total of the Structural Business Statistics and the Capital value in the European System of Accounts.

Balance sheet total consists of the sum of items 1 to 16 of the asset side of the balance sheet or of the sum of items 1 to 14 of the liability side of the balance sheet. (Structural Business Statistics (SBS) Code 43 30 0, Commission Regulation (EC) No 2700/98).

Capital value is the total accumulated value of all net investments in the enterprise at the end of the year. ESA 7.09 to 7.24 European System of Accounts 1995 (Regulation (EC) No 2223/96, Regulation (EC) No 1267/2003, Eurostat ESA 1995 manual).

Net Investments:

“Net investments” refers to the difference between Purchase (Gross investment in tangible goods) and Sale (Sales of tangible investment goods) of assets during the year.

Gross investment in tangible goods is the Investment during the reference period in all tangible goods. Included are new and existing tangible capital goods, whether bought from third parties or produced for own use (i.e. Capitalised production of tangible capital goods), having a useful life of more than one year including non-produced tangible goods such as land. The threshold for the useful life of a good that can be capitalised may be increased according to company accounting practices where these practices require a greater expected useful life than the one-year threshold indicated above.

All investments are valued prior to (i.e. gross of) value adjustments, and before the deduction of income from disposals. Purchased goods are valued at purchase price, i.e. transport and installation charges, fees, taxes and other costs of ownership transfer are included.

Own produced tangible goods are valued at production cost. Goods acquired through restructurations (such as mergers, take-overs, break-ups, split-off) are excluded. Purchases of small tools which are not capitalised are included under current expenditure. Also included are all additions, alterations, improvements and renovations which prolong the service life or increase the productive capacity of capital goods. Current maintenance costs are excluded as is the value and current expenditure on capital goods used under rental and lease contracts. Investment in intangible and financial assets are excluded. Concerning the recording of investments where the invoicing, delivery, payment and first use of the good may take place in different reference periods, the following method is proposed as an objective:

i) Investments are recorded when the ownership is transferred to the unit that intends to use them. Capitalised production is recorded when produced. Concerning the recording of investments made in identifiable stages, each part-investment should be recorded in the reference period in which they are made.

In practice this may not be possible and company accounting conventions may mean that the following approximations to this method need to be used:

i) investments are recorded in the reference period in which they are delivered,

ii) investments are recorded in the reference period in which they enter into the production process,

iii) investments are recorded in the reference period in which they are invoiced,

iv) investments are recorded in the reference period in which they are paid for.

Gross investment in tangible goods is based on Gross investment in land (15 12 0) + Gross investment in existing buildings and structures (15 13 0) + Gross investment in construction and alteration of buildings (15 14 0) + Gross investment in machinery and equipment (15 15 0). (Structural Business Statistics (SBS) Code 15 11 0, Commission Regulation (EC) No 2700/98).

Sales of tangible goods includes the value of existing tangible capital goods, sold to third parties. Sales of tangible capital goods are valued at the price actually received (excluding VAT), and not at book value, after deducting any costs of ownership transfer incurred by the seller. Value adjustments and disposals other than by sale are excluded. (Structural Business Statistics (SBS) Code 15 21 0. Commission Regulation (EC) No 2700/98).

Debt:

Financial assets created when creditors lend funds to debtors, either directly or through brokers, which are either evidenced by non-negotiable documents or not evidenced by documents.

Short-term loans: loans whose original maturity is normally one year or less, and in exceptional cases two years at the maximum, and loans repayable on demand.

Long-term loans: loans whose original maturity is normally more than one year, and in exceptional cases more than two years at the minimum.

“Debts” account for provisions and long- and short-term debt (STECF meeting SGECA 06-01).

Livestock (volume):

Volume of livestock purchased during the reference period. The livestock volume should correspond to the livestock cost.

Fish feed (volume):

Volume of feed purchased during the reference period. The feed volume should correspond to feed cost.

Volume of sales:

The volume of sales should correspond to the variable on turnover value. In case of hatcheries and nurseries conversion factors from numbers to tonnes should be stated in the national programmes.

Number of persons employed (Total employment):

This indicator refers to the number of people employed (including full-time and part-time employees) (SGECA-09-03). It corresponds to the Number of people employed of the Structural Business Statistics.

