European Commission

FRESHWATER AQUACULTURE IN THE EU

EUMOFA

European Market Observatory for Fisheries and Aquaculture Products

Maritime affairs and Fisheries

ANNEX 1

COUNTRY PROFILES

APRIL 2021

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Manuscript completed in April 2021.

Luxembourg: Publications Office of the European Union, 2021

PDF ISBN 978-92-76-38493-9 doi:10.2771/817228 KL-02-21-722-EN-N

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1. Methodology

The country profiles provided in this document have been developed in the context of the study on freshwater aquaculture in the EU. They summarise the available information on the freshwater aquaculture sector in the EU Member States (MS). 19 country profiles have been developed in MS where freshwater aquaculture is present (freshwater production is above 500 tonnes) and where a minimum level of statistical information is available (country profiles have not been developed for Slovakia, Slovenia, Estonia and Latvia due to lack of data).

These fiches do not provide an evidence-base analysis but they provide a compilation of information gathered from:

- Different statistical sources: mainly EUROSTAT, DCF/EU-MAP, statistics of the European Aquaculture Producers (FEAP). The latter source was used to provide additional and more recent information as 2019 data are available in the 2020 FEAP production report; and
- Studies available at EU and national levels. At EU level, main sources used are the Economic report of the EU aquaculture sector (STECF-18-19 and STECF-20-12) and the EU fish market (2020 Edition). At national levels, the multiannual plans for the development of aquaculture were studied[1].
- Feedbacks from national authorities and professional organisations consulted in the context of the study on freshwater aquaculture in the EU.

The country profiles have different levels of details depending on the data available. Each country profile includes the following sections:

- Market dimension of the freshwater aquaculture;
- Weight in terms of food supply, growth and jobs;
- Benefits of freshwater aquaculture in the EU;
- Assessment of the level of investment in the sector;
- Assessment of the level of innovation of the sector;
- Existence and weight of “quality schemes” in the sector;
- Assessment of the sector’s growth potential;
- Sources of information.

Country profiles have been sent to national authorities for validation. From the 19 country profiles, 3 have not been validated (no feedback from national authorities), which are: Austrian, Italian and Portuguese country profiles.

[1] The programmes studied concern the period 2014-2020. Member States are currently working on their new strategies for the development of aquaculture but these versions are not publicly available yet.

2. Country profiles

2.1 Austria

2.1.1 Market dimension of the freshwater aquaculture

Production

Between 2008 and 2018, aquaculture production has increased both in terms of volume and value (by respectively 95% and 108% according to EUROSTAT). The development over the last ten years shows an increase in production, while the value seems to be driven mostly by species with highest prices.

Table 1 – Freshwater aquaculture volume (tonnes) and value (1.000 EUR), 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	EVOL.
Volume	2.087	2.141	2.167	2.909	3.128	3.237	3.394	3.503	3.486	3.863	4.078	95%
Value	12.278	13.111	19.397	13.701	17.868	16.769	8.170	22.243	22.400	23.376	25.510	108%

Source: Eurostat

Production by species + relative weight in the production

- The top three species are rainbow trout (33% of production volume and 35% of its value), common carp (16% of the production volume and 9% of its value) and brook trout (13% of production volume and value).
- Except the production of rainbow trout which slightly increased between 2009 and 2018, the production of all the other species has significantly increased (the production of common carp and brook trout increased respectively by 88% and 109%).

Table 2 - Breakdown of the production volume by species between 2009 and 2018 – tonnes

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainbow trout	1.246	1.211	1.271		1.322	1.277	1.185	1.220	1.303	1.358
Common carp	345	348	596	590	619	573	618	607	620	647
Brook trout	244	256	393	426	455	431	426	477	551	511
North African catfish	81	85			289	335	347	369	396	461
Sea trout										421
Arctic char			24		37	178	187	178	201	299
Others	225	267	626		516	600	740	636	792	381
Total	**2.141**	**2.167**	**2.909**	**3.128**	**3.237**	**3.394**	**3.503**	**3.486**	**3.863**	**4.078**

Source: FAO

Description and the share of the different farming techniques

- Carps are reared in natural ponds.
- Trout production occurs in flow-through systems, raceways.

Table 3 - Breakdown of freshwater aquaculture by aquaculture methods in 2016 (last year for available data)

Aquaculture methods	Share
Ponds	38%
Tanks and Raceways	52%
RAS	10%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

Data are not available.

2.1.2 Weight in terms of food supply, growth and jobs

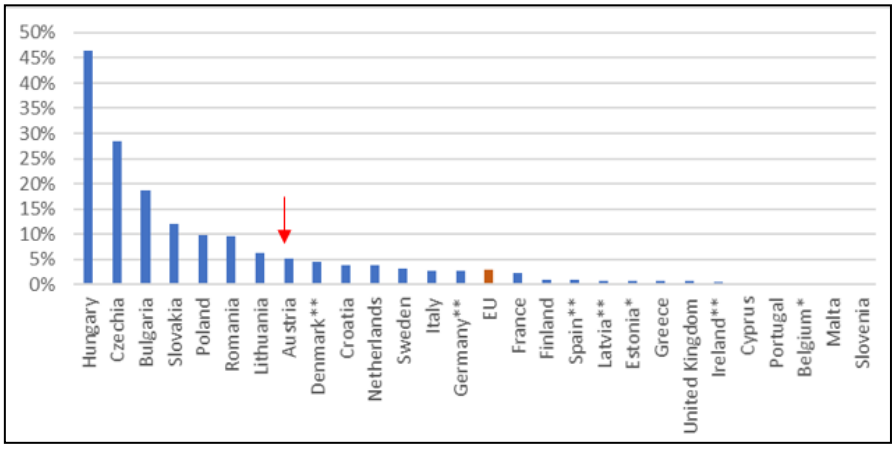
Production share of freshwater aquaculture in the total aquaculture production

Austria is a landlocked country producing only freshwater aquaculture products. In 2017, 3.863 tonnes were produced for a total value of circa EUR 23,5 million.

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Per capita consumption of fisheries and aquaculture products in Austria has increased in last years due to changed nutritional awareness and also the rich offer of ready-made meals in the fish sector: 13,12 kg/ capita/ year in 2018.
- Low contribution of freshwater aquaculture to Austrian consumption of fisheries and aquaculture products and overall low degree of self-sufficiency.

Figure 1 - % of freshwater aquaculture in apparent consumption[2]



Source: EUROSTAT and FAO for catches data

Socio-economic data: number of enterprises, employment, turnover

The following latest data available are for 2010:

- Carp production: Carp production disposes of about 2.700 ha of pond area, from which 20% (550 ha) are organic fish farms. There are 683 ponds in Austria.
- Trout production: There are 250 production facilities. Besides, there is a great number of small facilities for own consumption.

Aquaculture is dominated by family enterprises: 438 family farms in 2010, with annual average production of 7 tonnes.

[2] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply : The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

2.1.3 Benefits of freshwater aquaculture

Economic insights and benefits

No information is available on the economic situation or benefits of freshwater activities in Austria.
The only available information come from the Austrian strategy which reports that the value added from fisheries and aquaculture are related to processing and marketing (which are very stimulating for the rural area).

Social benefits

No information available on social benefits of aquaculture activities in Austria.

Environmental benefits

No data available.

2.1.4 Assessment of the level of investment in the sector

No information available.

2.1.5 Assessment of the level of innovation in the sector and main drivers

The Austrian strategy 2020 outlined that new technologies are still at an early stage and that recirculation systems require important investments and cost.

According to EUROSTAT data, 10% of Austrian production occurs in RSA.

2.1.6 Existence and weight of "quality schemes" in the sector

A significant share of organic pond carp farming is at organic standards (20% of area used for carp farming in 2010).

The label «Carp from the Waldviertel region" was identified: production standards for large-scale, high quality carp farming using natural methods.

2.1.7 Assessment of the sector's growth potential

The Austrian strategy to increase the national fish production has set the following goals to be achieved by 2020:

- Increase of trout production to reach 4.000 tonnes,
- Increase carp pond farming to reach 1.000 tonnes,
- Increase recirculation systems to 500 tonnes.

Which imply an annual increase of 2.400 tonnes per year until annual production reach 5.500 tonnes.

2.1.8 Sources of information

- Statistics: FAO, EUMAP, EUROSTAT.
- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- The EU fish market.
- The multiannual plan for the development of aquaculture in Austria (under revision).

2.2 Bulgaria

2.2.1 Market dimension of the freshwater aquaculture

Production

Data show a general increase of the production between 2008 and 2018 both in terms of volume and value.

Table 1 – Freshwater aquaculture volume (Tonnes) and value (1.000 EUR) 2008-2018, tonnes

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Evol.
Vol	6.656	7.100	7.222	6.345	6.062	6.292	6.883	7.539	9.069	9.796	9.232	39%
Val	16.272	18.815	18.976	16.389	16.649	15.515	13.201	19.996	23.499	22.158	28.205	73%

Source: Eurostat

Hatcheries and nurseries for both fry and human consumption:

- **For human consumption:** Production are recorded only between 2011 and 2013 on EUROSTAT (4,75 tonnes for EUR 1,94 million in 2013). Species concerned are Danube sturgeon, beluga, Siberian sturgeon and starry sturgeon.
- **For fry**: 39,7 million of eggs and 32,5 millions of juveniles were produced in 2018. The main species were trout (Rainbow trout: 24,7 million of juveniles and 15,5 million of eggs in 2018 and cyprinids (common carp: 3,2 millions of juveniles and 14,7 millions of eggs in 2018)

Table 2 – Production of eggs and juveniles volume, 2008-2018, million unit

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Evol
Eggs	91,8	44,0	43,0	39,2	15,0	31,9	30,3	28,6	20,9	23,8	39,7	-56%
Juveniles	22,9	16,0	21,2	21,1	15,9	20,4	22,4	23,2	23,0	31,2	32,5	41%

Source: Eurostat

Production by species + relative weight in the production

- The first species reared in Bulgaria is rainbow trout (52% of freshwater fish production volume and 66% of its value), with a significant increase between 2008 and 2018.
- The second most important species is common carp (26% of the production volume and 19% of its value).
- Other species are: other carp species, sturgeon species and others. North African catfish and Mississippi paddlefish are newly introduced species.

Table 3 – Breakdown of freshwater aquaculture production by species in Bulgaria – 2008 – 2018, tonnes

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainbow trout	2.805	2.700	2.909	2.312	2.651	2.858	2.865	2.322	3 092	2.956	4.793
Common carp	2.056	2.488	1.906	1.805	1.584	-	1.885	2.142	2.508	2.303	2.363
Bighead carp	1.084	914	1.294	1.049	970	2.227	1.273	1.576	1.483	1.663	963
Danube sturgeon	120	256	333	241	278	260	233	217	146	60	177
Goldfish	76	108	168	219	94				24	221	154
Wels(=Som) Catfish	91	128	87	99	87	165	97	109	201	112	154

Silver carp	51	54	29	73	78	69	125	227	227	70	113
North African catfish			10	2				286	541	342	108
Grass carp	190	176	168	182	171	296	208	264	262	150	104
Other	182	277	319	364	148	252	197	396	386	1.918	303
Total	**6.656**	**7.100**	**7.222**	**6.345**	**6.062**	**6.292**	**6.883**	**7.539**	**9.069**	**9.796**	**9.232**

Source: EUROSTAT

Description and share of the different farming techniques

In 2018, EUROSTAT recorded the most important share of production under the category "not specified".

The Bulgarian multiannual plan for the development of aquaculture distinguishes **4 farming techniques**:

- Extensive aquaculture in dams. Main species reared are silver carp and grass carp.
- Pools specially built for aquaculture (artificial ponds and channel pools). Species reared are catfish, sturgeons, carps (in artificial ponds), and trout (in channel pools). This is the main method used in Bulgaria. Farms' sizes vary from some ha to hundreds of ha.
- Cages: they are mainly located in medium and big dams. Carps, catfish, sturgeon and trout are reared in cages.
- RAS.

Rainbow trout is mainly reared in intensive production systems while common carp is mainly reared in semi-intensive systems.

Table 4 - Breakdown of freshwater aquaculture by aquaculture methods in 2018

Method	%
Tanks and raceways	3%
Recirculation systems	2%
Not specified	95%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

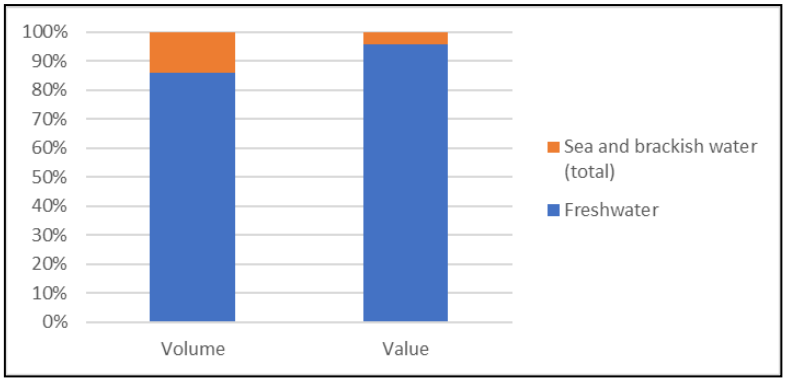
No information.

2.2.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in the total aquaculture production

In 2018, the Bulgarian freshwater aquaculture production is estimated at 9.232 tonnes for over EUR 28,2 Million which represented 86% of the Bulgarian aquaculture production volume and 96% of its value.

Figure 1 – Breakdown of aquaculture in Bulgaria by aquaculture environment in 2018

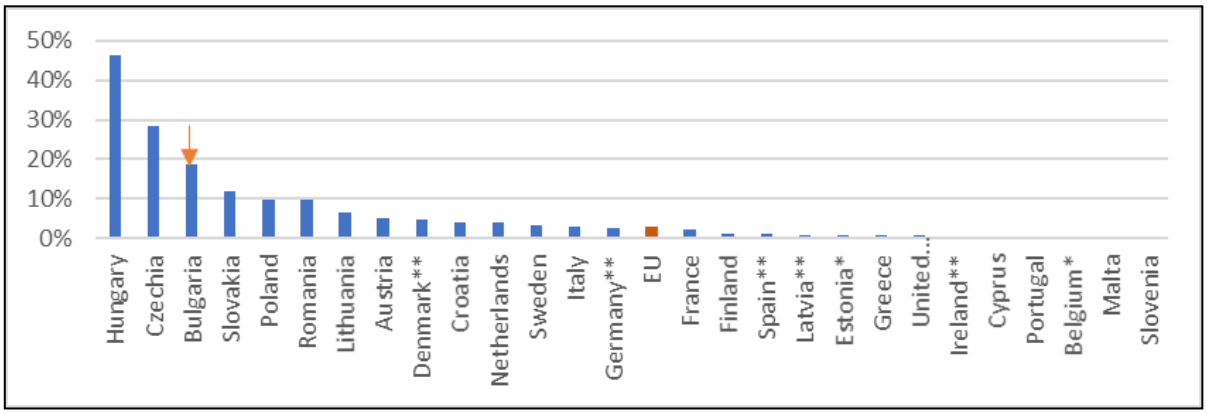


Source: EUROSTAT

Share of freshwater aquaculture fish in fish consumption

- Apparent consumption of fisheries and aquaculture products: 7 Kg / capita / year in 2018. It is one of the EU country with the lower consumption of fish (source: EUMOFA).
- Carp is the most consumed fish in the country (33% of fish consumption) followed by rainbow trout (13%) (source: national plan for aquaculture).
- Total fish consumption in Bulgaria accounted for 49.227 tonnes in 2018. 9.232 tonnes were produced in freshwater accounting for 19% of the total national consumption.

Figure 2 - % of freshwater aquaculture in apparent consumption[3]



Source: EUROSTAT

Socio-economic data: number of enterprises, employment, turnover

- The number of enterprises in 2018 with less than five employees and more than 10 employees has increased by 8% and 30% respectively compared with 2015, while the number of enterprises with 6-10 employees decreased by 16% compared to 2015.
- The number of employees in the Bulgarian freshwater aquaculture activities has increased between 2015 and 2017, from 879 to 1140 and has decreased between 2018 and 2019, from 1140 to 973.

Table 6 – Number of enterprises, employees and turnover of freshwater aquaculture activities

Variables	2015	2016	2017	2018
Number of enterprises <=5 employees	499	517	510	538
Number of enterprises >10 employees	12	9	15	10
Number of enterprises 6-10 employees	18	12	18	26
Number of enterprises	529	538	543	574
FTE	706	775	952	786
Total employees	**879**	**887**	**1140**	**973**

National statistics provided by national authority (2015-2016) and EU-MAP data (2017-2018)

2.2.3 Benefits of freshwater aquaculture

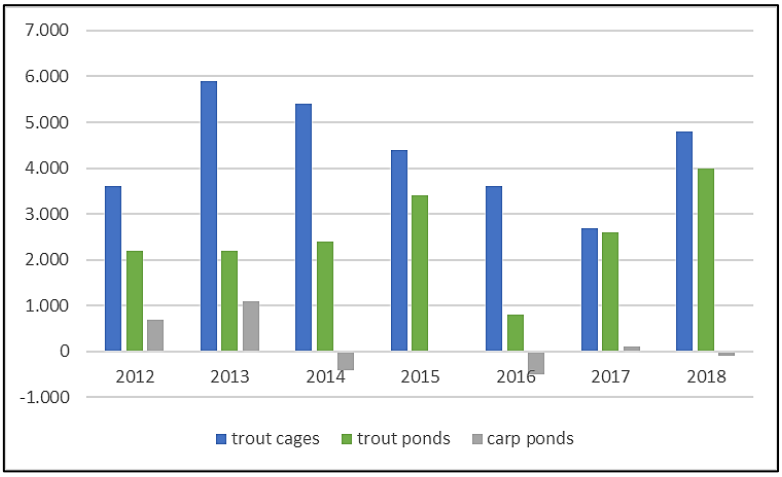
Economic insights and benefits

- Carp ponds is the biggest segment in terms of the number of enterprises (the segment consists of 414 enterprises in 2018). It represented 66% of all the active enterprises in Bulgaria and it employed 49% of the FTE in the sector. Enterprises of this segment are characterized as extensive and their production and income were small in comparison to the other freshwater aquaculture segments. The net income in 2018 was EUR 8,2 million (it increased by 16% compared to 2017).

[3] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

- Trout cages is the most important segment in terms of turnover. The value of the total income in 2018 increased by 38% compared to 2017, and by 45% compared to the average of the period 2012-2017.
- The segment of trout ponds consisted of 89 active enterprises in 2018. The value of total income in 2018 was EUR 12,1 million, which is 46% more than in 2017, and more than 100% compared to the average for the period 2012-2017.

Figure 3 - Net profit of freshwater aquaculture activities by segment from 2012 to 2018 (1.000 EUR)

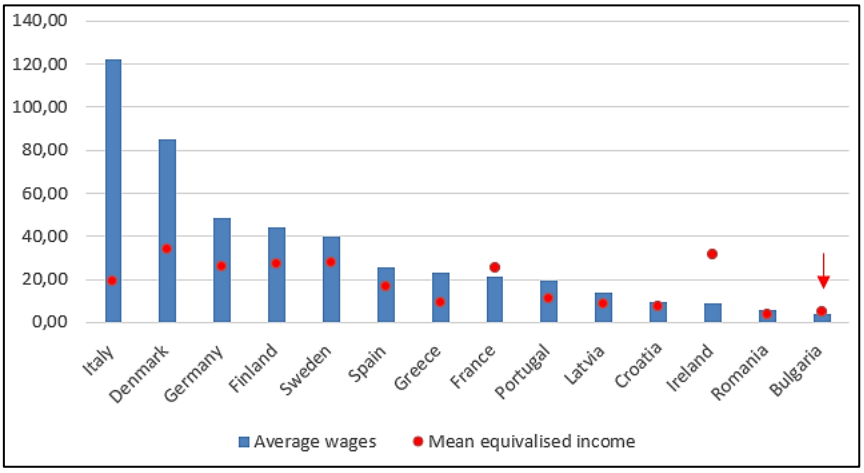


Source : DCF/EU-MAP data

Social benefits

- Average wages from aquaculture was below the mean equivalized net income[4] in 2018. Bulgaria has the lowest average wage from freshwater aquaculture activities in the EU. This is related to the predominance of extensive aquaculture production in Bulgaria.

Figure 3- Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (1.000 EUR)



Source: EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalized net income

Environmental benefits

- Carps contribute to the biological control of water quality.
- Black carps are used to fight the invasive zebra mussel.

[4] Mean equivalised net income is the mean of total income of all households, after tax and other deductions, which is available for spending, divided by the number of household members converted into equivalised adults.

Sturgeon aquaculture permit to respond to an important demand without exploiting natural resources of sturgeons, threatened by extinction.

2.2.4 Assessment of the level of investment in the sector

According to the Bulgarian national authority, in the last years, the EMFF has supported building several new farms, including RAS and modernizing the existing farms, as well as the production of new species and species with high value.

2.2.5 Assessment of the level of innovation in the sector and main drivers

- Lack of interactions between research sector and the aquaculture sector.
- Introduction of new farmed species: North African catfish, Mississippi paddlefish, Siberian sturgeons.
- The part of RAS in the freshwater production was 1% in 2018.

2.2.6 Existence and weight of "quality schemes" in the sector

No quality scheme identified.

2.2.7 Assessment of the sector's growth potential

Main drivers and opportunities

- Increase of demand for fish in the Bulgarian market.
- High prices of caviar and stable demand in international markets (even though no production is recorded since 2013).
- Development of the production of new species (Mississippi paddlefish, Siberian sturgeon and north African catfish).
- Development of RAS with renewable energy (RAS need few water).
- Potential for improving the freshwater species processing and marketing.
- Potential for developing direct sales of aquaculture products.
- Potential for developing organic production.
- Positive economic performance of the trout segment (profitable and sustainable) and increasing interest in trout farming.

Challenges and gaps

- Zebra mussel invasion with consequences on farmed fish breeding.
- Limits of dams production: difficulties to catch the farmed fish, conflict with other usage of the dams (tourism, electricity production mainly), and water pollution linked to the several activities taking place in the dams.
- Lack of market structures (like producers organizations) and promotion of Bulgarian aquaculture product in national and international markets.
- Risks related to drought.
- Important prices competition in EU market for farmed fish.

2.2.8 Sources of information

- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- National strategic plan for aquaculture 2014.
- EUMOFA, "The EU fish market, 2019 edition".

- National authority survey.

2.3 Croatia

2.3.1 Market dimension of the EU freshwater aquaculture

Production

Croatia produced almost 3.000 tonnes of freshwater fish in 2018 for a total value of EUR 6,7 million. Production has experienced a significant decrease since 2008.

Table 1 – Freshwater aquaculture volume (Tonnes) and value (1.000 EUR), 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Evol.
Volume	5.175	5.066	5.058	6.283	4.214	3.235	3.808	4.832	4.034	3.272	2.899	-44%
Value	-	10.125	11.770	12.140	7.904	6.587	6.854	8.322	7.869	6.966	6.741	-34%

Source: Eurostat

Juveniles' production concerns mainly common carp, which has decreased significantly between 2010 and 2018.

Table 2 – Production juveniles volume, 2010-2018, million unit

	2010	2011	2012	2013	2014	2015	2016	2017	2018	Evol. 2018/10
Volume	82	63	106	114	130	105	114	113	20	-76%

Source: EUROSTAT

Production by species + relative weight in the production

- The first species reared in Croatia is common carp. In 2018, it represented 68% of the production volume and 67% in value. The common carp production has increased by 16% between 2008 and 2018.
- Rainbow trout is the second most important species. In 2018, it represented 12% of the production volume and 17% in value. It was the first species reared in 2008 (2.689 tonnes) but its production has significantly decreased between 2011 and 2013 and remained at low level since (maximum of 666 tonnes in 2015). According to the national plan for aquaculture the decrease of production is partly due to droughts in 2010 and 2011: the droughts would have provoked a lack of available food in the habitats of wild predators and their presence in trout farms have increased with significant losses in production.
- Most of rainbow trout and common carp farms rear other species in addition to the 2 main species, in smaller quantities, mainly other carp species (bighead carp and grass carp are the most important produced species (respectively 10% and 5%)).

Table 3 – Breakdown of freshwater aquaculture production by species – 2008 – 2018, tonnes

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Common carp	1.689	2.058	1.816	2.891	2.484	2.100	2.284	3.401	2.698	2.039	1.959
Rainbow trout	2.689	1.982	2.482	2.481	1.000	345	369	666	454	367	336
Bighead carp	381	492	309	522	296	303	519	295	472	477	301
Grass carp	134	196	231	158	202	209	288	132	134	169	141
Other	282	338	220	231	233	278	348	338	275	221	163
Total	5.175	5.066	5.058	6.283	4.214	3.235	3.808	4.832	4.034	3.272	2.899

Source: EUROSTAT

Eurostat (table above) and FEAP data (table below) are overall consistent, although some discrepancies are observed (portion rainbow trout). New species farming (catfish and Sturgeon) has developed since 2016.

Table 3 bis – Breakdown of freshwater aquaculture production by species – 2009 – 2019, tonnes

SPECIES	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Common Carp	2.058	1.816	2.891	2 484	2.100	2.284	3.401	2.698	2.039	1.959	2.500
Bighead carp						519	295	472	477	301	300
Portion Rainbow Trout	2.000	2.095	2.358	1.232	350	378	679	467	395	370	300
Grass carp	196	231	158	202	200	288	132	134	169	141	200
Silver Carp	100	70	95	384	350	194	174	135	73	36	100
Other Species*						31	22	17	22	15	55
European Wels Catfish								40	40	23	50
African Catfish										20	20
Sturgeons nei										7	5
Total	**4.354**	**4.212**	**5.502**	**4.302**	**3.000**	**3.694**	**4.703**	**3.963**	**3.215**	**2.872**	**3.530**

*Other species include Tench, Perch, Pike-Perch, Roach ... *Source: FEAP production report 2020*

Description and the share of the different farming techniques

- The main farming technique is ponds. All the carps are reared in ponds.
- Tanks and raceways technique corresponds to the production of rainbow trout.
- North African Catfish is reared in RAS (20 tonnes in 2018).

Table 4 - Breakdown of freshwater aquaculture by aquaculture methods in 2018

Method	%
Ponds	86%
Tanks and raceways	13%
Recirculation systems	1%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

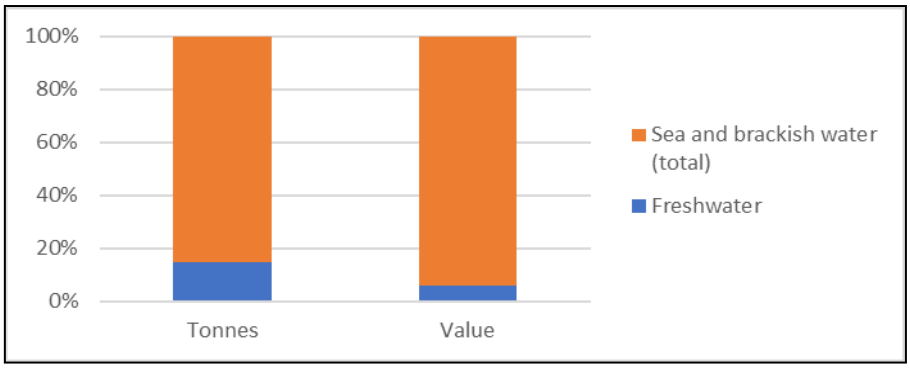
Mainly food markets. Some small family farms produce fish for sport fishery and catering as part of rural tourism.

2.3.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in the total aquaculture production

In 2018, the Croatian freshwater aquaculture production is estimated at 2.899 tonnes for over EUR 6,7 Million which represented 15% of the Croatian aquaculture production volume and 6% of its value.

Figure 1 – Breakdown of aquaculture in Croatia by aquaculture environment in 2018

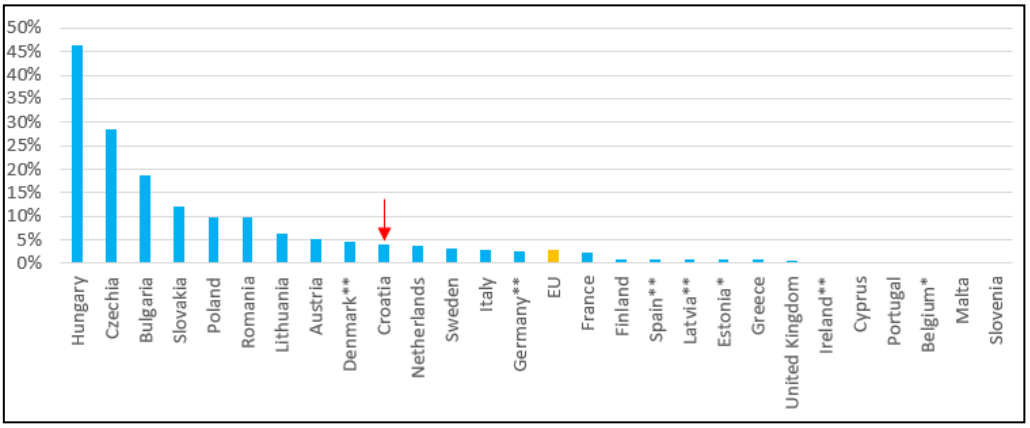


Source: EUROSTAT

Share of freshwater aquaculture fish in fish consumption

- Apparent consumption of fisheries and aquaculture products: 19,19 Kg / capita / year in 2018.
- Total fish consumption in Croatia accounted for 66.988 t in 2017. 3.272 tonnes were produced in freshwater in Croatia accounting for 5% of the total national consumption.
- According to STECF "the freshwater aquaculture production is mostly sold at the national market, and only a small fraction is exported to the EU market.

