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Factors affecting cross-border investments in EU aquaculture

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Executive summary

European aquaculture is diversified as many species are farmed in different countries. Farming takes place in both in marine environments and in in-land sites and the farming techniques vary widely. The aquaculture industry structure also varies significantly within the EU depending on the species farmed. In the north of the EU (and Europe in general), aquaculture is dominated by salmon and the industry consists of several large operators. In the Mediterranean, seabass and seabream are the main species produced, by both large and small enterprises. Structural changes have also taken place in this sector, especially in Greece, which is the main EU producer.

For other farmed species, especially inland farming, the aquaculture industry is far more fragmented, often consisting of small family owned companies with only few exceptions to this general rule.

The differences in structures and technologies seem to have an impact on factors considered important for investments and growth. For salmon farming, where a significant share of the industry has good access to capital (many companies are listed and/or have professional investors), operational and investment support arrangements have not been identified as important barriers for facilitating cross-MS investments and investments in general, while this issue seems to be more important for smaller scale operators (independently from species).

Even though the research in this report only covers a limited portion of the aquaculture industry in the EU, a factor jointly mentioned as a barrier to cross MS investments and investments in general is the bureaucracy and time for the application process related to licencing.

The seabass and seabream farming industry in the Mediterranean, which has experienced some boom and bust cycles, highlights increased effort on marketing as *leitmotiv* for investments and growth.

The lack of incentives to build scale, and to both promote and accept a focus on producing fewer species, where EU-Member States could take a leading role in cost competitiveness or market volume leadership, is mentioned as a potential barrier to achieving economies of scale. By enhancing ideas of “Diversifying” rather than “Specialisation and scalability”, there is a risk that enterprises end up without the sufficient scale to be attractive. Lack of attractiveness could be relevant in several areas -- financial institutions, R&D and educational institutions, suppliers, and among qualified workforce – that eventually should represent and inject increased productivity and innovations into the sector.

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1 Objective and methodology

1.1 Objective

The aim of this study is to explore investments in aquaculture farms across different Member States in order to provide an overview of the current extent of cross-border investments, and to identify barriers and drivers influencing such investments.

1.2 Methodology

The study has been structured into the following steps:

- literature review: available information on cross-border investments;
- interviews with aquaculture companies;
-compilation of the main barriers and drivers for cross-border investments.

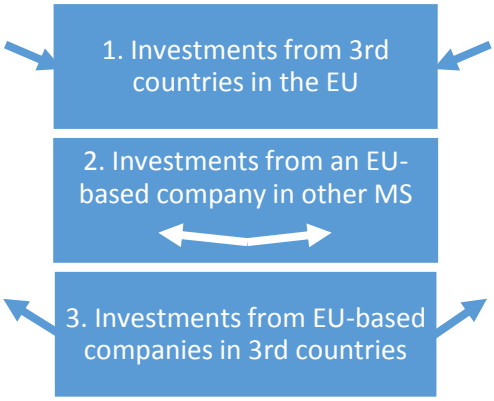
The selection of companies/persons to interview was not easy for two reasons: many companies operating across different Member States are Norwegian and the comparison of some sister companies can be irrelevant because these companies may operate at different stages of the process (hatchery, nursery, on-growing) or with different marketing objectives (mainstream conventional products, quality products such as Label Rouge, organic products).

Three companies were selected and all of them were willing to be interviewed. The three companies have invested in two or more MS and the investment involved the following species: Atlantic salmon, seabass and seabream, corvina (meagre) and cobia/warm water shrimp (not in the EU). Their investments include both investments in Northern Europe and in the Mediterranean. The companies interviewed have expertise in land based (RAS) aquaculture.

The listing of main barriers and drivers for cross-MS investments, are based on literature reviews and interviews.

1.3 Definitions and limitations

In defining aquaculture investments in this study, the scope is limited to aquaculture operations (biological production). Other investments related to aquaculture, such as processing facilities, logistic hubs, sales organisations and other investments, are not taken into consideration when mapping cross-MS investments. It should, however, be noted that investments in non-biological production (such as processing facilities, logistic units, sales/marketing units) could be a result of or trigger for cross-MS aquaculture investments. In a wide sense, cross MS aquaculture investments could be defined as all aquaculture investments of the same company in two or more MS, and it could be illustrated as follows:



In the first category one can find the majority of the investments. Examples of companies falling under this category are the largest salmon farming companies in Europe, such as: Marine Harvest, Lerøy Seafood Group, Salmar and Grieg Seafood. They have in common that they are Norwegian based companies and listed at the Oslo Stock Exchange (OSE), and they have investments in the EU.

Some investments are also identified in the 2nd category. The Greek company ANDROMEDA GROUP (seabass/seabream) is an example of a company within this category, which is present in Greece and Spain.

In the last category, we find companies like Pescanova (or Nueva Pescanova). This company, based in Spain, has invested in tropical shrimp farming in Brazil, Guatemala, Nicaragua, Honduras and Ecuador, and also had, before the re-financing of the group, salmon farming operations in Chile.

Some companies fall under more than one category as they have aquaculture operations both in and outside the EU. Pescanova is one example. In addition to the investments in 3rd countries, the company has also farming operations in Spain and Portugal (turbot and shrimp).

In this study, the focus is categories 1 and 2, investments in the EU.

2 Cross-border investments within EU aquaculture

2.1 Place of the EU in world aquaculture

In 2015, world aquaculture production reached close to 109 million tonnes. China is by far the largest producer, accounting for 56.5% of world production, reaching 61.5 million tonnes. The second largest producer is Indonesia, with 14.4% of world production, or 15.6 million tonnes. EU production amounted to 1.3 million tonnes in 2015, accounting for 1.2% of world production.