The number of persons employed is defined as the total number of persons who work in the observation unit (inclusive of working proprietors, partners working regularly in the unit and unpaid family workers), as well as persons who work outside the unit who belong to it and are paid by it (e.g. sales representatives, delivery personnel, repair and maintenance teams). It includes persons absent for a short period (e.g. sick leave, paid leave or special leave), and also persons on strike, but not those absent for an indefinite period. It also includes part-time workers who are regarded as such under the laws of the country concerned and who are on the pay-roll, as well as seasonal workers, apprentices and home workers on the pay-roll. The number of persons employed excludes manpower supplied to the unit by other enterprises, persons carrying out repair and maintenance work in the enquiry unit on behalf of other enterprises, as well as those on compulsory military service. Unpaid family workers refer to persons who live with the proprietor of the unit and work regularly for the unit, but do not have a contract of service and do not receive a fixed sum for the work they perform. This is limited to those persons who are not included on the payroll of another unit as their principal occupation. (Structural Business Statistics (SBS) Code 16 11 0, Commission Regulation (EC) No 2700/98).

The number of employees should be reported by gender.

FTE National:

“FTE national” is the number of employees converted in full time equivalents (calculation methodologies vary between countries).

It corresponds to the “Number of employees in full time equivalent units” of the Structural Business Statistics.

The number of employees converted into full time equivalents (FTE). Figures for the number of persons working less than the standard working time of a full-year full-time worker, should be converted into full time equivalents, with regard to the working time of a full-time full-year employee in the unit. Included in this category are people working less than a standard working day, less than the standard number of working days in the week, or less than the standard number of weeks/months in the year. The conversion should be carried out on the basis of the number of hours, days, weeks or months worked. (Structural Business Statistics (SBS) Code 16 14 0, Commission Regulation (EC) No 2700/98).

Reporting the number of FTE national by gender is optional.

Number of enterprises:

The “Number of enterprises” parameter corresponds to a count of the number of enterprises active during at least a part of the reference period (SGECA-09-03).

A count of the number of enterprises registered to the population concerned in the business register corrected for errors, in particular frame errors. Dormant units are excluded. This statistic should include all units active during at least part of the reference period. (Structural Business Statistics (SBS) Code 11 11 0, Commission Regulation (EC) No 2700/98).

Both definitions are similar. However, there are often some divergences with Eurostat data. This is mostly due to the use of the Veterinary list (which is necessary to trade with food products) to update the business register and so companies that are dormant or focusing on other products have been excluded.

Moreover, under the DCF regulation, the number of companies should be disaggregated by the number of persons employed (in ≤5; 6-10 and >10 FTE) (Structural Business Statistics (SBS) Code 16 14 0, Commission Regulation (EC) No 2700/98).

9.4.2 Indicators calculated under the DCF

Average wage:

The average salary or mean wage estimates the salary an employee working full time is receiving on this sector. It includes the salaries themselves, the social security costs and imputed value of unpaid labour.

Mean wage = (Wages and salaries + Imputed value of unpaid labour) / FTE

Gross Value Added (GVA):

Gross Value Added measures the contribution of the sector to the economy.

The Gross Value Added indicator calculated in this report is similar, but does not fully correspond to the Value added at factor cost of the Structural Business Statistics.

Value added at factor cost as defined in the Structural Business Statistics is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. It can be calculated from turnover, plus capitalised production, plus other operating income, plus or minus the changes in stocks, minus the purchases of goods and services, minus other taxes on products which are linked to turnover but not deductible, minus the duties and taxes linked to production. Alternatively, it can be calculated from gross operating surplus by adding personnel costs. Income and expenditure classified as financial or extra-ordinary in company accounts is excluded from value added. Value added at factor costs is calculated "gross" as value adjustments (such as depreciation) are not subtracted. (Structural Business Statistics (SBS) Code 12 15 0, Commission Regulation (EC) No 2700/98).

Thus, Gross Value Added is calculated on this report as:

GVA = Turnover + Other Income – Energy costs – Livestock costs – Feed costs - Repair and maintenance - Other Operational costs.

GVA to Revenues:

Gross value added to revenue ratio - indicates the share of revenue that contributes to the economy through factors of production (returns to labour and returns to capital). Indicator is calculated as the ratio between gross value added and revenue (the sum of Turnover and Other Income). Expressed as a percentage.

$$GVA\ to\ Revenue = \frac{GVA}{Turnover + Other\ Income}100\%$$

Earnings Before Interest and Tax (EBIT):

“Earnings before interest and taxes (EBIT)” or “Operating profit” is a measure of a firm's profitability that excludes interest and income tax expenses.