Figure 2 - % of freshwater aquaculture in apparent consumption[5]



Source: EUROSTAT

Socio-economic data: number of enterprises, employment, turnover

- In 2018, the freshwater sector in Croatia employed 345 persons in 38 enterprises and generated circa EUR 28,9 million. 87% of enterprises are small enterprises (10 employees or less).
- There is a significant decrease in employment in Croatia. This is explained by the STECF report by a strong trend of diversification to processing, fisheries, marine aquaculture or other agriculture activities. The STECF report expects that this variation in the number of employees will continue.
- Most part of carp farms have their own production of eggs and larvae and other species are reared with carps. They may also have an agriculture production for fish feed.

Table 6 – Number of enterprises, employees and turnover of freshwater aquaculture activities

Variables	2012	2013	2014	2015	2016	2017	2018
Number of enterprises <=5 employees	23	19	20	26	28	26	26
Number of enterprises >10 employees	9	12	9	10	9	10	7

[5] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

Number of enterprises 6-10 employees	9	5	4	7	6	4	5
Number of enterprises	**41**	**36**	**33**	**43**	**43**	**40**	**38**
FTE	618	625	833	526	559	361	296
Total employees	**838**	**735**	**1126**	**989**	**998**	**421**	**345**

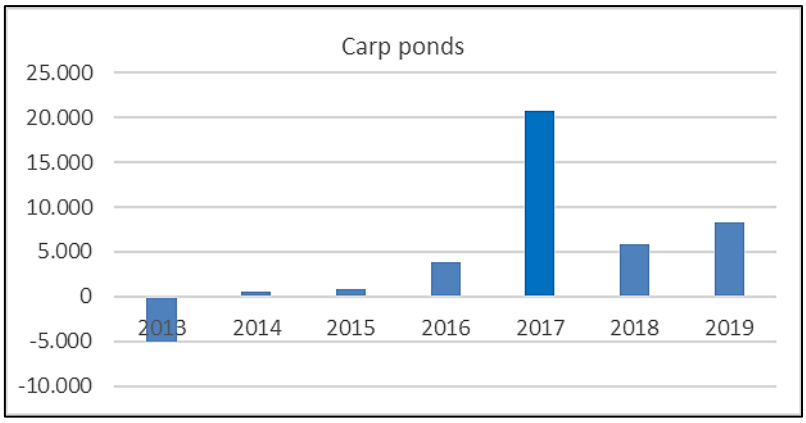
Source: DCF/EU-MAP data

2.3.3 Benefits of freshwater aquaculture

Economic insights and benefits

From 2017 to 2019, volume of carp production declined from 2. 039 tonnes to 2.037 tonnes. Although carp production in Croatia has a long tradition, currently is in a phase of stagnation and struggling to diversify activities according to the STECF report. However, there is an improvement in economic performance which is likely to be related to investments in the sector, particularly on vertical integration (recently carp farms encompasses the whole system of farming, from spawns and juveniles to market size fish).

Figure 3 - Net profit of freshwater aquaculture activities by segment from 2013 to 2019 (1.000 EUR)



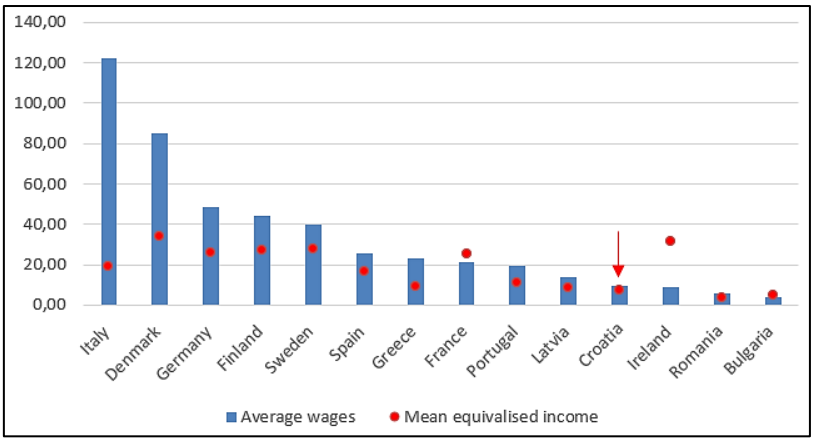
Source: DCF/EU-MAP data

Social benefits

- The recent positive trend in economic performance (see above) was correlated with an increase of the average wages in 2017 and 2018 (according to EU-MAP data). The Croatian average wage from freshwater aquaculture was slightly above the Croatian mean equivalised net income[6] in 2018 (figure below).
- Most part of freshwater fish farms are located in rural areas (hill and mountains for trout farms and lowlands for common carps) and contribute to rural development.

Figure 4- Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (1.000 EUR)

[6] Mean equivalised net income is the mean of total income of all households, after tax and other deductions, which is available for spending, divided by the number of household members converted into equivalised adults.



Source: DCF/EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalized net income

Environmental benefits

Croatian carp farms contribute to the protection of biodiversity, especially bird diversity, and are included in the Natura 2000 network.

2.3.4 Assessment of the level of investment in the sector

Bank loans are the main way of funding for small businesses and they lack of financial funding.

2.3.5 Assessment of the level of innovation in the sector and main drivers

According to EUROSTAT, the share of RAS in the freshwater production is 0,7% in 2018 which correspond to 20 tonnes of North African catfish.

2.3.6 Existence and weight of "quality schemes" in the sector

Less than half of freshwater aquaculture companies have Certification of business processes, HACCP. Four large freshwater aquaculture companies have certificates for product certification, like: CROATIAN CREATION, CROATIAN QUALITY, LIVING HEALTHY AND FISH OF CROATIA. Only one freshwater aquaculture company has LIVE HEALTH breeder certificate, only for some products (Common carp chips, Common carp offal, Common carp head-tail, smoked Common carp fillet, cleaned Common carp, Common carp fillet, Common carp steak, catfish steak, whole Common carp, pike steak).

2.3.7 Assessment of the sector's growth potential

Main drivers and opportunities

- Development of new production technology, including RAS, that could be a response to the lack of available area (source: STECF).
- Potential of development of organic certification and labialization for carp produced in Natura 2000 network.
- Potential of development of tourism activities beside aquaculture production (source: national plan).

Challenges and gaps

- Freshwater aquaculture development is restricted by available area.
- Lack of organization of the sector (lack of OP).
- Lack of communication with consumer (lack of branding and certification).
- Lack of funding for small businesses.

- Climatic conditions (lack of water in specific part of the year) and wild predators.
- Lack of processing facilities.
- Dependence on the imports of juvenile fish, food and equipment.
- Competitiveness with cheaper, lower quality products imported from third countries (*source: national plan)*.

2.3.8 Sources of information

- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- National strategic plan for aquaculture, 2014.
- EUMOFA, "The EU fish market, 2019 edition".
- National authority survey.

2.4 Czechia

2.4.1 Market dimension of the EU freshwater aquaculture

Production

During the period between 2008 and 2017, while Czechia has maintained its production at the same level, around 20 thousand tonnes, the production value has increased by 37% according to EUROSTAT data, which indicates a significant increase of prices.

Table 1 – Freshwater aquaculture volume (Tonnes) and value (1.000 EUR), 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Evol. 18/08
Volume	20.395	20.071	20.420	21.010	20.763	19.360	20.163	20.200	20.950	21.685	21.751	7%
Value	41.538	39.267	37.108	39.865	36.778	35.267	42.451	35.049	46.970	56.879	48.595	17%

Source: Eurostat

In addition of this production, there is an activity for producing eggs and juveniles, which concerns mainly common carp, with a significant decrease of egg production (the juvenile production has remained stable between 2009 and 2017).

Table 2 – Production of eggs and juveniles volume, 2009-2017, million unit

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Evol. 2017/09
Eggs		620	124	127	47	47	27	23	26	26	-96%
Juveniles			396	405	254	337	368	426	457	394	-1%

Source: EUROSTAT

Production by species + relative weight in the production

- According to EUROSTAT data, the common carp farmed in extensive pond aquaculture is the dominant species. With circa 18.500 tonnes, it represented 85% of the total aquaculture production volume in 2018 and 80% of its value. The second most important species is grass carp with 3% of the production volume, followed by rainbow trout, which represented 2% of production volume and 5% of its value. According to FAO, brook trout, brown trout and grayling are also cultured, particularly for the purpose of stocking angling ground (source: FAO).
- Particularly, the production of common carp has remained stable. The production of rainbow trout has increased by 28% between 2008 and 2018.

Table 2 - Breakdown of aquaculture production by species in Czechia – tonnes – 2008-2018

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Common carp	17.507	17.258	17.746	18.198	17.972	16.809	17.833	17.860	18.354	18.460	18.429
Miscellaneous fish	785	855	624	831	857	812	691	749	705	1.034	982
Grass carp	394	409	488	412	456	384	337	445	490	567	515
Rainbow trout	614	526	476	580	380	439	421	368	364	507	784
Bighead carp	394		318	354	379	355	289	239	244	492	341
Brook trout	201	145	262	235	363	237	267	243	301	268	322
Tench	284	252	215	180	166	158	152	152	157	158	147
Others	216	626	291	220	190	166	173	144	336	199	231

Total	20.395	20.071	20.420	21.010	20.763	19.360	20.163	20.200	20.950	21.685	21.751

Source: EUROSTAT

Eurostat data (table 2 above) and feap data (table 2 bis) are relatively consistent, in particular for the main species (common carp, grass carp and rainbow trout). Freshwater fish production appears steady from 2016, circa 21.000 – 22.000 tonnes.

Table 2 bis - Breakdown of aquaculture production by species in Czechia – tonnes – 2009-2019

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Common Carp	17.258	17.746	18.198	17.972	16.809	17.833	17.860	18.354	18.460	18.430	17.945
Other Species*						0	152	145	1.243	1.223	1.099
Portion RainbowTrout	526	476	580	388	439	426	368	367	509	784	649
Grass carp	409	488	412	456	384	337	445	490	567	515	536
Bighead carp	461	461	460	379	358	309	264	402	473	393	389
Silver Carp	601	583	546	162	150	133	113	172	203	168	167
African Catfish									130	142	125
EuropeanWels Catfish	58	47	52	50	61	54	63	74	100	91	76
Sturgeon nei								2	2		
Total	19.313	19.801	20.248	19.407	18.201	19.092	19.265	20.006	21.687	21.746	20.986

Source: FEAP production report 2020

Description and the share of the different farming techniques

- Production in recirculation systems is negligible and concerns rainbow trout production.
- Carps are reared in extensive ponds. Carps (grass carp and bighead carp), predatory species (pike and perch) and traditional supplementary fish (tench and coregonids) are produced in ponds.

Table 3 - Breakdown of freshwater aquaculture by aquaculture methods in 2017

Aquaculture method	Percentage
Ponds	96,9%
Recirculation systems	0,1%
Tanks and raceways	3%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

FAO reports that a share of salmonid production (particularly brook trout, brown trout and grayling) is used for the purpose of stocking angling ground.

According to national authorities survey, 40% of freshwater farmed fish is sold alive, 11,3% is to be processed and 48,7% is exported in 2019.

2.4.2 Weight in terms of food supply, growth and jobs

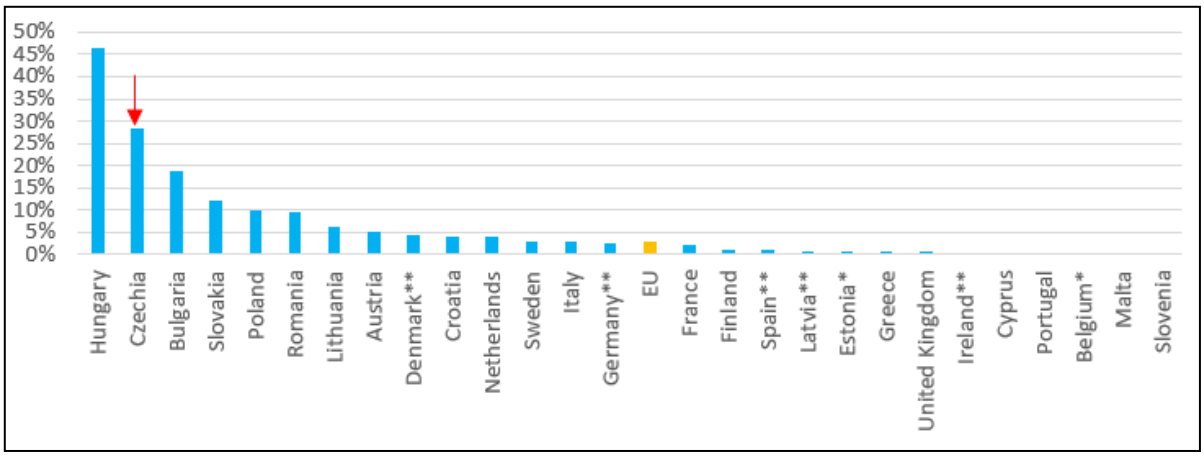
Production share of freshwater aquaculture in the total aquaculture production

Being a landlocked country only freshwater species are raised in Czechia. In 2017, 21.751 tonnes were produced for a total value of circa EUR 49 million.

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

According to EUMOFA, apparent consumption of fisheries and aquaculture products: 5,6 Kg / capita / year (ranks last MS at EU level) in 2018.
The share of freshwater aquaculture in apparent consumption is 29%.
The most consumed freshwater fish produced in the Czech Republic is common carp.

Figure 2 - % of freshwater aquaculture in apparent consumption[7]



Source: EUROSTAT

Socio-economic data: number of enterprises, employment, turnover

EUMAP data are not available for Czechia (reporting freshwater production data is not mandatory).

According to National Authorities survey, 650 aquaculture production companies are registered in Czechia, employing more than a thousand persons. About 70 firms are major producers (over 5 tons of fish per year), the others are small farmers. Most of major producers are part of the Fishing Association of the Czech Republic, which manages about 85% of the areas used for fish farming in Czechia.

Table 4- Number of employees

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total employees	1.013	1.032	1.248	1.203	1.349	1.242	1.222	1.239	1.229	1.157	1.148

Source: National Authorities survey

2.4.3 Benefits of freshwater aquaculture

Economic insights and benefits

- Seasonal employment demand related to the seasonal demand for carp: peek of demand in Christmas (traditional Christmas Eve dish) and very low sale in the rest of the year.
- Loss of income for pond production related to restrictions for environment purposes (loss of production), fish predators (the great cormorant8 and the European otter) and to siltation and drought.

Social benefits

[7] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply : The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.
[8] Production losses related to great Cormorant estimated to: 1500 – 2000 tonnes / year (indirect losses are not estimated) and to 1500 tonnes / year for the European otter.

- Pond farming is a traditional form of aquaculture in Czechia and where there is specialized knowledge. Fish pond farming has deep historical roots and is part of national heritage.
- Ponds also have an important social, cultural and recreational function and this contributes to the sustainable development of living conditions, not only in relevant region, but also in adjacent regions.

Environmental benefits

According to the multiannual plan for the development of aquaculture of Czechia and the National Authorities survey, there are positive externalities of aquaculture production in ponds, including:

- Water retention and flood prevention,
- Protection against fires,
- Preservation and protection of biodiversity,
- Cleaning of surface water,
- Improvement in humidity balance in nature,
- Aesthetic function.

The FAO indicated that there are 52.000 ha available for fish farming in Czechia, of which 41.000 ha are used for fish production.

2.4.4 Assessment of the level of investment in the sector

According to the multiannual plan for the development of aquaculture, the investment in the sector seems limited to the modernization of existing production sites. It also outlined the low economic return on investment.

According to National Authorities survey, Support from EMFF is a significant driver of aquaculture investments. The greatest interest of applicants / beneficiaries is in productive aquaculture investments (fish farming equipment and fish farming facilities).

2.4.5 Assessment of the level of innovation in the sector and main drivers

According to the multiannual plan for the development of aquaculture in Czechia, current technologies are already at a very high level, but with relatively high initial costs of the investment.

For the 2014-2020 period, EMFF has supported developing process and product innovations, according to the National Authorities survey. Product/market innovation are developing. This development is driven by the need to gain added value from the products and make the products more attractive for the final consumers.

2.4.6 Existence and weight of "quality schemes" in the sector

We identified the following products under quality schemes, both for carp:

- The Protected Geographical Indication (PGI): Třeboňský kapr
- The Protected Designation of Origin (PDO): Pohořelický kapr

2.4.7 Assessment of the sector's growth potential

The multiannual plan for aquaculture indicates that the realistic prediction of annual **development for 2024: +0.75% per year**.

Development strategies according to multiannual plan for the development of aquaculture are:

- Building new capacities for intensive recirculation systems (mainly for salmonids and other new species).
- Supporting the existing fish production in order to produce a wider range of high-quality fish species (salmonids, catfish, pike-perch, perch or eel), especially for the domestic market.
- Expanding the possibilities for fish farming in freshwater aquaculture, introducing new species whose aquaculture production is low or non-existent and whose market prospects are good.

- Introducing energy saving and environmentally friendly technologies.

Main drivers and opportunities:

- EMFF support - Financial support to non-productive functions of ponds
- Competitiveness
- The support of processing plants
- Higher level of fish consumption
- Diversification of aquaculture activities

Challenges and gaps

- Reducing costs per unit of production is essential
- Reducing the negative impact of aquaculture activities
- Low diversity of species reared
- Low production of valuable species (such as salmonids or predatory fish)
- Impact of fish eating predators and eutrophication
- Climate change
- Seasonal demand (low demand during the year with a peek at Christmas time)

2.4.8 Sources of information

- Quo vadis pond aquaculture? An example story of the current state. Czech Fish Farmers' Association. 2020.
- National aquaculture sector overview: Czech Republic: http://www.fao.org/fishery/countrysector/naso_czechrepublic/en
- Multiannual plan for the development of aquaculture in Czechia.
- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- EUMOFA, "The EU fish market, 2019 edition".
- National authority survey.

2.5 Denmark

2.5.1 Market dimension of the EU freshwater aquaculture

Production

Danish production of freshwater aquaculture products reached 25.120 tonnes for human consumption in 2018, fir a value of over 49 million EUR. There is also a significant activity of fry production which exceeded 6.000 tonnes in 2018 for almost 19 million EUR.

Table 1 – Freshwater aquaculture volume (tonnes) and value (1.000 EUR), 2008-2018

Source	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume (Tonnes)											
National stat – human consump°	25.120	22.291	17.739	19.048	19.024	19.678	19.529	20.405	19.058	19.010	25.120
National stat - Fry	6.192	6.534	9.827	8.912	12.573	10.774	13.544	12.419	14.293	13.721	6.192
Total national	31.312	28.825	27.566	27.960	31.597	30.452	33.073	32.824	33.351	32.731	31.312
Value (1.000 EUR)											
National stat – human consump°	49.219	38.598	33.016	40.008	34.889	37.983	38.206	38.833	37.612	40.320	49.219
National stat - Fry	18.783	20.208	28.561	26.536	28.876	30.948	37.020	32.851	40.652	36.461	18.783
Total national*	68.002	58.807	61.577	66.544	63.765	68.931	75.226	71.683	78.264	76.781	68.002

Source: National statistics

National stat 1: fish for consumption. National stat 2: Fry, fingerlings and other production. (*) Production value has been estimated based on the exchange rate on 01/04/2020.

Table 1 bis – Freshwater aquaculture production by species in volume (Tonnes), 2009-2019

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Portion Rainbow Trout	26.374	26.538	26.538	21.895	27.591	26.925	26.925	21.022	19.404	25.086	25.086
Large Rainbow Trout	10.139	9.832	10.854	10.491	10.506	11.115	11.115	13.500	13.500	11.599	11.599
European eel	1.699	1.532	1.154	1.061	1.079	789	789	750	750	*	*
Total	**38.212**	**37.902**	**38.546**	**33.447**	**39.176**	**38.829**	**38.829**	**35.272**	**33.654**	**36.685**	**36.685**

Source: FEAP production report 2020.(*) confidential data (less than 5 farms)

FEAP's production statistics provide yearly volumes slightly superior to those of Eurostat, due to the inclusion of trout reared at sea by FEAP.

Production by species + relative weight in the production

- The main species farmed in Denmark is from far rainbow trout (including marine species) which represented 98% of the volume.
- The production of farmed European eel decreased by 57% between 2008 and 2017, due to the closure of half of the farms and to the restriction on the harvesting of glass eels. Volumes are not disclosed since 2017 due to confidentiality issues.
- The production of other freshwater species (pike-perch, brook trout and chars) has significantly decreased and is no more monitored since 2018.

Description and the share of the different farming techniques

- Rainbow trout has been farmed in Danish freshwater ponds for more than 100 years.
- Recirculation systems, initially used for eel production are nowadays suitable to other species including trout.

Table 2 - Breakdown of freshwater aquaculture volume by aquaculture methods in 2018

Aquaculture method	% Vol
Ponds	21%
Recirculation systems	66%
Tanks and raceways	13%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

According to FAO:

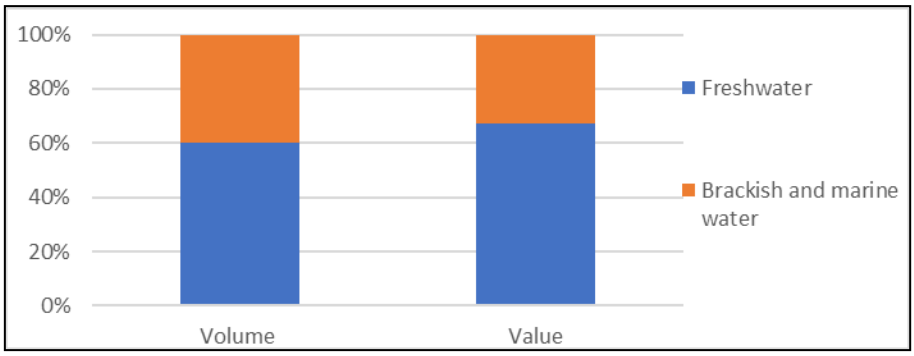
- The greater part of the portion sized rainbow trout (250-300 grams weight) production is mainly exported to Germany for processing.
- Fish juveniles are also produced in specialized hatcheries and sold for further on-growing in freshwater ponds and mariculture units, or for restocking purposes.
- A small but growing amount is sold for "put-and-take" angling.

2.5.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in total aquaculture production

In 2018, freshwater aquaculture production represented 60% of the Danish production volume and 67% of its value.

Figure 1 – Breakdown of aquaculture in Denmark by aquaculture environment in 2018

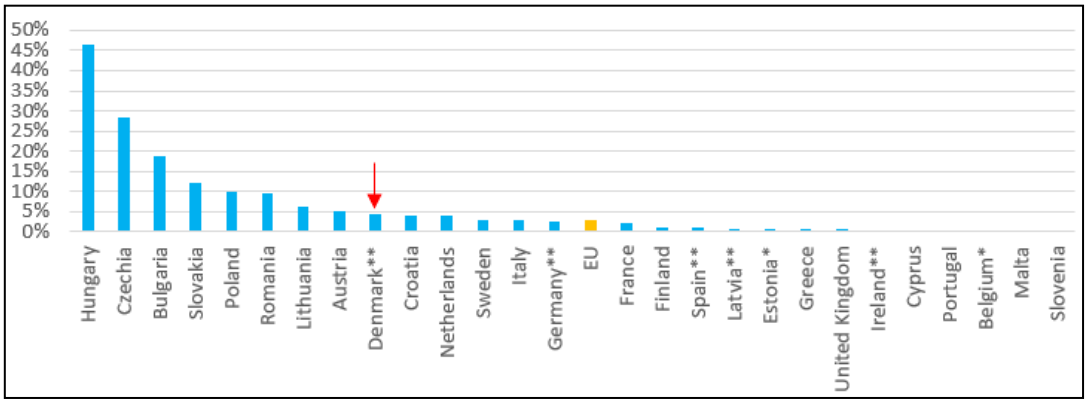


Source: EUROSTAT

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Apparent consumption of fisheries and aquaculture products: 39,835 Kg / capita / year (ranks 4th at EU level) in 2018.
- In 2018, freshwater aquaculture production represented almost 5% of the Danish apparent consumption of fisheries and aquaculture production.

Figure 2 - % of freshwater aquaculture in apparent consumption[9]



*Source: EUROSTAT / *) FAO / **) National statistics*

Socio-economic data: number of enterprises, employment, turnover

National statistics provided below show the number of farms involved in freshwater aquaculture production. 173 farms were involved in freshwater aquaculture activities in 2018.

Table 7- Number of enterprises involved in freshwater aquaculture by segment from 2009 to 2018

Segments	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Traditional trout farms	189	177	162	157	157	145	138	131	127	123
Trout farms with re-circulation, type 1	14	19	17	16	17	17	17	18	17	17
Trout farms with re-circulation, type 3	11	13	13	13	16	15	16	17	16	16
Eel farms	9	8	8	8	7	5	5	5	*	*
Other farms	8	6	6	7	8	7	10	9	14	17
Total	**231**	**223**	**206**	**201**	**205**	**189**	**186**	**180**	**174**	**173**

(*)Eel farms are aggregated in other farms due to confidentiality issues Source: National statistics

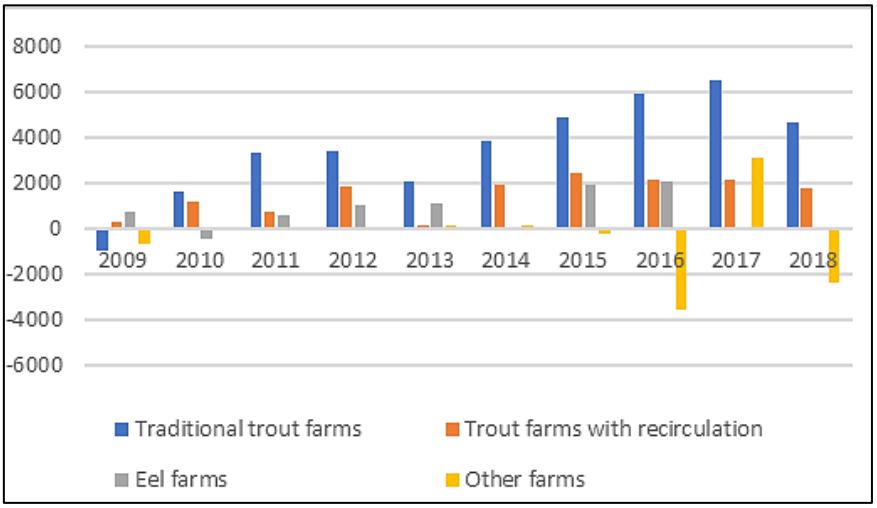
2.5.3 Benefits of freshwater aquaculture

Economic insights and benefits

- National statistics distinguish trout in ponds from trout in recirculation systems. They show that since 2010, pond farms generate the highest net profit. Recirculation system farming records positive net profits during the last 10 years (but less than pond trout farming due to large investments).

[9] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

Figure 3 – Net profit of freshwater aquaculture activities by segment (1.000 EUR) (2009-2018)

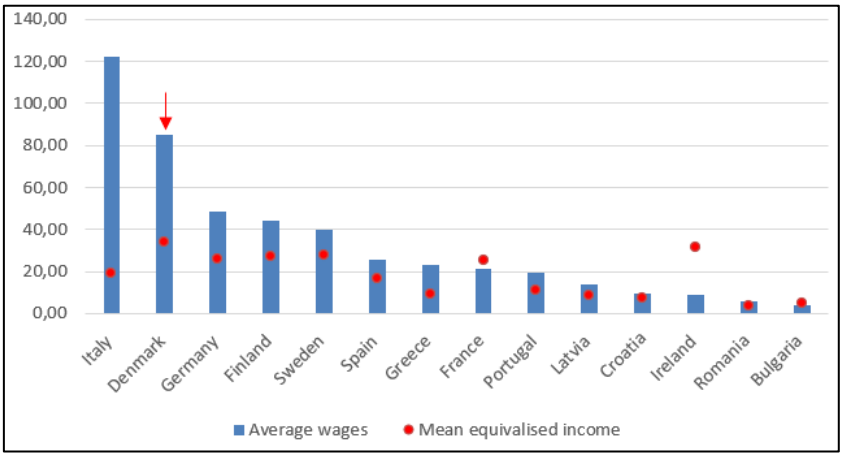


Eel farms are aggregated in other farms since 2017 due to confidentiality issues. *Source: National statistics*

Social benefits

- In addition to the employment directly related to farming activities, a significant number of people are employed in associated industries such as processing and smoking.
- Average wages from aquaculture was above the Danish mean equivalised net income in 2018. The high level of salaries is explained by the need of skilled workforce (with high salaries) in the intensive trout aquaculture in RAS which is prominent in Denmark.

Figure 4- Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (1.000 EUR)



Source: DCF/EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalized net income

Environmental benefits

- Interaction with environment: with recirculation technology requiring the water to be filtered and rinsed, Danish eel farming had no difficulty in complying with environmental regulations.

