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Integrate Aquaculture:
an eco-innovative solution to foster
sustainability in the Atlantic Area

INTERREG Atlantic Area 2014-2020 Project EAPA_232/2016

# WP6 – Defining a network for IMTA development

# Action 3 report: Diagnosis of the IMTA sector in the Atlantic Area

**DELIVERABLE 6.3**

Interreg Atlantic Area
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## Target audience

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# CONTENTS

# 1 Context and methods

## 1.1 The INTEGRATE project

The objective of the INTEGRATE project is to promote Integrated Multi-Trophic Aquaculture (IMTA). These systems are based on the cultivation of multiple species belonging to different trophic levels and interacting on the same site. This project is also an opportunity to enhance the cooperation between the research sector and industries in the innovating aquaculture sector while supporting technology transfer to professionals and educational institutions.

One phase of the project, Work Package N°6 “Defining a Framework for IMTA development: Action Plans for the Atlantic Area” is split into four actions:

- identification of barriers to the implementation of IMTA throughout the Atlantic Area (AA);
- stakeholders’ position on IMTA in Europe;
- regulatory analysis of IMTA in the Atlantic Area;
- how to develop an action plan: from diagnosis to action.

Agrocampus Ouest is in charge of managing this work package and designed the method to conduct the survey and achieve the different actions. This method was then applied by the different partners in their own countries to obtain as much data as possible about the IMTA sector in the Atlantic Area.

## 1.2 Diagnosis of the IMTA sector

The objective of Action 3 in this Work Package was to carry out a diagnosis of the IMTA sector for each of the partner countries. This diagnosis was made using a strategic analysis tool: the SWOT (Strengths, Weaknesses, Opportunities, Threats) matrix. This tool combines the study of the strengths and weaknesses of an organisation, a territory, a sector, etc. with that of the assets and threats of its environment, to help define a development strategy. Strengths and weaknesses are often internal, while opportunities and threats usually stem from the external environment. The name is an acronym for the four parameters considered:

- Strengths: characteristics that give the sector an edge over others.
- Weaknesses: characteristics that disadvantage the sector compared to others.
- Opportunities: elements of the environment that the sector could utilise to its advantage.
- Threats: elements of the environment that could cause problems in the development of the sector.

SWOT matrices were created to analyse the technical, environmental, social and economic dimensions of IMTA, thus providing a complete overview of the sector in each country. A brief synopsis of the regulatory environment in partner countries in relation to the IMTA sector was also drawn up as well as a diagnosis of each country's regulatory environment through additional SWOT matrices.

This work appears as an extension of the studies carried out under Actions 1 and 2 of Work Package 6 (Eyrolles et al., 2018a, 2018b). The results of this work as well as those of the various workshops, organised as part of Work Package 4 to identify the good practices to implement in IMTA, were used as a working basis. These sources of information made it possible to present the specificities of each country and to highlight the common problems or challenges to overcome for the development of the IMTA sector.

The matrices presented hereafter provide a synthesised presentation of the results obtained. More detailed information can be found in the previous action reports of Work Package 6 (Eyrolles et al., 2018a, 2018b). The comparison of these different analyses of national challenges makes it possible to draw up a diagnosis for the development of IMTA throughout the Atlantic Area. A general SWOT matrix summing up these different results is also provided.

# 2 Diagnosis of the IMTA sector per country

For each AA partner country, a diagnosis was made of the environmental, social, economic and technical characteristics of the IMTA sector.

## 2.1 Ireland

### Technical

STRENGTHS

- Aquaculture is technically advanced and seeking to innovate, which can help the multi-trophic approach. BIM (Bord Iascaigh Marha) is working with the industry to trial an innovative freshwater integrated multi-trophic aquaculture (IMTA) system in Ireland.
- Sound knowledge and experience of how to raise some of the species individually.
- Numerous species combinations have been trialled in Ireland.
    - Marine systems: Atlantic Salmon (*Salmo salar*) - Seaweed (*Alaria sp.*);
    - Land-based systems:
        - Rainbow trout (*Oncorhynchus mykiss*) - Seaweed (*Ulva lactuca, Porphyra dioica*),
        - Perch (*Perca fluviatilis*) – Duckweed algae (*Lemna spp.*)
- Newly developed models for IMTA within the TAPAS project. They are improved for interaction of nutrients, impacts and mitigation for coastal IMTA. Different models have also been developed on shellfish growth and carrying capacity, shellfish microbial contamination, and cross contamination of farms (e.g. sea lice). Modelling of the trophic interactions in Bantry Bay, where many separate aquaculture facilities are located, is also underway as part of the Bluefish project. This will help to develop understanding of how trophic pathways in incidental IMTA function.

**Associated references:** Bluefish; Hanniffy and Kraan; Hughes et al., 2016; Mhara; Ratcliff et al., 2019; Soler-Vila and Ratcliff, 2019

WEAKNESSES

- Added complexity. New species require new and specific skills and technical knowledge. Aquaculture operations are already run very efficiently leaving few resources available for new operations.
- There are common viral diseases reported in Atlantic salmon that are hosted in bivalves, gastropods and crustaceans, but not much has been reported in the AA on how these pathogens actually bioaccumulate and are transmitted.
- There is not much experience in Ireland, leading to many as yet unanswered research questions, like the spatial organisation of trophic levels to maximise nutrient uptake.
- Nutrient capture on the scale of operations at sea is difficult – and not necessarily a high priority, due to hydrodynamic regimes.
- New species need to be domesticated. Optimisation of hatchery production, optimal procedures for both novel and commercial species need to be identified for specific invertebrate species e.g. sea cucumbers and sea urchins.
- The most significant, by value, aquaculture species farmed in Ireland is Atlantic salmon. This industry is mainly owned by one company. This company currently operates on a monoculture basis.

- Assessment of suitability of IMTA is very site-specific so it is currently difficult to make generalisations. Published work often does not include site-specific information such as current speed, direction, Chlorophyll-a concentrations, etc.

**Associated references:** James et al., 2016; Kerrigan and Suckling, 2018; Molloy et al., 2013; Ratcliff et al., 2019

OPPORTUNITIES

- Improvement in total productivity, i.e. at IMTA unit scale (rather than individual species scale). Largely anecdotal now – enhancements in macroalgal productivity and shellfish productivity when in close proximity to salmon farms (productivity declines on cessation of salmon farming).
- Increasing awareness of and interest in IMTA by state bodies (Marine Institute, Bord Iascaigh Mhara, Department of Agriculture, Food and the Marine).
- Modelling capacity is well developed and now being further adapted to include IMTA specific situations (e.g. Bantry Bay through Bluefish project, Marine Institute via TAPAS project.)
- Discharge limits and trade effluent licences (TELs) present an opportunity to encourage integration of extractive species in land-based systems. It is considered likely that 'remediation' will become a central part of future TELs.

**Associated references:** Cooney et al., 2017; Hughes et al., 2016; Ratcliff et al., 2019

THREATS

- Fish farmers do not want close association with other species, for practical reasons – e.g. limiting the accessibility of sites by boats, etc.
- Potential spread of pests, pathogens, contaminants, and potential food safety issues. These issues need much more research in order to understand the real implications.