EBIT = Turnover + Other Income + Subsidies – Energy costs – Wages and salaries - Imputed value of unpaid labour - Livestock costs – Feed costs – Repair and maintenance – Other Operational costs – Depreciation of capital

Net profit:

“Net profit” is a measure of a firm's profitability that includes the results of financial activity of the enterprise.

Net profit = EBIT – Financial_costs_net

Net profit margin:

Net profit margin is a measure of the economic performance of a sector or enterprise expressed in relative terms. It is a difference between total income and all incurred costs (operating, capital and financial). Expressed in percentage.

$$Net\ profit\ margin = \frac{Net\ profit}{Total\ Income}100\%$$

Return on Investment (ROI):

Return on investment is a performance measure to evaluate the profitability (efficiency) of an investment.

During the SGECA-10-04 meeting it was decided that it was more appropriate to calculate the Return on Investment using the “Earnings Before Interest and Tax (EBIT)”, rather than the Net profit.

$$ROI = \frac{EBIT}{Total\_Value\_of\_Assets} * 100\%$$

Running Cost to Turnover Ratio (in %):

This indicator shows how much of the turnover (income) is consumed by production costs.

Running cost to turnover ratio = (Energy costs + Wages and salaries + Livestock costs + Feed costs + Repair and maintenance + Other Operational costs) x 100 / Turnover

Earnings Before Interest and Tax (EBIT) to Revenue ratio:

"Earnings before interest and taxes (EBIT) to revenue ratio" measures the margin of the companies' profit. Expressed in percentages.

$$EBIT\ to\ Revenue = \frac{EBIT}{Turnover + Other\ Income} * 100\%$$

Labour productivity (by FTE or Employee):

Labour productivity is calculated as the average output per worker or per time unit. It can be calculated as Gross Value Added (GVA) divided by Full Time Equivalents (FTE). This indicator describes the value added to the economy from the activity, in this case the value added to the economy by one FTE.

$$Labour\_productivity = \frac{GVA}{FTE}$$

When a MS cannot report the level of employment in FTEs, the number of employees is used as a second best alternative. However, this alternative compromises the comparison and should be clearly stated in the report.

Capital productivity:

Capital productivity is calculated as the average output per unit of capital. It can be calculated as Gross Value Added (GVA) divided by Capital value (total value of assets) in percentage. The indicator describes the value added to the economy by one unit of capital.

$$Capital\ productivity = \frac{GVA}{Total\ value\ of\ assets} 100\%$$

Future Expectations of the Industry indicator:

The indicator "Future Expectations of the Industry" can be interpreted as a proxy for the industry's intent to remain in the market in the medium/long term. If investment minus depreciation is positive, it has the meaning that the sector is allocating resources to increase its production capacity, and therefore it expects to remain in the market to recover the cost of the investment. If investment minus depreciation is close to zero, it could be interpreted as an indicator that the sector is only wishing to maintain its production capacity in the future, and that it is not planning to expand. The third case is where the sector is not even covering its depreciation costs, thus disinvesting with the possible intention to reduce its presence in the market in the future. Therefore, this indicator would be used to approximate the industry's investing behaviour in the future and it has been considered useful by the experts.

$$FEI = \frac{(Net\_investment - Depreciation)}{Total\_value\_of\_\ assets} * 100\%$$

Change 2019-20:

The indicator of the relative change in corresponding indicators compared to the previous year. Expressed in percentage, calculated as following:

$$Change\ 2019-20 = \frac{(X_{2020} - X_{2019})}{X_{2019}} * 100\%$$

Development 2020/(2017-2019):

The indicator of the relative change in corresponding indicators compared to the average of previous years for which the data are available (e.g. 2017-2019). The estimate is showing a more long term development of the corresponding indicator. Expressed in percentages, calculated as following:

$$Development\ 2020/(2017-2019) = \frac{(X_{2014} - average(X_{2017,}X_{2018,}X_{2019}))}{average(X_{2017,}X_{2018,}X_{2019})} * 100\%$$

9.4.3 Parameters requested under the EUMAP

Gross sales (total): corresponds to the DCF variable “Turnover”.

Operating Subsidies: corresponds to the DCF variable “Subsidies”. It refers to direct payments which general government or the institutions of the European Union make to resident producers. (ESA D.3).

Other Income: corresponds to the DCF variable “Other Income”.

Wages and salaries: corresponds to the DCF variable “Wages and salaries”.

Imputed value of unpaid labour: corresponds to the DCF variable “Imputed value of unpaid labour”.

Energy Costs: corresponds to the DCF variable “Energy Costs”.