- The Danish regulation for aquaculture production was changed in 2012 in order to encourage producers to use more environmental friendly technology. This change implies the switch from a feed quota system (restriction of input=feed) to nitrogen system (output=discharge).

2.5.4 Assessment of the level of investment in the sector

There is a growing need for investment in measures required to meet tightening environmental regulations which has resulted in economic strains being placed on fish farmers.

2.5.5 Assessment of the level of innovation in the sector and main drivers

In recent years, the feed and feeding techniques have been improved to such a degree that the average feed conversion ratio in Danish fish ponds has been reduced to about 0,95. This development has been dependent on the use of high-quality fish meal and fish oil, primarily produced from Danish sand eel fisheries in the North Sea (source: FAO).

Recirculation technology is now well established and also suitable for a number of other species. Danish eel farming technology is of a high standard and there is a considerable level of export of this technology and know-how.

2.5.6 Existence and weight of "quality schemes" in the sector

In recent years, a segment of organic aquaculture producers has been established. According to the STECF report, nine land based farms are involved in producing organic trout. The organic producers have higher costs for feed and fry and for water analysis at sea, but they are also receiving a price premium for their products. According to the institution in charge of statistics, organic aquaculture is increasing. However, these producers are an inhomogeneous group that has been hard to differentiate in the national statistics.

ASC certifications should also be covered.

2.5.7 Assessment of the sector's growth potential

According to the Danish strategy for sustainable development of aquaculture sector 2014-2020, the production goal was to be raised by 25% to reach 55.000 tonnes in 2020. According to interviews conducted, this growth potential is driven by mussel farming. Fish is not increased to the same extent.

Main drivers and opportunities:

The future growth is highly dependent of the technological development – no further growth if the technology remains at the same level.

Challenges and gaps:

The administrative procedures are still perceived by the farmers to be the main hindrance for raising production volume (the switch of environmental regulation was very time consuming).

2.5.8 Sources of information

- Statistics: FAO, EUMAP, EUROSTAT and national statistics: https://www.dst.dk/en/Statistik/emner/erhvervslivets-sektorer/fiskeri-og-akvakultur
- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- The EU fish market.
- The multiannual plan for the development of aquaculture in Denmark.
- FAO – National aquaculture sector overview: http://www.fao.org/fishery/countrysector/naso_denmark/en

- National authority survey.

2.6 Finland

2.6.1 Market dimension of the EU freshwater aquaculture

Production

- 2.265 tonnes were produced in freshwater in Finland. Freshwater production has been stable over the period between 2008 and 2018.
- LUKE research institute indicates that confidentiality issues could hinder EUROSTAT users to distinguish fish farmed in inland waters and in sea waters.

Table 1 – Freshwater aquaculture volume, 2008-2017, tonnes

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Evol.
Volume	2.159	2.513	1.925	803	906	1.811	1.807	2.403	2.400	2.217	2.265	+ 5%

Source: EUROSTAT

Production by species + relative weight in the production

- Freshwater production is mainly constituted of rainbow trout (91% in volume and 82% in value). The other significant production is European white-fish (9% in volume and 18% in value). Only a part of both rainbow trout and European White fish national volumes is produced in freshwater. These species are mainly reared in salt water (about 11.000 tonnes of large Rainbow trout and 600 tonnes of European white fish reared in salt water each year) (sources: EUROSTAT).
- Sturgeons and arctic char are also reared in less important volumes (50-60 t of sturgeon in 2015-2016 according to FEAP).

Table 2 - Breakdown of the production volume by species between 2008 and 2018 – tonnes

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainbow trout	1.926	2.230	1.714	1.569	1.843	1.433	1.625	2.122	2.009	1.827	2.061
European whitefish	85	150	146	275	279	269	181	280	225	265	204
Other	147	133	65				1	1	166	125	0
Total	2.158	2.513	1.925				1.807	2.403	2.400	2.217	2.265

Source: EUROSTAT

Description and the share of the different farming techniques

According to EUROSTAT data, freshwater aquaculture takes place mainly in tanks and raceways (66% of the production volume and 70% of its value) and in lesser extent in cages (34% of the production volume and 30% of its value). However, according to Fish farmer's association there is production in recirculation system but mainly for juvenile production (10 RAS unites are operational according to Finnish fish farmers association). There is also production in natural ponds which are used for production of fish to be released to the wild (like pike and pikeperch).

Table 5 - Breakdown of freshwater aquaculture volume by aquaculture methods in 2018

Method	% volume	% value
Tanks and raceways	66%	70%
cages	34%	30%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

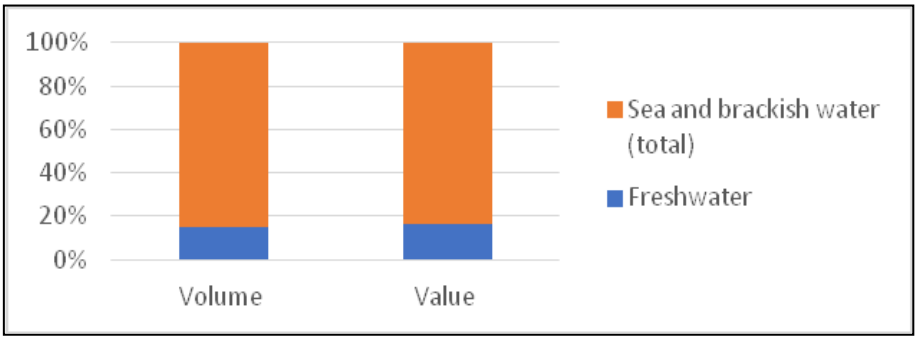
No information available.

2.6.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in the total aquaculture production

In 2017, the Finnish freshwater aquaculture production is estimated at 2.217 tonnes for over 11,6 Million EUR, which represents 15% of the Finnish aquaculture production volume and 16% of its value.

Figure 1 – Breakdown of aquaculture in Finland by aquaculture environment in 2017

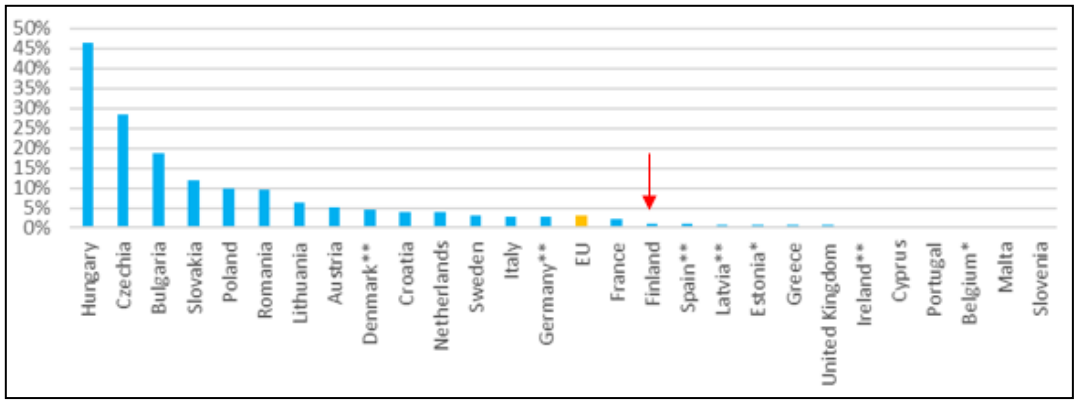


Source: EUROSTAT

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Apparent consumption of fisheries and aquaculture products in Finland: 25,56 kg/ capita in 2018. According to STECF "almost all aquaculture production in Finland is consumed in the domestic market" and "only a few special products (fry and roe) are exported."
- In 2018, freshwater aquaculture production represented circa 1% of the Finnish apparent consumption of fisheries and aquaculture production.

Figure 2 – % of freshwater aquaculture in apparent consumption[10]



*Source: EUROSTAT / *) FAO / **) National statistics*

[10] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply : The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

Socio-economic data: number of enterprises, employment, turnover

According to DCF/EU-MAP data, in 2018, the freshwater aquaculture sector in Finland employed 300 persons in 128 enterprises. The sector is dominated by very small scale enterprises, with 89% of enterprises with less than 5 employees.

Table 8 – Number of enterprises, employees and turnover of freshwater aquaculture activities

Variables	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Nb. of enterprises <=5 employees	127	116	114	114	133	127	136	134	134	135	114
Nb. of enterprises >10 employees	5	6	7	7	6	8	8	5	6	6	6
Nb. of enterprises 6-10 employees	6	11	9	9	9	15	7	7	5	8	8
Nb. of enterprises	**138**	**133**	**130**	**130**	**148**	**150**	**151**	146	**145**	**149**	**128**
FTE	209	311	266	235	282	310	260	217	201	218	209
Total employees	**282**	**369**	**347**	**296**	**360**	**490**	**426**	**330**	**310**	**335**	**300**

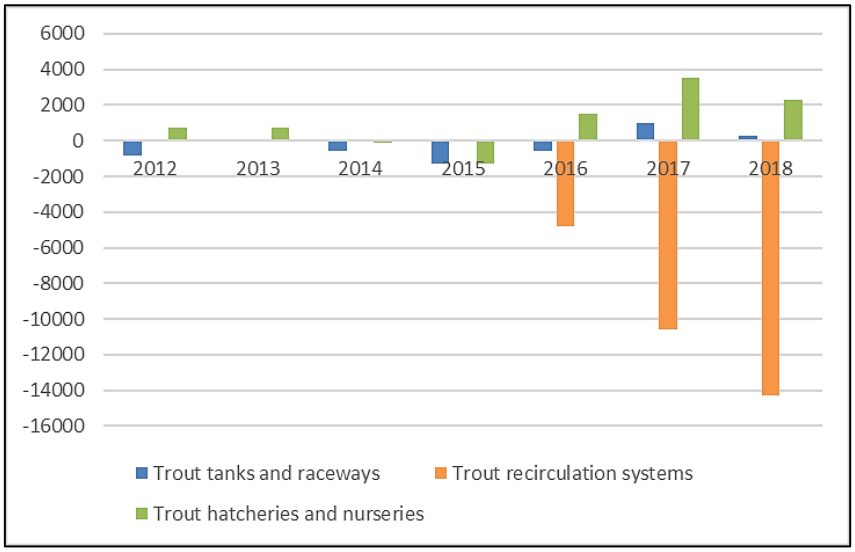
Source: DCF/EU-MAP data

2.6.3 Benefits of freshwater aquaculture

Economic insights and benefits

- The EU-MAP data distinguish three freshwater aquaculture segments: trout tanks and raceways, trout recirculation systems and trout hatcheries and nurseries. After several unprofitable years the segment of trout tanks and raceways has been able to make positive result in 2017 and 2018. The net profit was €0.3 million in 2018. The recirculating system was making losses in 2016, 2017 and 2018, this is related to the important investments and increasing operating costs, which have doubled between 2016 and 2018. At the same time, investors still have faith in the industry and considerable investments to new RAS production units were made. The segment of trout hatcheries and nurseries consists of rainbow trout fry for food fish farming and has recorded positive net income since 2016.

Figure 3 - Net profit of freshwater aquaculture activities by segment from 2008 to 2018 (1.000 EUR)

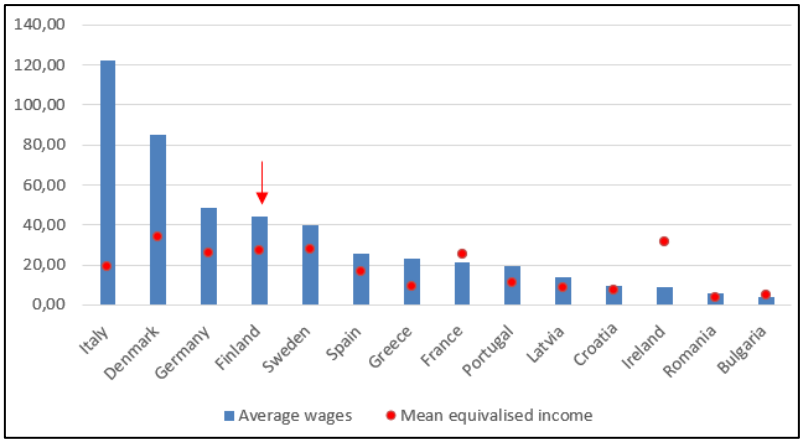


Source: DCF/EU-MAP data

Social benefits

Average wage from freshwater aquaculture was above the mean equivalised net income[11] in Finland in 2018.

Figure 4- Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (thousand EUR)



Source: DCF/EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalized net income

Environmental benefits

Restocking of migrant salmonids to strengthen existent population is being taking place in Finland.

2.6.4 Assessment of the level of investment in the sector

Overall low level of investment.

2.6.5 Assessment of the level of innovation in the sector and main drivers

Innovation initiatives and projects on RSA:

- 5 recirculating systems units producing producing 800 tonnes in 2018 according to the STECF report.
- Research on new RAS for northern environments and test of RAS for new species.

Innovation related to other aspects: new industrial symbiosis has been developed, where aquaculture production makes use of other industrial production processes and vice versa.

2.6.6 Existence and weight of "quality schemes" in the sector

We have not identified any quality scheme related to freshwater aquaculture products in Finland.

2.6.7 Assessment of the sector's growth potential

Main drivers and opportunities

- Fish prices and livestock prices (concerning the segments of hatcheries and nurseries) are the main drivers of the sector performance.
- Strong professional skills, which is important for European whitefish rearing because this specie is sensitive especially as regards moving at sea or the severity of off-shore conditions.
- Government willingness to improve the security of supply by increasing domestic production.

[11] Mean equivalised net income is the mean of total income of all households, after tax and other deductions, which is available for spending, divided by the number of household members converted into equivalised adults.

Challenges and gaps

- Strict environmental regulation that prevent farmers to intensify their production and do economies of scale (the environmental permit policy leaded some fish farmers to move their production to Sweden).
- High production cost (energy) for RAS.

2.6.8 Sources of information

- The Finnish fish farmer's association, « Fish farming in Finland »
- EUMOFA, "The EU fish market, 2019 edition"
- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).

2.7 France

2.7.1 Market dimension of the EU freshwater aquaculture

Production

Production is almost stable according to EUROSTAT. In 2018, freshwater production reached 37.807 tonnes.

Table 1 – Freshwater aquaculture volume (Tonnes) and value (1.000 EUR), 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume	43.475	44.258	44.005	41.004	40.380	40.513	39.581	33.870	44.874	44.273	37.807
Value	137.073	139.141	136.643	125.108	117.443	121.666	127.511	113.848	147.126	154.024	139.878

Source: Eurostat

Hatcheries and nurseries for both fry and human consumption:

- **For human consumption** (119,12 tonnes for EUR 23,04 million): Trout and Sturgeons caviar. Positive trend in value since 2008.

Table 2 – Hatcheries and nurseries for human consumption, volume (Tonnes) and value (1.000 ERU), 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Evol.
Volume	113,1	111,3	114,4	100,9	103,4	118,5	113,1	123,3	110,15	119,12	5%
Value	9.118	12.818	14.437	11.355	11.987	15.199	14.627	15.255	17.759	23.040	153 %

Source: EUROSTAT

- **For fry:** 38,209 million of eggs and 18,571 millions of juveniles of salmonids are produced in 2017 (EUROSTAT).

Production by species + relative weight in the production

FEAP's production statistics (table 3 bis) provide a slightly different figure from Eurostat (table 3). In both sources, the reliability of information concerning pond aquaculture species (carp, roach, tench…) is questionable and most of the data are estimations reconducted year to year. Concerning rainbow trout, the volumes reported by FEAP are superior by 8.000 t to those of EUROSTAT.

- Rainbow trout is the most important species reared in France. In 2018, it represented 86% of freshwater production volume. Rainbow trout production seems stable between 2008 and 2018 according to EUROSTAT, with slight annual fluctuations. According to National authority, the drop of production in 2014 and 2015 data does not correspond to reality but to a temporary change of the service responsible of the statistics.
- Other farmed species are mainly pond fish. Pond production data (common carp, roaches and tench on the table) from 2008 to 2017 correspond to the 2005 production, which has been reported until 2017, because of the lack of new data. Up to date data on pond aquaculture is available from 2018. Main pond species are common carp (4% of freshwater production) and roach (3%). Pond species production importantly decreased between 2005 and 2018 (-65% for common carp volume and -41% of roaches volume).

Table 3 – Breakdown of freshwater aquaculture production by species in France – 2008 – 2018, tonnes

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainbow trout	34.153	35.152	34.545	30.806	30.627	30.818	29.347	23.489	35.674	34.906	32.596
Common carp	4.200	4.200	4.200	4.200	4.200	4.200	4.200	4.200	4.200	4.200	1.488
Roach	1.900	1.900	1.900	1.900	1.900	1.900	1.900	1.900	1.900	1.900	1.119
Tench	900	900	900	900	900	900	900	900	900	900	265
Sea trout	794	741	832	1.079	1.081	946	1.234	1.083	658	697	947
Others	1.528	1.364	1.628	2.118	1.672	1.749	2.271	2.299	1.542	1.634	1.392
Total	**43.475**	**44.258**	**44.005**	**41.004**	**40.380**	**40.513**	**39.851**	**33.870**	**44.874**	**44.237**	**37.807**

Source: EUROSTAT

Table 3 bis – Breakdown of freshwater aquaculture production by species in France – 2009 – 2019, tonnes

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Common Carp	6.000	4.000	3.500	3.500	3.500	3.000	3.000	3.000	n.a.	n.a.	n.a.
Large Rainbow Trout	9.000	12.000	12.500	12.500	11.130	12.000	12.766	13.000	13.064	14.295	14.500
Portion Rainbow Trout	25.000	22.000	23.500	23.500	20.870	22.000	23.947	24.200	24.506	26.814	26.000
Sturgeons nei	250	380	280	250	280	298	241	450	500	453	500
Total	**40.250**	**38.380**	**39.780**	**39.750**	**35.780**	**37.298**	**39.954**	**40.650**	**38.070**	**41.562**	**41.000**

Source: FEAP production report 2020

- France is the first Mondial producer of trout eggs and one of the most important mondial caviar producers (with Italy and China).
- Hatcheries and nurseries for human consumption concern sturgeons caviar **(27% of production volume and 92% of its value)** and trout. Sturgeon caviar production has more than double between 2008 and 2018 in volume and value.

Table 4 – Breakdown of eggs production for human consumption by species in France – 2008 – 2017, Tonnes

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Trout	97,6	92,9	92,9	84,1	86,2	96,5	92	101,5	81,1	82,3	107,7
Siberian sturgeon	15,5	18,4	21,5	16,8	17,2	22	21,1	21,8	29,0	36,8	39,8
Total	**113,1**	**111,3**	**114,4**	**100,9**	**103,4**	**118,5**	**113,1**	**123,3**	**110,1**	**119,1**	**149,5**

Source: EUROSTAT

Description and the share of the different farming techniques

- In EUROSTAT, the most important share of freshwater aquaculture production is provided under the category "not specified" in 2017 which is likely to correspond to tanks and raceways (as the case for previous years). Thus, tanks and raceways is the dominant technique and is used for trout and sturgeons.
- The second main farming technique is ponds (18% of freshwater production in 2017). This production is steady; around 8.000 tonnes are produced each year since 2008. The species concerned are principally carp, tench and roach.
- Only 41 tonnes ware produced in recirculation systems in 2017. They concern trout production. Important volumes were produced in RAS in 2018 (3.784 tonnes).

Table 5 – Breakdown of freshwater aquaculture by aquaculture methods in 2017

Method	%
Ponds	18,1%
Tanks and raceways	1,3%
Recirculation systems	0,1%
Not specified	80,5%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

- Salmonids production (mainly rainbow trout) is mainly marketed to food market. About 3.707 tonnes are produced for restocking and leisure fishing purposes in 2018.
- Pond fish is produced for both leisure fishing and restocking purposes (1.740 tonnes in 2018) and for food market (1.569 tonnes in 2018).
- Sturgeons and other freshwater species are mainly produced for food market.

Table 6 – Breakdown of freshwater aquaculture by market in 2018

Market supplied	Salmonids	Pond fish	Sturgeons and other freshwater species	Total
Sales to another fish farmer	7%	0%	32%	7%
Leisure fishing	8%	27%	0%	9%
Restocking	2%	22%	0%	4%
Food market	61%	44%	68%	59%
Other/unknown	22%	8%	0%	21%

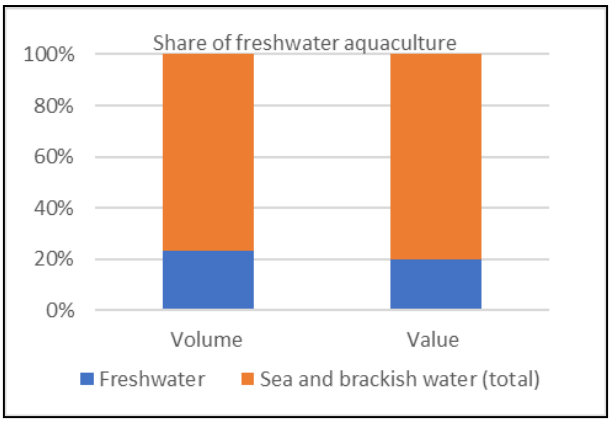
Source: National statistics

2.7.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in the total aquaculture production

In 2017, the French freshwater aquaculture production is estimated at 44.237 tonnes for over EUR 154,0 Million which represented 23% of the French aquaculture production volume and 20% of its value. In addition to this production, the caviar sector generates significant revenue as it is a highly valuable product (caviar production generated EUR 21,5 million in 2017).

Figure 1 – Breakdown of aquaculture in France by aquaculture environment in 2017

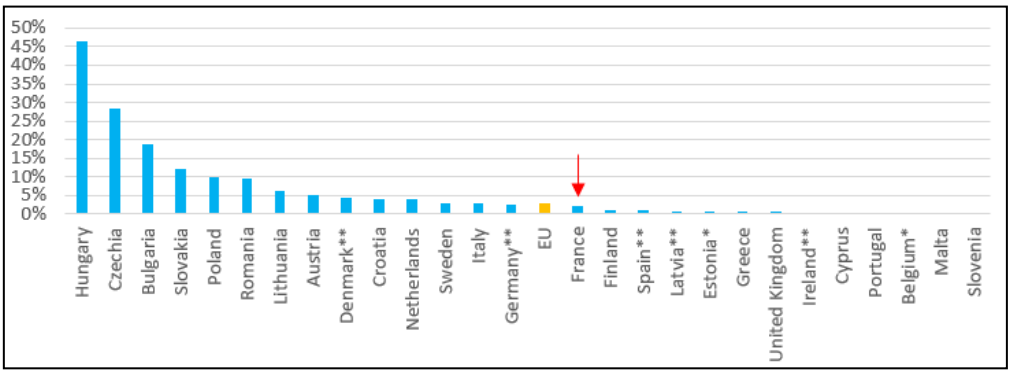


Source: EUROSTAT

Share of freshwater aquaculture fish in fish consumption

- Apparent consumption of fisheries and aquaculture products: 33,52 Kg / capita / year in 2018.
- According to FranceAgriMer, 11% of fish consumed in France come from aquaculture (both marine and freshwater).
- The share of freshwater products consumption is estimated at 3%. However, it could be very significant for some species such as trout (100% of self-sufficiency, apparent consumption of trout is 26.990 when the production exceeded 30.000 tonnes according to FranceAgriMer).

Figure 2 - % of freshwater aquaculture in apparent consumption[12]



*Source: EUROSTAT / *) FAO / **) National statistics*

- Trout is sold throughout the year in supermarkets, fresh (whole or fillets) and smoked. Smoked trout sales have increased by 15% between mid-2018 and mid-2019.
- Pond fish consumption is mainly local and seasonal (from end of autumn to the beginning of spring). However some enterprises sell carp throughout the year, fresh or processed (smoked, as a terrine, rillettes or fish and chips).

Socio-economic data: number of enterprises, employment, turnover

- Farmers' profile and level of education: about 48% of freshwater farms owners have no diploma. Half of freshwater farms owners are older than 50 years.
- Pond aquaculture is characterized by a lack of organization and the dominance of enterprises for which freshwater production is not the main activity.

[12] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply : The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

- Caviar production sector is concentrated in 8 enterprises, with important investments.
- According to STECF report, trout farms have very different sizes, some produce around 10 tonnes/year while others exceed 1.000 tonnes/year. The smallest farms specialized in niche markets (sell live fish to stock ponds or river or for sports fishing) while the medium and large companies work with supermarkets. In 2016, around 80 enterprises (associations, federal fish farms) produce fish for the restocking of river.

Table 7 – Number of enterprises and employees of freshwater activities in 2018

Main activity	Nb. enterprises	Permanent employment	Temporary employment	Total employment	Full-time equivalent	Average FTE per enterprise	Median FTE per enterprise
		Nb. persons			Nb. FTE		
Freshwater aquaculture (except ponds)	**346**	**1.339**	**425**	**1.764**	1.358,10	3,9	2
Pond aquaculture	**212**	**369**	**189**	**558**	226,3	1,1	0,9

Source: National statistics

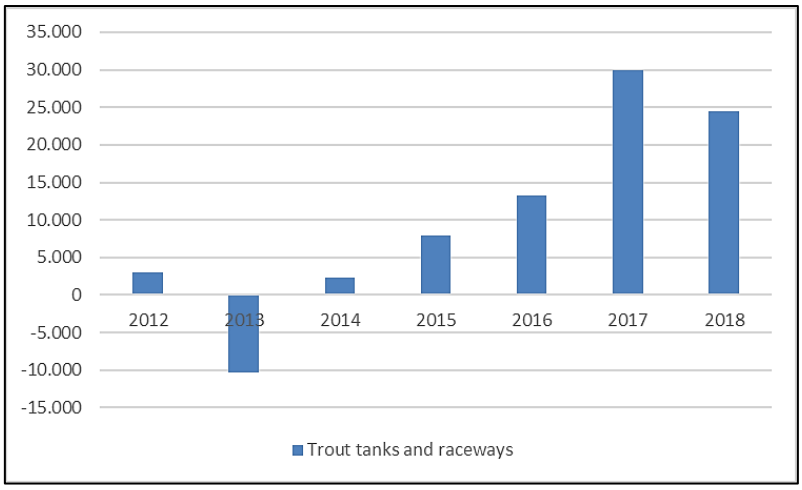
2.7.3 Benefits of freshwater aquaculture

Economic insights and benefits

Economic data are available only for trout production.

- The turnover of trout production has decreased by -11% between 2010 and 2016. The STECF reports indicates that the stagnation of prices combined with the increase of feed cost limit margins and profitability of the activity.
- Since 2016, the economic performance of trout farms has increased. The evolution of main indicators is positive like as evidenced by the net profit (multiplied by 4,5).

Figure 3 - Net profit of freshwater aquaculture activities by segment from 2012 to 2018 (EUR)



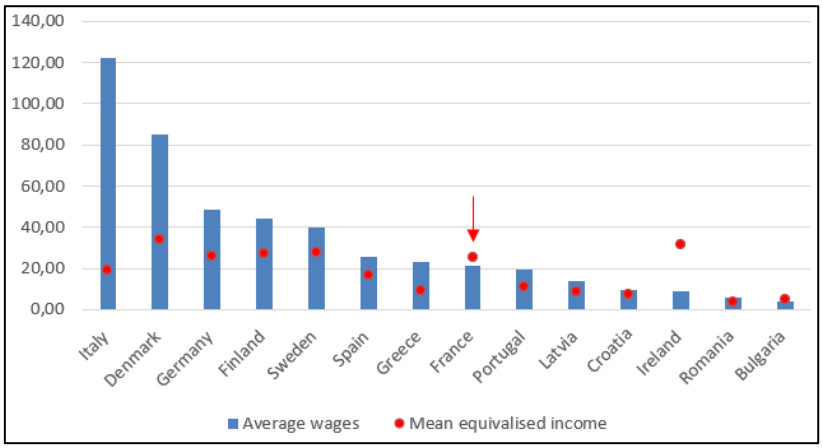
Source : DCF/EU-MAP data

Social benefits

Data concern only trout production.

- The average wage from aquaculture in France was below the mean equivalized net income in the country in 2018.

Figure 3- Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (1.000 EUR)



Source: DCF/EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalized net income.

Environmental benefits

According to the French national authority, from the 112.000 ha of ponds in France, about 60 000 are used as fish ponds. Benefits of fish ponds are:

- Food production with low inputs,
- Important wildlife, including amphibians and birds,

- Management of water levels: ponds keep water during droughts, come in support to low water levels and reduce flood risks.
- Adaptation to climate change.

Moreover, 902 tonnes of salmonids and 783 tonnes of pond fish are produced in 2018 for restocking purposes.

2.7.4 Assessment of the level of investment in the sector

- Biggest farms are able to invest in technologies.
- Investments in new production systems: RAS, aquaponics.
- EMFF support, especially productive investments in aquaculture which allowed the modernization of freshwater farms. However, it is difficult for small farms to get funding from EMFF (lack of administrative capacity).
- Strong investment in innovation by the salmonids sector, especially under EMFF support.
- Administrative burdens make investing to increase production or to create new facilities very difficult.