**Associated references:** Ratcliff et al., 2019

**Social**

STRENGTHS

- Improved public perception, once explained. It was found that people thought IMTA could increase food production and improve overall sustainability and waste management >60% respondents)

**Associated references:** Ratcliff et al., 2019

WEAKNESSES

- Limited public knowledge of IMTA. In general, awareness of what IMTA is was < 20% (in Ireland), and this was not significantly affected by demographics.
- It can be difficult to communicate about IMTA as it is such a varied concept, and often 'academic'. There is no single IMTA model. It applies to many different systems and species and arrangements.
- The acronym is rather complex. We lose people with such a long 'name', and particularly with the inclusion of 'multi-trophic'. Although this is important from a technical standpoint, we received many comments that it is unintelligible to the majority of people, and therefore off-putting.

**Associated references:** Ratcliff et al., 2019

OPPORTUNITIES

- To create greater collaboration and a cooperative approach between producers. This may be necessary in order to address certain problems, for example the mismatch in scales between finfish / shellfish / macroalgae production, or to create common access to markets that might be inaccessible to smaller production volumes, etc.
- With species diversification there is the opportunity to create new jobs. Certain candidate IMTA species (for example urchins, polychaetes, sea cucumbers) are not yet commercially available. The Research, Development & Commercialisation for these species, along with provision for hatcheries and on-growing could create additional skilled jobs for the aquaculture sector.

**Associated references:** Ratcliff et al., 2019

THREATS

- Producers of extractive species do not necessarily want the negative association of finfish aquaculture.
- The 'vocal minority' (anti-aquaculture groups etc.) who objects to aquaculture development under any circumstances and at times forms a strong negative voice.

**Associated references:** Producers' personal communication

**Environmental**

STRENGTHS

- In land-based systems there is a clear opportunity to improve effluent quality and emissions to the environment in flow-through systems. At present the data demonstrating this in Ireland are from research or pilot-scale systems.

**Associated references:** Paolacci et al., 2018

WEAKNESSES

- How to monitor environmental benefits? No clear system for measuring or monitoring the extent of mitigation of nutrients at sea. There are no life cycle assessments (LCAs) from which to generalise because the data are missing because nothing is at scale yet.
- Issues of scale. This refers to the amount of space required to achieve large percentages of organic and/or inorganic nutrient remediation.
- What percentage of remediation is considered acceptable for an IMTA system is also as yet unspecified.
- IMTA does not address other aspects of sustainability such as fish meal/oil use, etc. An environmental label that endorses IMTA products as a 'green' choice may be misleading if other important issues are not considered under such a scheme.

**Associated references:** Fossberg et al., 2018; Holdt and Edwards, 2014

OPPORTUNITIES

- Nutrient trading schemes, e.g. Carbon trading – the EU Emissions Trading System (EU ETS), a tool for reducing greenhouse gas emissions from power stations and industry plants as well as airlines that operates within the EU. The ETS covers about 45% of EU emissions, 29% of total emissions in Ireland.
- Cooperative approach – to manage the development of aquaculture in bays and inshore waters, e.g. through Co-ordinated Local Aquaculture Management Systems (C.L.A.M.S). This links to what is referred to as *Unintentional IMTA*, i.e. the siting of independent aquaculture facilities in close proximity to each other without being intentionally integrated but with potential for trophic interaction between different trophic levels.

**Associated references:** (Department of Communications, Climate Action and Environment, 2019)

THREATS

- Negative interactions between IMTA systems and the local ecosystems, i.e. a depletion of nutrients available for phytoplankton and the knock-on effects this could have. These have not yet been investigated.

**Economic**

STRENGTHS

- Although an increase in overall productivity of 'IMTA units' has the potential to occur, there are not yet any data to show that this is the case in an Irish context.

WEAKNESSES

- Scale mismatch: Irish aquaculture production is dominated by a few species (salmon 19,305 t; Japanese oyster 9,879 t; rope mussel 8,549 t; seabed cultured mussel 7,781 t). The productions are dominated by the finfish industry. Shellfish growers operate on a very small scale.
- Integrating the two is therefore not straightforward.
- As there are no figures regarding IMTA for Ireland – no financial planning is possible.
- Lack of markets for secondary species (but see point 1 in Opportunities).
- No economic proof of concept for IMTA and no way currently to command a higher price for IMTA products.

**Associated references:** Ratcliff et al., 2019

OPPORTUNITIES

- With a diversification of cultivated species would come the possibility of developing new markets.
- Possibility to develop new niche markets i.e. capitalise on the eco-credentials of IMTA (through certification etc.) and for high quality products. This could fit very well with the market positioning of Irish aquaculture products that aims at the high quality and organic markets.
- There is the potential to develop systems for internalisation of ecosystem service costs – polluter-pays principle.
- Improvement in public perception: In Ireland over 80% of respondents strongly agreed that fish farming creates opportunities for local employment in coastal areas and that lower price of farmed fish products encouraged people to eat more fish. It should be noted that it was not clear that positive attitudes to fish farming would translate into a willingness to pay more.

**Associated references:** Ratcliff et al., 2019

THREATS

Not documented

## 2.2 United Kingdom (Scotland)

### Technical

STRENGTHS

- We already have a very good knowledge of the individual cultivation systems used for specific species (oysters, mussels, scallops, seaweed). These have been built over many years and are adaptable to most locations and conditions on the Scottish coast.
- Current and whole loch-system modelling in Scotland is fairly advanced due to many years of practical experience and research. This means that the siting of facilities in relation to water flow and quality is fairly advanced and is assisted by modelling programmes such as DEPOMOD. There is a continuous, ongoing development of these areas.
- Demand and capacity constraints in the aquaculture sector are leading to technical innovation from the sector – there is genuine interest from all the players in the sector in new technical developments and specifically in IMTA for benthic bioremediation purposes.

**Associated references:** Weise et al., 2009

WEAKNESSES

- The traditional IMTA model where cultivation 'strands' are immediately adjacent may not be ideal in many high-energy Scottish sites, as damage in one section may result in damage to the whole site. It also potentially increases the cost of installation of the shellfish/seaweed component due to higher standards.
- The shared usage of vessels and staff time between sites (often cited as a benefit of IMTA) is not really likely in Scotland, as staff and facilities time on salmon sites is fairly strictly managed through the business model – there is not a lot of flexibility for extra work.
- 'Desirability' of species – the typical current species set-up for a Scottish IMTA site is likely to be very labour intensive based on the scale needed to make it profitable. There would need to be significant technical and research investment in designing systems to reduce labour/time input as regards grading, cleaning and harvesting.

OPPORTUNITIES

- IMTA has the potential to be of huge benefit to the Scottish industry by allowing capacity enhancement while potentially reducing localised environmental impacts – something, as noted above, that the industry is very interested in.
- The design, development and installation of new physical holding systems for the benthic IMTA component offer opportunities for other aquaculture systems, as this is an area in which there has not been much development.
- Teaching IMTA skills to a new generation of aquaculturists will lead to innovation and development in its own right.
- The drive to use local species in IMTA systems may lead to the development of markets for new or currently overlooked species.