Livestock costs: corresponds to the DCF variable “Livestock costs”.

Feed costs: corresponds to the DCF variable “Feed costs”.

Repair and maintenance: corresponds to the DCF variable “Repair and maintenance”.

Other operational costs: corresponds to the DCF variable “Other operational costs”.

Consumption of fixed capital: corresponds to the DCF variable “Depreciation of capital”.

Total Value of Assets: corresponds to the DCF variable “Total Value of Assets”.

Net Investments: corresponds to the DCF variable “Net Investments”.

Debt: corresponds to the DCF variable “Debt”.

Livestock used: corresponds to the DCF variable “Livestock”.

Fish Feed used: corresponds to the DCF variable “Fish Feed”.

Total weight of sales: corresponds to the DCF variable “Total sales volume”.

Persons employed: corresponds to the DCF variable “Total employees”.

Persons employed FTE: corresponds to the DCF variable “Total FTE”.

Less or equal than 5 employees: corresponds to the DCF variable “Less or equal than 5 employees”.

6-10 employees: corresponds to the DCF variable “6-10 employees”.

More or equal than 11 employees: corresponds to the DCF variable “More or equal than 11 employees”.

Financial Expenditure minus Financial Income: corresponds to the DCF variable “Financial Costs, net”.

Subsidies in investments: Direct payments which general governments or the institutions of the European Union make to resident producers to finance all or part of the costs of their acquiring assets related to the company.

Number of hours worked by employees and unpaid labour: The aggregate number of hours worked by the persons employed and the unpaid labour during the reference period.

Unpaid labour: Number of workers that have not received compensation in the form of wages, salaries, fees, gratuities, piecework pay or remuneration in kind.

Unpaid labour FTE: The number of workers that have not received compensation in the form of wages, salaries, fees, gratuities, piecework pay or remuneration in kind converted into full time equivalent jobs (FTE).

9.4.4 Indicators calculated under the EUMAP

Average wage:

The average salary or mean wage estimates the salary an employee working full time is receiving on this sector. It includes the salaries themselves, the social security costs and imputed value of unpaid labour.

Under the EUMAP, the indicator is calculated as follows:

Mean wage = (Wages and salaries + Imputed value of unpaid labour) / (Persons employed FTE + Unpaid labour FTE)

$$\text{Mean wage } = \frac{Wages\ and\ salaries\ +\ Imputed\ value\ of\ unpaid\ labour}{Persons\ employed\ FTE\ +\ Unpaid\ labour\ FTE}$$

Gross Value Added (GVA):

Gross Value Added measures the contribution of the sector to the economy.

The Gross Value Added indicator calculated in this report is similar, but does not fully correspond to the Value added at factor cost of the Structural Business Statistics.

Value added at factor cost as defined in the Structural Business Statistics is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. It can be calculated from turnover, plus capitalised production, plus other operating income, plus or minus the changes in stocks, minus the purchases of goods and services, minus other taxes on products which are linked to turnover but not deductible, minus the duties and taxes linked to production. Alternatively, it can be calculated from gross operating surplus by adding personnel costs. Income and expenditure classified as financial or extra-ordinary in company accounts is excluded from value added. Value added at factor costs is calculated "gross" as value adjustments (such as depreciation) are not subtracted. (Structural Business Statistics (SBS) Code 12 15 0, Commission Regulation (EC) No 2700/98).

Thus, under the EUMAP, the indicator is calculated as follows:

GVA = Gross sales (total) + Other Income – Energy costs – Livestock costs – Feed costs - Repair and maintenance - Other Operational costs.

GVA to Revenues:

Gross value added to revenue ratio - indicates the share of revenue that contributes to the economy through factors of production (returns to labour and returns to capital). Indicator is calculated as the ratio between gross value added and revenue (the sum of Turnover and Other Income). Expressed as a percentage. Under the EUMAP, Gross Value Added is calculated as under the DCF:

$$GVA\ to\ Revenue = \frac{GVA}{Turnover + Other\ Income}100\%$$

Earnings Before Interest and Tax (EBIT):

"Earnings before interest and taxes (EBIT)" or "Operating profit" is a measure of a firm's profitability that excludes interest and income tax expenses. Under the EUMAP, the indicator is calculated as follows:

EBIT = Turnover + Other Income + Operating Subsidies – Energy costs – Wages and salaries - Imputed value of unpaid labour - Livestock costs – Feed costs – Repair and maintenance – Other Operational costs – Consumption of fixed capital.