2.7.5 Assessment of the level of innovation in the sector and main drivers

- At least 51 RAS production sites in France of which 22 commercial production farms, 17 research sites, and 12 pedagogic sites. In 2014 commercial production concerned eggs and fry of trout, salmon smolts, perch and pike perch (zander). About fifteen freshwater species have been identified as potentially interesting to produce in RAS aquaculture systems. (Source: *«Étude sur la pisciculture en circuit « recirculé», France Agrimer, 2019 and Multiannual plan)*
- According to National Authorities survey, there are 2 trends in RAS production: some systems are permanent with no more of natural water inputs and other are seasonal in order to adapt the production to a temporary period of lack of water.
- Regarding the market innovation, targeting the smoked market by trout producers allowed to produce bigger trout. Pond producers also created new processed products: fillets without bones, *rillettes,* terrines, fish and chips.

2.7.6 Existence and weight of “quality schemes” in the sector

- Organic production : estimated at 2.300 tonnes in 2016.
- Label rouge
- Collective brands : *Aquaculture de nos regions, Bretagne truite.*

2.7.7 Assessment of the sector’s growth potential

Main drivers and opportunities

- Availability of skilled scientific institution and current researches on new feed for fish and new production techniques (RAS and aquaponics)
- Ability to produce fresh, diversified and high-quality products
- Interest of consumers on high quality products (demand for certificated and local products).
- EMFF support
- Ponds are associated with landscape and tradition
- Innovative investments by the trout segment
- The Fish Health Plan 2020, launched in 2014, aims to obtain a qualification "free of these diseases" with a view to improving the health level of fish farms and reducing the constraints linked to fish movements.

Challenges and gaps

- Important feed costs in addition to the need of improving feed for salmonids in order to improve aquaculture image.
- Lack of new generation entering the sector and lack of new sites development
- Regulatory and administrative requirements difficult to satisfy for family business.
- Difficulties to develop the organic aquaculture because of regulatory constraints and the presence of other anthropogenic activities in the areas that makes the environment not suitable to this production method.
- Lack of specific knowledge on the state and resilience of ecosystems to aquaculture activities.
- Predation in fish ponds.
- Need of improving fish ponds image.
- Lack of investment capacities of small farms.

2.7.8 Sources of information

- France Agrimer, « Consommation des produits de la pêche et de l'aquaculture 2018 ».
- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- France Agrimer « Etude sur la pisciculture en circuits « recirculés »», 2019.
- National strategic plan for aquaculture (PSNPDA) 2015.
- Wezel A et al (2014), Biodiversity patterns of nutrient-rich fish ponds and implications for conservation, Limnology, 15, 3, 213–22.
- Study on an interim evaluation of the Open Method of Coordination (OMC) for the sustainable development of EU Aquaculture: French case study.
- Al Domany M et al (2020), Une zone humide perd-elle autant, moins ou davantage d'eau par évapotranspiration qu'un étang par évaporation ? Etude expérimentale en Limousin, Annales de géographie.
- National authority survey.

2.8 Germany

2.8.1 Market dimension of the EU freshwater aquaculture

Production

Germany produced 18.765 tonnes in 2018. Since 2012, the freshwater aquaculture production has remained more or less stable at about 20.000 tonnes, despite the country's water resources and technological capacity.

Table 1 – Freshwater aquaculture volume, 2012-2018, tonnes

	2012	2013	2014	2015	2016	2017	2018	Evol.
Total grow out	20.064	21.434	22.229	21.005	20.414	20.596	18.765	-6%
Juveniles and caviar	4.140	4.615	5.654	6.392	4.966	4.102	3.766	-9%

Source: National statistics

Production by species + relative weight in the production

- Traditional aquaculture species reared in Germany are rainbow trout and common carp. Trout production in flow-through-systems is the most important aquaculture method in terms of volume and revenue generated. It represented 42% of the production volume in 2018 (volume excluding juveniles and caviar). The carp production is the second major type of German aquaculture practiced and has a long tradition. Carp production represented 25% of the total volume production in Germany.
- The main other species reared are European eel and African catfish reared in warm water systems.

Table 2 – Main reared species in Germany – 2012-2018 – Tonnes

Aquaculture type	Species	2012	2013	2014	2015	2016	2017	2018
Warm water ponds	**Carp**	5.521	5.699	5.285	4.916	5.238	4.957	4.746
	Carp juveniles	2.300	2.346	2.442	2.240	2.421	1.722	2.072
	Others	55	771	909	1.254	795	770	849
Coldwater systems, including RAS	**Trout**	9.378	9.601	9.937	8.527	8.533	8.397	7.852
	Trout Juveniles	1.840	2.269	3.212	4.152	2.545	2.380	1.694
	Others	3.114	3.273	3.535	3.168	2.765	3.234	2.406
Warm water systems, including RAS	**Eel**	744	758	926	1.176	1.099	1.112	1.132
	European catfish	115	136	160	166	161	163	158
	African catfish	607	675	919	1.309	1.245	1.345	1.099
	Carp	289	259	225	210	196	195	150
	Sturgeon	81	72	95	29	33	63	13
	Tilapia	-	63	116	3	112	112	142
	Pike-perch	-	9	46	44	40	132	64
	Others	75	1	1	100	74	46	33
Net enclosures	**Rainbow trout, carp, Sturgeon, Arctic char**	85	117	75	103	123	70	121
Total excluding juveniles and caviar		20.064	21.434	22.229	21.005	20.414	20.596	18.765
Total		24.204	26.049	27.883	27.397	25.380	24.698	22.531

Source: National statistics

Description and the share of the different farming techniques

Warm water ponds: 23.231 ha of ponds were used for aquaculture in 2018. Ponds are the most traditional form of fish farming. At least 7.600 tonnes were produced in warm water ponds, including 2.072

tonnes of juveniles. Carp constituted the most important species reared in ponds. However, the interest of the pond owners in the breeding of other fish species in warm water ponds has increased in recent years. Pond farms are mainly located in the south of the country and in the eastern part (Brandenburg & Sachsen).

Coldwater systems, including partial circular systems (the share of circular systems is not known): Rainbow trout dominates around ¾ of the total amount of fish produced in coldwater systems. In 2018, 11.900 tonnes were produced (mainly rainbow trout + minor species: Brown trout, grayling and char), from which 1.694 tonnes are rainbow trout juveniles.

Warm water systems (including RAS systems – 82% of total production in warm water systems): Complete recirculation systems where the water temperature is kept in a physically optimal range for the respective fish species. Total production in warm water systems is 2.790 tonnes, from which 2.294 tonnes in recirculation systems, with a strong increase in production volumes in last years. RAS farms are located mainly in the North of the country.

Table 4 - Breakdown of freshwater aquaculture by aquaculture methods in 2018

Aquaculture method	Percentage
Total pond	34%
Coldwater systems (included RAS)	53%
Warm water systems (including RAS)	12%
Net enclosures	1%

Source: German annual report

Markets supplied: restocking / leisure fishing / food markets

According to the German annual report:
Carp: the marketing channels for carp differ regionally depending on the quantities produced:

- In the main producer regions (Saxony): a significant part of the carp is marketed by **wholesalers** (up to 90%) due to the large quantities that are obtained in a relatively short time. Wholesalers almost exclusively buy the fish alive.
- In other regions (Lander of Schleswig-Holstein, Rhineland-Palatinate), the most important share (up to 80-90%) is mainly sold to **local restaurants**.
- **Fishing clubs and associations** also buy larger quantities of live carp as stock fish for their waters. This sales channel accounted for around 25-30% of total marketing in Bavaria and Saxony-Anhalt in 2018. In Baden-Württemberg, almost the entire carp harvest was sold to fishing clubs as stock fish.

Other species produced in warm water ponds: sales to fishing clubs and associations are dominant (In Baden-Württemberg, all minor fish harvested from ponds were sold to fishing clubs in 2018, in Bavaria and Saxony-Anhalt it was at least 50-60%.).

Trout: marketing trout vary depending on the size, structure and location of the farms:

- Direct sale to end consumers (ready-to cook and smoked fish (*)[13] and restaurants are advantageous for producers (highest prices),
- Sales to fishing clubs are also lucrative (prices): it accounts at least 20% of total sales,
- Sales to wholesalers (live) are only important for few large producers and accounts for 5-20% of total production.

Other species: freshly slaughtered fish, fillets and smoked goods dominate in direct sales and sales to retailers. Wholesalers mainly buy live fish.

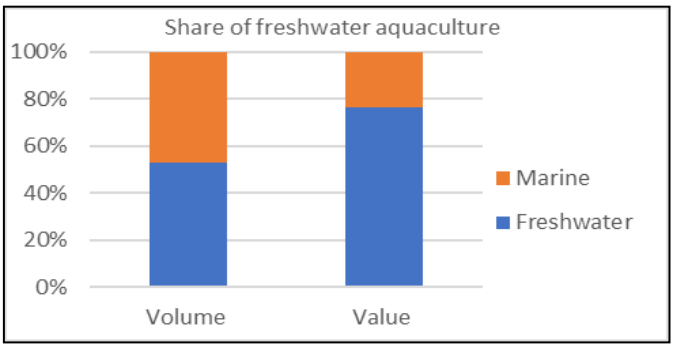
[13] (*) A trend towards increased processing of the raw material before the sale has been observed for some years. For example, fillets and smoked fillets have conquered a constant market and are often offered vacuum-packed.

2.8.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in the total aquaculture production

According to FAO, in 2017, 19.043 tonnes were produced for a value of EUR 64,6 million (excluding the caviar and juveniles sectors), which represented 53% of total production volume and 77% of its value.

Figure 1 – Breakdown of aquaculture in Germany by aquaculture environment in 2017



Source: FAO

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Apparent consumption and aquaculture products in Germany: 14,5 Kg/capita/ year in 2018.
- According to the German annual report, total fish consumption in Germany accounts for circa 686.000 t. Thereof 140.000 t was fish from aquaculture, which was mainly imported (76.9%). Only, 19.043t (23.1%) were produced in Germany accounting for 3% of the total national consumption.
- However, contrary to almost all other species from aquaculture and fishing, carp comes predominantly from domestic pond and carp has self-sufficiency rate of 55%.
- Self-sufficiency for trout: 21% (imports remain important despite the increase of production in recent years).

Socio-economic data: number of enterprises, employment, turnover

Number of enterprises:

At least, there are 2.995 farms in inland water in Germany, distributed as follows:

- Warm water ponds: 1.803 farms in 2018. Companies below the production volume threshold defined by the statistical institute in charge of data collection (1 tonne) do not take part of the survey conducted in Germany to collect data.
- Coldwater systems including circular systems: 1.125 farms in 2018 (of which more than half are located in Bavaria). There are 600 farms that produced less than 1 t and thus excluded from the survey. Rainbow trout dominates around ¾ of the total amount of fish produced in coldwater systems.
- Heated water systems: 51 farms from which 50 farms are operating in recirculation systems. Very significant increase of fish production in recirculation systems over the past ten years.
- Enclosures: there are 16 located in inland waters: 8 rainbow trout, carp: 1, Sturgeon: 1, Arctic char: 1 and other: 5.

Employment

Germany starts to submit socio-economic data on freshwater aquaculture under the EU-MAP. According to the STECF report, the survey 2017/2018 among freshwater aquaculture enterprises has still been at the beginning and faces some shortcomings. According to this survey, 1.707 persons were employed in the freshwater aquaculture sector.

Analysis of the position and the relative price of freshwater products

Prices are dependent on marketing channels. In 2017, the average price for carp was € 5,01 / kg for direct marketing and € 2,45 / kg for distribution to wholesalers. Concerning trout, from the prices provided by marketing channels (table below), there are clear differences between direct marketing and wholesale. African catfish when sold through retail or to end consumers it was 50 to almost 100% above the wholesale price. In the case of the European catfish, on the other hand, the price variation between wholesale and retail prices was only slight.

Table 5 – Average prices of the main species produced in Germany by market in 2017 (EUR/Kg)

Species	Direct sale	Wholesale	Retail	Others
European eel	13,03	12,88	n.a.	n.a.
Brown trout	7,84	5,11	6,41	6,71
Rainbow trout	7,58	4,14	5,28	4,93
Pike	10,26	6,21	5,86	9,33
Common carp	5,01	2,45	2,88	3,13
Brook trout	10,95	5,83	5,92	6,74
Tench	7,68	4,2	4,6	5,54
Siberian sturgeon	11,96	6,88	9,83	11,76
African catfish	2,18	1,38	2,6	1,64
European catfish	n.a.	5,54	6,06	6,69
Pike-perch	20,41	10,48	11,17	14,32

Source: German annual report

2.8.3 Benefits of freshwater aquaculture

Economic insights and benefits

General comment on the freshwater aquaculture sector as a whole: according to the multiannual plan, the freshwater sector mainly suffers from diseases, predators like cormorant, lack of successors and a lack of concentration in order to increase market power and thereby producer prices. Economies of scale do not occur due to the small production unit, with decreasing demand for, also reflected in the low prices for this species.

Trout production: In general, trout farming in freshwater recirculation system is the most profitable segment of production, both in terms of quantity and the revenue generated.

Carp pond farming:

- the profitability of many carp farms faced economic challenges because carp consumption has been steadily shrinking over a long time and producers in the neighboring countries such as the Czechia and Poland are strong competitors.
- The risk of losses which can be up to 60-80% (related mainly to predators protected under conservation law) could be a significant challenge for carp farmers. Losses of small carp are sometimes replaced. Without replacement fish, years of high losses of fish results in reduced harvests in subsequent years.
- Carp is a seasonal and regional fish.
- The pond yield has significantly decreased in the last years (from 400 kg/ha --> 320 kg/ha).
- The pond yield is dependent upon the annual weather and in particular on the temperature in the growing season and the distribution of precipitation.
- The level of professional education in respect to aquaculture and/or marketing of fish is very low. The good practical knowledge results form own experiences and the traditional knowledge of local families.
- Many farms are family owned, small size and operate at low levels of production. Access to the fish market is difficult.

Social benefits

Concerning **pond carp production**: a case study on the carp pond in the Aischgrund indicated that small scale farmers (< 1ha) work part-time in agriculture and aquaculture and that they gain nearly the total annual income (95%) from employment in other sectors (mainly the industrial sector because several corporations are located in the area).

Environmental benefits

- The carp represents the pond landscape and transmits regional identity and integration.
- Some of the ponds or chains of ponds are classified as nature conservation or bird protected areas.

Carp pond production is seen as ecologically sustainable system: The pond landscape is of very high ecological value providing habitats for a large variety of water related flora and fauna, in particular for birds. Most ecological requirements of the ecosystems in and around carp ponds are in line with current farming practices. Carp is important for the maintenance of ponds because they feed on grasses and keep the ponds clean. The carp population keeps the nutrient level in the ponds in balance because it consumes nearly all nutrients from cereals added to the ponds.

2.8.4 Assessment of the level of investment in the sector

No information.

2.8.5 Assessment of the level of innovation in the sector and main drivers

At least 14% of the freshwater aquaculture production uses RSA. It exists as either warm or cold water systems. RSA with cold freshwater produces eel, trout, pike-perch, carp and some other species. RSA with warm freshwater is usually established in connection with the construction of a biogas plan because warm water fish system can use the exhaust heat of biogas plan efficiently. Costs for heating represent about 15% of the total costs production. The multiannual strategy for the development of aquaculture highlighted the objective to increase the German aquaculture production in RSA significantly. Today, RSA use reliable technologies but the number of farms is still very limited. Technical expertise, high costs of production and the compliance with manifold legal requirements challenge existing and new fish farms and make difficult to ensure profits for the existing ones.

2.8.6 Existence and weight of “quality schemes” in the sector

The Protected geographical indications were identified: „Frankenkarpfen“ / „Aischgründer Karpfen“ / « Schwarzwaldforelle », « Oberpfälzer Karpfen », « Holsteiner Karpfen » et « Oberlausitzer Biokarpfen » - as initiatives to improve quality and enhance profitability and respond to the consumers demand regarding local products. In 2018, 140 carp farmers operating 550 ponds (500 ha) were given PGI certification. That corresponds to a share of about 15% of total carp farmers and 25% of total production in the Aischgrund. That is a slight increase of labelled producers since 2015”. The carp production in the Aischgrund is around 1.700 t/year.

Regarding organic farming, DESTATIS reports 64 farms, which declare to be organic. Their total production was only 270 t in 2017.

2.8.7 Assessment of the sector’s growth potential

The multiannual plan highlighted three objective for the development of aquaculture in Germany:

- Stabilizing the current capacity of the sector;
- Increase the freshwater aquaculture production by +148%.
- Maintain the extensive traditional pond aquaculture, which provide ecological and cultural services for the society.

Main drivers and opportunities:

- The positive contribution of carp farming to the regional economy (traditional fish restaurants, rural tourism, regional image, etc.) is significant.
- The reduction of cormorant numbers related to the fact that farmers are allowed to shoot, under restrictions, cormorants, is seen as key factor for the future of fish farming.
- There are opportunities to improve economic profitability of fish farming in recirculation systems by coupling them with energy and material flows from biogas plans.
- Linking agriculture systems with aquaculture helps to establish a closed circular flow of nutrients. Both segments could take advantages from synergies.

Challenges and gaps

Aquaculture in general:

- Legal framework considered inadequate to the aquaculture activities,
- Strong price pressure from imports,
- Bad image of aquaculture in general, mainly because of feeding practices based on fishmeal, fish oil and the use of antibiotics.

Carp pond production:

- Damage caused by various predators and protected animals (cormorants and Otter) led to a loss of profitability.
- Infectious and parasitic diseases
- Contrasting situation: positive development demand at regional level but at national level, interest in carp as a food fish has been declining for a long time, which affects the prospects in warm water ponds.
- Although local successes are being achieved, carp sales in Germany are steadily declining and pond owners have to adapt to persistently difficult economic conditions.

Trout:

- Diseases
- Fish losses due to Cormorants and gray herons.
- Heavy rain led to flooding of facilities and thus loss of fish stocks. High temperature could cause losses.
- Low prices of imported trout.

Heated water systems

- Administrative burdens related to obtaining permits for the use of innovative aquaculture systems, obtaining discharge permits for wastewater
- Low economic profitability
- Producers of African catfish strive to increase the market share of direct sales and retail. However, special licensing and hygiene requirements must be met for this, which can be difficult.

2.8.8 Sources of information

- Statistics: FAO, EUMAP, EUROSTAT.
- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- The EU fish market.
- The multiannual plan for the development of aquaculture in Germany.
- Jahresbericht zur Deutschen Binnenfischerei und Binnenaquakultur 2017.
- Sufisa fish farming report. Case study in Germany, 2018.
- FAO – National aquaculture sector overview: Germany.
- National authority survey.

2.9 Greece

2.9.1 Market dimension of the EU freshwater aquaculture

Production

According to national statistics, freshwater aquaculture production has decreased by -39% between 2008 and 2018 in terms of volume and by -25% in terms of value.

Table 1 – Freshwater aquaculture volume (tonnes) and value (1.000 EUR), 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume	3.992	3.094	3.204	2.709	2.330	2.342	1.959	2.102	2.071	2.440	2.610
Value	13.505	11.038	11.778	10.904	10.357	9.868	8.603	8.987	9.853	11.117	10.472

Source: National statistics[14]

In addition to this production, 9 millions of juveniles (trout) were produced in 2018.

Production by species and relative weight in the production

As EUROSTAT data are sporadic, data from FAO were used for the breakdown of production by species.

- Rainbow trout is the dominant specie reared. It represented 82% of the production volume in 2018. Its production has decreased by -38% between 2008 and 2018.
- The second main fish reared is European Eel, which represented 14% of the production volume in 2018.
- The production of common carp was around 110 tonnes before 2011 according to FAO and superior to 489 tonnes according to national statistics, but both sources indicate that it decreased significantly since 2011 and the production is very low in 2017 (<1% of the total production according to FAO) and no production has been recorded in 2018.

Table 2 – Breakdown of freshwater aquaculture production by species in Greece – 2008 – 2018

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainbow trout	3.430	2.588	2.712	1.912	1.968	2.017	1.611	1.759	1.644	1.989	2.126
European eel	399	341	320	209	281	217	253	286	405	308	372
Spirulina	0	0	0	198	174	93	126	148	96	152	94
Common carp	113	114	123	52	38	41	28	14	6	7	-
Others	49	50	48	27	12	5	54	28	7	33	5
Total	3.991	3.093	3.203	2.397	2.472	2.371	2.073	2.235	2.157	2.489	2.597

Source: FAO

Description and the share of the different farming techniques (EUROSTAT / EUMAP)

- Production corresponds mainly to artificial raceways (83% according to EUROSTAT). According to national authority, there were 1.240 raceways facilities in Greece in 2018. Raceways are exclusively used for rainbow trout production and rainbow trout is essentially produced in raceways.
- Freshwater ponds facilities are 128 in the country. 32 tons of rainbow trout are produced in ponds in 2017.

Table 3 - Breakdown of freshwater aquaculture by aquaculture methods in 2017

[14] Ελληνική Στατιστική Αρχή www.statistics.gr

Methods	%
Not specified	15%
Ponds	2%
Tanks and raceways	83%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

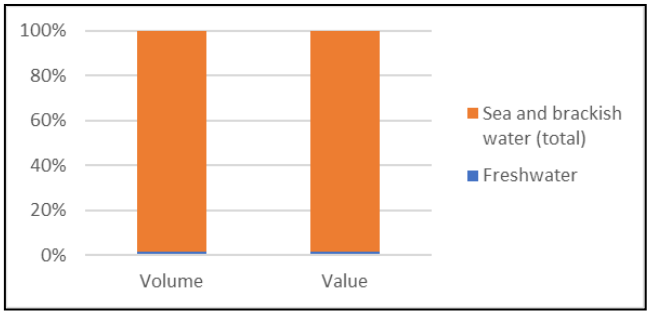
There are no data available on the markets supplied by the freshwater aquaculture production.

2.9.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in the total aquaculture production.

The freshwater aquaculture constitutes a small segment in Greece. In 2018, the Greek freshwater aquaculture production is estimated at 2.233 tonnes for over EUR 7,8 Million which represent 2% of the Greek aquaculture production volume and 1% of its value (source: EUROSTAT).

Figure 1 – Breakdown of aquaculture in Greece by aquaculture environment in 2018

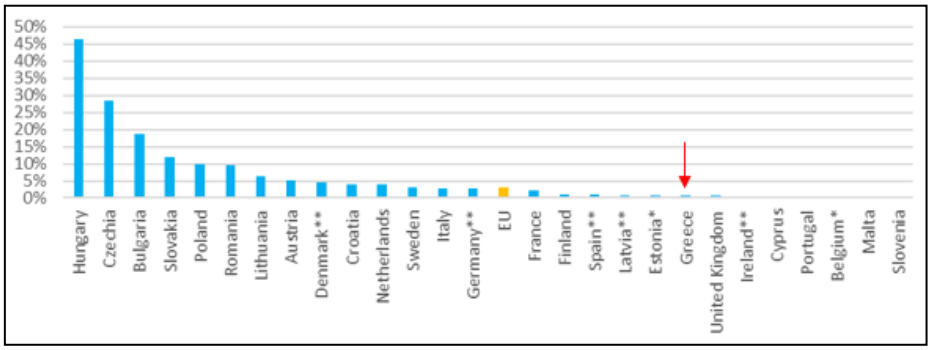


Source: EUROSTAT

Contribution of freshwater aquaculture products to fisheries and aquaculture markets and consumption

Per capita consumption of fisheries and aquaculture products: 19,85 kg/capita in 2018 *(source: EUMOFA)*.The contribution of freshwater aquaculture products in the fisheries and aquaculture market is very limited (<1%).

Figure 2 - % of freshwater aquaculture in apparent consumption[15]



*Source: EUROSTAT / *) FAO / **) National statistics*

Socio-economic data: number of enterprises, employment, turnover.

- According to national data, 1.532 facilities involved in freshwater aquaculture were recorded in Greece in 2018. The number of enterprises has decreased by -15% between 2008 and 2018, with a variability

[15] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

according to aquaculture methods: while the number of ponds has significantly decreased, the number of facilities producing in artificial raceways production has slightly decreased.

- The national authority indicated that there are some facilities operating in RAS but production is still limited (mainly to grow eel).

Table 4- Number of facilities by aquaculture method

Number of facilities	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Natural and artificial ponds	383	383	356	182	182	169	172	143	143	128	128
Cages	59	59	59								
Artificial raceways	1.345	1.324	1.373	1.334	1.441	1.508	1.443	1.423	1.351	1.342	1.240
Other	11	12	3	121	236	239	239	229	228	228	164
Total	**1.798**	**1.778**	**1.791**	**1.637**	**1.859**	**1.916**	**1.854**	**1.795**	**1.722**	**1.698**	**1.532**

Source: National statistics

- According to national statistics, in 2018 the freshwater aquaculture sector employed 264 persons: 226 full time employees (86%) and 38 part time employees (14%).
- The total number of employees in the freshwater aquaculture sector has decreased between 2008 and 2018 but the number of specialized employees (technicians and qualified employees) has increased.

Table 5- Number of employees by type of employment

Number of employees	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Full time specialized employees	18	16	18	37	35	33	33	36	28	30	31
Full time unspecialized employees	294	291	281	223	233	245	210	205	206	219	195
Part time employees	19	24	23	29	33	46	37	39	41	44	38
Total	**331**	**331**	**322**	**289**	**301**	**324**	**280**	**280**	**275**	**293**	**264**

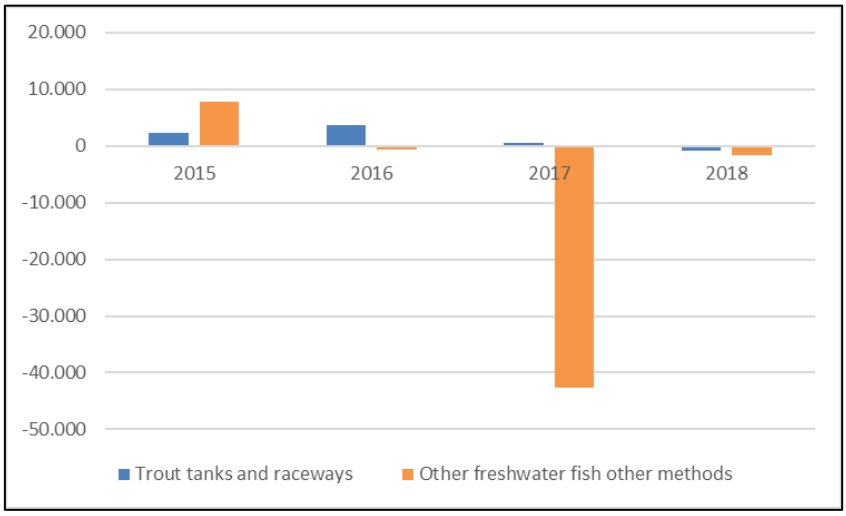
Source: National statistics

2.9.3 Benefits of freshwater aquaculture

Economic benefits

The freshwater aquaculture had negative net profits in 2017 and 2018. According to the STECF report, the trout segment is undergoing a restructure and the increased sales volume and value were followed by an increase in employment and operating costs. The segment demonstrates losses in net profit and drops in capital productivity and return on investment.

Figure 3 - Net profit of freshwater aquaculture activities by segment from 2015 to 2018 (EUR)

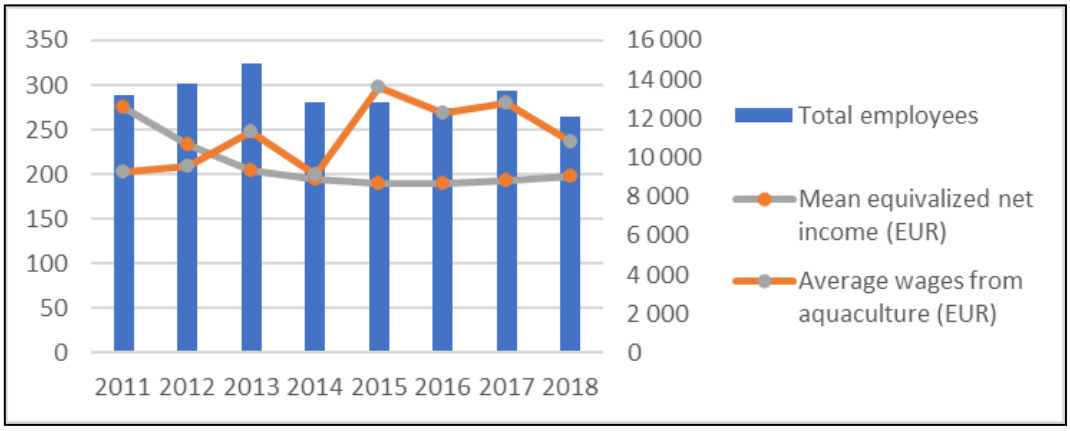


Source: DCF/EU-MAP data

Social benefit

- 264 persons were employed in freshwater aquaculture in 2018 (including 38 part time employees) according to national statistics.
- Freshwater aquaculture provides employment in mountainous and remoted areas, particularly in Epirus and Western Macedonia where this activity is concentrated (sources: Multiannual plan for aquaculture and Federation of Greek maricultures, "Greek Aquaculture 2019").
- According to national statistics, the average wages from aquaculture has increased between 2011 and 2018. Since 2014, average wages from aquaculture are higher than the mean net income in Greece.

Figure 3 – Number of employees and average wages for freshwater aquaculture activities (2008 – 2018)



Source: National statistics and EUROSTAT data for mean income

Environmental benefits

There are no specific information on this section.