**Associated references:** (Alexander and Hughes, 2017)

THREATS

- Desirability of IMTA-grown products –, there is a perception amongst some growers that species grown in the vicinity of a finfish farm are consuming waste and are thus of lower quality. In Scotland this is a particular issue as the marketing effort for both the salmon and shellfish industries is reliant on the pristine nature of the product.
- The co-location of species as part of an IMTA system may lead to issues such as increased fouling. There is also the possibility that other species in close proximity may act as vectors for the spread of sea lice or other infection. Although this is very unlikely, the threat may be enough to deter some farmers from experimenting or adapting.
- If IMTA proceeds using species that are commercially desirable, but not of local provenance, this may open IMTA up to negative publicity and negate the positive perception of IMTA.

**Social**

STRENGTHS

- IMTA enjoys a positive perception overall, both from the general public and from the industry and regulators.
- The application of IMTA in some situations and locations may make stakeholders and the general public more amenable to general aquaculture development.

**Associated references:** Alexander et al., 2016; Hughes et al., 2016

WEAKNESSES

- **Does IMTA need a better definition?** While the loose definition of what constitutes IMTA benefits its development at present, in the longer term it will hinder its growth, as there is the potential for confusion about the claimed benefits of its implementation.

OPPORTUNITIES

- **Development of the 'brand':** IMTA will deliver real technical change on the ground, but the social development of IMTA will be its public face, and hopefully will deliver a step change in the public's attitude towards aquaculture.
- **Cooperation and knowledge sharing:** A positive example of where science and aquaculture can work together to bring about innovation and development.

THREATS

- **Increased development:** Increased aquaculture development could be perceived by some stakeholders to be a negative occurrence, unless the benefits of IMTA are clearly explained and stakeholders are involved at all stages of the consultation process. As IMTA installations will follow the same planning path as other aquaculture sites, this should not be a major issue, but it may be that its benefits are overlooked.

**Environmental**

STRENGTHS

- **Removal of primary waste from the system:** A reduction in the depositional and dispersive nutrient effects – this is dependent on the individual site and conditions (see weaknesses *below).*
- **Potential secondary benefits to the finfish farmer**: The common mussel has been shown to be an effective remover of sea lice larvae from the water column. While this needs further investigation, any secondary benefit such as this could be very valuable to the farmer.

**Associated references:** Molloy et al., 2011

WEAKNESSES

- **Better evaluation:** How IMTA systems remove nutrients from the water is very variable depending on the location of the farm and the associated water characteristics. The IDREEM results found that all of the existing farms studied had very localised environmental impacts, and the effects of these farms could not directly be noted in any of the IMTA systems adjacent to them.
- **How do we monitor the effect of IMTA?** Following on from above, the measurement parameters to satisfactorily detect the effects of nutrient release as waste can be very fine-scaled and difficult to detect, especially in areas with high water turnover. An inability to prove the removal of waste by the IMTA system will detract from its attractiveness.

**Associated references:** Hughes et al., 2016

OPPORTUNITIES

- **Public perception:** The environmental benefit provided by IMTA has to be its main selling point, and this is one that is already understood by the general public. An opportunity exists to expand on the public perception of IMTA and use it as a key marketing tool for aquaculture in general.
- **Changing frameworks**: In Scotland there are about to be some fundamental changes in environmental regulation for finfish aquaculture (https://consultation.sepa.org.uk/sector-plan/finfishaquaculture/) which will introduce new regulations for the sector. As the regulatory framework changes, IMTA may become more attractive as a method for the bioremediation of existing waste – more so than its economic case.
- **Better modelling leading to greater outputs**: Environmental modelling has been shown to assist in site selection for IMTA. Some base models adapted for the IDREEM project (FARM model) show large potential increases in output by altering siting and stocking practices.

**Associated references:** Alexander and Hughes, 2017; Ferreira et al., 2007

THREATS

- **Long term strategy**: There may be a possibility that, without further definition, IMTA will be adopted by different parties, to different ends. While this may be done with the best intentions, there is the possibility of 'diluting' the brand, or causing damage to it, by certain activities that may be carried out under the umbrella of IMTA.



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**Economic**

STRENGTHS

- **Diversification**: As already mentioned, this is a major aspect of the economic case, and has been specifically mentioned by all of the Scottish producers we spoke to. It is often felt that the industry has to adapt and innovate with new species and new methods of cultivation, and IMTA was often seen as an ideal way to carry this out. This view was consistent across site locations and different cultivation systems.
- **New markets**: An increase in production in the shellfish sector will allow expansion into new markets, both nationally and internationally. This can be a chance to further the sale of species suitable to IMTA culture at a time when demand will increase due to concerns over land-based cultivation.

**Associated references:** Alexander et al., 2016; Hughes et al., 2016

WEAKNESSES

- **Scale mismatch**: In Scottish aquaculture, the big issue is the difference in scales between the finfish and shellfish sectors respectively. The current interest in IMTA in Scotland is largely for bioremediation rather than economic development. This arises from a disparity between the scales – shellfish producers are largely small, and in no position to expend large amounts of capital developing new systems, whereas salmon producers will not get a sufficient commercial return in shellfish to make it of interest from a financial viewpoint alone.
- **Scaled investment**: Following on from the scale issue, development funding for smaller organisations interested in diversification may be more difficult to obtain until IMTA develops further, and more experience is gained in its practice.

OPPORTUNITIES

- **Market strategy**: From the social perspective, provided IMTA comes up with a suitable definition that is accepted by the market, IMTA products may be able to attain higher market prices than 'conventional' seafood products due to higher public estimation of their value.
- **Change in regulatory regime**: Although technically a regulatory issue, a change in the framework (as noted in *Environmental* above), may herald a change in the direction in which aquaculture is heading in Scotland. If there is sufficient demand for change, the economic incentives will alter and a new avenue will open up for IMTA.

**Associated references:** Alexander et al., 2016

THREATS

- **Economic volatility**: Large scale investment is likely to come from the salmon industry initially. The finfish sector, with salmon in particular, has had a long spell of good sale prices, which has encouraged investment and development. Changes to this – i.e. a market collapse, or changes in demand (perhaps caused by external factors such as Brexit?) - may alter the desirability within the sector to innovate and develop.

## 2.3 France (Atlantic coast)

### Technical

STRENGTHS

- **Improvement of the system's total productivity:** Species interactions in the same area may increase the productivity of each species, thus resulting in greater profitability of the whole system. Co-culture systems [shrimp - oyster] in Charente Maritime have also shown that IMTA systems contribute to optimising the surface area devoted to the cultivation of two complementary species.

**Associated references:** Kang et al., 2003; Lander et al., 2012

WEAKNESSES

- **IMTA models not adapted to the particularity of French aquaculture:** Marine aquaculture activity in France is mainly based on shellfish farming. Very few IMTA systems are designed for foreshore activities and new models must be created.
- **High environmental constraints in the open sea:** Aquaculture sites are often chosen in areas presenting fewer constraints for other marine activities and are therefore not always ideal for the establishment of an aquaculture activity.
- **Technical complexity:** IMTA's complexity and the difficulty of mastering the cultivation of multiple species simultaneously appear to be a major barrier to the development of IMTA, along with the additional workforce needed to develop and market the new product (diversification of the markets, new providers and new clients).
- **Domestication of new species:** This question is crucial for the sector of seaweed aquaculture to ensure profitability for companies. The species authorised to be grown in France only enable short-term economic sustainability. Mastering the life cycle of new detritivore species may also ensure optimisation of IMTA systems and reduce the impact of fish farming on the benthos.
- **Variability of open-sea systems:** The performance of IMTA systems can vary significantly from one site to another depending on hydrological parameters. Thus, environmental and production performance can be negligible.