Net profit:

"Net profit" is a measure of a firm's profitability that includes the results of financial activity of the enterprise. Under the EUMAP, the indicator is calculated as follows:

Net profit = EBIT – (Financial Expenditure - Financial Income)

Net profit margin:

Net profit margin is a measure of the economic performance of a sector or enterprise expressed in relative terms. It is a difference between total income and all incurred costs (operating, capital and financial). Expressed in percentage. Under the EUMAP, the indicator is calculated as follows:

$$Net\ profit\ margin = \frac{Net\ profit}{Turnover\ +\ Other\ Income\ +\ Operating\ Subsidies} 100\%$$

Return on Investment (ROI):

Return on investment is a performance measure to evaluate the profitability (efficiency) of an investment.

During the SGECA-10-04 meeting it was decided that it was more appropriate to calculate the Return on Investment using the “Earnings Before Interest and Tax (EBIT)”, rather than the Net profit. Under the EUMAP, the indicator is calculated as under the DCF:

$$ROI = \frac{EBIT}{Total\_Value\_of\_Assets} * 100\%$$

Running Cost to Turnover Ratio (in %):

This indicator shows how much of the turnover (income) is consumed by production costs. Under the EUMAP, the indicator is calculated as under the DCF:

Running cost to turnover ratio = (Energy costs + Wages and salaries + Livestock costs + Feed costs + Repair and maintenance + Other Operational costs) x 100 / Turnover

Earnings Before Interest and Tax (EBIT) to Revenue ratio:

“Earnings before interest and taxes (EBIT) to revenue ratio” measures the margin of the companies’ profit. Expressed in percentages. Under the EUMAP, the indicator is calculated as follows:

$$EBIT\ to\ Revenue = \frac{EBIT}{Turnover\ +\ Other\ Income\ +\ Operating\ Subsidies} * 100\%$$

Labour productivity (by FTE or Employee):

Labour productivity is calculated as the average output per worker or per time unit. It can be calculated as Gross Value Added (GVA) divided by Full Time Equivalents (FTE). This indicator describes the value added to the economy from the activity, in this case the value added to the economy by one FTE. Under the EUMAP, the indicator is calculated as follows:

$$Labour\_productivity = \frac{GVA}{Persons\ employed\ FTE\ +\ Unpaid\ labour\ FTE}$$

When a MS cannot report the level of employment in FTEs, the number of employees is used as a second best alternative. However, this alternative compromises the comparison and should be clearly stated in the report.

Capital productivity:

Capital productivity is calculated as the average output per unit of capital. It can be calculated as Gross Value Added (GVA) divided by Capital value (total value of assets) in percentage. The indicator describes the value added to the economy by one unit of capital. Under the EUMAP, the indicator is calculated as under the DCF:

$$Capital\ productivity = \frac{GVA}{Total\ value\ of\ assets} 100\%$$

Future Expectations of the Industry indicator:

The indicator “Future Expectations of the Industry” can be interpreted as a proxy for the industry’s intent to remain in the market in the medium/long term. If investment minus depreciation is positive, it has the meaning that the sector is allocating resources to increase its production capacity, and therefore it expects to remain in the market to recover the cost of the investment. If investment minus depreciation is close to zero, it could be interpreted as an indicator that the sector is only wishing to maintain its production capacity in the future, and that it is not planning to expand. The third case is where the sector is not even covering its depreciation costs, thus disinvesting with the possible intention to reduce its presence in the market in the future. Therefore, this indicator would be used to approximate the industry’s investing behaviour in the future and it has been considered useful by the experts. Under the EUMAP, the indicator is calculated as follows:

$$FEI = \frac{(Net\_investment - Consumption\ of\ fixed\ capital)}{Total\_value\_of\_\ assets} * 100\%$$

9.5 Annex V: Data coverage

As foreseen in the Regulation No 2017/1004, the Commission asked Member States to provide aggregated scientific data from within their National Data Collection programs to support scientific advice.

The data requested refers to 2019 and 2020; while previous years (2008-2018) could be submitted or resubmitted as full annual data sets in cases where the already submitted data are considered incomplete or required correction. Data requested for 2018 and 2019, in accordance within their National Data Collection programs, had to be provided under the provisions of Regulation 2017/1004 (i.e., EUMAP).