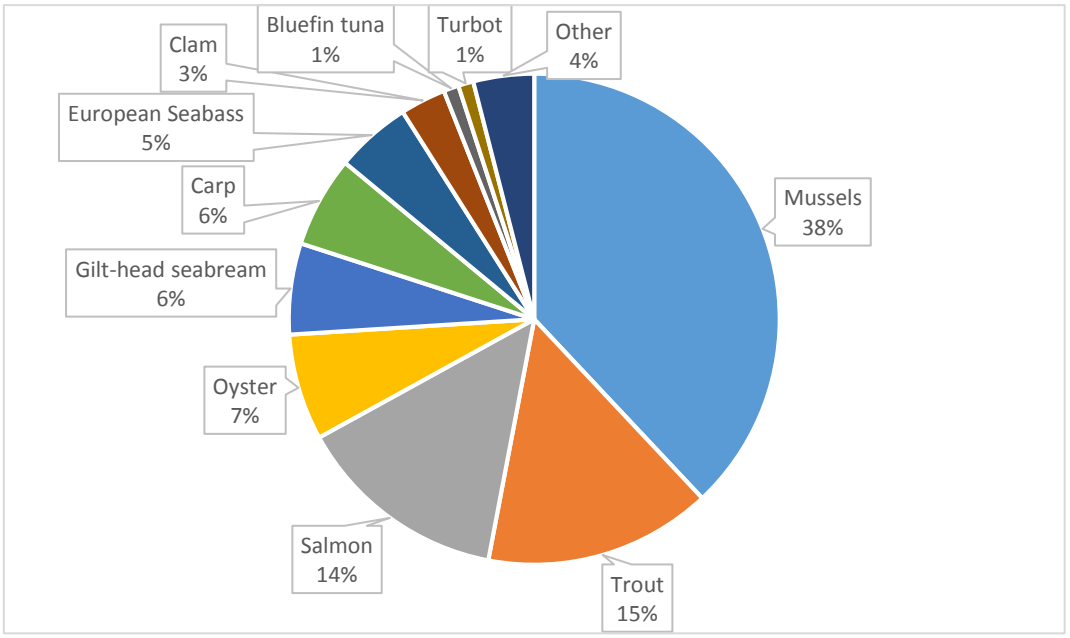
Table 1: World aquaculture production in 2015 (tonnes)

Countries	Production volume	% total
China	61.536.375	56.5%
Indonesia	15.649.311	14.4%
India	5.238.019	4.8%
Vietnam	3.450.200	3.2%
Philippines	2.348.159	2.2%
Bangladesh	2.060.408	1.9%
Korea	1.676.489	1.5%
Norway	1.478.661	1.4%
EU 28	**1.310.000**	**1.2%**
Egypt	1.174.831	1.1%
Japan	1.146.212	1.1%
Chile	1.057.742	1,0%
Myanmar	999.630	0.9%
Thailand	897.096	0.8%
Other	8.815.999	8.1%
Total	108.839.132	100%

Sources: EUMOFA (2017) The EU Fish Market and FAO data

In terms of volume, the largest farmed species within the EU in 2015 were mussels (492.000 tonnes), trout (192.000 tonnes), salmon (172.000 tonnes), oyster (91.000 tonnes) and gilt-head seabream (83.000 tonnes).

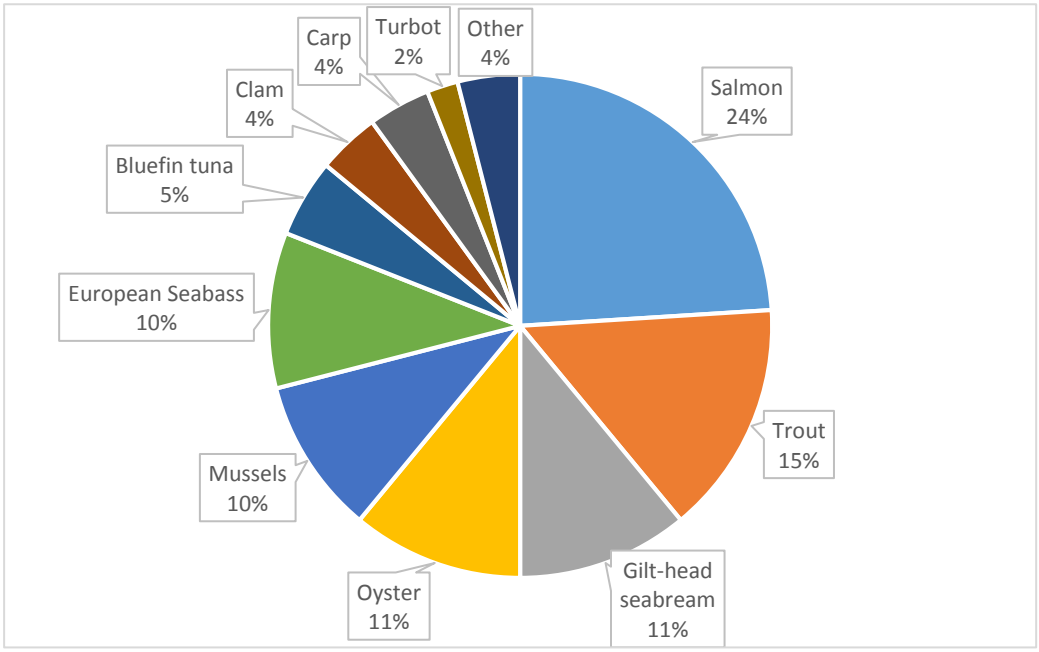
Figure 1: EU aquaculture production breakdown by main species (in volume)



Source: EUMOFA (2017) The EU Fish Market

Measured by value, in ranked order the top species farmed within the EU in 2015 were salmon (EUR 975 million), trout (EUR 614 million), gilt-head seabream (EUR 449 million), oyster (EUR 446 million) and mussels (EUR 434 million).