**Associated references:** Hughes et al., 2016; Kinney, 2017; Kleitou et al., 2018; Navarrete-Mier et al., 2010; Ratcliff et al., 2019; Thomas, 2010

OPPORTUNITIES

- **Development of new educational tools:** To overcome the lack of knowledge and skills to monitor these systems, vocational training institutions could set up new curricula.

**Associated references:** Thomas, 2010

THREATS

- **Quality of IMTA products:** The taste and the composition of shellfish or seaweed cultivated near fish cages must be analysed to verify that their quality is at least equivalent to that of traditional aquaculture systems. Health and hygiene of these products are also questioned. Studies carried out with the veterinary services may help resolve the issue simply and could reassure consumers and authorities alike.
- **Interaction between species**: Questions remain about whether such integrated systems increase productivity. There is also a lack of information about the consequences, on the whole system, of using medications and antibiotics for treating a given species. Studies are needed to prove the sanitary quality of IMTA products. There is also a need to understand the interactions between species and quantify the use of resources and energy fluxes.

**Associated references:** Hughes and Black, 2016; Kleitou et al., 2018; Ratcliff et al., 2019

**Social**

STRENGTHS

- **Perception of IMTA:** Improved social acceptability of IMTA practices compared to traditional aquaculture.

**Associated references:** Carras, 2017

WEAKNESSES

- **Perception in terms of image:** Several studies have shown that consumers would agree to pay a premium for IMTA products but it would be hard to communicate on the practices of IMTA as it is complex and consumers might not agree with the idea of using molluscs to recycle fish waste.

OPPORTUNITIES

- **Cooperation and knowledge sharing:** Cooperation with scientists is not a specific motivation for the producers to get involved in IMTA but a necessity for them to access innovation. IMTA systems might also be an attraction for curious consumers
- **Skill improvement:** The complexity of IMTA practices requires mastering multiple species in aquaculture, as well as knowing how to balance the system and use the monitoring tools. This aspect may be a good opportunity for employees to develop their skills and grow professionally.
- **Territorial development:** Aquaculture, as well as fisheries, contributes to local economic development with non-seasonal activities.

**Associated references:** Ratcliff et al., 2019

THREATS

- **Lack of communication about the practices:** The complexity of IMTA, even in its very name, might make communication about the practices difficult and could generate mistrust.
- **Product acceptance:** The fact that molluscs and algae recycle the excrement of fish might be a barrier for consumers in France.
- **Representativeness of local stakeholders:** Local communities ask to be better represented in the decisions concerning new activities in their territory, and projects to create new aquaculture sites raise more and more discussions. Participatory tools should be used to construct these projects. Representativeness of every stakeholder (NGOs, residents, economic players) should be taken into account.

**Associated references**: Foucard et al., 2015; Paul, 2016; Ratcliff et al., 2019

**Environmental**

STRENGTHS

- **Reducing nutrient emissions:** The reduction of the environmental footprint is crucial for the development of aquaculture and IMTA systems can provide such solutions.

WEAKNESSES

- **Variability of environmental benefits:** For open-sea systems, environmental performances are very much site-dependent as the absorption of fish waste depends on the hydrodynamics of each site. IMTA environmental benefits are debatable on this point.
- **No solution for certain issues**: Open-sea IMTA cannot solve aquaculture issues related to genetic pollution due to fish escaping. However, by establishing good practices (for IMTA and traditional aquaculture) this could be remediated.

**Associated references:** Navarrete-Mier et al., 2010; Ratcliff et al., 2019

OPPORTUNITIES

- **Image of fish farming:** IMTA is sometimes considered as a way of making fish farming more acceptable, by communicating on the environmental benefits of such practices.
- **Company image:** Few companies communicate about their IMTA practices in France. It is mainly due to the fact that there is no legal definition of IMTA and because consumers have very limited information about aquaculture practices in general.

THREATS

- **Divergence on IMTA benefits:** Not every producer agrees about the potential benefits of IMTA compared to a traditional system. Different points of view arise (utopia, greenwashing, virtuous principle but more research needed).
- **IMTA must not be greenwashing:** The environmental benefits of IMTA should be promoted so that sustainable aquaculture can be developed, but these systems also have their limits. Developing IMTA must be done using participatory tools and after assessing the relevance of potential projects for the local area.

**Associated references:** Ratcliff et al., 2019

**Economic**

STRENGTHS

- **Diversification:** This item was raised by a large number of producers during our interviews. Diversification appears to be a good way to become less dependent on single species and with respect to hazards (climate, mortalities). However, seeing the low mortality rates in recent years and the stability of markets, producers show little interest in diversification.
- **Access to new markets:** Related to diversification, cultivating new species gives access to new markets and new clients.

**Associated references**: Hughes and Black, 2016; Ratcliff et al., 2019; Thomas, 2010

WEAKNESSES

- **Profitability compared to monoculture systems:** An IMTA system associating salmon and seaweed would remain less profitable than just growing salmon on the same surface area. Moreover, there are uncertainties about the profitability of seaweed aquaculture with the species currently authorised in France and IMTA systems often include seaweed production.
- **Investment:** Producers need more information about IMTA systems' profitability before these practices can be envisaged. The notion of risk and investment is dependent on the notion of profitability.
- **Increased labour load:** Cultivating two species leads to a greater work load due to the time needed to process the products and find clients and suppliers.

**Associated references:** Hughes et al., 2016; Kinney, 2017; Kleitou et al., 2018; Martinie-Cousty and Prévot-Madère, 2017; Ratcliff et al., 2019

OPPORTUNITIES

- **Premium price, marketing:** Willingness to pay for IMTA products is higher. Nonetheless, a good communication strategy is needed to choose which point the company will communicate about, since consumers have very little knowledge about aquaculture practices**.**
- **Application of the polluter-pays principle:** IMTA companies could buy back nitrogen or phosphorus quotas, and gain in competitiveness in the case where non-environmentally sustainable aquaculture is taxed.
- **Implementing a production insurance policy:** Use EMFF (European Maritime and Fisheries Fund) money to guarantee minimum revenues in case of heavy losses (article 56.1 of the EMFF for oyster farmers extended to all aquaculture producers).

**Associated references:** Carras, 2017; CIMTAN, 2011; Kinney, 2017; van Osch et al., 2017; Ratcliff et al., 2019; Yip, 2012

THREATS

- **Communication:** The complexity of IMTA might make its communication and marketing difficult. Differentiating IMTA with arguments such as faeces absorption or bioremediation might not be the best strategy.
- **Seaweed market:** Many aquaculturists abandoned seaweed cultivation because of its poor profitability. To become attractive, seaweed farming needs an initial processing step to give it added value, but this will require investing in additional infrastructures for the producers.

**Associated references:** Altintzoglou et al., 2010; Kinney, 2017; Ratcliff et al., 2019

## 2.4 Spain (Atlantic coast)

### Technical

STRENGTHS

- **Improvement of the system's total productivity:** Species interactions in the same area may increase the productivity of each species, thus resulting in greater profitability of the whole system.