2.9.4 Assessment of the level of investment in the sector

Incapacity to attract new investors in the aquaculture sector in general *(source: Multiannual Plan for Aquaculture).*

2.9.5 Assessment of the level of innovation in the sector and main drivers

Enterprises are interested in new species production and tested some, including sturgeons, cyanobacteria, spirulina, ulva macrophyte (*sources: Multiannual plan for aquaculture and Federation of Greek maricultures, "Greek Aquaculture 2019"*).

2.9.6 Existence and weight of "quality schemes" in the sector

No quality schemes related to freshwater aquaculture recorded.

2.9.7 Assessment of the sector's growth potential

Freshwater expansion is mainly restricted by the unavailability of suitable space in Greece.

Main drivers and opportunities

- Good knowledge of production process for the aquaculture sector in general.
- Possibilities of development of organic production.
- The new label "Fish from Greece" (recently introduced) may aid to level playing field between the Greek products produced under strictly regulated conditions in the EU and non-EU products.

Challenges and gaps

- Difficulties related to getting a license in the aquaculture sector in general
- Difficult investment due to lack of new investors in the aquaculture sector in general
- Unfair competition between fish farmers in general
- Difficult access to remote locations
- Lack of organisation of the sector, few participation to producers' organizations in the aquaculture sector in general
- Lack of suitable space to develop freshwater aquaculture.

2.9.8 Sources of information

- Federation of Greek maricultures, "Greek Aquaculture 2019" ("Ελληνική Υδατοκαλλιέργεια 2019").
- National statistics: Ελληνική Στατιστική Αρχή www.statistics.gr
- EUMOFA, "The EU fish market, 2019 edition".
- Multiannual strategic plan for aquaculture- 2014.
- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- National authority survey.

2.10 Hungary

2.10.1 Market dimension of the EU freshwater aquaculture

Production

- According to EUROSTAT, circa 18.000 tonnes were produced in 2018 for circa EUR 39 million.
- The Hungarian aquaculture production has increased between 2008 and 2019 both in terms of volume and value.

Table 1 – Freshwater aquaculture volume (Tonnes) and value (1.000 EUR), 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume	15.000	14.171	13.637	15.509	14.558	14.383	15.366	17.337	16.520	18.258	17.900
Value	30.373	26.495	27.164	30.293	29.885	25.575	29.502	30.634	31.490	38.007	38.755

Source: Eurostat

Production by species + relative weight in the production

- According to EUROSTAT data, common carp was the main species produced by the Hungarian aquaculture sector, representing 64% of production volume and 67% of its value.
- North African catfish is the second important fish species with 19% of the Hungarian production volume and 16% of its value. While the carp production has slightly increased, the North African catfish has significantly increased between 2008 and 2018.
- With less important volume, there is production of other species of carp, such as silver carp and grass carp, with respectively 3% and 7% of the production volume.

Table 2 – Breakdown of aquaculture production by species – tonnes – 2008-2018

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Common carp	10.485	9.931	9.927	10.807	9.985	9.632	10.291	10.725	10.321	12.240	11.462
North African catfish	1.839	1.716	1.810	1.913	1.852	2.050	2.187	2.840	3.039	3.174	3.333
Silver carp	1.493	1.567	1.081	1.545	1.681	1.624	1.434	2.169	1.144	883	1.200
Grass carp	578	480	437	719	502	576	516	516	583	579	474
Wels(=Som) Catfish	153	175	156	175	225	212	158	149	178	216	252
Other	452	302	226	350	313	289	780	938	1.256	1.166	1.178
Total	**15.000**	**14.171**	**13.637**	**15.509**	**14.558**	**14.383**	**15.366**	**17.337**	**16.520**	**18.258**	**17.900**

Source: EUROSTAT

FEAP and EUROSTAT statistics are overall consistent, with different levels of detail by species.

Table 2 bis– Breakdown of aquaculture production by species – tonnes – 2009-2019

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Common Carp	10.500	9.927	10.807	9.985	9.632	10.290	10.725	10.321	12.240	11.462	11.436

African Catfish	2.000	1.810	1.913	1.852	2.050	2.187	2.840	3.039	3.174	3.987	3.610
Silver & bighead Carp	652	1.132	1.613	1.762	1.673	1.494	2.253	1.320	1.088	1.370	943
Grass carp	600	437	719	502	576	516	516	583	579	474	425
European Wels Catfish	150	156	175	225	212	158	149	178	216	252	206
Sturgeons nei	34	14	14	51	56	47	142	76	97	139	87
Portion Rainbow Trout	40	48	56	56	52	61	42	67	54	99	76
Other Species						79	57	115	69	76	60
Total	**13.976**	**13.524**	**15.297**	**14.433**	**14.251**	**14.832**	**16.724**	**15.699**	**17.517**	**17.859**	**16.843**

Source: FEAP production report 2020

Description and the share of the different farming techniques

- Fish ponds are the dominant production facilities of Hungarian aquaculture with an average operating fishpond area of 25.121 ha between 2008 and 2018. The average food fish production was 15.694 tonnes in the same period. The year-to-year fluctuations of pond fish production mainly depend on weather conditions. According to EUROSTAT data, pond production represented 81% of the Hungarian fish production volume and 80% of its value. The species concerned: common carp, other carp species and catfish.
- In addition to fish production, intensive aquaculture based on the exploitation of geothermal resources plays an increasing role in aquaculture. Intensive aquaculture facilities (tanks and raceways) yielded 19% of fish production in 2018, where the highest species is African catfish (96% of the production in intensive systems), followed by rainbow trout (72 tonnes) and sturgeons (69 tonnes).

Table 3 - Breakdown of freshwater aquaculture volume by aquaculture methods in 2018

Aquaculture method	% Volume	% Value
Tanks and raceways	18%	19%
Ponds	82%	81%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

No information on the breakdown of freshwater aquaculture production by market.

2.10.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in total aquaculture production

Hungary is a landlocked country producing only freshwater aquaculture products.

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Per capita consumption of fish is very low: 6,12 kg / capita / year in 2018. It is very low in comparison to both European and the world average (respectively 24,36 Kg / capita / year and 20 kg / capita / year).
- Apparent consumption of freshwater aquaculture products is estimated to reach 47.064 live weight, i.e. 38% of national consumption of fisheries and aquaculture products in 2018.
- Seasonal consumption with a peak in Christmas. According to national source, 30% of produced fish food sold in supermarkets is sold in the Christmas period.
- There a are several initiatives and efforts undertaken to promote eating fish in Hungary (gastronomic events, a community fish marketing programme called ("Get hooked!") in the period of the Fisheries Operational Programme of 2007-2013 and the Hungarian Fisheries Operational Programme of 2014-2020.

Socio-economic data: number of enterprises, employment, turnover

No information available.

2.10.3 Benefits of freshwater aquaculture

Economic insights and benefits

- Fish production represents only a small part of the national economy, contributing to 0,03 % to the national economy's GDP and 1,69% of the Hungarian animal husbandry sector. However, the significance of the sector goes beyond the statistical numbers, as pond aquaculture involves a number of economically and socially important aspects that cannot be directly expressed in production terms. These include ecosystem services whose specific share is the highest of all agriculture sectors in Hungary.
- According to the national authority, there are differences between pond aquaculture and intensive aquaculture, the latter having better profitability levels. Intensive production takes place in closed systems, it requires more knowledge and qualification, and it is also characterized by higher investments. An analysis of investment figures shows that the gross investment of producers with better profitability levels significantly exceeds that of less profitable farms.

Social benefits

- Fish production facilities play an important role in the economy of some rural regions and the employment of the rural population, especially taking into account the increasing importance of aquaculture in the provision of services. Pond aquaculture and intensive aquaculture units employed 1.449 persons in 2018, from which 1.274 are employed for full-time jobs (69%) and 640 for part-time jobs (12%).
- According to national authority, the revenue of individual farmers has shown an overall growing trend in the last ten years, the total revenue exceeded 1.5 billion HUF in 2017. The majority of individual farmers get a revenue of less than 8 million HUF (predominantly even less than 4 million HUF).

Other benefits (historical, cultural)

- There are many similarities between the pond aquaculture of Hungary and Eastern European countries. They learned pond aquaculture from each other. Hungarians learned pond aquaculture from Germany and Bohemia. They learned the technology of large-scale carp propagation from Hungary.

Environmental benefits

Maintenance of aquatic habitats and biodiversity

Role of the fishponds as potential biological water treatment units.

2.10.4 Assessment of the level of investment in the sector

According to national authority, investment in the sector has been difficult in the last period as a result of the low profitability. Successful investments have mostly resulted from grants and subsidies. Because of the low profitability, the interest of investors in the sector is also limited

2.10.5 Assessment of the level of innovation in the sector and main drivers

Pond aquaculture:

In the last years: Polyculture production has been improved in Hungary. The technologies applied in Hungarian pond aquaculture are mostly still based on traditional methods. The specificities of the Hungarian pond aquaculture: Hungary has nearly 30 State-approved breeds. Excellent breeds are sought for in the world. It can be mentioned as an example that, when common carp seed was exported from Hungary to other countries (Iran, Mexico, Uzbekistan and Vietnam), the receiving countries was quite satisfied with its quality.

In the future:

- the growing production of predatory fishes is due to research on the rearing of these species. Hopefully, Hungarian production technologies of freshwater predatory fishes and selectivity bred breeds will help the sector to become a regional leader in the production of these species in the near future.
- The energy- and water-efficient pond aquaculture developed as an answer to climate change, among others, plays an important role in preserving the environmental and natural values and is expected to become even more important in the future.

Innovative fish production technologies :

- It is a big challenge of pond aquaculture how fish ponds, as valuable wetlands, can be preserved in a way that could still contribute to increasing the production and employment. The solution is to combine the operation of a fish pond and an intensive fish production units. This solution is called: **Intensive-Extensive (CIE) system.** An example could be the "pond-in-pond system in which high-value species are reared in the intensive unit (floating tank), while traditional pond aquaculture is applied in the extensive fish pond treating the effluent. Another example of applying CIE system in farm conditions is the "cage-in-pond" system where intensive rearing of catfish is combined with the production of pond aquaculture species. The efficiency of the system's operation is supported by such innovative practices as the use of solar energy and the application of microorganisms assisting the decomposition of bottom sediments.
- Another type of CIE systems is linking small intensively used ponds and large extensive ponds („pond recirculation"), which ensures water and nutrient recycling, and thus, water-efficiency and a more complete nutrient utilization.
- **Multifunctional pond farming** which associates pond farming with other activities: ecosystem and tourist services but there is also a purposefully developed system of facilities available for visitors including, inter alia, pensions, restaurants, wellness centres, summer camps and museums.
- The **Freshwater Integrated Multitrophic Aquaculture** (IMTA).
- **Partial recycling of coldwater** aquaculture and treatment of the tanks' waters.
- **The renewal of the hatcheries' technological solutions**: optimizing energy demand by using renewable energy (water and air cooling/ heating), the manpower need was rationalized and relieved through the introduction of new technologies (e.g. flow meters) and techniques (e.g. installation of equipment taking into account ergonomic aspects).

2.10.6 Existence and weight of "quality schemes" in the sector

The following quality schemes have been identified: Three PGIs: Szegedi tükörponty, Szilvásváradi pisztráng, Balatoni hal and one PDO: Akasztói szikiponty. According to the national authority, under each of these quality schemes, fish is currently produced by only one or two companies. Because of the low number of farms, data are considered confidential under the Law on Statistics (data identifiable at farm level are not publicly available).

The "Quality Fish from Hungary" quality scheme (managed by the Hungarian Aquaculture and Fisheries Interbranch Orgenization) has been awarded to two farms. Volume is unknown due to confidentiality.

2.10.7 Assessment of the sector's growth potential

The aquaculture development strategy in Hungary shows that aquaculture development is not only a possibility for Hungary, but also a need, whose importance exceeds the economic wight of the sector. Increasing the Hungarian fish consumption (Hungary is the last in the European ranking) and eliminating its seasonality are strategic objectives from both economic and health point of views. The approaches that could help to achieve these objectives include:

- Development of multifunctional aquaculture which in addition to ensuring economic stability for fish producer can also improve the public image of the sector.

- The national assets of Hungary such as the geothermal ressources should be better exploited.
- The use of recirculating aquaculture systems should be expanded.
- The development of combined systems, which is a way to ensure the sustainable intensification of fish production.
- Increasing the processing capacities and improving exploiting existing facilities.
- Promotion and marketing of highly processed products, kitchen-ready products, attractively and hygienically packaged fish products. In addition to promoting the health effects and organizing traditional events (e.g. fish festivals).

Main drivers and opportunities:

- Financing is possible through both the Hungarian Fisheries Operational Programme and Hungarian project opportunities.
- Hungarian aquaculture has a good record of developing new fish production systems and technologies in both pond aquaculture and intensive fish production in tanks.
- The abundantly available and relatively cheaply exploitable thermal sources of Hungary offer good possibilities of intensive warm water fish rearing and the introduction of tropical species into production.
- Several research institutes in fisheries and aquaculture in Hungary.

Challenges and gaps:

- Could Hungary produce more carp? Probably yes. However, market is the real limiting factor.
- Low consumption of fish products (but increasing !).
- Low level of profitability and limited possibilities for investment, which are the reasons for the strong dependence of the farmers on grants.

2.10.8 Sources of information

- Statistics: FAO, EUMAP, EUROSTAT.
- Fisheries and fisheries advocacy in Hungary in 2018, MA-HAL.
- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- The EU fish market.
- The multiannual plan for the development of aquaculture in Hungary.
- National authority survey.

2.11 Ireland

2.11.1 Market dimension of the freshwater aquaculture sector

Production

The freshwater production in Ireland refers to the production of freshwater trout (60% of national production volume and 33% of its value) and salmon smolt (40% of the production volume and 67% of its value). Perch production has never exceeded 70 tonnes in the last years.

Table 1 – Freshwater aquaculture volume and value, 2008-2019

Species	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volume (Tonnes)										
Salmon ova/smolt	359	489	451	473	488	527	610	528	256	400
Rainbow trout	668	601	601	728	728	705	705	647	557	608
Others	64	56	50	80	78	45	15	-		-
Total Volume	**1.091**	**1.146**	**1.103**	**1.281**	**1.294**	**1.277**	**1.330**	**1.175**	**813**	**1.008**
Value (1.000 EUR)										
Salmon ova/smolt	2.012	3.468	5.687	3.261	3.203	4.845	4.167	5.086	5.118	3.393
Freshwater Trout	1.960	1.934	1.784	2.147	2.147	1.962	1.934	1.971	1.590	1.674
Others	460	399	322	507	546	266	105	0	0	
Total value	**4.432**	**5.801**	**7.793**	**5.915**	**5.896**	**7.073**	**6.206**	**7.057**	**6.708**	**5.068**

Source: National statistics

FEAP's statistics (table below) are slightly different from national statistics, with a higher volume of rainbow trout reported (1.057 t in 2018 for 557 t in national statistics). This is likely to be due to most of large trout is reared in seawaters.

Table 1 bis – Freshwater aquaculture volume 2009-2019

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Portion Rainbow Trout	1.000	1.000	1.000	1.000	1.000	1.000	500	500	500	500	-
Large Rainbow Trout	1.000	434	434	434	450	400	500	500	500	557	500
Total	**2.000**	**1.434**	**1.434**	**1.434**	**1.450**	**1.400**	**1.000**	**1.000**	**1.000**	**1.057**	**-**

Source: FEAP production report 2020

Description and the share of the different farming techniques

According to EUROSTAT, trout production occurs in tanks and raceways.
No RAS production.

Markets supplied: restocking / leisure fishing / food markets

- Rainbow trout market: domestic market.
- Salmon smolt market: on-growing units in Ireland, with a small percentage being exported to Scotland and France.
- Perch is mainly exported.

2.11.2 Weight in terms of food supply, growth and jobs

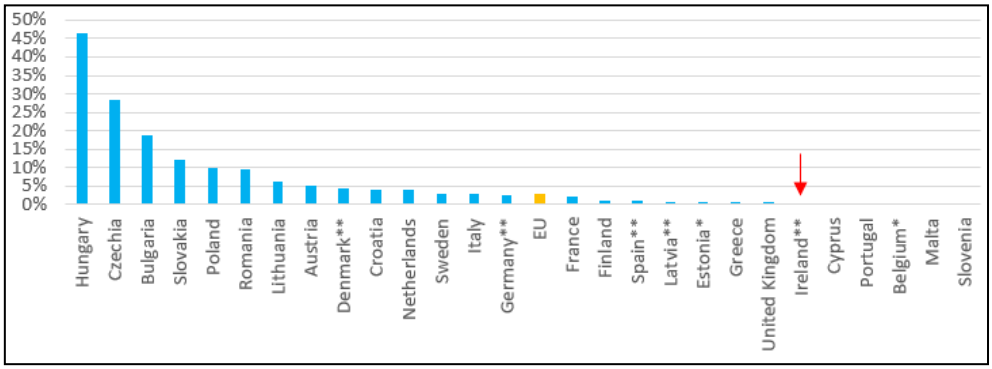
Production share of freshwater aquaculture in the total aquaculture production.

If we take into account the juvenile sector, the Irish freshwater aquaculture production represents 6% of the Irish aquaculture production volume and 5% of its value.

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

Per capita consumption of fisheries and aquaculture: 23,13 Kg / capita / year in 2018. The contribution of freshwater aquaculture products in the fisheries and aquaculture market seems negligible. The national authority confirmed that "freshwater trout consumption is a niche market rather than a traditional or common purchase".

Figure 1 - % of freshwater aquaculture in apparent consumption[16]



*Source: EUROSTAT / *) FAO / **) National statistics*

Socio-economic data: number of enterprises, employment, turnover.

- In 2018, 6 enterprises were active in freshwater aquaculture production in Ireland. The freshwater aquaculture activities is constituted exclusively by small enterprises (< 10 employees).
- The freshwater production employed 49 persons (26 employed in salmon hatcheries and nurseries and 23 employed in trout grow-out production).
- The number of enterprises as well as the number of employees has significantly decreased between 2008 and 2016.

Table 3 – Number of enterprises, employees and turnover of freshwater aquaculture activities

Variables	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Nb. of enter. <=5 employees	20	19	17	21	16	15	13	11	11	4	5
Nb. of enter. >10 employees	0	0	0	0	0	0	0	0	0	0	0
Nb. of enter. 6-10 employees	3	3	3	4	3	3	2	3	3	1	1
Nb. of enter.	**23**	**22**	**20**	**25**	**19**	**18**	**15**	**14**	**14**	**5**	**6**
FTE	92	57	59	63	47	45	39	42	38	12	16
Total employees	**120**	**75**	**77**	**86**	**65**	**63**	**56**	**52**	**49**	**14**	**20**

Source: DCF/EU-MAP data

[16] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

2.11.3 Benefits of freshwater aquaculture

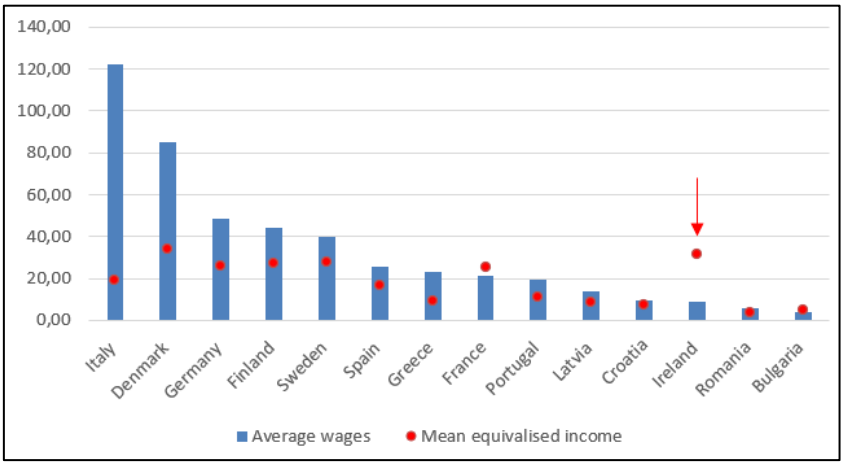
Economic benefits

- Decrease of turnover of freshwater aquaculture activities between 2008 and 2016 by -37%.
- Although the freshwater trout sector is significantly smaller and production and prices have remained static, all production supplies the domestic market. Trout is imported from Spain and France when there is a gap.
- Economic indicators show negative trends. Profit margins are indeed shrinking in the face of increasing costs which tend to affect small producers most. All freshwater units in Ireland are small enterprises.

Social benefits

- The number of employees related to freshwater aquaculture activities follows a decreasing trend until 2017.
- Revenue from aquaculture activities was below the mean equivalised net income[17] in 2018.
- According to the strategic multiannual plan for the development of aquaculture, 87% of the trout production is concentrated in specific regions: Kilkenny and Wicklow. Trout production is important for these regions.

Figure 2 – Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (1.000 EUR)



Source: DCF/EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalised net income

Environmental benefits

According to national authority, sustainable employment is maintained in rural or remote areas of limited alternatives and production of both finfish and shellfish do not require the input of chemicals or nutrients, beyond feed requirements of finfish, compared with mainstream agriculture.

2.11.4 Assessment of the level of investment in the sector

- Lack of private investment for the aquaculture sector in general
- Insufficient investment in R&D for the aquaculture sector in general
- Lack of access to finance for the aquaculture sector in general (source: Multiannual Plan for Aquaculture)
- According to national authority, administrative burdens to get licences alongside with costs associated to external markets and the low home market contribute to discourage investment.

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2.11.5 Assessment of the level of innovation in the sector and main drivers

Low level of innovation (some isolated initiatives in RSA and multi-trophic system).

However, trout units are vertically integrated

2.11.6 Existence and weight of "quality schemes" in the sector

100% of salmon production have an organic scheme and the Irish salmon hatcheries have organic certification.

2.11.7 Assessment of the sector's growth potential

According to the strategic multiannual plan for the development of aquaculture, rainbow trout production in freshwater has low growth potentialities.

The potentialities for growth of the salmon grow-out sector may imply growth potentialities of salmon hatcheries and nurseries.

2.11.8 Sources of information

- Economic Report of EU aquaculture sector (STECF-16-19 and STECF-20-12).
- The EU fish market.
- Ireland's Seafood Development Agency, "National seafood survey: Aquaculture report 2019".
- National strategic Multiannual plan for Aquaculture.
- National authority survey.

2.12 Italy

2.12.1 Market dimension of the EU freshwater aquaculture

Production

36.736 tonnes of freshwater fish were produced in Italy in 2018. The Italian production has remained relatively stable over the period between 2008 and 2018.

Table 1 – Freshwater aquaculture volume (tonnes according to several statistical sources, 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Vol.	38.793	39.339	41.105	38.804	38.966	39.015	34.857	34.717	-	39.628	36.736
Val.	243.679	35.761	112.651	106.096	121.988	124.959	109.459	123.317	-	138.598	120.202

Source: Eurostat

Hatcheries and nurseries for both fry and human consumption:

- For human consumption (61,1 tonnes for EUR 38,5 million): Rainbow trout and Sturgeons caviar. Positive trends since 2010.

Table 2 – Hatcheries and nurseries for human consumption, volume (tonnes) and value (1.000 EUR), 2010-2018

	2010	2011	2012	2013	2014	2015	2016	2017	2018	Evol.
Volume	11,08	17,08	31,35	31,3	35,85	37,15	40,45	46,05	61,1	451%
Value	5.886	11.016	24.103	23.643	19.702	21.171	24.994	23.948	38.446	553%

Source: EUROSTAT

- Hatcheries and nurseries for fry: mainly salmonids (Rainbow trout) and in anectodical volumes carps, tench, with positive trends.

Table 3 – Production of eggs and juveniles volume, 2009-2017, million unit

product	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Eggs	163	156	241	231	224	205	225	346	-	275	268
Juveniles	110	110	122	114	121	112	144	200	-	139	149

Source: EUROSTAT

Production by species + relative weight in the production

Rainbow trout is the important freshwater species reared in Italy (in terms of value, it is the most important species in Italy including marine production). In 2018, it represented around 89% of freshwater production volume and 79% of its value. Rainbow trout is followed by Sturgeons (3% of production volume and 8% of its value), sea trout (2% of production volume and value) and European eel (1% of production volume and 4% of its value). Except sturgeons production which has known a significant increase, the production of the other species has decreased.

Table 4 – Breakdown of freshwater aquaculture production by species in Italy – 2010 – 2018, tonnes

Species	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainbow trout	35.697	34.366	35.261	35.004	31.300	30.503	34.307	34.407	32.826
Sturgeons nei	732	838	714	717	824	725	920	2.040	1.179
Sea trout	1.251	1.485	144	153	782	1 013	668	436	648
European eel	567	471	575	586	528	446	669	832	454
Others	2.858	1.644	2.272	2.556	1.424	2.030		1.913	1.630
Total	41.105	38.804	38.966	39.015	34.857	34.717	-	39.628	36.736

Source: EUROSTAT

FEAPs statistics (table below) provide a slightly different figure for Italian freshwater aquaculture, with circa + 5.000 for the total volume of production in 2018, which are likely to correspond to large rainbow trout production.

Table 4 bis– Breakdown of freshwater aquaculture production by species– 2009 – 2019, tonnes

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Portion Rainbow Trout	40.500	39.000	39.000	36.300	36.000	36.800	37.000	33.800	33.300	35.000	32.800
Large Rainbow Trout	600	1 000	2 000	1.500	2.000	2.000	1.000	2.500	1.800	2.500	4.000
Sturgeons nei	1.350	1.900	1.900	1.700	1.900	2.000	1.480	1.000	1.000	1.000	1.000
Other Species*									800	800	900
European eel	1.070	960	1.100	1.100	1.000	1.000	1.000	850	850	850	750
Common Carp	750	700	750	750	700	700	700	700	600	600	550
European Wels Catfish	215	300	550	550	600	600	300	350	350	450	450
Arctic Char									100	150	175
African Catfish											40
Total	**44.485**	**43.860**	**45.300**	**41.900**	**42.200**	**43.100**	**41.480**	**39.200**	**38.800**	**41.350**	**40.665**

Source: FEAP production report 2020

Hatcheries and nurseries for human consumption concern sturgeons caviar **(80% of production volume and** 99% of its value) and rainbow trout. According to EUROSTAT, 49 tonnes (52 tonnes according to the Italian producers associations-API) of caviar were produced in 2018, which represents a significant increase in comparison to 2010 (10 tonnes were produced°. Italy is the leader producer in Europe and the second Mondial producer.

Description and the share of the different farming techniques

- Main farming technique is tanks and raceways, used to rear trout, European eel and sturgeons.
- The other farm technique is ponds, it is used for carps, channel catfish, sturgeons and tench.

Table 5 - Breakdown of freshwater aquaculture by aquaculture methods in 2018

Method	% volume	% value
Ponds	13%	16%
Tanks and raceways	87%	84%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

The caviar production is exported to more than 90%.

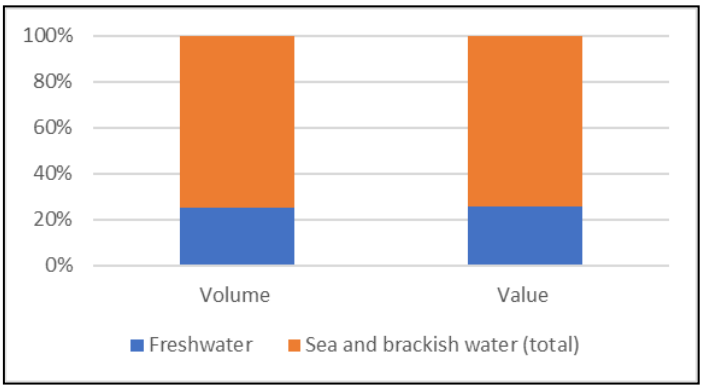
According to interviews with the "Associazione Piscicoltori Italiani", usually rainbow trout is marketed in: supermarkets (40% of the production), HORECA (20%), put and take fisheries (20%) and export (20%).

2.12.2 Weight in terms of food supply, growth and jobs

Production volume and value

In 2017, the Italian freshwater aquaculture production was estimated at 39.628 tonnes for over EUR 138,8 Million which represented 25% of the Italian aquaculture production volume and 26% of its value. In addition to this production, the caviar sector generates significant revenue as it is a highly valuable product. In 2017, the caviar sector generated EUR 23,5 million.

Figure 1 – Breakdown of aquaculture in Italia by aquaculture environment in 2017

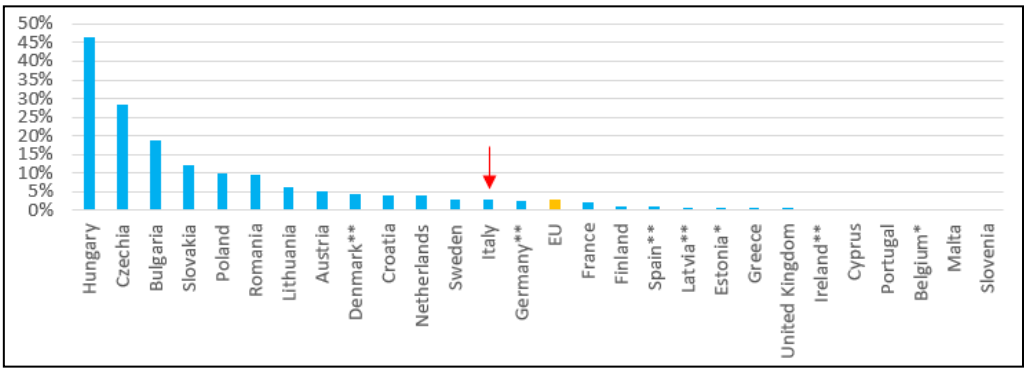


Source: EUROSTAT

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- The EU fish market indicates that in 2018, the apparent consumption of fisheries and aquaculture products in Italy is 31,02 kg/ capita / year.
- Freshwater eel are mainly consumed during Christmas holidays.
- Aquaculture products are seen as "supermarket fish" and Italian consumer have an affective preference for caught fish.
- Total apparent fish consumption in Italy accounts for circa tonnes 1,3 million and only 3% were from freshwater aquaculture.