Figure 2: EU aquaculture production breakdown by main species (in value)



Source: EUMOFA (2017) The EU Fish Market

2.2 Extent of cross-border investment within EU aquaculture

In order to learn the extent of cross-border investments in aquaculture in the EU, research was performed by contacting European aquaculture associations, aquaculture companies, persons with specific knowledge on the topic and a search was made on the internet.

Findings from the research are presented below, on marine aquaculture, shellfish aquaculture and fresh water aquaculture.

2.2.1 Marine Aquaculture

Marine aquaculture is capital intensive, in the sense that relatively large investments are needed for the physical equipment and the stocking of cages compared to the input of labour. Labour productivity in sea cage farms is high compared to other aquaculture segments in the EU.

The most important marine species in terms of total sales volume was Atlantic salmon (with 48% of the total), followed by Gilthead seabream (24%) and European seabass (14%). In terms of total sales value the leading species were Atlantic salmon (44%), European seabass (24%), and Gilthead seabream (14%)[1].

Most of the company structures and investments can be found in the marine aquaculture category. A majority of the investments identified are carried out by relatively large companies, with a solid capital base. Another characteristic is that the same species as initially farmed by a company are targets for investments (using the company's experience and expertise). For salmon, most of the cross-MS investments seems to be driven by 3rd country ownership, mainly from Norway. For seabass and seabream, cross MS investments are made by Greek companies.

Cross-MS investments in salmon and bass/bream aquaculture have some similarities as most of the investments have taken place through acquisitions.

The companies identified within this category are:

Marine Harvest ASA

The history of Marine Harvest goes back to 1965 when the company, under its founding name Mowi, started working with salmon. In the early 1980's the company acquired a salmon farming company in Scotland (Golden Sea Produce (GSP)) and a company in Ireland (Fanad). Today the 2 companies are the Scottish and Irish salmon farming divisions of the Norway based company Marine Harvest.

The company is still a salmon farming company and has become the largest salmon farmer in the world. Besides salmon farming operations in Norway, Scotland and Ireland, Marine Harvest farms salmon on the Faroe Islands, in Canada and in Chile.

Andromeda Group

The Andromeda Group was founded in 1998 in Greece and its headquarters are located in Athens, from where the international operations today are managed. In 2006, SEEF, a fund advised by Global Finance, acquired a majority stake in Andromeda. In 2008 the company acquired Acuimar Group (seabass and seabream) in Spain (Valencia region). The following year it acquired Niordseas SL (bass/bream and meagre (corvinea) in Spain and Piscimar, also in Spain. Based in Burriana, Piscimar is the largest hatchery and nursery company in Spain with facilities dedicated to the breeding and pre-fattening of gilthead sea bream, sea bass and other Mediterranean species. In 2016, SEEF sold its controlled share (90%) of Andromeda to the US-based fund Amerra Capital Management.

[1] Scientific, Technical and Economic Committee for Fisheries (STECF) – Economic Report of the EU Aquaculture Sector (EWG16-12)

Nireus

Nireus started operating in Chios (Greece) in 1988 as a fattening unit. Since 1995 Nireus has been listed on the Athens Stock Exchange. In 2007 the company went ahead with acquisition of Spanish Predomar, with juvenile pre-growing facilities. In 2009, production in cages (on-growing) in Spain started.

Cooke Aquaculture

Cooke Aquaculture was established in 1985 by the Cooke family on the east coast of Canada. The company acquire Culmarex S.A., the largest sea bass and sea bream farming operation in Spain. In 2015 Cooke acquired Meridian Salmon Farms Limited (now Cooke Aquaculture Scotland) - a leading Scottish salmon farming company with assets in Shetland, Orkney and the mainland of Scotland. The latest investment was done in 2015 with the acquisition of Thompson Bros. Salmon Limited, a salmon farming company located on Shetland, UK. This investment was made through their already existing Scottish branch. By adding this investment, Cooke Aquaculture harvest 22 500 tonnes of salmon in the EU (in Scotland in 2015)[2] and 20 000 tonnes of sea bass and sea bream.[3]

Stolt Sea Farm

Owned by Stolt-Nielsen Limited, this company is listed on the Oslo Stock Exchange. The activities of the company (besides fish farming) include operations of percel tankers, terminal services for chemicals and gas products, operation of bitumen tankers and LNG supply chain services. The annual operating revenues for the last three years have been around 2 billion USD.

Stolt Sea Farm operates 15 land-based farms in Europe and the USA. Operating revenue was 72 million USD in 2017, which was 3,6% of the group's total.

In Europe, Prodemar, headquartered in Santiago de Compostela, Spain, is Stolt's subsidiary farming fish (flat fish). The company has seven land-based fish farms in Spain, one in Portugal (Tocha, turbot), one in France (Anglet, with a producing capacity of 350 tonnes of sole), one in Iceland (Hafnir, production of Senegal sole based on warm water from geothermal power production) and one in Norway.