WEAKNESSES

- **IMTA models not adapted to aquaculture in Spain:** The aquaculture models found in Spain are based on the cultivation of a single species, whether finfish or shellfish.
- **High environmental and legal constraints in the open sea and in coastal areas:** Aquaculture areas may come into conflict with other economic activities and uses.
- **Technical complexity:** There are still many technical limitations to the correct implementation of IMTA from an economic and environmental sustainability perspective.

OPPORTUNITIES

- **Gaining experience in IMTA:** In some regions, such as Galicia and Andalusia, this type of aquaculture is beginning to be taken into account by public authorities.
- **Public funding:** Specific public funding for sustainable aquaculture is starting to be seen (for example in the EMFF).

THREATS

- **Quality and food safety of IMTA products:** The taste and the composition of shellfish or seaweed cultivated along with fish must be analysed to verify their quality and food safety. It would be interesting to compare this quality with similar products from conventional aquaculture based on European and Spanish regulations.
- **Interaction between species**: The exact interaction between species is unknown. This can have consequences for the spread of diseases or the effect of antibiotics and other types of treatment.

**Social**

STRENGTHS

- **Consumer acceptance:** More and more consumers prefer sustainable products.

WEAKNESSES

- **Image of extraction production (second and third levels):** Consumers may have a negative image regarding the consumption of organisms fed with waste from other organisms.

OPPORTUNITIES

- **Support from public authorities and research organisations for the promotion of sustainable aquaculture:** The administration, research organisations and NGOs support sustainable aquaculture practices such as IMTA. This can foster the creation of synergies and boost IMTA in Spain.
- **Creation of new jobs:** The creation of new IMTA aquaculture facilities can promote the creation of jobs with a certain level of specialisation in the sector.
- **IMTA certification:** It is necessary to create a special brand or adapt some type of existing certification to ensure the success of this type of aquaculture. Doing this will give more value to products from IMTA.
- **Communication and information about IMTA:** Although aquaculture in Spain may be considered negatively, good communication about the benefits of this type of aquaculture can change this perception.

THREATS

- **Lack of knowledge/awareness of IMTA:** Aquaculture is already unfamiliar for many people and IMTA is an even more complex concept.
- **IMTA definition:** It is necessary to define IMTA at all levels in order to provide the public (businesses, consumers, administrations, etc.) with correct information

**Environmental**

STRENGTHS

- **Reducing the nutrient load:** Nutrient load reduction has been demonstrated in IMTA (except in open-space for the moment). This fact is important in aquaculture facilities that are usually located in or near environmental protection zones, as is the case in Spain.

WEAKNESSES

- **Variability of environmental benefits:** For open-sea systems, environmental performances are very much site-dependent as the absorption of fish waste depends on the hydrodynamics of each site. On land (earthen ponds) there are also other complex trophic interactions.
- **Balance**: It is difficult to establish which exact proportion of the different organisms is required in an IMTA system to produce environmental benefits (and make the system profitable).

OPPORTUNITIES

- **Increase in aquaculture products:** IMTA promotes the diversification of more affordable products for consumers.
- **Company image:** The adoption of this type of aquaculture by existing (monoculture) companies can improve their image.
- **More space available:** The promotion of environmentally sustainable aquaculture activities by public authorities can drive the development of this type of aquaculture.

THREATS

- **IMTA benefits?** The economic profitability and technical feasibility of IMTA must be demonstrated first before evaluating the environmental benefits (for farmers).

**Economic**

STRENGTHS

- **Diversification:** Cultivation of several species lowers the risk associated with growing only one species. However, it is necessary to demonstrate the economic profitability at all levels.
- **Access to new markets and new consumers:** Cultivating new species, and especially seaweed, gives access to new markets and new clients.

WEAKNESSES

- **Profitability of IMTA:** Reliable technical knowledge to demonstrate the economic viability of IMTA is lacking.
- **Investment:** Companies are reluctant to show initiative due to the lack of existing success stories and research studies transferable to aquaculture companies.
- **Increased labour load:** Cultivating two (or three) species leads to a heavier work load due to the time needed to develop and market the products, find clients and suppliers. It also requires qualified personnel specialised in each species or in the combination of these species (ideally).

OPPORTUNITIES

- **Higher market value:** It is important to give greater value to IMTA products to compensate the effort required by their production.

THREATS

- Communication: Good familiarity of IMTA's strengths and weaknesses is needed in order to successfully communicate its benefits.
- **Commercial difficulties:** For producers it is difficult to open markets to different products.

## 2.5 Portugal

### Technical

STRENGTHS

- **Available areas devoted to aquaculture:** Several areas with abandoned earthen ponds are found along the Portuguese coastal zone, many of them previously used for salt and fish production. They can be used for IMTA purposes and some companies have already used them for combined fish-oyster or fish-seaweed production.
- **Sound knowledge about aquaculture:** Marine fish and oyster productions are quite well established in Portugal and companies and research institutes have extensive knowledge about several species that can be used for IMTA production.
- **Development of seaweed farming:** There is also a Portuguese Algae Producers Association (PROALGA) that can help future farmers establish IMTA systems.

WEAKNESSES

- Lack of association and integration between farmers, regulators and research groups.
- Very few companies operate in offshore fish culture and they are still improving their finfish production.
- Introduction of new species is not expected in the short term

OPPORTUNITIES

- **Growing interest in IMTA:** According to studies carried out at IPMA's aquaculture research station, technical knowledge about combining oysters with fish production has improved and combinations with the macroalgae *Ulva* spp are being investigated. This has attracted the attention of several investors who have shown interest in implementing a similar approach in restrictive areas within natural parks.
- **The potential market for new species is driving research:** Asia's appetite for sea urchins, sea cucumbers and seaweeds has driven some successful research in sea urchin rearing at IPMA station and protocols with Chinese institutions for echinoderm aquaculture partnerships are under way. Currently sea urchin production is being tested in offshore facilities in southern Portugal with good results.
- **New species to resolve the environmental issues of aquaculture:** Sea cucumber, as a detritivore species, together with fish, is being studied in several Portuguese research centres for bioremediation purposes. Polychaetes are also studied at IPMA to test their growth under different feeding regimes (natural, fish waste, organic matter from fishponds, oyster and sea urchin faeces).

THREATS

- **Environmental risks:** An exposed coast line and rough seas are major drawbacks for investors to implement seaweed production with fish cages in offshore IMTA.
- **Lack of knowledge** about fish-seaweed production is still a major obstacle to the feasibility of seaweed production near fish cages in areas with strong currents and waves.
- **Concerns about species interactions in IMTA systems:** Fish diseases are mentioned by fish producers as a reason for not wanting to grow seaweeds close to fish cages. Apparently seaweeds can be a vector for fish parasites.

**Social**

STRENGTHS

- **Good image of IMTA practices:** Workshops about IMTA showed that the public and stakeholders agreed on the fact that the IMTA approach could be a good strategy to increase sustainability and were in favour of more studies to corroborate this goal.
- **Better social acceptance:** There is growing acceptance of IMTA by regulators. The system is accepted to be less impacting and can be implemented in sensitive areas.