Figure 2 - % of freshwater aquaculture in apparent consumption[18]



*Source: EUROSTAT / *) FAO / **) National statistics*

Socio-economic data: number of enterprises, employment, turnover

- In 2018, the freshwater aquaculture in Italy employed 683 persons in 146 enterprises. The sector is mainly represented by small-size enterprises, dominated by family run businesses (86% of enterprises have less than 5 employees).
- According to the "Associazione Piscicoltori Italiani", the figures on number of enterprises and persons involved in freshwater production are underestimated. The professional organization is currently working on collecting these information.

[18] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

Table 7 – Number of enterprises, employees and turnover of freshwater aquaculture activities

Variables	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Nb. of enter. <=5 employees	207	207	206	181	181	181	181	167	105	105	126
Nb. of enter. >10 employees	13	13	13	11	13	13	13	35	20	20	12
Nb. of enter. 6-10 employees	50	50	45	34	32	32	32	60	21	21	8
Nb. of enterprises	270	270	264	226	226	226	226	262	146	146	146
FTE	132	140	26	137	131	208	100	725	112	95	136
Total employees	**1.577**	**1.374**	**784**	**929**	**915**	**1.158**	**1.060**	**853**	**559**	**531**	**683**

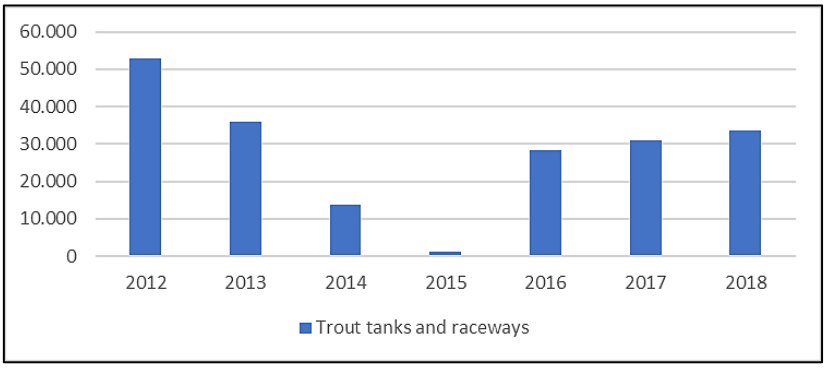
Source: DCF/EU-MAP data

2.12.3 Benefits of freshwater aquaculture

Economic insights and benefits

Overall, the trout segment has recorded positive net profit since 2012.

Figure 2 - Net profit of freshwater aquaculture activities by segment from 2012 to 2018 (EUR)



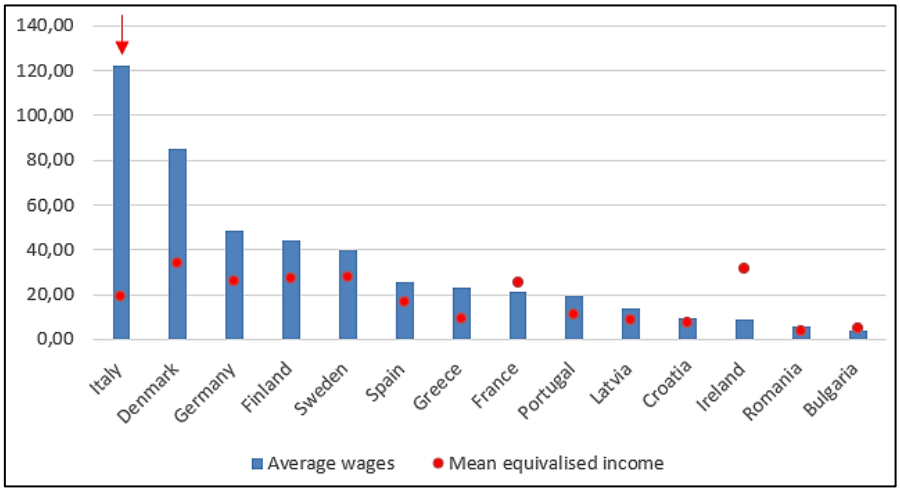
Source: DCF/EU-MAP data

Social benefits

According to EU-MAP data on wages, the average wage from freshwater aquaculture was significantly higher than mean equivalised net income[19] in 2018. Italy, where intensive trout aquaculture dominates, reported the highest wages from freshwater aquaculture in the EU.

[19] Mean equivalised net income is the mean of total income of all households, after tax and other deductions, which is available for spending, divided by the number of household members converted into equivalised adults.

Figure 3- Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (1.000 EUR)



Source: DCF/EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalized net income

2.12.4 Assessment of the level of investment in the sector

- Lack of investment in new equipment (tanks have been constructed in 60's) (Source: STECF 16-19)
- The "Associazione Piscicoltori Italiani" considers that the self-financing capacity is good but the access to credit is difficult.

2.12.5 Assessment of the level of innovation in the sector and main drivers

Since 2014 only one farm produces rainbow trout in RAS. The production recorded is 2 tons in 2017 and 2,5 tons in 2018. It is at experiment stage.

2.12.6 Existence and weight of "quality schemes" in the sector

- DOP "Tinca Gobba Dorata del Pianalto di Poirino" on tench
- DOP "trote del trentino" on rainbow trout
- ASC and organic rainbow trout

2.12.7 Assessment of the sector's growth potential

Main drivers and opportunities

- Varity of species farmed and growing interest on rearing new species.
- Successful initiatives to produce in Integrated Multi-trophic systems, including aquaponics.
- Increase of carp and catfish national demand (due to the presence of people from Eastern Europe and Asia in Italy).
- High prices for caviar and sturgeons.
- Considerable interest in labels (e.g. organic, quality schemes, etc.) and increasing number of local certification schemes.

Challenges and gaps

- Dependence on other EU states for freshwater fry provision.
- Important cost of creation of eel farm and competition of North European and Asiatic countries on this species.
- Trout sector has reached its environmental, social and economic carrying capacity (*Sources: Multiannual Plan for Aquaculture and STECF 2016-19).*
- Low level use of EMFF support.

2.12.8 Sources of information

- Italian Fish Farmers Association (API), 2019.
- Economic Report of EU aquaculture sector (STECF 16-19 and STECF 20-12).
- The EU fish market, 2019 Edition.
- National strategic plan for aquaculture 2015.

2.13 Lithuania

2.13.1 Market dimension of the EU freshwater aquaculture

Production

Acccording to Eurostat, 3.446 tonnes were produced in Lithuania in 2018, which marks an increase of production volume by 15% and of production value by 69%.

Table 1 – Freshwater aquaculture volume (Tonnes) and value (1.000 EUR), 2008-2018

Source	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume	3.008	3.428	3.088	2.877	3.226	3.841	3.353	4.085	4.099	3.459	3.446
Value	6.636	6.655						9.517	10.938	10.858	11.221

Source: EUROSTAT

- Significant decrease of juvenile production between 2008 and 2017.
- Main species produced are: common carps (83% of juveniles production in 2017), bighead carp, sturgeons, crucian carps, grass carps, northern pike, pike perch and tench.

Table 2 – Freshwater juveniles production according to several EUROSTAT, 2008-2017, MIO

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Juveniles	135.52	137.64	1.07	7.924	13.287	15.355	15.947	10.868	11.595	15.167

Source: EUROSTAT

Production by species and relative weight in the production

- Common carp is the most important species reared in Lithuania. In 2018, it represented 78% of freshwater production volume and 66% of its value, despite a slight decrease in the last ten years (by -4% in terms of volume).
- New species production appeared during the last 10 years, even though production volumes remained low: North African catfish (6% of freshwater production in volume and 8% in value in 2018), rainbow trout (3% in volume and 4% in value) , grass carp (2% in volume) and crucian carp (<1% in volume)

Table 3 – Breakdown of freshwater aquaculture production by species in Lithuania – 2008 – 2018, tonnes

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Common carp	2.823	3.222	2.951	2.703	2.968	3.457	2.900	3.401	3.252	2.710	2.701
North Afri. catfish					13	33	44	131	118	167	214
Sturgeons	17	9	17	43	53	115	73	83	118	117	153
Rainbow trout	80				54	52	38		328	106	111
Bighead carp	11	64	30	25	18	46	93	89	158	160	110
Others	77	133	90	106	120	138	205	381	125	199	157
Total	3.008	3.428	3.088	2.877	3.226	3.841	3.353	4.085	4.099	3.459	3.446

Source: EUROSTAT

Description and the share of the different farming techniques

- Pond is the main production technique. Common carp is the main species which is mostly produced in polyculture with other cyprinids (crucian carp, bighead carp, grass carp, etc.) and other freshwater species (Northern pike and Tench).
- RAS is the second most important technique with 565 tonnes produced in 2019 (13% of the production volume and 18% of its value). North African Catfish production corresponds integrally to RAS and half of the salmons production (50 tonnes) is produced in RAS.

Table 4 - Breakdown of freshwater aquaculture by aquaculture methods in 2018 and 2019

Method	2018		2019	
	Volume	Value	Volume	Value
Ponds, tanks and raceways	90%	84%	87%	82%
RAS	10%	16%	13%	18%

Source: National statistics provided by national authority

Markets supplied: restocking / leisure fishing / food markets

- 87% of Lithuanian aquaculture production is sold in internal market in 2019. The rest is exported (mainly to Poland and Latvia).
- Destination of aquaculture production is firstly food fresh market (63% of the Lithuanian sales in internal market in 2019), processing (25%) and restocking (11%).
- Carp is sold to local and export markets (mainly fresh). North African catfish is sold only in national market for the processing industry. Sturgeons are mainly exported.
- Other valuable species are also produced for the processing industry such as sturgeons, pike-perch and European catfish.

Table 5 – % of sale in Lithuania by market

Market	2018		2019	
	Volume	Value	Volume	Value
Production for restocking	10%	12%	11%	13%
Processed by aquaculture units which has processing facilities*	22%	28%	25%	32%
Sales in Lithuania of live/fresh/chilled for consumption	68%	60%	63%	55%

Source: National statistics provided by national authority

2.13.2 Weight in terms of food supply, growth and jobs

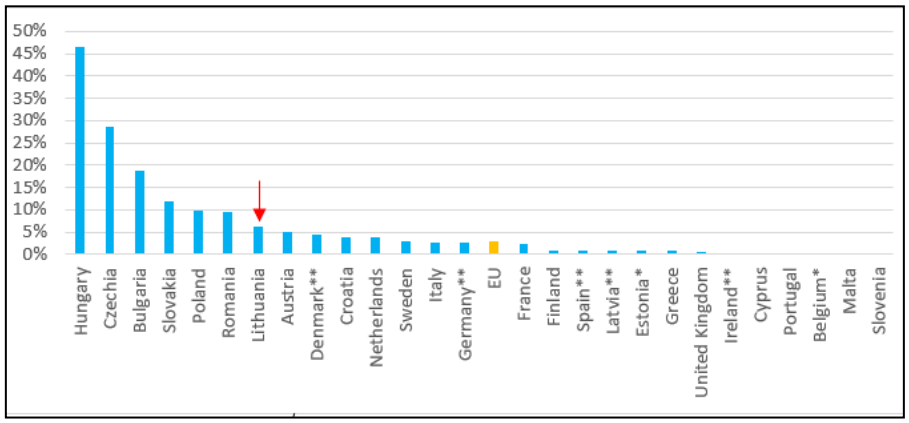
Production share of freshwater aquaculture in the total aquaculture production.

Only freshwater aquaculture is practiced in Lithuania.

Share of freshwater aquaculture fish in fisheries and aquaculture consumption

- Per capita consumption of fisheries and aquaculture products in 2018: 13,78 Kg / capita / year.
- Increase in the local market is related to higher demand for processing aquaculture production, as new processing units were developed.
- Total consumption of fisheries and aquaculture products accounts for 99.543 tonnes and only 3.459 tonnes was from aquaculture (freshwater).

Figure 1 - % of freshwater aquaculture in apparent consumption[20]



*Source: EUROSTAT / *) FAO / **) National statistics*

Socio-economic data: number of enterprises, employment, turnover.

In 2019, Lithuanian aquaculture sector consisted of 54 enterprises and aquaculture farms and 420 persons employed (-14%% less than 2015):

- Units involved in pond and tanks and raceways production cover the highest share of total production (84% of the production volume in 2019). In 2019, they were responsible for 77% of employment in the freshwater aquaculture sector (325 employees).
- In 2019, RSA employed 95 persons.

Table 6 – Number of enterprises

Method	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Ponds, tanks and raceways	19	19	20	26	23	22	24	25	26	28
RAS	2	2	6	9	16	19	31	22	23	26
Total	**21**	**21**	**26**	**35**	**39**	**41**	**55**	**47**	**49**	**54**

Source: National statistics provided by national authority

Table 7 – Number of employees

Number of employees	2015	2016	2017	2018	2019
Ponds, tanks and raceways	386	371	349	329	325
RAS	101	141	83	81	95
Total	**487**	**512**	**432**	**410**	**420**

Source: National statistics provided by national authority

2.13.3 Benefits of freshwater aquaculture

Economic insights and benefits

Negative net profits for the RAS segment is explained by the high investments made in the last years.

[20] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

Table 8 – Net profit of aquaculture segments in Lithuania

Method	2017	2018	2019
Ponds, tanks and raceways	485.375	85.679	442.591
RAS	- 442.430	- 632.043	- 1.051.882
Total	42.945	- 546.364	- 609.291

Source: National statistics provided by national authority

Environmental benefits

Ponds participate to water conservation, local climate regulation and wild birds protection. Ponds' area is estimated to reach 9.904ha.

2.13.4 Assessment of the level of investment in the sector

Lack of financial resources of aquaculture enterprises to invest in technologies, modernize their infrastructures or innovate

Public support is not enough (*Source: Multiannual Plan for Aquaculture).*

2.13.5 Assessment of the level of innovation in the sector and main drivers

RAS correspond to 13% of the national production volume and 18% of its value.

According to national authority, there is an intention to develop aquaponic activities (one enterprise combining fish and green cultivation is currently operating).

2.13.6 Existence and weight of "quality schemes" in the sector

Organic production represents significant share of the national aquaculture production (20% in 2018).

Table 9 – Organic production by species (2010-2019)

Species	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Carp	894	900	1.079	1.336	1.088	1.164	872	943	659	729
Crucian carp	15	14	23	14	20	8	7	4	5	18
Northern pike	8	15	16	15	13	16	11	13	8	11
White amur	3	9	19	24	39	16	17	16	14	9
Bighead carp	1	4	5	11	19	2	7	7	10	4
Tench	1	1	2	3	2	2	2	2	3	4
Other species	2	0	0	0	0	0	0	0	5	3
Total	**922**	**944**	**1.145**	**1.405**	**1.182**	**1.209**	**917**	**984**	**704**	**778**

Source: National statistics provided by national authority

2.13.7 Assessment of the sector's growth potential

The multiannual strategic plan for the development of aquaculture highlighted the following drivers and challenges to growth:

Main drivers and opportunities

- Large water resources.

- Increasing demand and consumption of fisheries products.
- Increased competitiveness through investments and diversification of income by vertical integration (processing facilities, restaurants, direct sales).
- Adaptation to the consumers' needs (with newly developed products) but at the same time supplying the market with traditional products allowing to maintain cultural heritage.
- Tradition and experience in pond aquaculture.
- Interest of enterprises for RAS.
- Ponds farms attract leisure fishers.

Challenges and gaps

- Dependence on energetic resources
- Low buying power of local population and threat of competition with cheaper imported products
- Overall lack of research and development in the aquaculture sector.

2.13.8 Sources of information

- The EU fish market 2019 Edition.
- Economic Report of EU aquaculture sector (STECF 16-19 and STECF 20-12).
- Multiannual strategic plan for development of aquaculture 2015.
- National authority survey.

2.14 The Netherlands

2.14.1 Market dimension of the EU freshwater aquaculture

Production

Between 2008 and 2018, the production volume has lost almost 3.700 tonnes but the production value has slightly increased (by 4% over the same period). The production value is largely dependent on the volume of eel, the most valuable species in the Netherlands.

Table 1 – Freshwater aquaculture volume (Tonnes) and value (1.000 EUR), 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume	8.565	7.727	6.470	4.080	3.235	6.375	5.625	5.190	5.190	4.761	4.911
Value	28.565	24.451	31.020	19.500	15.808	32.057	23.580	23.535	24.535	28.165	29.687

Source: Eurostat

Production by species + relative weight in the production

Freshwater aquaculture is dominated by production of European eel and North African catfish. Catfish has low value but is produced in relatively high volumes. Eel production was equivalent to catfish production (in termes of volume), but total value was almost 6 times higher (in relation to the high prices of European eel).

Table 2 – Breakdown of aquaculture production by species – tonnes – 2008-2018

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
North African catfish	4.000	4.450	3.200	1.620	1.200	3.100	2.900	2.900	2.900	2.470	2.470
European eel	3.700	2.800	3.000	2.050	1.800	2.885	2.335	2.000	2.000	2.000	2.150

Source: EUROSTAT

FEAP and EUROSTAT data (table 2 and table 2 bis) are relatively consistent for the two main species (North African catfish and European eel). FEAP statistics include circa 600 t of other species, among which pike perch, perch, sturgeons and rainbow trout, which are not reported in EUROSTAT.

Table 2 bis– Breakdown of aquaculture production by species – tonnes – 2009-2019

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
North African Catfish	3.500	3.200	3.000	3.000	3.100	3.100	3.100	3.100	2.470	2.470	2.470
European eel	3.200	3.000	2.800	2.300	2.885	2.885	2.885	2.885	2.000	2.150	2.150
Other species	115	100	120	120	150	150	150	150	150	100	400
Portion Rainbow Trout	50	50	50	50	70	70	70	70	100	40	40
Sturgeons nei							50	50	5	150	150
Total	**6.865**	**6.350**	**5.970**	**5.470**	**6.205**	**6.205**	**6.255**	**6.255**	**4.725**	**4.910**	**5.210**

Source: FEAP production report 2020

Description and the share of the different farming techniques

100% of the production occurs in recirculation system in the Netherlands.

Markets supplied: restocking / leisure fishing / food markets

There are no accurate information on the markets supplied by freshwater production. However, according to the multiannual plan for the development of aquaculture, fish products in the Netherlands are currently mainly sold

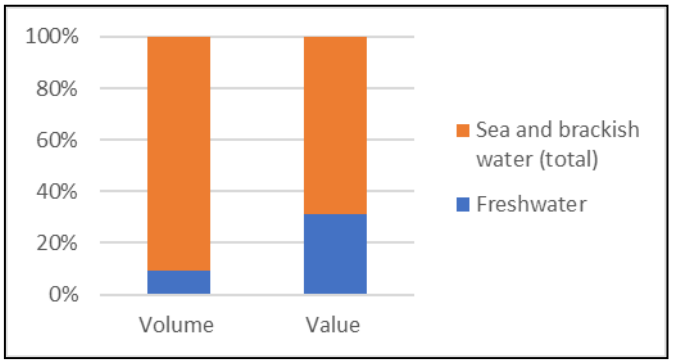
to the food market at regional level to HORECA (directly or through wholesalers) or in the neighborhood countries on the European markets, such as Germany, Belgium, France or Italy.

2.14.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in total aquaculture production

The freshwater aquaculture constitutes a small segment in terms of volume but an important segment in terms of value. In 2018, the Dutch freshwater aquaculture production was estimated at 4.911 tonnes for over EUR 29 Million which represent 9% of the Dutch aquaculture production volume and 31% of its value.

Figure 1 - Breakdown of aquaculture in Netherlands by aquaculture environment in 2018

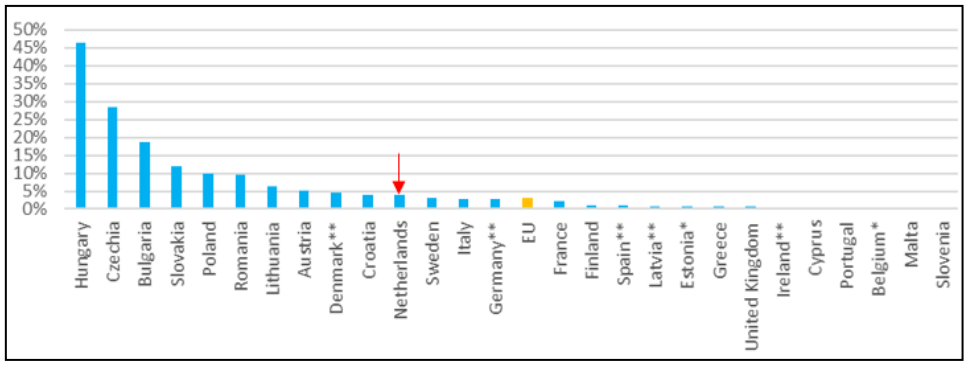


Source: EUROSTAT

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Apparent consumption of fisheries and aquaculture products : 20,9 Kg / capita / year (ranks 14 at EU level).
- Total fish consumption in Netherlands accounts for 126.872 t in 2018, from which 4.911 tonnes were produced in freshwater in Netherlands accounting for 4% of the total national consumption.

Figure 2 - % of freshwater aquaculture in apparent consumption[21]



*Source: EUROSTAT / *) FAO / **) National statistics*

Socio-economic data: number of enterprises, employment, turnover

- The production size of freshwater aquaculture has decreased over the years, as did the number of active companies. Between 2008 and 2014, the number of enterprises has decreased from 50 enterprises to 36.
- No information on employment. DCF data on soocio-economic indicators are partial.

[21] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

2.14.3 Benefits of freshwater aquaculture

Economic insights and benefits

- Freshwater aquaculture is a relatively small sector in the Netherlands (according to the STECF report). In 2018, turnover dropped by -43%, mainly due to a decrease in eel sales volume, which is related to the fact that some companies stopped the production or have been acquired by other companies due to low economic results (in relation to difficulties to be supplied with eel glasses, caught in the French estuaries and subject to quotas). However, based on anecdotal evidence, there are signs that the remaining companies succeed in business model innovation to increase revenues. Direct sales to consumers of processed products, even online, can increase revenues.
- The freshwater aquaculture sector shows some signs of change. Apart from the decreasing number of companies, there are signs that direct sales and local sales become more important.

Social benefits

No information on employment and on the benefits of the freshwater aquaculture activities in terms of revenue.

Activities are dispersed throughout the country, with some concentration around traditional fishing communities, thus with possible benefit to these communities.

2.14.4 Assessment of the level of investment in the sector

No information on this topic.

2.14.5 Assessment of the level of innovation in the sector and main drivers

100% of freshwater aquaculture occur in RSA.

2.14.6 Existence and weight of “quality schemes” in the sector

No identified “quality schemes” in the sector.

2.14.7 Assessment of the sector’s growth potential

According to the multiannual plan for the development of aquaculture, the objective is to increase the production value by 3% by 2023 (including marine aquaculture). The development strategy concern the following strategic directions which concern all aquaculture products (some of them are not specific to freshwater aquaculture):

- Production of exclusive and /or regional products for niche markets and adding value to fish products.
- New/ innovative cultivation systems.
- Marketing: increasing the sale in the current markets and the markets that are familiar with the freshwater products such as Germany and France. Cooperation with the processing sector and wholesalers, who have knowledge of the sales opportunities in the various markets, is essential for the successful marketing of existing but also possible new fish species.

Main drivers and opportunities:

- The increasing demand and consumption of freshwater aquaculture products in the Eastern European countries could represent an opportunity to create new sale channels.
- Developing the production of glass eels, supplying fish fry
- Cooperation and knowledge share,
- Creating new form of sales for sustainable fish
- Further develop animal welfare and slaughtering method and use it as opportunity for the German market.

Challenges and gaps:

- Problem of marketing and sales: most producers do not have budget for marketing and communication.
- Opportunities to sell products for the processing segment seem limited, because of the competition with the imported products.
- Most products reared in the Netherlands have small volumes and do not have continuous opportunities to sell the product in the retail segment.
- Few cooperation within the aquaculture sector,
- Low economic profitability for many companies,
- Small size of the sector,
- Too high production costs
- Too high degree of specialization
- Poor competitive position.
- Farmed fish certification (RAS could not have ASC or organic certifications).

2.14.8 Sources of information

- Statistics : EUMAP, EUROSTAT, FEAP.
- Economic Report of EU aquaculture sector (STECF 16-19 and STECF 20-12).
- The EU fish market.
- The multiannual plan for the development of aquaculture in Netherlands.
- The National Authority survey.

2.15 Poland

2.15.1 Market dimension of the EU freshwater aquaculture

Production

The production volume has remained stable over the period between 2008 and 2018. But the value of freshwater aquaculture production has significantly increased.

Table 1 – Freshwater aquaculture volume and value, 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume	36.813	36.503	36.503	34.246	33.226	31.258	36.336	33.560	35.452	35.419	36.806
Value	73.285	76.373		101.685	105.079	75.073	88.410	86.603	91.457	101.052	104.667

Source: EUROSTAT

- Significant eggs' production for human consumption, almost 23 tonnes in 2018 generating more than 9 million EUR (mainly sturgeon caviar: 84% of egg production volume and 99% of its value).
- Poland is the first producer of juvenile (mainly salmons, carps, pike perch, vendace, etc.) and second producer of eggs (after Denmark) in Europe (mainly rainbow trout and vendace).

Table 2 – Production of eggs and juveniles volume, 2009-2018, million unit

Stage	2013	2014	2015	2016	2017	2018
Eggs	332	354	699	903	806	924
Juvenile	481	501	634	731	563	802

Source: EUROSTAT

Production by species + relative weight in the production

- Common carp and rainbow trout are the most important species, representing respectively 45% and 40% of the production volume and 39% and 42% of the production value in 2018.
- Poland has become one of the most important market for portion (250 gr-400 gr) rainbow trout for human consumption.
- High diversity of reared species as many farms produce in polyculture more than one freshwater species, mainly African and European catfishes, grass carp, silver carp, bighead carp, crucian carp, pike, tench and sturgeon.
- European catfish production decreased (350 tonnes produces in 2008 against 109 in 2018). According to interview in Poland, this is due to the cessation of production of this species by the leading producer. The change in the profile of this producer resulted in an increase in the production of sturgeon.

Table 3 – Breakdown of aquaculture production by species – tonnes – 2008-2018

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Common carp	17.150	18.133	18.133	17.491	18.317	16.778	18.368	16.223	17.400	16.851	16.478
Rainbow trout	16.522	14.872	14.872	10.398	10.724	10.251	13.449	12.727	13.730	13.808	14.902
Chars nei	n.a.	n.a.	n.a.	196	665	891	1.172	1.238	938	1.253	1.543
Sturgeons nei	270	148	148	385	346	400	329	317	459	764	659
Bighead carp	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	111	536
Atlantic salmon	n.a.	n.a.	n.a.	43	18	0	0	4	272	394	493
Other	2.871	3.350	3.350	5.733	3.156	2.938	3.018	3.051	2.653	2.238	2.195
Total	**36.813**	**36.503**	**36.503**	**34.246**	**33.226**	**31.258**	**36.336**	**33.560**	**35.452**	**35.419**	**36.806**

Source: EUROSTAT

Data from FEAP 2009-2019 production report (table 3 bis) mention an overall production of circa 43.000 t of freshwater fish by Polish aquaculture, which is 6.000 t over EUROSTAT statistics. It has to be noted that FEAP data are rounded values that seems to be estimates sometimes reported from one year to another.
Although Common carp and Rainbow trout rank at first and second place in the two sources, FEAP reported in 2018 + 4.000 t of carp compared to EUROSTAT et + 5.000 t of rainbow trout.

Table 3 bis – Breakdown of aquaculture production by species – tonnes – 2009-2019

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Common Carp	18.300	15.400	14.400	16.500	17.700	18.000	18.000	18.000	18.000	20.000	18.300
Portion Rainbow Trout	14.000	11.000	13.000	14.500	14.500	17.500	19.000	18.000	19.000	20.500	15.600
Large Rainbow Trout											8.400
Bighead carp										570	680
Sturgeons nei	148	200	240	241	95	140	193	560	600	750	650
Grass carp	550	550	225	290	270	320	310	0	0	450	600
African Catfish	1.100	1.100	400	400	400	500	500	1.000	1.000	300	185
Other Species						260	na		0	210	170
Silver Carp	600	600	260	374	320	360	360	0	0	112	155
European Wels Catfish	350	400	220	219	250	250	250	200	200	76	120
European eel								51	86	1	11
Total	**35.048**	**29.250**	**28.745**	**32.524**	**33.535**	**37.330**	**38.613**	**37.811**	**38.886**	**42.969**	**44.871**

Source: FEAP production report 2020

Description and the share of the different farming techniques

The aquaculture sector in Poland includes two main components:

- Semi-intensive aquaculture in ponds, which produces mostly common carp and other species, such as Grass carp, silver carp, bighead carp and diverse coarse fish. 84,4% of the area used for pond farming are used to produce carp: 64.000 ha.
- Intensive aquaculture, among which trout is the most important.