Species produced in Europe are turbot (the main species, with a production capacity of 5 400 tonnes) and sole (production capacity of 500 tonnes)

All Stolt Seafarm hatcheries are located in Galicia, Spain[4]. Stolt Sea Farm was established in 1972 as a smolt producer. The company has since then maintained a strong position in juvenile/fingerling production. The strong know-how in the first phase of the production cycle has been a major factor in developing the company. In addition to turbot and sole, the company has during recent decades been involved with production of clam and oyster seed, prawn post larvae, seabass and seabream juveniles, halibut, tilapia and bluefin tuna (in Australia).

According to industry sources, there are also French investments in seabass and seabream farming in Italy.

2.2.2 Shellfish Aquaculture

Sixteen Member States are involved in the shellfish aquaculture sector. This sector is to a large extent based on small-scale, family-owned enterprises. This sector contributes actively to external trade and has a very important social dimension, given the large number of persons employed. The shellfish sector does not face limiting environmental concerns in terms of nitrogen and phosphorus emission, because shellfish help to improve water quality by filtering the water for phytoplankton absorbing

[2] Cooke Aquaculture Scotland press release July 30, 2015
[3] Cooke Aquaculture web page
[4] Stolt-Nielsen web pages

these nutrients. However, shellfish farmers suffer other problems in terms of limitation of suitable production sites, competition for space (conflicts of interest between users) and spreading of diseases (e.g. in France for oysters, red ties in Spain, etc.). This sector has experienced high volatility over the years in the areas of environment issues, seeds, prices, livestock purchases, species, technics, etc.

The shellfish aquaculture industry structure, as described above, seems to be the main reason why limited cross-MS investments are found in this sector.

Nevertheless, some cross-MS company structures/investments have been identified. Most of the cross-MS investments are found in the oyster sector. A majority of the cross-MS investments identified are made by French interests. The main drivers behind the investments have been disease/loss challenges in France, and opportunities to invest in other MS not having the same challenges. French investments have taken place in both Ireland and Portugal. Another area for investment is mussels (especially bottom culture), where investments from Dutch companies in Ireland have been increasing for several years.

Ireland

French oyster producers have a significant presence in Ireland and it can be estimated that at least 20 French oyster farmers are involved in farming in Ireland. An industry expert estimated that Ireland accounts for around 25% of production directly and that another 25% of production is produced under contract with French companies[5].

Usually the equipment as well as the spat[6], and often also the employees, are coming from France. The spat is generally provided by hatcheries located in Normandy, Charente or Vendée.

A significant move to Ireland occurred from 2008, when the production in France has been hit by a virus destroying the larvae, but some French oyster farmers had settled earlier.

Ownership is mixed with growing French investments and partnerships with local license holders. Two main kinds of investment approach can be distinguished:

The first approach is related to diversification. As an example, Benoît Massé, a producer farming oysters in France (Oléron Island), sends young Oléron oysters to Ireland, where they grow in Irish waters rich in nutrients. Another example is the French oyster farming company Les Parcs de Saint Kerber (Cancale in Britanny) which in 2009 established Celtic Kerber Ltd to grow high range oysters. A third example is Speciales Gillardeau. The company invested in production in County Cork in Ireland 10-15 years ago. The motivation behind investing/moving half of the production to Ireland included cleaner waters (less agricultural runoff) and the sites were easier to farm. In addition, there were fewer parasites[7].

The second approach is related to creation *ex-nihilo* or acquisition of an Irish company. An example is Sofi Shellfish (French-Irish company), which was created by replacing a small declining company in Clew Bay (County Mayo) acquired by Nicolas Tessier, a Marennes oyster farmer. The company produces 200 to 250 tonnes of cupped oysters yearly. The spat are bought in French hatcheries and come by refrigerated truck from France. Then they grow during 18 to 24 months in Clew Bay waters before going either to France (Normandy) or South-east Ireland (Bannow Bay) for the final growing

[5] Renwick A. (2015), The economic importance of the Irish oyster industry (a report prepared for the Irish Shellfish Association)
[6] Scientific, Technical and Economic Committee for Fisheries (STECF) – Economic Report of the EU Aquaculture Sector (EWG16-12)
[7] Erlanger S., A French Family Dynasty Reinvents the Oyster, New York Times, October 2008

stage. Once the market size is reached, the oysters are stocked in basins in Marennes-Oléron before being shipped to consumers.

Patrick Boutrais (www.lafamilleboutrais.com) seems to be a key player in the development and financing of French oyster-farming investments in Ireland.

Portugal

Probably more than 10 French oyster farmers (mostly from the Marennes-Oléron area) are involved in production in Portugal, either in the Aveiro bay or in the Algarve region (Faro). One of these, the company LUSOSTREA (registered office in Normandy) has been established by oyster farmers of Normandy, with the aim of bypassing the juvenile mortalities occurring in French farms. In this case the employees are Portuguese. The spat also come from France. Market-size oysters are marketed in France.

Another example is the oyster farming company OSTREATLANTIQUE, located in the Arcachon bay, which has created OSTREA SELECT in Algarve, where the oysters that are spawned in Arcachon are shipped in the Valdelama lagoon, where they grow. They come back to France for the final growing stage and marketing.

2.2.3 Freshwater Aquaculture

Freshwater aquaculture is by far the oldest type of fish farming in Europe. The main species are rainbow trout and common carp. Rainbow trout is more suitable for temperate environments with carp being better in the more extreme continental conditions as in Central Europe.

The total volume of EU freshwater aquaculture was 297 000 tonnes in 2014 generating a value of more than EUR 1 billion. Compared to the EU marine aquaculture sector, the volume is almost the same, but freshwater aquaculture value equals only half of the marine aquaculture value.