WEAKNESSES

- There is a major lack of interest in knowing more about aquaculture in general and in reducing the consumption of endangered species (like tuna or sardines).

OPPORTUNITIES

- The IMTA concept fits well in the current trend of reducing the ecological footprint, recycling waste, and with the efforts to produce more with fewer resources.
- **Eco-certification:** People appreciate ecological labels if well explained and if they have a good understanding of organic production concepts.

THREATS

- **Public perception of aquaculture** in Portugal is quite poor, with negative perspectives, since Portuguese consumers have difficulty in accepting that an aquaculture product can be as good and safe as a wild animal, even with scientific studies supporting that claim. Also concerns about excessive use of antibiotics in salmon farming are now being extended to the whole aquaculture sector.

**Environmental**

STRENGTHS

- IMTA applied in ponds, as tested by IPMA (fish with oysters in earthen ponds), showed that with a slight increase in aquaculture labour it is possible to recover more biomass from the same unit than with a monoculture system, and with better water quality.
- Oysters in fishponds can control microalgae blooms and reduce turbidity.

WEAKNESSES

- Increased surface areas (algae, oyster bags, trays) provide greater opportunities for fixing bacteria and parasites. Recirculation of water between trophic levels can carry diseases which can spread outside the system to natural waters.

OPPORTUNITIES

- Public awareness of the IMTA concept as a way of reducing waste may trigger faster acceptance for IMTA systems. This can be coupled with the use of eco-labels and a national plan for the consumption of IMTA products as has been successfully done in recent years for mackerel (*Scomber scombrus*) in order to reduce the consumption of sardines (S*ardina pilchardus*)
- Environmental accounting with Life Cycle Assessment tools is used in aquaculture and applied in IMTA systems. This information will provide better insight into the importance of nutrient recycling in the overall economic and environmental picture of IMTA systems and could be used for eco-labelling.

THREATS

- **Balance of IMTA systems:** The equilibrium achieved by an optimal IMTA system is hard to obtain and fluctuates with different stocking densities throughout the production cycle. This means that environmental benefits may be only achieved over short periods of time. This can hinder the argument of sustainable production if good results are only short lasting. Detrimental results can also appear before farmers get to know the ecological carrying capacity of their water body and this threshold can change locally due to global warming.

**Economic**

STRENGTHS

- Better nutrient use is the goal of every farmer and IMTA should increase the net return for every input used.
- Production risks will decrease with the diversification of products.
- Diversification of products, especially from different trophic levels, is well viewed in Portugal. This could be an opportunity to develop certain species with high demand in Asia, like sea urchins, sea cucumbers and macroalgae and explore new markets like pharmaceuticals, cosmetics and biofuels.
- Ecosystem services provided by the IMTA system may be used as an economic opportunity and in recent years there has been increased awareness of this approach among stakeholders.
- There are potential side benefits for the finfish farmer: species like bivalves or macroalgae, which grow much faster than fish, may bring short-term returns for the fish farmer and this could be a good economic strategy.

WEAKNESSES

- The greater complexity of the IMTA approach can be a drawback for farmers with poor knowledge of the different trophic levels
- Higher probability of failure due to the higher number of rearing structures and operations.
- Site-specific criteria for each species may create more difficulties to find proper sites for joint rearing.

OPPORTUNITIES

- With new products come new markets and the business plan may expand to incorporate more clients, countries and regions.
- As for Scotland and elsewhere, there could be a great opportunity in coming years for a change in public perception of aquaculture and IMTA could lead the way to greater consumer acceptance of aquaculture products.
- With increasing IMTA production there will be new partners, and this will diversify the aquaculture industry.

THREATS

- Intensive aquaculture in Portugal is recent and expanding slowly. Portuguese companies may feel that for now there is no scope for more investment in integrated systems.
- Social acceptance and public perception may drop if IMTA systems are used just as a brand and not really for the environmental benefits promoted and sold to the public.
- Finding new markets and distribution channels in Europe and overseas to sell IMTA products may prove a disappointing path for small companies.

# 3 Analysis of regulatory environments

The regulatory environment in the different partner countries was analysed in order to highlight the main barriers specific to each country or region and point out the non-homogeneity of regulatory frameworks across the Atlantic Area. The survey was split into 4 major lines of research to cover the different aspects of the regulations applying to aquaculture:

- **Licensing process:** Learn about and evaluate the complexity of the licensing process and the time required to obtain the authorisation to cultivate new species or to obtain a lease or concession.
- **Sanitary and zoosanitary approval:** Evaluate potential health issues related to the association of species and potential impacts of different management techniques on the associated species.
- **Regulations related to protecting the environment and environmental surveys:** Determine how environmental sustainability of aquaculture can be guaranteed while removing pressure on the producers. Assessing this will enable us to understand what major barriers prevent the development of aquaculture and which laws can ensure the environmental sustainability of aquaculture.
- **Planning management:** Understand how spatial planning of marine areas is organised, then highlight development strategies and priorities.

The SWOT matrices presented thereafter provide an analysis of the IMTA sector regulatory environment in each AA partner country. Each partner was in charge of conducting a survey of the national regulations relating to aquaculture and IMTA in its country. Agrocampus Ouest was also in charge of conducting a similar survey at the European level. The main legislative texts regulating aquaculture activities are presented in the following section, with specific details about their implications, limits and issues.

## 3.1 European level

This section lists the various European directives and regulations applicable to IMTA. Their transposition into national law is presented in the sections thereafter.

**Sanitary and zoosanitary approval**

- Regulation 178/2002 (EC) (European Parliament and Council, 2002) (**Hygiene Package**) and 5 other regulations complementing it: n°853/2004 (European Commission, 2004a), n°882/2004 (European Parliament and Council, 2004), n°852/2004 (European Commission, 2004b), n°854/2004 (European Commission, 2004c), n°183/2005 (European Commission, 2005). This regulation is very complex and too many different texts refer to it, so it is not possible to give a short synthesis. Still, the main point of this set of regulations is to establish the sanitary management of production and processing sites using the HACCP (Hazard Analysis Critical Control Point) method, including, at each step of the production cycle, an analysis of the specific risks and the different means implemented to control them.

- Directive 2006/88/EC (European Council, 2006) sets animal health requirements for aquaculture animals to prevent diseases (record of inspections, disease list, exchange rules, inspection management, etc.).

There is no additional text regulating IMTA on sanitary and zoosanitary issues, and good practices implemented within the frame of the HACCP method are considered to be adequate to secure these systems and manage potential interactions between the species.

**Environment**

- Directive 92/43/EEC (European Council, 1992) (**Natura 2000**) on the conservation of habitat and biodiversity, setting up special areas of conservation. Creating aquaculture activities is a constraint in these areas and project sponsors must provide proof that the impact of the activity is acceptable.

- Directive 2000/60/EC (European Parliament and Council, 2000) (**EU Water Framework Directive - WFD)** requires, inter alia, that good chemical and ecological status of waters be reached. This good status can be defined by the concentration of certain substances in water, in sediments, or in organisms. Two other objectives regarding the limitation or the removal of dangerous substances and compliance with the objectives of protected areas are mentioned in this directive.