Recirculation system is used in Poland to produce mainly rainbow trout, North African catfish and other species (chars, sturgeons, brook trout, etc.).

Table 4 - Breakdown of freshwater aquaculture volume by aquaculture methods according to Eurostat and national stat in 2017

Method_PL	Aquaculture method	National statistics
		% Volume
Stawy (betonowe i ziemne)	Ponds	44,5%
Baseny i tory wodne	Tanks and raceways	40,8%
Przegrody	Enclosures and pens	1,2%
Systemy recyrkulacyjne	Recirculation systems	12,5%

Source: National statistics

Markets supplied: restocking / leisure fishing / food markets

Carp is produced for the domestic market. Demand is seasonal and stagnating. Most carp is sold in December before Christmas Eve in the form of live fish and fresh whole fish.

The most important market for trout is processing. Export opportunities of processed trout (mainly smoked) are significant (mainly to the German market).

2.15.2 Weight in terms of food supply, growth and jobs

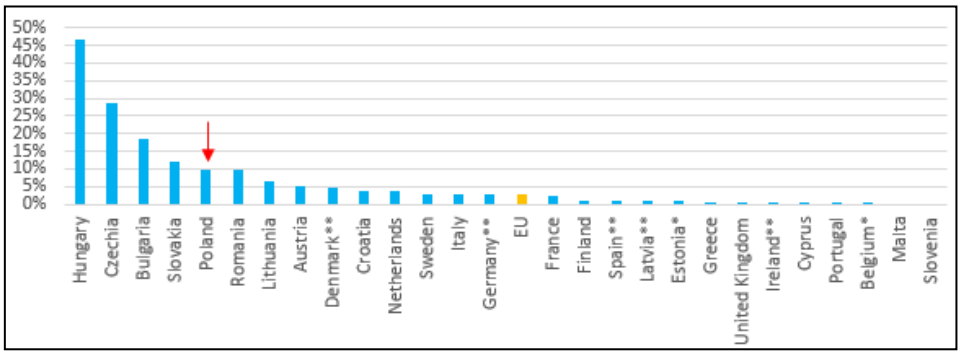
Production share of freshwater aquaculture in total aquaculture production

Almost all aquaculture production is realized in freshwater in Poland..

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Apparent consumption of fisheries and aquaculture products : 13,02 Kg / capita / year (ranks 20 at EU level).
- Total fish consumption in Poland accounts for 345.507 t in 2018. 36.806 tonnes were produced in freshwater in Poland accounting for 11% of the total national consumption.

Figure 1 - % of freshwater aquaculture in apparent consumption[22]



*Source: EUROSTAT / *) FAO / **) National statistics*

Socio-economic data: number of enterprises, employment, turnover

- According to Polish national stat, 1.050 enterprises were active in the Polish aquaculture sector in 2017 (850 involved in extensive farming and 200 in intensive farming).
- Overall, the aquaculture farms in Poland are managed mainly by micro and small family enterprises or small and medium companies. The DCF data show that the Polish freshwater aquaculture sector is dominated by small enterprises (70% of enterprises have less than 5 employees and 88% have less than 10 employees).
- According to national statistics, the total number of persons employed in the Polish freshwater aquaculture sector was 6.262 persons in 2017 and it slightly decreased in comparison to 2016 (-1%). A significant share of employees are self-employed or family members (45% in 2017) (table 5).

Table 5 – Employment structure in Poland in 2016 and 2017

		Self-employment and family members		Employment of external persons	
		2016	**2017**	**2016**	**2017**
Staff directly involved in production	**Permanent staff**	1.628	1.696	1.726	1.731
	Seasonal employment	944	955	840	882
Other staff		218	198	992	800
Total		**2.790**	**2.849**	**3.558**	**3.413**

Source: A. Lirski, L. Myszkowski, Inland Fisheries Institute, Obraz polskiej akwakultury w 2017 r.... Gdynia 2018.

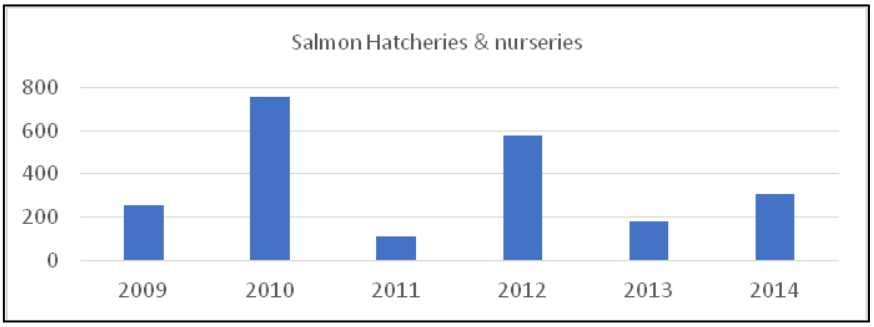
[22] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

2.15.3 Benefits of freshwater aquaculture

Economic insights and benefits

- Economic data are not available for the most important segments (as data reporting in freshwater is not mandatory). Economic data in EUMAP are only available for salmon hatcheries and nurseries which constitute a small segment in the freshwater aquaculture activity (only 3% of the freshwater aquaculture turnover).
- Net profit of the hatcheries and nurseries segment has fluctuated between 2009 and 2014 (there are no economic data since 2015).

Figure 2 - Net profit of freshwater aquaculture activities by segment from 2009 to 2014



Source: DCF/EU-MAP

Social benefits

- Important segment in terms of employment.
- Family enterprises.

Environmental benefits

The area of fish ponds: 64.000 ha (according to the national authority).

Due to the biological diversity of habitat and animal species of special importance for Poland, some Polish extensive fish ponds, were included in the Natura 2000 areas. In this case, many farms are turned into multifunctional fish farms ponds, which also offer services in recreation, maintaining biodiversity and improving water management.

2.15.4 Assessment of the level of investment in the sector

According to the national authority, the investment level in the freshwater sector is low. The main barriers include: bureaucratic barriers, changing legislation, growing problems to hire employees, uncertainty of return on invested funds.

The EU funds constitute an opportunity for investment.

2.15.5 Assessment of the level of innovation in the sector and main drivers

Recirculating system is used but is still at early stage. The main challenge is that RAS is considered very energy- and cost-intensive. The RAS experience in the salmon sector showed low level of economic performance which discouraged trout farmers.

2.15.6 Existence and weight of “quality schemes” in the sector

- Karp zatorski

- Recent implementation of certification for product safety and organic production: ASC and GlobalGap.

2.15.7 Assessment of the sector's growth potential

The National aquaculture strategy sets objectives by 2020 and 2023:

- Freshwater fish farming should maintain current extensive production level (carp) and over 100% growth of intensive production volume (trout) by 2020. This up-ward trend should be related to reducing piscivorous animals pressure, improve fish farms epizootic conditions and promotion of carp as slow food and a traditional Christmas dish.
- Increase the production by 50% in 2023.

Main drivers and opportunities:

- Significant processing industry in Poland.
- Good image of the Polish aquaculture products (the trout production has benefited from the effects of recurrent promotional actions (2011/2014) that succeeded in developing a positive image of trout as locally produced, environment-friendly and healthy).
- Sector with growing market potential.
- Export opportunities for trout (mainly smoked to the German market).
- EU funds for investments: Poland remains the biggest recipient of EU structural funds: Total allocations for Poland, amounting to 734 million EUR until 2020.
- The European Commission's Blue Growth agenda for the Baltic Sea Region identifies aquaculture as one of the most promising sectors of the region's maritime economy in terms of growth and job potential. Special emphasis will be given to recirculating aquaculture systems (RAS) and innovative combinations of RAS systems with e.g. plant production (aquaponic systems) and/or renewable energy.

Challenges and gaps:

- Water law
- Disease risk
- Administrative investment barriers
- Access to capital
- Low access to new qualified staff.
- Export opportunities of carp are low.
- The reared species and the production technique are dependent on the prevailing meteorological conditions: in the case of carp, too low autumn temperature shortens the feeding period and growth of fish. In the case of trout, too high temperature continuing the period from June to August limits feeding and weight gain of fish.
- Outbreaks of viral diseases.
- Pressure of piscivorous animals (cormorants, otters).

2.15.8 Sources of information

- Statistics: EU-MAP, EUROSTAT, FEAP.
- Economic Report of EU aquaculture sector (STECF 16-19 and STECF 20-12).
- The EU fish market.
- Price structure in the supply chain of fresh portion trout in Poland, EUMOFA, 2017.
- The multiannual plan for the development of aquaculture in Poland.
- National stat: Inland Fisheries Institute, National Marine Fisheries Research Institute
- FAO – National aquaculture sector overview.
- National authority survey.

2.16 Portugal

2.16.1 Market dimension of the EU freshwater aquaculture

Production

- Circa 700 tonnes were produced in freshwater in Portugal for over EUR 2 million.
- Production volume and value have significantly increased between 2008 and 2017.

Table 1 – Freshwater aquaculture volume (Tonnes) and value (1.000 EUR), 2008-2017

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Volume	305	251	951	1.115	479	775	788	890	676	697
Value	741	565	2.208	2.597	1.418	1.902	1.974	2.136	1.779	2.084

Source: Eurostat

Production by species + relative weight in the production

Freshwater aquaculture is exclusively dedicated to intensive trout production in cages and concrete tanks.

Table 2 – Breakdown of aquaculture production by species – tonnes – 2008-2017

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Rainbow trout	304	251	951	1.115	479	775	788	890	676	665
European eel	1									32

Source: EUROSTAT

The FEAP production report 2020 only reports data in volume for rainbow trout (Table 2 bis), the production of European eel being not disclosed for confidentiality issues (number of farms <5). Data appears consistent with EUROSTAT for trout.

Table 2 bis – Breakdown of aquaculture production by species – tonnes – 2009-2019

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Portion Rainbow Trout	936	951	900	900	1.000	788	890	676	665	662	660
Large Rainbow Trout							290	306			
Total	**936**	**951**	**900**	**900**	**1.000**	**788**	**1.180**	**982**	**665**	**662**	**660**

Source: EAFP production report 2020

Description and the share of the different farming techniques

Until 2012, production was recorded under tanks and raceways and cages. "Not specified" is likely to correspond to cages (this information has not been validated by the national authority).

Table 3 - Breakdown of freshwater aquaculture volume by aquaculture methods in 2017

Aquaculture method	% Volume	% Value
Tanks and raceways	5%	16%
Not specified	95%	84%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

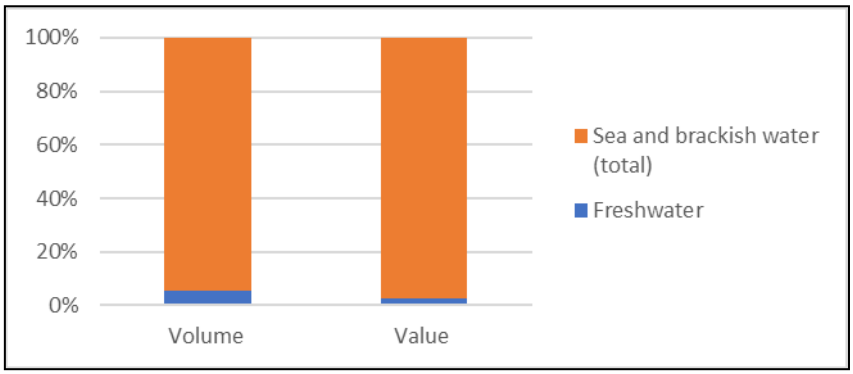
There is no information on the breakdown of freshwater aquaculture production by market.

2.16.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in total aquaculture production

Freshwater aquaculture segment represents only a very small segment in Portugal. In 2017, it represented 5% of the total aquaculture production and 2.5% of its value.

Figure 1 - Breakdown of aquaculture in Portugal by aquaculture environment in 2017



Source: EUROSTAT

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Apparent consumption of fisheries and aquaculture products in 2018: 60,92 Kg / capita / year (ranks second at EU level).
- Total fish consumption in Portugal accounts for circa 448.691 t in 2017, from which only 697 tonnes were produced in freshwater in Portugal accounting for 0,2% of the total national consumption.

Socio-economic data: number of enterprises, employment, turnover

In 2017, only 7 enterprises were active in freshwater aquaculture production in Portugal. 29 persons were employed in the sector the same year.

Table 4 – Number of enterprises, employees, wages (1.000 EUR) and turnover (1.000 EUR) of freshwater aquaculture activities

Variables	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Nb enterprises <=5 employees	9	12	10	7	15	8	5	8	4	5
Nb enterprises >10 employees	1	0	2	1	1	1	1	1	2	1
Nb enterprises 6-10 employees	1	0	1	1	1	1	1	1	0	1
Nb enterprises	**11**	**12**	**13**	**9**	**17**	**10**	**7**	**10**	**6**	**7**
FTE		35	48	31	52	33	27	34	28	27
Total employees	**44**	**37**	**48**	**34**	**64**	**39**	**31**	**38**	**32**	**29**

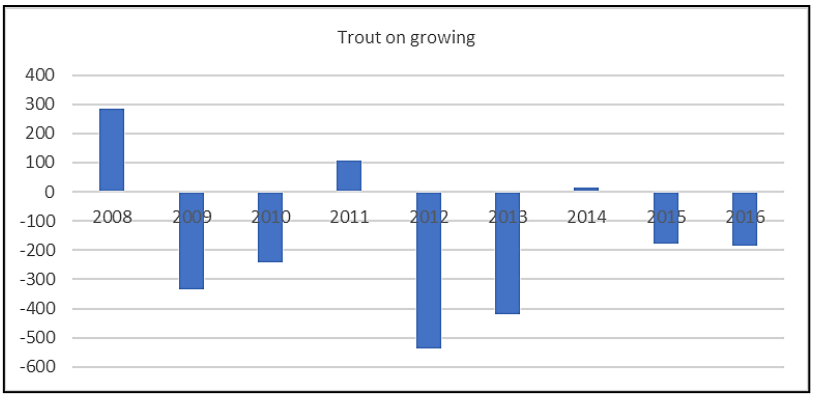
Source: DCF/EU-MAP

2.16.3 Benefits of freshwater aquaculture

Economic insights and benefits

Overall small or negative net profits.

Figure 3- Net profit of freshwater aquaculture activities by segment (1.000 EUR) from 2008 to 2016

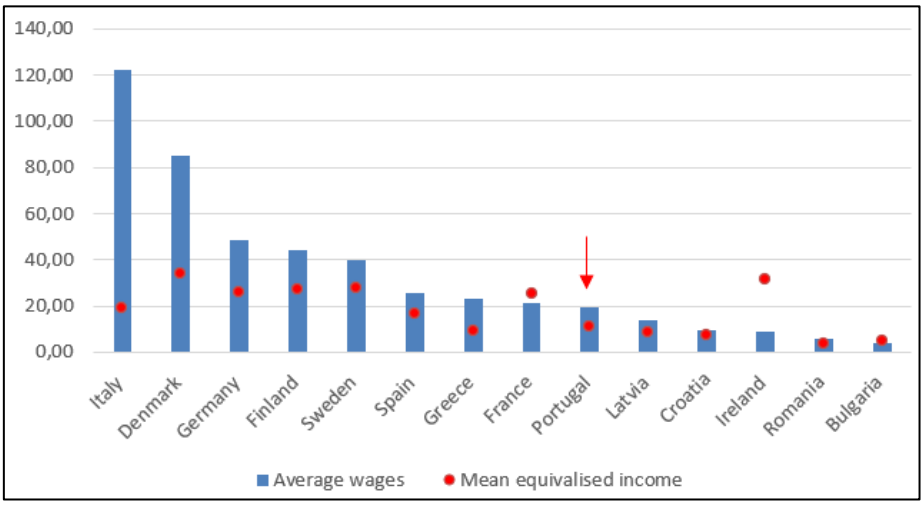


Source: DCF/EU-MAP

Social benefits

EU-MAP data show a level of revenue form freshwater aquaculture activities which was above the national mean equivalised net income[23] in 2018.

Figure 4 - Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (thousand EUR)



Source: DCF/EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalized net income

2.16.4 Assessment of the level of investment in the sector

There is no information specific to freshwater aquaculture in Portugal.

2.16.5 Assessment of the level of innovation in the sector and main drivers

There is no information.

2.16.6 Existence and weight of "quality schemes" in the sector

No quality scheme identified for freshwater aquaculture.

[23] Mean equivalised net income is the mean of total income of all households, after tax and other deductions, which is available for spending, divided by the number of household members converted into equivalised adults.

2.16.7 Assessment of the sector's growth potential

Main drivers and opportunities:

- Existence of highly deficient national and European market with an upward trend for fish consumption
- The European Commission's commitment to the development of the European aquaculture sector
- Work in collaboration with the processing sector.

Challenges and gaps:

- Strong competition with third countries.
- Financing difficulties.

2.16.8 Sources of information

- Statistics: FAO, EUMAP, EUROSTAT, FEAP.
- Economic Report of EU aquaculture sector (STECF 16-19 and STECF 20-12).
- The EU fish market.
- The multiannual plan for the development of aquaculture in Portugal.

2.17 Romania

2.17.1 Market dimension of the EU freshwater aquaculture

Production

- The production has fluctuated over the period between 2008 and 2018, with an overall slight decrease production volume and a significant increase of its value.
- There is an activity of hatcheries and nurseries (existence of both enterprises involved only in hatcheries and nurseries and combined farms, producing fry for their own use).

Table 1 – Freshwater aquaculture volume (Tonnes) and value (1.000 EUR) 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume	12.532	13.131	8.981	8.352	9.995	10.130	10.643	10.987	12.529	12.798	12.298
Value	18.131	16.990	5.605	15.888	18.135	20.619	19.162	21.722	26.918	32.790	33.557

Source: Eurostat

Production by species + relative weight in the production

The aquaculture production in Romania concerns cyprinids and rainbow trout. In 2018, cyprinids represented 76% of the aquaculture production volume and rainbow trout represented 10% of the production volume but 23% of its value. While the cyprinids production remained relatively stable, the production of rainbow trout has significantly increased from 268 to 1.251 tonnes between 2008 and 2018.

Table 2 – Breakdown of aquaculture production by species – tonnes – 2008-2018

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Common carp	3.977	4.142	2.888	2.652	3.266	3.395	3.737	4.349	4.841	4.539	4.357
Bighead carp	2.228	2.352	1.020	1.289	2.110	2.110	2.287	1.840	2.121	2.771	2.548
Silver carp	2.959	2.971	2.016	1.323	2.087	2.031	1.900	1.843	2.364	1.854	1.692
Rainbow trout	268	320	1.400	1.678	1.074	1.072	1.152	1.345	1.109	1.840	1.251
Crucian carp				1.048	868	1.003				862	729
Miscellaneous freshwater fishes	378	211	356	185	293	211	345	327	530	307	242
Sturgeons			39	19	12	16	8	14	35	252	53
Others	2.722	3.135	1.262	158	286	292	1.216	1.270	1.529	373	1.426
Total	12.532	13.131	8.981	8.352	9.995	10.130	10.643	10.987	12.529	12.798	12.298

Source: EUROSTAT

Description and the share of the different farming techniques

- Extensive and semi-intensive production in ponds for carps (polyculture).
- Intensive rainbow trout production in tanks and raceways.
- Brook trout in cages.

Table 3 - Breakdown of freshwater aquaculture volume by aquaculture methods

Aquaculture method	% Volume	% Value
Ponds	82%	70%
Tanks and raceways	16%	28%
Cages	2%	3%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

In addition to supplying the food market, the aquaculture play a role for the recreational fishing.

2.17.2 Weight in terms of food supply, growth and jobs

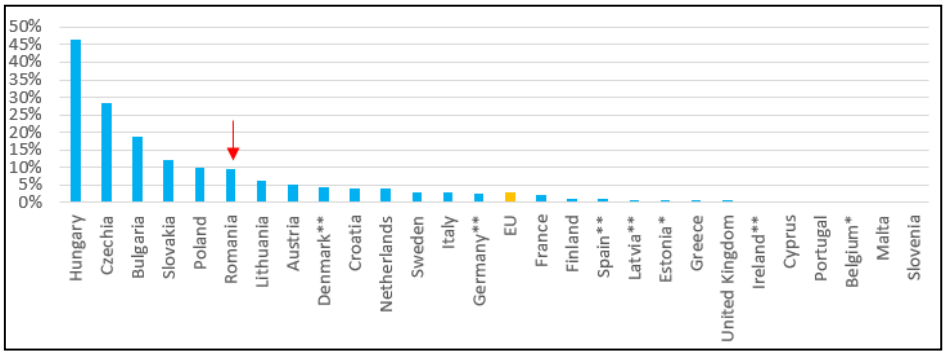
Production share of freshwater aquaculture in total aquaculture production

Almost all aquaculture production concerns freshwater activities. The STECF report recorded one pilot farm of mussels which produce only negligible volumes.

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Apparent consumption of fisheries and aquaculture products in 2018: 7,99 Kg / capita / year (ranks 24 at EU level).
- Total fish consumption in Romania accounts for 123.700 t in 2017. 12.798 tonnes were produced in freshwater in Romania accounting for 10% of the total national consumption.

Figure 1 - % of freshwater aquaculture in apparent consumption[24]



*Source: EUROSTAT / *) FAO / **) National statistics*

According to the Romanian annual report 2018, 93% of consumers prefer fresh fish, followed by fish roe salad with 74.47%, canned fish 53.37% and frozen fish 53.19%. Favorite place to buy fresh or live fish is the specialized store, it is found that the accessibility of fresh local products is the main factor in increasing fish consumption in Romania. Concerns about the development of consumption of fishery products are closely linked to the growing demand of consumers to have a balanced diet, which contributes to maintaining and even improving health and to a large extent to the development of the sector.

Socio-economic data: number of enterprises, employment, turnover

In 2018, 456 farms were involved in freshwater aquaculture production which employed 2.065 persons in the same year.

Table 4 – Number of farms and of employees

Year	Farms	No. of employees	
		Part-time	Full-time
2014	430	541	2.001

[24] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

2015	658	672	2.683
2016	386	459	1.495
2017	440	221	2.115
2018	456	627	1.438

Source: National statistics provided by national authority

- The aquaculture sector in Romania is dominated by small enterprises with less than five employees. In recent years, the number of enterprises has not experienced a significant change but there has been a change in the structure, with the increase of number of small enterprises and a reduction of the biggest producers.
- This change has significant implications on the employment. Total employees number has decreased in 2014 in comparison to the period 2009-2013. In 2018, the number of employees decreased in comparison to 2017, despite the number of farms increased.

Table 5 – Number of enterprises, employees, wages (1.000 EUR) and turnover (1.000 EUR) of freshwater aquaculture activities

Variables	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2017**	**2018**
Nb enterprises <=5 employees	169	225	211	278	277	304	319	214
Nb enterprises >10 employees	66	116	48	83	50	55	52	49
Nb enterprises 6-10 employees	79	101	58	66	97	67	67	190
Nb enterptises	**314**	**442**	**317**	**427**	**424**	**426**	**438**	**453**
FTE	2.541	3.929	2.528	2.522	1.691	1.994	2.080	1.947
Total employees	**2.668**	**3.929**	**2.655**	**2.967**	**2.350**	**2.535**	**2.080**	**1.947**

Source: DCF and EU-MAP

Analysis of the position and the relative price of freshwater products

According to the national authority, a significant part of buyers wants to buy fish on a short distribution chain, directly from aquaculture farms, where the price is lower and freshness, quality and hygiene are guaranteed. Large stores only work with large aquaculture farms that can provide the required quantities.

Table 6 – First sale prices of freshwater species (RON/Kg) and in (EUR/Kg) in 2019 (using the exchange rate on September 2020)

Species	**Medium Price (RON/Kg)**	**Medium Price (EUR/Kg)**
Cyprinus carpio	12,76	2,61
Hypopthalmichthys nobilis	7,44	1,52
Hypopthalmichthys molitrix	8,28	1,69
Ctenopharyngodon idellus	11,08	2,27
Carassius auratus gibelio	8,35	1,71
Acipenseridae	31,40	6,42
Polyodon spathula	15,70	3,21
Silurus glanis	15,60	3,19
Sander lucioperca	15,99	3,27
Esox lucius	13,65	2,79
Perca fluviatilis	7,76	1,59
Salmo trutta	17,55	3,59
Osteichthyes	7,71	1,58

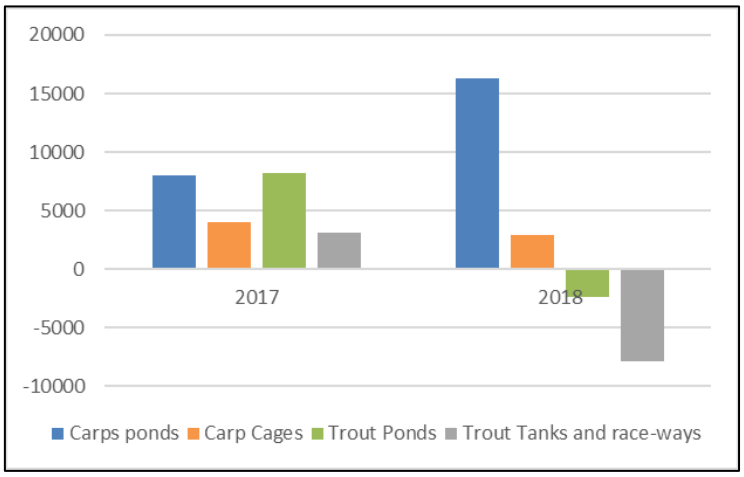
Source: National statistics provided by the national authority

2.17.3 Benefits of freshwater aquaculture

Economic insights and benefits

The STECF report (20-12) focuses on the following segments: carp ponds, carp cages, trout ponds, trout tanks and raceways. Due to the change in the segments studied by STECF following the transition in data collection between DCF and EU-MAP, only data for 2017 and 2018 are presented in the figure below. The segment of carp ponds is the most important in terms of number of farms. Net profit increased to EUR1,6 million in 2018, from EUR 0,8 million in 2017. The net profit of the segment of carp in cages decreased from EUR 4 million in 2017 to EUR 2,9 million in 2018. The net profit of the segment of trout ponds has decreased from EUR 8,2 million in 2017 to EUR -2,4 million in 2018. While the net profit of trout tanks and raceways has decreased from EUR3,1 million in 2017 to EUR-7,9 million in 2018.

Figure 2- Net profit of freshwater aquaculture activities by segment (1.000 EUR) from 2009 to 2014



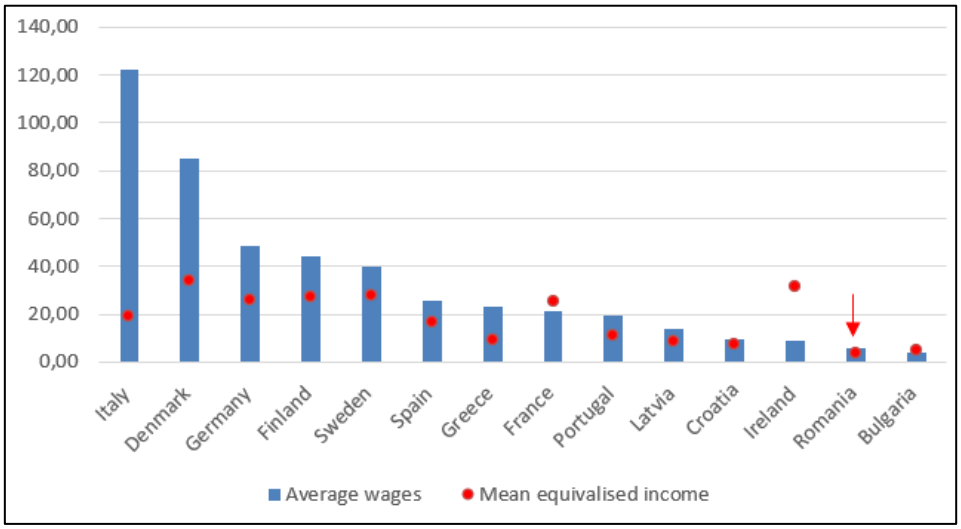
Source: EU-MAP

Social benefits

- 1.947 persons were employed in the freshwater aquaculture activity in 2018 in Romania according to the STECF report.
- The change in the sector structure (decrease of large enterprises and increase of small enterprises) had implications on employment (number of employees decreased).
- The average wage from freshwater aquaculture was above the mean equivalised net income[25] in Romania in 2018. However, Romania has a low revenue from freshwater aquaculture in comparison to the other EU MS, which is related to the fact that the pond extensive aquaculture production dominates in Romania.

[25] Mean equivalised net income is the mean of total income of all households, after tax and other deductions, which is available for spending, divided by the number of household members converted into equivalised adults.

Figure 3 - Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (thousand EUR)



Source: DCF/EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalized net income

Environmental benefits

- 80.091 ha of ponds are used for fish production in Romania.
- Most aquaculture farms in ponds have relatively long history and fit very well within the natural landscape, playing an important role in strengthening ecological balance, securing and maintaining large areas of wetlands.
- In many of the Natura 2000 sites in Romania, aquaculture activities are carried out, these being fully compatible with the conservation of the natural values of the sites.