There were more than 3 400 enterprises in the EU freshwater sector in 2014[8]. On average, each enterprise employed 5 persons.

Interviews, literature search and contacts with industry stakeholders have revealed few cross MS aquaculture investments. When excluding brood stock and fry/smolt production, two cross MS investments have been mentioned:

- Dutch investment in eel farming operations in Germany;
- French investment in trout and sturgeon farming in Spain.

3 Barriers to cross-border investments

All the barriers mentioned in this chapter are applicable both for sea-based and land-based aquaculture, unless otherwise explicitly mentioned.

The scope of this analysis is cross-border investments related to biological production. First, we will focus on the different operational and structural barriers (chapter 3.1).

The operational and structural barriers are associated with different levels of potential risks and rewards, which in turn will have an effect on financial barriers to cross-border investments (chapter 3.2).

[8] Scientific, Technical and Economic Committee for Fisheries (STECF) – Economic Report of the EU Aquaculture Sector (EWG16-12)

3.1 Operational and structural barriers

A successful aquaculture production is dependent on several factors. First, in all MS, one needs licensing from the relevant regulative authorities, it being local, regional or national. Furthermore, the different regulatory decisions within the MS need to be in accordance with EU or other international regulations.

Second, one needs a location suited for the species of production, which in turn can also be subject to licensing or regulations.

Third, one needs access to the relevant equipment and input for production. Generally, this is dependent on two factors. One is knowledge of the different challenges, e.g. biological risks, regarding aquaculture production in different geographical circumstances/environments and of different species. The other is knowledge of and access to suitable technology to address the challenges.

Fourth, one needs workers with the correct skill-sets regarding, for example, the biological production, the local geographical conditions and the workings of the local and national authorities.

Finally, the maturity of the aquaculture sector for a given species or in a given MS, and hence the competition faced upon entry will potentially influence, positively or negatively, some or all of the above-mentioned barriers. Different operational and structural barriers will be stronger or weaker according to the specific type of investment, because of, inter alia, synergies and scale. For example, there is a difference between acquisitions of existing aquaculture operations versus investing in building new ones from scratch. Furthermore, the different operational and structural barriers can amplify or weaken the total effect when combined.

3.1.1 Regulations and licensing

The main reasons for the burden in the licensing process are bureaucracy and conflicts between different governing units.

Multilevel governance can also constitute barriers, both with respect to different levels within the MS and between the MS and the EU, in relation to e.g. the Marine Strategy Framework Directive (2008), the Directive for Maritime Spatial Planning (2014) for marine environments, the EU Water Framework Directive and River Basin Management principles for freshwater environments and more generally Natura2000.[9] The interactions between local, regional, national and EU legal requirements can often make the licensing process unpredictable and protracted.

While these barriers apply both to cross-country and to local investment, feedback from the industry indicates significant differences between MS in the regulation of the aquaculture sector as a whole. In this regard, cultural differences could also be a relevant factor. As a result, there is a need to engage local people who have knowledge about the laws and regulations applicable for the MS and can help navigate through the application process; this can represent a further difficulty for investors without an established local presence.

The European Commission has already identified the need for a faster, more responsive, less bureaucratic approach by Member State governments as one of the keys to successful development of European aquaculture (COM 2013/229). Despite this, there are still examples of licensing processes of several years.

[9] DG IPOL (2014), The long-term economic and ecologic impact of larger sustainable aquaculture.

3.1.2 Production locations

Access to suitable locations is essential when establishing aquaculture production and this barrier is likely to be similar, both for local and cross-border investments.

Regarding marine aquaculture, a JRC report published in October 2014 focused on area and coastline occupation by marine aquaculture and concludes that aquaculture does not occupy much geographic space. Of the ten EU countries[10] analysed, the study found that aquaculture cages occupy less than 2% of the available coastline. The report, which covers 95% of EU marine finfish production, also conclude that aquaculture cages tend to be concentrated close to shore, hidden from beaches and other touristic infrastructures.[11] Despite that, there are strong conflicts with tourism-based uses of the coastline.[12]

A significant challenge for marine cage aquaculture operators is to find "good" sites, in terms of depth, current, temperature, wave and wind exposure, water quality and established infrastructure (roads, harbours, quays). When taking these factors into consideration, the access to suitable sea sites becomes more limited.

Where suitable locations are available, approving them for aquaculture production, both on land and in the sea, is often subject to resistance from, inter alia, environmental agencies, the fisheries sector, the tourist industry and the local inhabitants. In this regard, prudent spatial planning that takes into account future possibilities and needs of aquaculture could reduce the administrative burden for private developers and limit the uncertainty and duration of approval processes, thus making investments more attractive.[13]

Scarce availability of suitable locations can also create a cost barrier as the cost of acquirement increases because of "lower supply".

For land-based freshwater aquaculture, the processes of general licensing and approval of suitable locations are often evaluated and regulated in combination. Inland planning can be more advanced compared to maritime planning, due e.g. to the existence of cadastre (property recording) or rating systems making information easily accessible to all relevant institutions.

Land-based freshwater aquaculture can generally be divided between intensive farming (i.e. closed tanks on land with access to a freshwater source) and extensive farming (i.e. farming in an existing lake or pond) and the considerations regarding regulation might differ between the two with respect to water use and waste management.

Unlike marine aquaculture, land-based freshwater aquaculture often relates directly to a specific geographical location with access to freshwater and the associated natural limitations. As a result, there is an additional barrier regarding production locations as the facility often faces local limitations on water access and waste disposal. The limitations can relate to local conditions regarding watercourses to and from the production location, as well as national, regional and local public policies.