**Planning management**

- Directive 2014/89/EU (European Parliament and Council, 2014) highlights the need to establish spatial planning for marine activities in view of their rapid development as well as the need for their cohabitation and sustainability. The objectives of this directive are to:
    - Take economic, social and environmental aspects into account to enhance the sustainable development and growth of the marine sector while implementing an ecosystem-based approach promoting the coexistence of relevant activities and uses;
    - Contribute to the sustainable development of the energy sector at sea, shipping, fishing and aquaculture sectors, and to the conservation and protection of the environment, including resilience to climate change through spatial planning;
    - Member states remain free to determine how these objectives are to be implemented in their own marine spatial planning system.

- Directive 2008/56/EC (European Parliament and Council, 2008) imposes the drafting of an action plan for the marine environment in each marine region that must present the ecological status of the waters, the means implemented to evaluate it, and the measures to preserve and improve such status.

## 3.2 National level

Different questions were asked to identify which points of the regulations are limiting the development of IMTA or the creation of new aquaculture sites in the different partner countries. These questions focused on the following points:

Licensing:

- What is the general licensing procedure?
- Is it possible to ask to produce fish, seaweed and shellfish at the same time, on the same concession? (at experimental and commercial scale?)
- Is it the same licensing authority that is in charge of the application for all 3 species?
- Can the exploitation of the concession be shared with another company?

Spatial planning

- Which legal texts regulate the use of the maritime domain?
- Is there any national or regional regulation to prioritise the use of the marine area?
- Notion of "opposable" or "non-opposable" texts (in legal terms, a document is “opposable” against third parties when everyone must comply with it, even those who have not signed it, so an opposable document provides legal legitimacy).

Environmental regulation

- Is a Natura 2000 environmental impact assessment needed?
- What are the requirements of the impact study? Can any text or document be used as an environmental assessment to spare producers the need to produce an environmental impact study?
- Are there any specific laws about marine areas and other parks?
- Are there any specifications about Facilities Classified for Environmental Protection in IMTA?

Sanitary and zoosanitary aspects

- Which legal texts regulate the cultivation of fish, shellfish and algae?
- What are the specificities to obtain sanitary approval for IMTA facilities?
- Is there any restriction for the use of medicines for fish farming in IMTA?
- Is there any requirement regarding the hygiene of co-cultured species?

These different questions were the basis of thought and discussion about regulatory aspects. Answering these questions helps in understanding the key constraints for IMTA implementation. Additional SWOT matrices regarding regulatory aspects alone are given below, after the section presenting the specific regulations in each partner country.

### 3.2.1 Ireland

**Licensing**

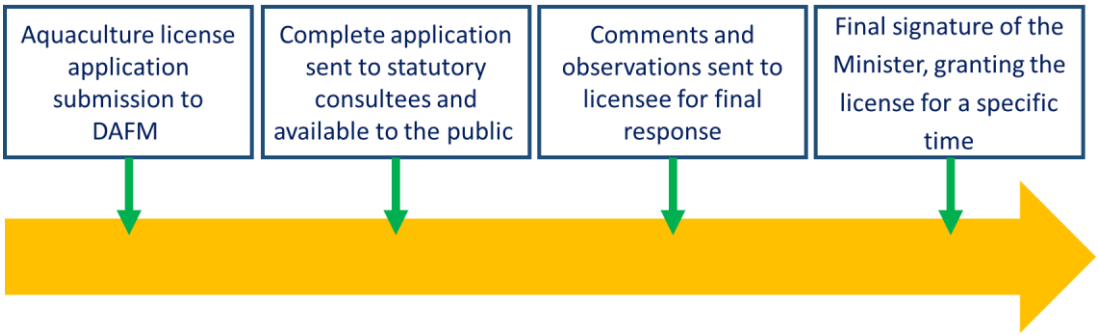


Figure 1: Diagram of the licensing procedure in Ireland

*NB : A detailed diagram is available in the « Review of the Aquaculture Licensing Process » (Independent Aquaculture Licensing Review Group, 2018). - DAFM: Department of Agriculture, Food and the Marine*

It is possible to apply for a production authorisation for several aquaculture species on the same concession. However, the way applications are examined and processed is different for fish farming and other productions. Marine fish farming will require an Environmental Impact Study (EIS) and other production authorisations. It is also possible to apply for authorisations on an experimental basis for a period not exceeding 3 years.

In Ireland, the operation of a concession can be shared between several companies. The project holder must choose the legal form of the company (partnership, company, cooperative, other...).

**Spatial planning**

At the national level, the various European directives are put in place and Ireland also follows the recommendations from the strategic guidelines for the sustainable development of aquaculture in the European Union. This strategy includes a plan for identifying potential aquaculture sites. These texts were the basis for establishing CLAMS (Co-ordinated Local Aquaculture Management Systems).

The CLAMS system is a long-established voluntary process, which enables co-ordination among existing aquaculture operators. This process will undoubtedly provide important bottom-up information for determining policies and strategies. In order to inform the maritime spatial planning (MSP) process and ensure that aquaculture's spatial needs are properly considered in developing marine spatial plans, a constraints and opportunities mapping project for aquaculture is carried out.

This unique Co-ordinated Local Aquaculture Management Systems process is a nationwide initiative to manage the development of aquaculture in bays and inshore waters throughout Ireland at a local level. In each case, the plan fully integrates aquaculture interests with relevant national policies, as well as Single Bay Management (SBM) practices, which were initially introduced by salmon farmers to co-operatively tackle a range of issues, and have now been extended to:

- all aquaculture species;
- the interests of other groups using bays and coastal waters;
- Integrated Coastal Zone Management Plans (I.C.Z.M.);
- county development plans.

**Sanitary and zoosanitary aspects**

There is no specific regulatory framework for IMTA in Ireland from a health or animal health point of view. Aquaculture farms need a Disease Management Plan (DMP), particularly to control sea-lice infestations. The Marine Institute is the competent authority to put in place the European directive on the prevention and control of aquatic diseases. The Marine Institute conducts a surveillance programme for the health of aquaculture fish and shellfish. This programme targets three pathologies: Herpes virus Koi, Herpes virus OsHV1 and *Bonamia ostreae*.

**Environment**

There is no specificity regarding environmental studies in IMTA. Each proposal to create an aquaculture site must be the subject of a study concerning the potential impacts on Natura 2000 areas.

ECOPACT is an initiative designed to ensure the widespread introduction of Environmental Management Systems (EMS) throughout the Irish aquaculture industry. This in turn promotes the responsible and sustainable development of fish farming. ECOPACT helps professionals meet the highest standards and produce a superior product in a sustainable and efficient manner. It covers all aspects of aquaculture, from farming and maintenance to the interaction of farm-related activities with the environment.

The ECOPACT document provided a solid basis for Irish fish and shellfish producers to set up their own EMS. It is a framework that helps companies manage their operations with a reduced impact on the environment. The profession's acceptance of ECOPACT represents a strong commitment to environmental sustainability, a standard that goes far beyond simply meeting legal requirements. There are currently more than 50 aquaculture companies with ECOPACT environmental management systems in place.

**SWOT analysis**

STRENGTHS

- The license application in Ireland includes a multispecies form. This allows IMTA to take place.
- In 2016, 11 multispecies licenses were operating in Ireland, mainly shellfish and seaweed combined.