Under the provisions of Regulation 199/2008, there were collected in previous years: Income (turnover, subsidies and other income), Personnel costs (Wages and salaries of staff and Imputed value of unpaid labour), Energy costs, Raw material costs (livestock costs and feed costs), Repair and maintenance costs, Other operational costs, Capital costs (depreciation of capital and financial costs), Extraordinary costs, Capital value, Net Investments, Debt, Raw material volume (livestock and feed), Volume of sales, Employment (Number of persons employed, gender and FTE national) and number of enterprises pertaining to the EU aquaculture sector. Moreover, turnover and volume of sales need to be detailed by species. The segmentation is set out in the Appendix XI of the Commission Decision.

Under the provisions of Regulation 2017/1004, there were requested the economic variables for the aquaculture sector detailed in Table 7 of the Commission implementing decision (EU) 2016/1251. In particular, Income (gross total sales, operating subsidies and other income), Personnel costs (Wages and salaries of staff and Imputed value of unpaid labour), Energy costs, Raw material costs (livestock costs and feed costs), Repair and maintenance costs, Other operational costs, Capital costs (consumption of fixed capital), Financial income and Financial expenses, Capital value, Net Investments, Subsidies in investments, Debt, Raw material volume (livestock and feed), Volume of sales, Employment (Number of persons employed their FTE national, number of unpaid labour and their FTE, and Number of hours worked by employees and unpaid labour) and number of enterprises pertaining to the EU aquaculture sector. Moreover, turnover and volume of sales need to be detailed by species. The segmentation set out in Table 9 of the Commission implementing decision (EU) 2016/1251. In addition, Member States were requested to provide the social data (i.e., demographic variables) for the aquaculture sector detailed in Table 6 of the Commission implementing decision (EU) 2016/1251.

Collection of data for freshwater species is not mandatory. However, if collected, Member States were invited to provide it during the data call.

The Data Collection Framework (DCF) and EU-MAP requires data quality assurance by Member States. Data checks were performed by the JRC through the comprehensive analysis of the data submitted and by experts attending the meeting to elaborate this report. As a consequence of these data checks data has been resubmitted by some of the countries after the deadline and during the EWG meeting. There have also been a few countries resubmitting data after the meeting due to discrepancies found during the meeting.

This was the eighth call for data on aquaculture. Although there is a continuous improvement in the overall data quality compared to the previous calls, there are still issues that have to be improved by the Member States. While the existence of thresholds to submit the aquaculture data on the Commission implementing decision (EU) 2016/1251 lead to reduced coverage compared to previous data calls under the DCF.

Under the DCF and EUMAP, the submission of marine aquaculture data is compulsory, while the submission of inland freshwater aquaculture data is voluntary. Therefore, landlocked countries (i.e., Austria, Czech Republic, Hungary, Luxembourg and Slovakia) are not obliged to report aquaculture data. On positive note, Czechia and Belgium submitted aquaculture data for the first time.

Lithuania only produces freshwater aquaculture, hence these MS did not carry out any data collection within the DCF and EUMAP frameworks. Moreover, aquaculture production in Belgium is very low. Cyprus and Poland did not provide data, already since 2015, and Estonia since 2016 because their (marine) aquaculture production is below the thresholds set in the EUMAP regulation.

France and Italy submitted data for 2019 and 2020 on most of their aquaculture production, but not for all of their production. For France, some species/segments are not included in the analysis in marine production (Sea bass & Sea bream Hatcheries & nurseries, Sea bass & Sea bream cages, Other marine fish on growing), in freshwater production (species reared in ponds as carp, pike, pike perch, roach, burbot, etc.), in shellfish production (mussel Raft, mussel Long line, Other shellfish Long line), and in aquatic plant (macro and micro algae including spirulina).

Spain did not submit the data for this data call in time. The data were received after this report was done and reviewed by STECF. Thus, 2019 and 2020 Spanish aquaculture data are missing from the report. But the 2019 and 2020 Spanish aquaculture data submitted after the deadline have been included in the excel file made public. Please be aware that these 2019 and 2020 Spanish aquaculture data have not been analysed or reviewed by the STECF.

The data coverage by country and variable is presented in the Table 9.5.1. The table is showing partially missing data by country and on the National total level.

Table 9.5.1: Coverage of the data provided during the data calls at National total level 2017-2020 (Y = submitted).