[10] Croatia, Cyprus, France, Greece, Ireland, Italy, Malta, Slovenia, Spain and the UK.
[11] European Commission Joint Research Centre (2014), Is lack of space a limiting factor for the development of aquaculture in EU coastal areas?
[12] Presentation of the JRC study at Aquaculture Europe, 2014: https://www.was.org/easonline/documents/MeetingPresentations/AE2014/AE2014_0012.pdf
[13] European Commission (2013) Strategic Guidelines for the sustainable development of EU aquaculture (COM 2013/229).

3.1.3 Equipment, technology and research and development

Building aquaculture farms requires equipment and other inputs. Different geographic conditions and species require different equipment and technologies. The equipment and other inputs needed to produce one species can differ according to production location. Similarly, production of different species on similar locations will also require different equipment and other inputs.

All biological production involves biological risks. These risks are also a combination of geography and species and some MS and species are more exposed to biological risks than others, e.g. parasite challenges in Norwegian salmonid farming, algae bloom in mussel production in Spain and oyster virus disease in France. In this respect, to acquire the essential equipment and technology one needs knowledge of both local conditions of the production location and the biology and production cycle of the species of interest.

Acquiring this knowledge is the first barrier to overcome. Another barrier is to know how to address the different challenges. The distinctive character of small-scale aquaculture companies is that they are attached to one geographical place, they hold on to a certain farming technology and they operate under conditions for which they have good knowledge. When facing new challenges, because of either a different location or species, a producer can rely on existing and tested technology, assuming that such technology exists and is readily available and affordable. If not, the time and resources needed for research and development can be a barrier to investment.

When a producer considers investments in another MS, the presence of a supplier market, both in terms of equipment, other input factors and research and development can alleviate these barriers. The cost of buying these services from experienced actors in a local supplier market will presumably be lower and involve less risk compared to establishing new infrastructures.

3.1.4 Knowledge along the value chain and skilled work force

Knowledge is an all-embracing barrier which affects the whole value chain. The aquaculture industry is fragmented and few universities and colleges offer good educational programs. This can lead to limited access to an educated and competent work force at the operational level on the farms and at the governmental level.

Access to skilled employees with competence and knowledge regarding the operations of farming the relevant species in the relevant geography, as well as management and owners who know how to navigate and cooperate with the local and national authorities are very important prerequisites; the absence thereof can be a barrier to investment.

3.1.5 Maturity of the aquaculture sector

The maturity of the aquaculture sector with respect to both geography and species may affect all of the above-mentioned barriers either positively or negatively. If the aquaculture sector for a species globally is mature, presumably the barriers with respect to technology, R&D and knowledge along the value chain will be lower. As an example, there are several suppliers offering different well-tested technologies for salmon farming for locations with different weather exposure. On the other hand, the access to technology for halibut or turbot farming is poorer, as these sectors are not developed to a comparable extent.

If a MS generally has a mature aquaculture sector, the barriers of regulation and licensing will likely be lower. There will probably also exist market functions that facilitates access to equipment and other input factors.

On the negative side, in a well-developed sector competition may be fierce, possibly making it tougher to gain access to equipment and suppliers. Furthermore, suitable locations for farming can be limited as the best sites are already used.

The existence of producer organizations (POs) can also alleviate the barriers to entry, as the POs are familiar with the different governmental agencies and the local suppliers and hence can help facilitate the establishment of new aquaculture units.

3.1.6 Operational and structural barriers combined

The barriers mentioned above can vary in intensity or some may not even be applicable under different circumstances. As explained in the chapter above, the level of a barrier can depend on the maturity of the aquaculture sector in the MS or of the species in general. It can also depend on the type of investment, the size of the undertaking considering investing, and the presence of pre-existing aquaculture in the MS.

First, we can generally assume that all the above-mentioned barriers will be lower or non-existent if the investment is an acquisition of an existing farming company in a different MS. Such an investment might even lead to synergies as the two companies combine their knowledge, technology and R&D regarding farming the same species in different local conditions.

Second, we can assume that large companies have the resources or the ability to acquire the necessary knowledge and technology through R&D activities. One the other hand, small companies are usually attached to one geographical place where they hold on to a certain farming technology and operate under conditions for which they have good knowledge, without the sufficient resources to acquire new knowledge, participate in R&D activities, or make use of R&D performed by others.

Third, if a company wishes to establish farming of a given species, we can assume that if the MS has any pre-exisiting aquaculture sector, then the barriers regarding access to equipment, knowledge along the value chain and access to downstream markets will be lower. This is even more likely if the pre-existing aquaculture includes the same species the company wishes to establish. On the other hand, location availability could be limited in this situation because, as noted, the best locations for farming already might be in use.

Finally, scale is an important factor that can influence several of the above-mentioned barriers. Aquaculture is a capital-intensive industry with relatively low marginal costs and is likely to benefit from economies of scale. For example, if the aquaculture regulations in a MS only allow operators with small volumes or few locations, the costs of investments will be higher. Furthermore, when establishing small-scale farming, there will be limited utilization of synergies such as R&D from other MS, limited number of raw material suppliers and service providers, generic marketing, technology, etc. For small-scale producers, stable access to downstream markets will often also be more difficult. The dominance of multiple retail stores for seafood and fish products is evident, affecting production and market policies of individual companies. The effects of scale can in large extent be alleviated by facilitating aquaculture clusters or development activities driven by the combined efforts of several companies.