Social and environmental services are provided by extensive aquaculture farms: recreation, maintenance of biodiversity and improvement of water management.

2.17.4 Assessment of the level of investment in the sector

According to the national authority, investment made in the last years, thanks to EMFF, for the development of a number of specialized units in order to rear species other than cyprinids or trout, such as sturgeon, tilapia, perch, African catfish.

2.17.5 Assessment of the level of innovation in the sector and main drivers

According to the national authority, the competitiveness of the aquaculture sector is low due to:

- the lack of research funding / reduced funding to provide scientific support to producers to identify opportunities to expand activities and increase productivity,
- the use of outdated technologies, without any scientific basis corroborated with a lack of involvement in research and development

2.17.6 Existence and weight of "quality schemes" in the sector

Novac afumat din Țara Bârsei: Protected Geographical Indication: smoked carp fish from the region Țara Bârsei.

2.17.7 Assessment of the sector's growth potential

The strategic pathways for the development of aquaculture in Romania are:

- Modernisation through technological development, innovation and knowledge transfer.
- Increasing the competitiveness and viability of aquaculture enterprises, including improving safety or working conditions, especially for SMEs.
- Promote a resource sufficient model of aquaculture.
- Promote aquaculture that provides environmental services (support by granting compensation for aquaculture farms located in Natura 2000 sites, support aquaculture farms that provide social and environmental services, ecological tourism, recreational / sport fishing, educational activities, etc.).
- Promoting measures of animal health and wellbeing as well as public health and safety.
- Development of vocational training, new professional skills and lifelong learning.
- Promoting innovation in the field of aquaculture in order to develop technical, scientific or organizational knowledge within aquaculture farms that reduce the impact on the environment, promote the sustainable use of aquaculture resources, improve animal welfare or facilitate new sustainable production methods.

Main drivers and opportunities:

- Availability of water resource suitable for aquaculture.
- Complementary activities can be carried out in aquaculture farms which can bring additional incomes (e.g. tourism, bird watching, recreational fishing, educational activities related to the knowledge and protection of aquatic biodiversity, etc).
- Development in recent years and thanks to the EMFF support of new specialized units on species other than cyprinids and trout.

Challenges and gaps:

The development of the capacity to innovate in aquaculture systems is the main challenge to help this sector to adapt, as well as to increase its competitiveness in the conditions of a competitive market.

2.17.8 Sources of information

- Statistics: EUMAP, EUROSTAT, FEAP.
- Economic Report of EU aquaculture sector (STECF 16-19 and STECF 20-12).
- The EU fish market.
- The multiannual plan for the development of aquaculture in Romania.
- National authority survey.

2.18 Spain

2.18.1 Market dimension of the EU freshwater aquaculture

Production

Circa 16.500 tonnes were produced in Spain in 2018 in freshwater environment, which marks a decrease of -26% between 2008 and 2018.

Table 1 – Freshwater aquaculture volume (tonnes) and value (1.000 EUR), 2008-2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Volume	22.233	18.960	17.929	17.088	16.775	16.216	15.513	16.589	17.627	17.257	16.456
Value	57.638	46.599	51.209	47.099	43.989	46.030	45.399	50.107	54.829	54.091	52.019

Source: Eurostat

Hatcheries and nurseries for both fry and human consumption

- **For human consumption**: 28,19 tonnes of rainbow trout eggs and 1,41 tonnes of sturgeons eggs produced in 2017.
- **For fry:** eggs for fry are almost exclusively rainbow trout eggs (279 MIO in 2016) and juveniles are mainly rainbow trout (38 MIO in 2016).

Table 2 – Production of eggs and juveniles volume, 2008-2016, million unit

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Eggs	232	205	213	259	219	438	309	199	280
Juveniles	82,09	387,92	68,02	57,33	57,17	48,86	51,27	47,84	44,42

Source: Eurostat

Production by species + relative weight in the production

- Rainbow trout is the main species reared in Spain. It represented 99% of the production volume in 2018. Between 20018 and 2018, rainbow trout production has decreased by -25% in Spain, due to the competition with salmon (according to the national authority).
- European eel is also reared but with very small volumes (342 tonnes in 2018).

Table 3 – Breakdown of aquaculture production by species – Tonnes – 2008-2018

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainbow trout	21.439	18.429	17.382	16.546	16.302	15.797	15.104	16.154	17.209	16.829	16.002
European eel	520	475	412	427	373	305	350	372	330	331	342
Other	274	56	135	115	100	114	59	63	88	97	112
Total	**22.233**	**18.960**	**17.929**	**17.088**	**16.775**	**16.216**	**15.513**	**16.589**	**17.627**	**17.257**	**16.456**

Source: Eurostat

Statistics from FEAP (Table 3 bis below) are overall consistent with EUROSTAT. They provide additional information on the volumes of portion and large rainbow trout and updates for 2019 year.

Table 3 bis – Breakdown of aquaculture production by species – Tonnes – 2009-2019

SPECIES	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Portion Rainbow Trout	20.000	18.000	18.000	14.400	15.000	13.000	13.260	13.260	12.922	13.671	13.680
Large Rainbow Trout	1.500	1 500	1 500	1.600	1.600	2.600	2.678	3.900	5.025	5.185	5.250
European eel	510	446	402	350	315	366	380	350	330	330	360
Sturgeons nei	166	35	40	66	66	100	120	110	110	125	132
Total	**22.176**	**19.981**	**19.942**	**16.416**	**16.981**	**16.066**	**16.438**	**17.620**	**18.387**	**19.311**	**19.422**

Source: FEAP production report 2020

Description and the share of the different farming techniques

- Rainbow trout is reared in Tanks and raceways.
- European eel is reared in recirculation systems.

Table 4 – Breakdown of freshwater aquaculture volume by aquaculture methods in 2017

Aquaculture method	% Volume	% Value
Tanks and raceways	98%	93%
Recirculation systems	2%	6%

Source: EUROSTAT

Markets supplied: restocking / leisure fishing / food markets

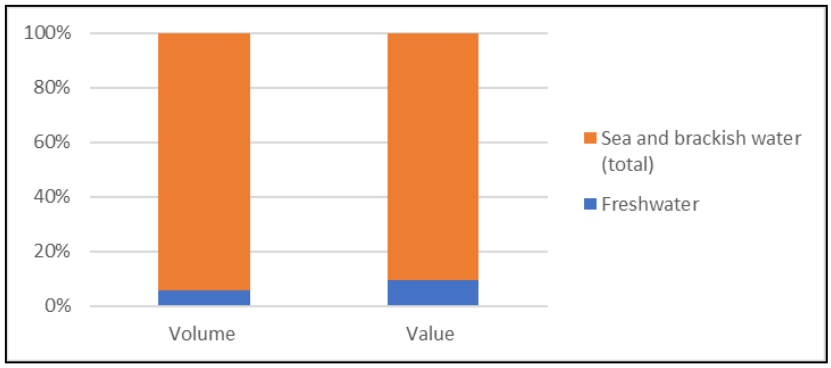
- Trout is sold in supermarkets, fishmongers, and in lesser extent through HORECA. About 80% of trout consumption take place at home in Spain (data from 2011-2012).
- Tench supplies different markets: mainly the fishing clubs, but is also sold for restocking or for human consumption.

2.18.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in total aquaculture production

Freshwater aquaculture is a small segment in Spain. In 2017, the Spanish freshwater aquaculture is estimated at 17.256 tonnes for over EUR 54 Million which represented only 5% of the Spanish aquaculture production volume and 9% of its value.

Figure 1 - Breakdown of aquaculture in Spain by aquaculture environment in 2017

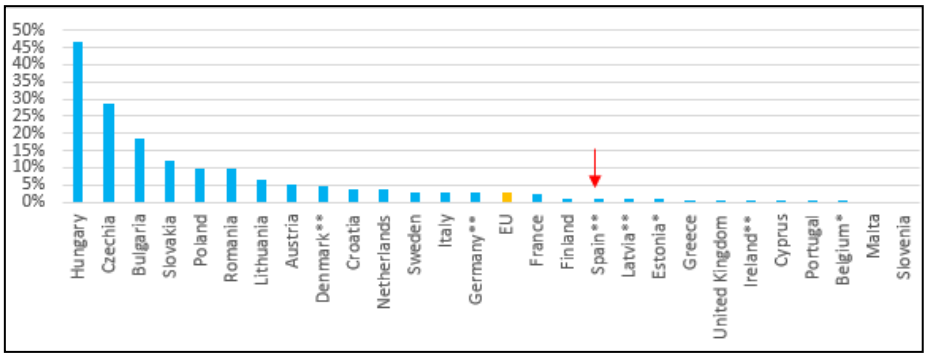


Source: EUROSTAT

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Apparent consumption of fisheries and aquaculture products : 46,01 Kg / capita / year (ranks 3 at EU level).
- Total fish consumption in Spain accounts for circa 1,8 million t in 2017, from which only 17.257 tonnes were produced in freshwater in Spain accounting for 1% of the total national consumption.
- In 2019, the consumption of fresh trout was 0.25 Kg/ capita, that is twice lesser than tuna and bonito consumption and 5 times less than salmon consumption. Trout is one of the species sold in various forms in Spain, such as: gutted fresh fish, precooked, frozen, smoked, prepared in sauce, etc.
- Tench and eel consumption is local and linked to tradition: tench in mainly consumed in Extremadura and eel in the Mediterranean coast.
- Sturgeon and caviar are mainly consumed in restaurants.

Figure 1 - % of freshwater aquaculture in apparent consumption26



Source: EUROSTAT / *) FAO / **) National statistics

Socio-economic data: number of enterprises, employment, turnover

- According to EU-MAP data, the freshwater aquaculture employed 909 persons in 141 enterprises in 2018.
- The EU-MAP data allow to study the sector structure: the sector is composed in great part of very small farms, 70% of aquaculture firms have 5 employees or less (2018 statistics).Between 2008 and 2018 the number of enterprises and the number of employees decreased. It is due to the increase of the size of enterprises and the improvement of their technologies, which reduces the need of workforce.
- Fish farms are spread around all the Spanish regions.

Table 6 – Number of enterprises, employees, wages (1.000 EUR) and turnover (1.000 EUR)

Variables	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Nb enterprises <=5 employees	126	124	121	132	123	127	137	143	153	132	99
Nb enterprises >10 employees	22	18	17	19	20	16	16	21	23	24	19
Nb enterprises 6-10 employees	18	18	34	23	17	19	20	15	18	20	23
Nb enterprises	166	160	172	174	160	162	173	179	194	176	141
FTE	812	677	697	692	625	589	634	662	724	701	678
Total employees	**1 063**	**831**	**829**	**918**	**886**	**776**	**868**	**879**	**967**	**964**	**909**

Source: DCF/EU-MAP

50,5% of aquaculture workforce in Spain are involved in freshwater aquaculture. Employment in the Spanish freshwater aquaculture sector is represented by both specialized and unspecialized employment (36% of total freshwater aquaculture employees each in 2018). High-level technicians represent 13% of total employees in the freshwater aquaculture sector.

[26] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

Table 7 – Employees' profile in freshwater aquaculture sector in Spain - 2018

	Total employees		Full Time Equivalent	
	Nb.	%	Nb.	%
Administrative	29	3%	22	3%
Non employees	73	8%	35	5%
Specialized workers	350	36%	260	36%
Unspecialized workers	353	37%	307	43%
High-level technicians	128	13%	87	12%
Others	29	3%	6	1%

Source: Statistics provided by the Spanish national authority in the context of the survey

Analysis of the position and the relative price of freshwater products

- First sales prices increased from 1,90 euro/kg in average in 2008 to 3,51 euro/kg in 2019.
- Trout wholesalers prices also followed an increasing trend from 2,78 euros/ kg in average in 2008 to 4,31 euros/kg in average in 2019 (national statistics).

According to the national authority, trout's final prices are lower than other fish from marine aquaculture (sea bass or sea bream) reared in Spain but similar to the prices of the imported sea bass or sea bream. They are also inferior to salmon prices (10,18 euro/ kg for fresh salmon against 6,17 euro/kg for fresh trout in 2019).

2.18.3 Benefits of freshwater aquaculture

Economic insights and benefits

- Trout production activities are spread around all the regions and involve all the cultivation stages, hatcheries, nurseries and fattening facilities. Economic indicators have improved in 2013 and 2014 in comparison to 2012 but have decreased since. Since 2017, total sales increased as well as net profits, benefited from better prices and a lower increase in operating costs according to the STECF report.

Table 8- Net profit of freshwater aquaculture activities (segment of trout in tanks and raceways) (1.000 EUR) from 2008 to 2018

	2008	2010	2012	2014	2016	2017	2018
Net profit (million EUR)	-34,2	23,7	16,7	34,7	4,5	14,4	15,8

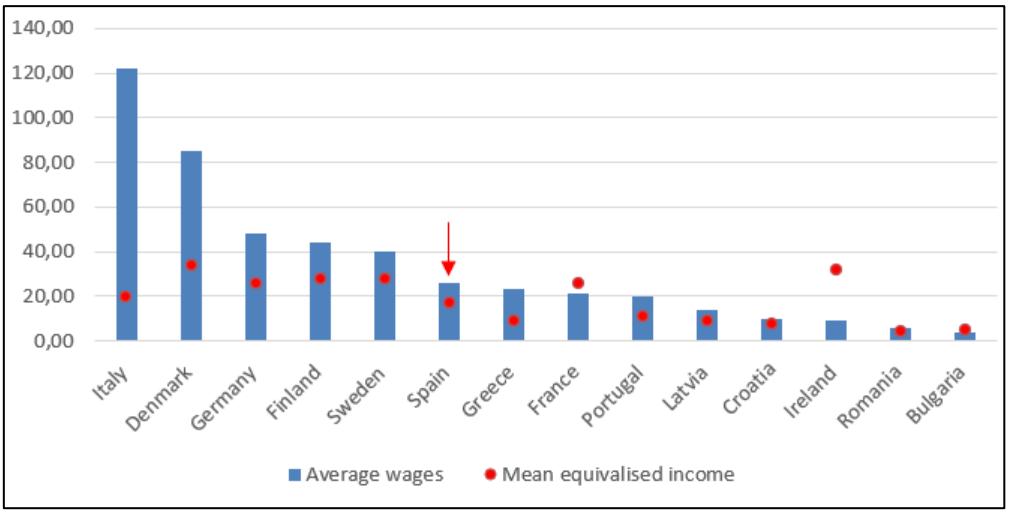
Source: DCF/ EU-MAP

Social benefits

- Aquaculture in Spain has in general a significant role in the economic and social development in certain areas. This is true for freshwater aquaculture as well. It provides employment opportunities in the areas where it develops.
- The average wages for aquaculture was above the mean equivalised net income[27] in Spain in 2018.

[27] Mean equivalised net income is the mean of total income of all households, after tax and other deductions, which is available for spending, divided by the number of household members converted into equivalised adults.

Figure 4 - Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (thousand EUR)



Source: DCF/EU-MAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalized net income

Environmental benefits

Environmental benefits of freshwater aquaculture production in Spain are linked to species reared to be released to the wild (to reinforce wild stocks): 8,96 million of continental fish at different stages of evolution were produced for restocking purposes in 2018. The restocking population includes 5,58 millions of sea trout, 1,67 millions of tench, 1,01 million of Atlantic salmon, and in a lesser extent, rainbow trout, tooth carp species, barbel, and other cyprinid species, etc.

2.18.4 Assessment of the level of investment in the sector

- Difficult access to credit.
- Difficult access to EMFF due to administrative burdens.

2.18.5 Assessment of the level of innovation in the sector and main drivers

- Important network of researches and innovation institutes dedicated to aquaculture.
- Lack of cooperation between research and innovation and the production sector.
- 342 tonnes of European eel are produced in RAS in 2018.
- According to the national authority, the national strategy for aquaculture development 2021-2030 will focus on innovation.
- Increase of investments in research, innovation and development during the last 4 years.
- Weak economic context.

2.18.6 Existence and weight of "quality schemes" in the sector

- 17 tonnes of organic fish were produced in 2018, including Adriatic sturgeon, Siberian sturgeon and rainbow trout.
- 20 tonnes of rainbow trout were produced in 2018 under the certification "Global G.A.P".

2.18.7 Assessment of the sector's growth potential

Main drivers and opportunities:

- Important size of Spanish fish market (high level of consumption per capita) that can absorb an increase in production.
- Consumers' willingness to pay for processed products increased and some enterprises started vertical integration (by developing processing units) in order to add value to their products.
- Suitable climatic conditions for the farming new species.
- New opportunities: recreational fishing, restocking, tourism, gastronomy.
- Experience and tradition in rearing freshwater species
- Increase of RAS installations in the context of climate change.

Challenges and gaps:

- Lack of species diversification: freshwater aquaculture is concentrated on rainbow trout.
- Increase in production costs.
- Competition with imported products.
- Effects of climate change on the inland ecosystems, droughts and diseases.
- Increase of environmental regulation and high cost of adaptation for firms
- Competency on water use with other sectors (electricity production and agriculture among others)
- Competition between rainbow trout and salmon (alternative choice for consumers).
- Lack of the sector's organization.

2.18.8 Sources of information

- Statistics: EUMAP, EUROSTAT, FEAP.
- Economic Report of EU aquaculture sector (STECF 16-19 and STECF 20-12).
- The EU fish market.
- The multiannual plan for the development of aquaculture in Spain
- Spanish observatory for aquaculture (OESA), « Certificaciones, estándares y marcas de interés para el sector acuícola español »
- Spanish observatory for aquaculture (OESA), « Caracterización de la cría en cautividad y repoblación de especies de interés a través de la acuicultura »
- National authority survey.

2.19 Sweden

2.19.1 Market dimension of the EU freshwater aquaculture

Production

- 7.546 tonnes were produced in freshwater environment, from which 6.815 tonnes for consumption and 731 tonnes for restocking in 2018.
- According to national authority these figures from official statistics are lower than the reality due to the absence of obligation for famers to report their production. Actual production would be between 12.000 and 15.000 tonnes according to estimations from Matfiskodlerna (producer organization) and the Swedish University of Agricultural Sciences.

Table 1 – Freshwater aquaculture volume, 2008-2018, tonnes

Year	EUROSTAT	National stat - Consumption	National stat - restocking	Total national stat
2008	4.016			-
2009	3.980	4.654	994	5.648
2010	6.884	6.883	1.078	7.961
2011	8.626	8.618	1.065	9.683
2012	9.398	9.390	1.047	10.437
2013	8.548	8.541	1.016	9.557
2014	8.668	8.667	1.130	9.797
2015	8.833	8.832	1.073	9.905
2016	11.006	11.028	861	11.889
2017	9.923	9.976	924	10.900
2018	6.815	6.815	731	7.546

Source: Eurostat, Swedish statistics

Production by species + relative weight in the production

EUROSTAT , Swedish Stat (table 1) and FEAP (table 1 bis) data appear overall consistent excepted for recent years. FEAP reported circa 10.000 t of freshwater fish produced by Swedish aquaculture, while national statistics only reported 7.500 t.

Table 1 bis – Breakdown of aquaculture production by species – Tonnes – 2009-2019

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Large Rainbow Trout	6.413	7.854	10.745	10.499	9.757	6.951	7.048	9.123	8.504	8.504	8.504
Arctic Char	600	1.307	1.128	1.849	1.808	1.644	1.675	1.760	1.310	1.310	1.310
European eel	0	0	90	93	92	64	104	117	105	100	96
Total	**7.013**	**9.161**	**11.963**	**12.441**	**11.657**	**8.659**	**8.827**	**11.000**	**9.919**	**9.914**	**9.910**

Source: FEAP production report 2020

- Freshwater production is mainly constituted of large rainbow trout, and in lesser extent arctic char. Eel and other fish, including tilapias, African catfish, sturgeon and pikeperch, represent only negligible share (less than 1% of aquaculture production). In 2018, Rainbow trout constituted 57% of production volume sold to food consumption and 64% of production volume used for restocking, including to sport fisheries (Source: National stat).
- In the last ten years, rainbow trout production for human consumption has increased (by 69%), while the production for restocking decreased by -28% (Source: National stat).

Description and the share of the different farming techniques

- Aquaculture production in cages is the dominant aquaculture technique used for producing fish for consumption (99% of freshwater production) (source: national stat).
- The other production methods, such as ponds and raceways are used mainly for producing fish for restocking. In 2017, 92% of production for restocking occurred mainly in ponds (Source: national statistics).
- National statistics have not recorded any production in recirculation systems until 2017. In 2018, only 8 tonnes have been recorded. However that production volume is underestimated and real production is more likely about 100 tonnes (Source: Swedish University of agricultural science). Species concerned are mainly salmon, tilapia and African catfish.

Table 2 - Breakdown of freshwater aquaculture by aquaculture methods in 2017

Aquaculture methods	Consumption	Restocking
Cages	99%	3%
Ponds	0%	92%
Raceways	1%	4%
RAS	0%	1%

Source: EUROSTAT for human consumption market and Swedish stat for restocking

Markets supplied: restocking / leisure fishing / food markets

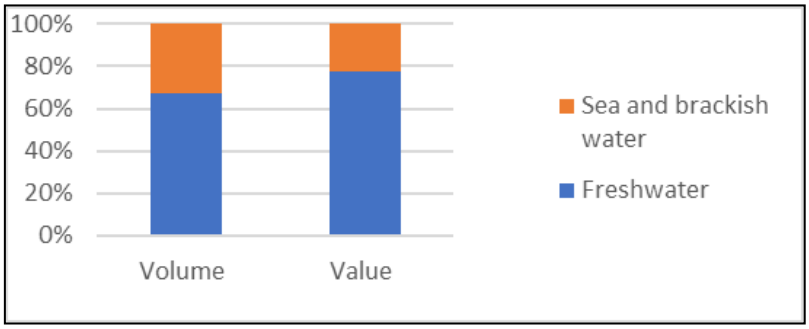
In 2018, main markets are: food markets (90%) and restocking (10%).

2.19.2 Weight in terms of food supply, growth and jobs

Production share of freshwater aquaculture in the total aquaculture production

In 2017, the Swedish freshwater aquaculture production is estimated at 9.923 tonnes for over EUR 41,5 Million, which represents 67% of the Swedish aquaculture production volume and 77% of its value.

Figure 1 – Breakdown of aquaculture in Sweden by aquaculture environment in 2017

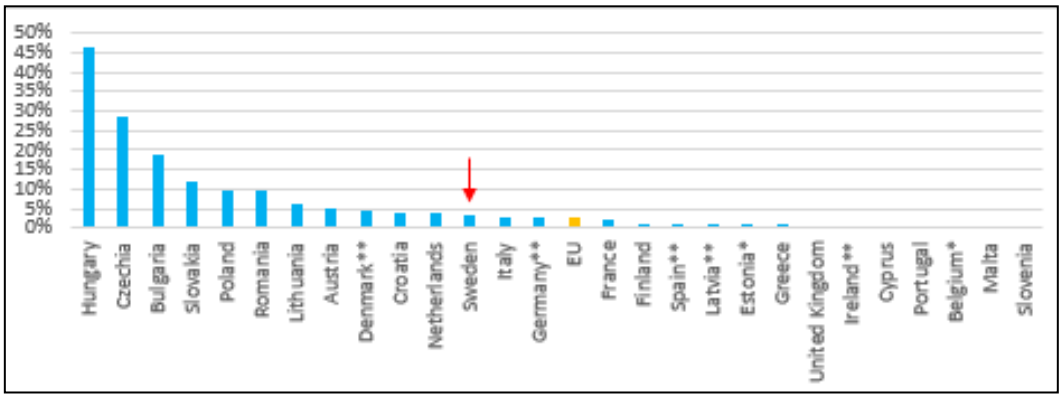


Source: EUROSTAT

Share of freshwater aquaculture fish in fisheries and aquaculture products consumption

- Apparent consumption of fisheries and aquaculture products in Sweden in 2018: 26,61 kg/ capita / year.
- The total fish consumption in Sweden is estimated at 209.543 tonnes, from which less than 5% come from freshwater aquaculture.

Figure 2 - % of freshwater aquaculture in apparent consumption[28]



*Source: EUROSTAT / *) FAO / **) National statistics*

Socio-economic data: number of enterprises, employment, turnover

In 2018, the freshwater aquaculture sector in Sweden employed 375 persons in 79 enterprises. The sector is dominated by small scale enterprises, with 92% of enterprises with less than 10 employees.

Table 3 – Number of enterprises, employees and turnover (1.000 EUR) of freshwater aquaculture activities

Variables	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Nb. of enterprises <=5 employees	61	137	126	104	102	101	90	80	91	67	63
Nb. of enterprises >10 employees	3	3	3	4	2	4	4	4	7	5	6
Nb. of enterprises 6-10 employees	3	4	9	7	8	9	8	11	11	15	10
Nb. of enterprises	67	144	138	115	112	114	102	95	109	87	79
FTE	141	200	213	241	239	280	254	247	276	485	263
Total employees	**232**	**339**	**341**	**338**	**320**	**361**	**359**	**344**	**421**	**389**	**375**

Source: DCF/EU-MAP

2.19.3 Benefits of freshwater aquaculture

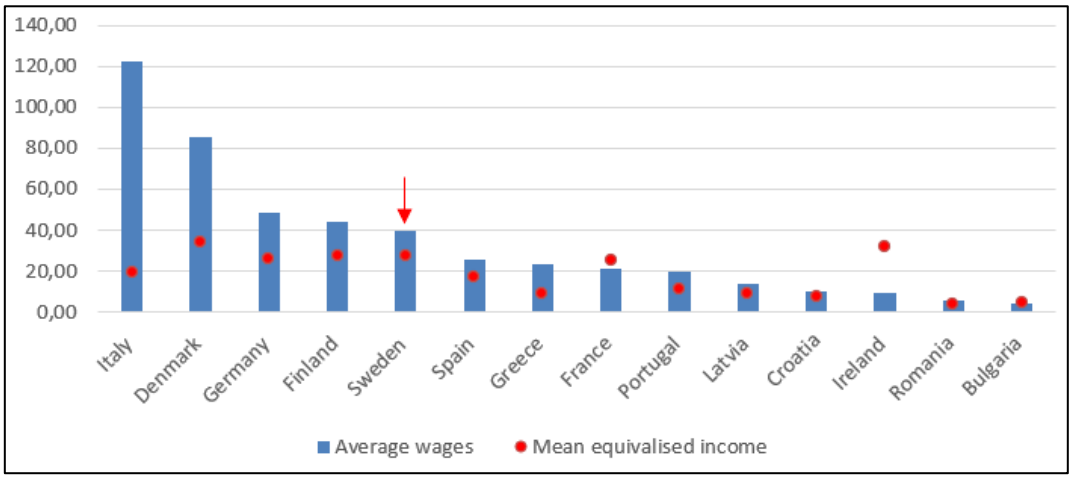
Social benefits

The average wage from freshwater aquaculture was above the mean equivalised net income[29] in Sweden in 2018.

[28] These figures are proxies that provide an overall picture of the contribution of freshwater production to the supply: The apparent consumption at MS level was calculated on the basis of production data (in live tonnes weight) and data on imports/ exports (in product weight). In the light of this, these figures should be considered with caution.

[29] Mean equivalised net income is the mean of total income of all households, after tax and other deductions, which is available for spending, divided by the number of household members converted into equivalised adults.

Figure 3- Average wages from freshwater aquaculture activities and comparison with the mean equivalised net income in 2018 (1.000 EUR)



Source: DCF/EUMAP data for average wages from freshwater aquaculture and EUROSTAT for mean equivalised net income

Environmental benefits

No data available.

2.19.4 Assessment of the level of investment in the sector

Overall, the level of investment is assessed to be low. The reasons include:

- Equipment and installations are expensive, especially for recirculating aquaculture systems,
- Difficulties to get finance from banks due to lack of knowledge and the negative image of aquaculture,
- Reluctance of insurance companies to insure aquaculture companies.

2.19.5 Assessment of the level of innovation in the sector and main drivers

New techniques such as recirculating systems are difficult to develop at a commercial scale. RAS is used only for hatcheries and nurseries, but not for grow out production.

2.19.6 Existence and weight of "quality schemes" in the sector

No quality scheme related to freshwater aquaculture products identified.

2.19.7 Assessment of the sector's growth potential

The multiannual plan for aquaculture objective was to double the aquaculture production in 2020 (from 12.500 tons in 2013 to 25.000 tons in 2020) but this has not been achieved.
Tilapias and African catfish production are expected to increase in the future with a production objective of 5.000-6.000 tonnes for tilapia and 3.000 tonnes for African catfish.

Main drivers and opportunities

- Negative trade balance of Sweden for fish (national share can increase)
- Availability of space for freshwater aquaculture Many lakes and rivers
- Several appliances of farmers to get expanded/new permits
- EMFF grants can facilitate investments

- Combination of aquaculture with hydropower dams

Challenges and gaps

- Difficulties of implementing new growing techniques
- Regulation
- Initial Investments
- Costs

2.19.8 Sources of information

- Statistics: EUMAP, EUROSTAT, FEAP.
- Economic Report of EU aquaculture sector (STECF 16-19 and STECF 20-12).
- The EU fish market.
- The multiannual plan for the development of aquaculture in Sweden.
- Swedish aquaculture – a green industry in blue fields strategy 2012 – 2020.
- National stat: Sveriges officiella statistika: Statistiska meddelanden JO 60 SM 1901
- National authority survey.

KL-03-21-170-EN-N

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