	2017	2018	2019	2020
Austria				
Belgium			Y	Y
Bulgaria	Y	Y	Y	Y
Croatia	Y	Y	Y	Y
Cyprus	Data not reported because of threshold			
Czechia	Y	Y	Y	Y
Denmark	Y	Y	Y	Y
Estonia	Data not reported because of thresholds			
Finland	Y	Y	Y	Y
France	Y	Y	Y	Y
Germany	Y	Y	Y	Y
Greece	Y	Y	Y	Y
Hungary	Y	Y		
Ireland	Y	Y	Y	Y
Italy	Y	Y	Y	Y
Latvia	Y	Y	Y	Y
Lithuania				
Luxembourg				
Poland	Data not reported because of thresholds for marine production			
Portugal	Y	Y	Y	Y
Romania	Y	Y	Y	Y
Slovakia	Y	Y	Y	
Slovenia	Y	Y	Y	Y
Spain	Y	Y		
Sweden	Y	Y	Y	Y

In chapter 2 of this report an EU overview is presented based on national total level data and estimated values covering the missing data for some countries or missing data from some years (as shown in the Table above). A brief description of the imputation methodology can be found in annex 2, and more detail in the 2018 aquaculture report.

In addition, the EU sector analysis in the chapter 3 is based on national aquaculture segment level data, which for each sector divided on production techniques and species produced. Missing data for some countries or missing data from some years can affect the results of the time series analysis. Thus, when reading this report, and in particular the EU overview in chapter 2 and the EU sector analysis in chapter 3, the numbers may not fully match.

Other relevant issues affecting quality and coverage of the data:

- Some Romanian data for 2019 were considered improbable by the EWG, and so not considered in the EU overview sections.
- Italy FTE data were also considered improbable by the EWG, and so not considered in the EU overview sections.
- Slovenia and the Netherlands only reported marine aquaculture production, not freshwater aquaculture.
- Some countries report inconsistent feed and livestock volumes and costs. So it was not possible to estimate the evolution of feed and livestock prices for all segments in all countries.
- These and other data issues are further detailed under the data issues in each national chapter.

In relation to the social data, data issues are detailed in chapter 7. The analysis for 2020 includes data provided by 18 countries under the 2022 EU-MAP data call – Belgium, Bulgaria, Croatia, Czech Republic, Germany, Greece, Denmark, Finland, France, Italy, Ireland, Latvia, Malta, Netherlands, Portugal, Romania, Slovenia, and Sweden.

Table 7.1 MS providing social data for 2020 aquaculture enterprises during 2022

Country	Gender	Age	Education	Nationality	Employment status
BEL	Y		Y		
BGR	Y	Y	Y	Y	Y
CZE	Y	Y	Y	Y	Y
DEU	Y	Y*	Y*	Y	Y
DNK	Y	Y	Y	Y	Y
ESP					
FIN	Y	Y	Y	Y	Y
FRA	Y				
GRC	Y	Y	Y	Y	Y
HRV	Y	Y	Y	Y	Y
IRL	Y	Y*	Y	Y	Y
ITA	Y	Y	Y	Y	Y
LVA	Y	Y	Y	Y	Y
MLT	Y	Y	Y	Y	Y
NLD	Y	Y	Y	Y	Y
PRT	Y	Y	Y	Y	Y
ROU	Y*		Y*		Y*
SVN	Y	Y	Y	Y	Y
SWE	Y	Y	Y	Y	Y

Source: MS data submissions under the 2022 Aquaculture data call and elaboration by the EWG.

*Data was in different format and had to be excluded from EU overview.

EWG 22-17 noticed the following issues:

- Romania reported 2020 social data for Gender, Education and Employment status, but all variables were in a format that is not consistent with the rest of the MS. The data was excluded from the EU overview and MS comparison. Instead, 2018 data from Romania was included in the report.
- Ireland provided age categories that are incompatible with the agreed age classes, this data was therefore excluded from the EU overview and MS comparison.
- Belgium did not report any data for Age, Nationality and Employment status; France did not report data for Age, Education, Nationality and Employment status.
- Germany reported data for Age and Education in a different format that could not be included in the report.

9.6 Annex VI: Quality and Coverage checking procedures on the data submitted under the 2021 aquaculture economic data call

Although the quality and coverage of the data reported under the Data Collection Framework (DCF) are a responsibility of the EU Member States, JRC (European Commission) has undertaken quality and coverage checking procedures on the data submitted, some carried out during the data uploading phase and some afterwards. The quality and coverage of the data has also been checked by national experts during the STECF EWG 22-17 meeting on the Economic Report of the EU aquaculture sector which took place hybrid (at Ispra, Italy and online), during the week 24 to 28 October 2022.