The land-based freshwater aquaculture industry is characterised by many micro-sized and small and medium sized enterprises. Because of small-scale operations, the enterprises may combine aquaculture with other activities, such as agriculture, angling, restocking, farm-sales, etc.[14] The need for additional activities may be a barrier for investments for companies whose focus is on expanding freshwater aquaculture production.

It follows from this assessment that several factors simultaneously affect the level of the different barriers. We have tried to summarize some of the general assumptions regarding the level of the barriers under different investment scenarios in table 2 below.

[14] DG IPOL (2014), The long-term economic and ecologic impact of larger sustainable aquaculture.

Table 2 Level of barriers in general investment scenarios

Lower / "Normal" / Higher **Investment scenario:**	Barriers					
	Regulation and licensing	Location availability	Equipment	Technology, R&D		Knowledge along the value chain
				Large company	*Small company*	
Aquisition of operational farming company of the same species in a different MS.	Lower	Lower	Lower	Lower	"Normal"	Lower
Establising new farming activity of the same species in a MS with pre-existing aquaculture sector of the same species.	"Normal"	"Normal"	Lower	Lower	"Normal"	Lower
Establishing new farming activity of the same species in a MS with pre-existing aquaculture sector of different species.	"Normal"	"Normal"	"Normal"	Lower	Higher	"Normal"
Establishing new farming activity of the same species in a MS with no pre-existing aquaculture sector.	Higher	Lower	"Normal"	"Normal"	Higher	Higher
Acquisition of operational farming company of a different species in a different MS.	Lower	Lower	Lower	Lower	"Normal"	Lower
Establishing new farming activity of a different species in a MS with pre-existing aquaculture sector of that species.	"Normal"	"Normal"	Lower	"Normal"	Higher	Lower
Establishing new farming activity of a different species in a MS with pre-existing aquaculture sector of other species.	"Normal"	"Normal"	"Normal"	"Normal"	Higher	"Normal"
Establishing new farming activity of a different species in a MS with no pre-existing aquaculture sector.	Higher	Lower	Higher	"Normal"	Higher	Higher

3.2 Financial barriers

Usually, the period from the first investment (in production equipment) to the first harvest is very capital demanding, although the size of the necessary investments can vary depending on the aquaculture sector. For example, it is more capital intensive to start salmonid farming compared to mussel farming. Companies starting from scratch and companies without a strong capital base are dependent on external financing.

The finance and insurance markets evaluate risk and reward. High operational and structural barriers, small-scale operations and small, inexperienced producers increase the risk of an investment.

3.2.1 Financing

Aquaculture stakeholders underline that scale is essential in order to make finance institutions interested. Banks are looking for low-risk business opportunities and the sector has to have a certain size in order for them to support the investment. Banks are usually reluctant to be involved in aquaculture of new species, especially if it requires new technologies.

There appear to be different policies between the MS regarding the sorts of collateral the companies can pledge. Normally, banks only accept real estate, inventory, equipment and machinery as collateral. In Norway however, companies can pledge biomass as a collateral and this has been an important factor for the growth in the salmonid aquaculture sector.

Using biomass as collateral requires the banks' involvement and knowledge. To agree to put effort into increased knowledge in the aquaculture sector, a bank demands a minimum production scale and a minimum level of predictability of the project. The importance of lack of knowledge and lack of focus on aquaculture among banks, has been highlighted by several stakeholders as an obstacle to the general access to capital in the EU.

Economists and other researchers are also tackling the same issue and they identify adequate access to bridging finance for working capital (investment in stocks) as a challenge for growth in the aquaculture sector.[15]

Deviating policies between MS regarding the forms of collateral the borrowers can pledge, may lead to higher financing barriers for cross-border investments as companies investing locally presumably are familiar with the policies and documentation requirements.

In the absence of bank financing, many companies that wish to expand or take advantage of new technology rely on EU or governmental grants, e.g. the European Maritime and Fisheries Fund (EMFF). In the programming period 2014-2020, EMFF has allocated 1.200 million EUR to sustainable aquaculture and a further 500 million EUR to employment and territorial cohesion in connection with coastal and inland fisheries and aquaculture development.[16]

As for operational and structural barriers, the size of the company can also mitigate the financial barrier. Large companies usually have access to capital through internal funds or private capital through listing on stock exchanges. Furthermore, borrower access to bank financing can be easier as large companies tend to have sufficient collateral.

[15] Bostock, J., Lane, A., Hough, C. et al. Aquacult Int (2016) 24: 699-733. An assessment of the economic contribution of EU aquaculture production and the influence of policies for its sustainable development.
[16] https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/pcp_en.pdf

3.2.2 Insurance

As with banks, insurance companies are reluctant to invest in operations in new countries and new species without sufficient knowledge. In some countries and for species of a certain scale, insurance companies are motivated to stay updated on the related risks, e.g. escapements, diseases, algae blooms, parasites and other biological factors.

In MS with limited knowledge along the value chain, insurance companies may not be able to evaluate the risks correctly. As a result, insurance tends to be prohibitively expensive, if available at all. On the other hand, if an insurer has a pre-existing relationship with a company, it might be more willing to take risks, based on the experience of their relationship.

Barriers regarding insurance are likely to be similar in form, if not in magnitude, both for local and cross-border investments.

3.3 Summary of barriers for seawater and freshwater aquaculture

The assessment in chapters 3.1 and 3.2 shows how the combination of several factors can affect cross MS investments in aquaculture. The operational and structural barriers can differ depending on the type of investments and with respect to the pre-existing conditions in the relevant MS, as shown in table 2.

The operational and structural barriers are evaluated by the financial sector as risk, but they can be mitigated by the scale of the operations. As previously mentioned, a large number of micro-enterprises and small and medium sized enterprises, who may also combine aquaculture with other activities, characterize the freshwater aquaculture industry. As a result, access to financing and insurance will normally be a higher barrier for investments in freshwater aquaculture compared to seawater aquaculture.

4 Land-based aquaculture based on RAS technology

The main reason for paying special attention to land-based aquaculture based on RAS (recirculation aquaculture system) technology is that many of the barriers described in the previous section of the report do not apply for RAS-based aquaculture.

High market prices for some aquaculture species (especially salmon) over the last few years and prospects for limited production growth in the marine sector have been strong drivers for developing robust RAS technology for intensive land-based salmon farming. RAS technology is commonly used in smolt production in farming of other aquaculture species.

Currently there are several land-based salmon farms in operation, as for instance:

- Swiss Apine Fish AG (/Italy) (planned production: 600 tonnes);
- Jurassic Salmon (Poland) (planned production: 1000 tonnes);
- Danish Salmon (Denmark);
- Langsand Laks (Denmark) (planned production: 1 500 tonnes).

Langsand Laks is the oldest land-based salmon farm and the company has already harvested its first salmon. Still, some production challenges and high production costs have not yet made land-based salmon profitable. They are currently expanding their production capacity to around 3 000 tonnes.

Despite rising costs of production, high salmon prices have kept the salmon farming industry profitable over the last several years. This in combination with the cost of commercial salmon farming licenses (cost of acquirement), limited access to good production sites, regulatory systems and goals which

limit the opportunity for growth and improved RAS technology, could be drivers for increased interest in land-based aquaculture based on RAS technology. In addition to the farms in operation, there are currently several land-based fish farms being in the planning phase.

Among RAS-facilities, a group with interests in both Denmark and Norway has been identified. Nordic Aquafarms is a Norwegian registered enterprise, but with newly implemented production facilities for yellowtail and yellowtail juveniles in Denmark (approx. 1000 tonnes), and for RAS-production of salmon in Norway (8-9000 tonnes planned production).

A separate study is recommended in order to know more about the drivers behind establishment of land-based (RAS) fish farms, differences in legislation between sea-based and land-based farming, possible barriers and how to facilitate for investments in land based RAS technology aquaculture.

5 Measures to facilitate cross-border investment / recommendations

In the research underlying this report there are measures and factors suggested by stakeholders in the EU aquaculture industry which will facilitate and stimulate cross MS investments. The measures and factors, which are listed below, are also recommendations.

Licencing issues

The experience of the EU aquaculture industry points to issues relating to licencing and the regulatory burdens as the main barrier for investments and development. This applies both for sea based and land-based aquaculture. This is probably the reason why most of the identified cross MS investments have been acquisitions of established aquaculture companies rather than creation of new ones.

There appears to be a mismatch between EU aquaculture objectives and how MS have adapted to them.

There are several European and national policies concerning the environment and water use which affect aquaculture licencing, challenging each MS as coastal and rural development are part of MS policies while local authorities are usually responsibility for operating licences.

It may be possible for MS on the national level to perform spatial planning of coastal areas, taking all the possible environmental issues into account and finding solutions with local authorities on licence operation issues. This may help shorten the licence application process and make the application process more predictable. The European Commission should push MS to force the work with management plans for their costal area. It is important that the aquaculture industry (their organisations) are heard in the planning process.

Marketing efforts

Over the last few decades there have been several boom-and-bust cycles in EU aquaculture. Due to the long-time lag from planning production to harvesting the fish (especially for marine fin fish farming), there is a considerable market risk.

To make growth in production and profit to go hand in hand and reduce market risk, strengthened marketing efforts is necessary. This is underlined by aquaculture stakeholders (especially in the Mediterranean).

Increased marketing of aquaculture products can be organised in different ways and on different levels (the EU level, the MS level, or the PO level).

Some stakeholders in the EU point to the Norwegian models as a possible solution. In Norway, generic marketing is financed with a small fee on exports of seafood products. The fee goes to the Norwegian Seafood Council (NSC) which plans and performs the marketing according to advice and input from the industry.

The PerformFISH research project (a five year €7 million EC-funded project for the Mediterranean) which was launched medio May 2017, appears to be a step along this line.

Specializing on few species in order to achieve scale and attract investors

Industry stakeholders point to scale economies in order to attract investors. To develop EU aqua culture one has to focus on a few species (the right species for different farming environments) and concentrate efforts on those species in terms of building scale. Building scale leads to better utilization of resources (governmental and private) in terms of R&D, supplier and financial institution knowledge, marketing.

By focusing on a few species, competitiveness can be improved (reduced cost, better market power, stable market deliveries at stable quality and improved competitiveness compared with imports).

Enhancing attractiveness of the EU aquaculture industry among financial institutions, through raising awareness and knowledge

The lack of knowledge among financial institutions, and lack of interest in especially smaller scale aquaculture sectors, are mentioned as important barriers to investments, and this applies to both intra- and cross-country investments.

More targeted awareness and promotional activities towards the financial sector could lower such thresholds.

Another potential measure that has been mentioned by stakeholders is a more built-in motivational factor when applying for grants (EU or national), towards co-financing models, where a higher share of achieved grants or public loans also triggers a higher level of private loan-funding. Such models would help reduce the risk for private lenders.

This study has not looked at details, to which extent such models already are available today.

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