Aquaculture data submitted under the 2022 data call and used for the STECF report have been checked in four subsequent steps. This section provides a synthetic description of each of them. More information of the quality and coverage checking procedures undertaken on DCF aquaculture data are available in the JRC technical report available at:

http://datacollection.jrc.ec.europa.eu/

Step 1- Data checks before and during uploading procedure to the JRC/DCF database

Several data checks are already embedded in the excel templates which the Member States are required to use for uploading data on their national aquaculture sector. In specific cells of these files, the data entry is restricted to certain records (e.g. acceptable codes, value types and ranges).

Furthermore, during the data uploading procedure, a number of automatic syntactic checks are carried out on the data before it is accepted by the DCF database hosted by JRC. Syntactic checks are carried out without any specific knowledge of what the data contains or its meaning. They tell if the data is present or not and in the correct format. These checks automatically reject data that do not confirm to specific restrictions, such as ensuring textual data is validated against defined parameters lists. In addition, numeric data are checked to make sure they contain numbers and not strings. Member States receive immediate feedback when attempting to upload their data submissions.

Step 2 - Results of the data quality checks/analyses are assessed by JRC experts

Once the datasets with the aquaculture data are successfully uploaded by the Member States, JRC produces different analyses on the data submitted in order to facilitate the assessment of its quality and coverage. Some of these analyses are presented in interactive online dashboards created using the software Tableau. The same software is also used for analyses not specifically related to data quality, i.e. analyses on the structure and economic performance of the EU aquaculture sector and overviews of the uploading status of DCF aquaculture data.

All the analyses performed by JRC in Qlik are available in interactive online dashboards, which are refreshed every morning and are accessible (only after authentication), on the following link:

https://datacollection.jrc.ec.europa.eu/data-analysis/aqua

Besides developing the checks and analyses, JRC experts actively participate in the analysis of their results. All quality issues (e.g. inconsistencies, outliers and missing data) concerning the data submitted, identified through the analyses performed in Tableau or with manual checks are listed by JRC in excel files, one for each MS, including the most relevant information concerning the problems identified (e.g. description of the problem, structural and economic indicators affected and assessed impact on the analyses of the final STECF report), together with comments and actions recommended by JRC to solve the issues.

Step 3 – National correspondents receive a list of data transmission issues and may resubmit revised data

The excel files listing the data quality issues (and including JRC experts' comments and opinions on the action to undertake) are sent to the national correspondents (each national correspondent receives information only about the country he/she represents).

MS are requested to consider the potential anomalies listed in the excel file, amend and re-submit the data as necessary. They are also requested to go over the quality analyses performed in order to detect additional (if any) problems and add them to the list. Finally, they are asked to provide feedback (i.e. whether or not the problem has been resolved, which actions have been taken and possible comments) in designated columns of the excel file.

Step 4 – The quality and coverage of the data have been checked by the STECF Expert Working Groups

In addition to being analysed by JRC's experts, the quality and coverage of aquaculture data submitted under the DCF is also checked by national fisheries experts during the STECF EWG meeting. Data submitted under the 2022 aquaculture economic data call has been checked during the EWG meeting 22-17 which took place during the week 24-28 October 2022.

At the beginning of the meeting, the experts received the excel files with the list of data transmission issues of the MS assigned to them, which also included for each specific issue comments by JRC and feedback sent by the MS when available. MS have been contacted whenever an inconsistency was found and the expert attending the meeting could not solve it by resubmitting data. Furthermore, all experts have been given access to the tableau dashboards. This has allowed them to visualise changes in the data whenever the MS have uploaded revised data during the meeting or submitted new templates.

The experts reported in the Data Transmission Monitoring Tool the relevant data coverage and quality issues that remained unsolved by the end of the STECF EWG.

10 LIST OF ANNEXES

Electronic annexes are published on the meeting's web site on: http://stecf.jrc.ec.europa.eu/web/stecf/ewg2217

List of electronic annexes documents:

EWG-22-17 – Annex 1 - Data

The economic data used to compile this report are provided in an Excel file as data tables at the following address: https://stecf.jrc.ec.europa.eu/data-reports.

11 LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on: http://stecf.jrc.ec.europa.eu/web/stecf/ewg2217

List of background documents:

EWG-22-17 – Doc 1 - Declarations of invited and JRC experts (see also section 8 of this report – List of participants)

STECF

The Scientific, Technical and Economic Committee for Fisheries (STECF) has been established by the European Commission. The STECF is being consulted at regular intervals on matters pertaining to the conservation and management of living aquatic resources, including biological, economic, environmental, social and technical considerations.

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