WEAKNESSES

- *Multi-trophic* is not specified in the multi-species license application form. This means that IMTA is not specifically recognised as differentiated from polyculture (e.g. multiple same trophic-level species).
- The aquaculture licensing process is complex and does not encourage license holders to apply for a new species.
- Difficulty in accessing commercial and non-commercial trial licenses to test IMTA. These can only be granted for a maximum of 3 years.

**Associated references:** Independent Aquaculture Licensing Review Group, 2018

OPPORTUNITIES

- Marine Spatial Planning (MSP) is a process that brings together multiple users of the ocean to make informed and co-ordinated decisions about how to use marine resources sustainably. Ireland's draft Marine Spatial Plan is currently in public consultation until the end of 2019. Stage 3 is the finalisation phase in which a plan will be prepared for submission to Government in 2020 with supporting environmental assessments (strategic environmental assessment under the SEA Directive, appropriate assessment under Birds and Habitats Directives) for approval before forwarding the final plan to the European Commission ahead of the March 2021 deadline set out under the Directive

**Associated references:** Foreshore, 2016; Government of Ireland, 2018

THREATS (The threats described are not specific to IMTA)

- The licensing process in Ireland is complex and involves many agencies.
- Granting a license in Ireland can take up to 144 weeks following the completion of an Appropriate Assessment (AA) of Natura 2000 sites within the bay concerned. The AA can take up to 36 weeks.

**Associated references:** Independent Aquaculture Licensing Review Group, 2018

### 3.2.2 United Kingdom (Scotland)

**Licensing**

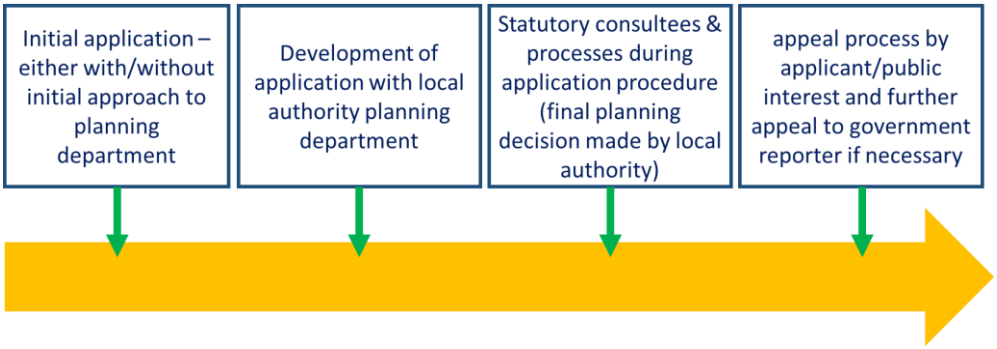


Figure 2: Diagram of the licensing procedure in the United Kingdom

It is possible to ask to produce fish, shellfish and seaweed on the same concession, although each aspect of the cultivation (fish, shellfish, seaweed) must go through a separate application process. Still, the project holder can apply for the three productions with the same licensing authority.

In theory, a company can share the exploitation of the concession with another company. However, it is still necessary to apply for the relevant authorisations if it is a new development, or if there is a marked increase in capacity/seabed usage or species stocked. In addition, the new party working on an existing site must comply with the welfare, maintenance and health and safety standards of the existing user. In practice this is very unusual, as most sites have a sole operator, and for reasons of practicality and disease/infection control, they prefer to work a site alone.

**Spatial planning**

The main licence authorisations required from a planning point of view for setting up an aquaculture installation in Scotland are presented below. These texts are “opposable”.

*Planning permission*

This is granted by the local authority (the lower level of local council). A complete planning application must be submitted to them for the development and will require approval from all the other statutory bodies.

*CAR licence (Controlled Activities Regulations)*

This is granted by the national environmental authority (SEPA – Scottish Environment Protection Agency) and controls discharges from the site (expected solid and diffuse waste, chemical use, etc.).

*Marine Licence*

This is granted by Marine Scotland, the government agency that controls development activities around the Scottish coast. Licences are split into either Finfish, Shellfish or Algae – there is nothing to prevent an operator from applying for all three for one site, although this is very unusual.

*APB authorisation (Aquaculture Production Business)*

This is provided by a separate department of the Scottish Government and concerns the welfare and safe husbandry standards for fish and shellfish.

*Seabed lease*

As the seabed around the UK is held by the crown, a lease must be granted from the Crown Estate. In Scotland the powers of the Crown Estate are being devolved to the Scottish Government in the near future. To complicate matters, in the far North of Scotland and on Orkney and Shetland, the Crown Estate does not own the seabed and the local authority deals with this.

Each of the statutory bodies that deals with the applications will have its own framework, or set of rules, to judge an application against. The source of these frameworks will be based on various laws set by either the UK or Scottish Government, and then interpreted by each organisation.

In addition, there are now zonal management plans for many parts of the Scottish coast (usually in areas where there are conflicts of use, or special habitats), which are administered as part of the planning process by the local authority.

Relevant texts:

- **Marine Scotland Act** (Scotland, 2010) resulted in the creation of the **National Marine Plan (2015)**
- Aquaculture is covered within the governmental framework by the **Aquaculture and Fisheries (Scotland) Act 2013** (Scotland, 2013) .
- **Article 5** of the **Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007** (Scotland, 2007) indicates that marine waters are divided into marine planning zones. **Article 5(1)** specifies the local authority which is to be the planning authority for the purposes of marine fish farming within a particular marine planning zone.
- 'Non-opposable' texts tend to be fewer, but are often individual strategies developed by central government for consultation and promotion within the industry – an example would be the **Scottish Government's seaweed cultivation policy** of **2017** (Scotland, 2017), which forms the opinion and policy of the national government (and is expected to be noted and followed by relevant agencies) but is not instilled into law.

**Environment**

For the local authority planning application, all benthic surveys and reports must aim to minimise benthic and immediate water column impact. The use of DEPOMOD modelling software is vital in finding the suitable loading for a particular site and there is very good modelling of coastal water characteristics in the west of Scotland. In areas with Natura 2000 significance, there will be an increased interest from SNH (Scottish Natural Heritage), the Scottish natural environment body – their views will be taken into account in the planning application. That said, there are marine aquaculture installations already present in areas of Natura 2000 relevance, and the key concern would be to limit damage to sites. Obviously the introduction of non-native species for cultivation is prohibited.

All finfish site applications will require a benthic survey of the site, along with current/wind measurements over a suitable period (the former usually carried out with an acoustic Doppler current profiler) to examine base conditions on site. Shellfish & seaweed cultivation is not submitted to such strict conditions, but will be site specific.

There are currently no marine national parks in Scotland. There are several MPA (Marine Protected Areas) and there are stricter rules for applications in these locations, although this can often be regarding visual

amenity as much as benthic impact. As mentioned previously, there are MPZ (Marine Planning Zones) in some coastal areas, although these are administered by the local authority to a pre-agreed plan, and only operate in some coastal waters where there are conflicts of use.

As noted by other respondents, as IMTA is not a widely accepted or used system yet in Scotland, there is nothing specific in the legal framework regarding it, other than a brief, positive mention in the **Seaweed Cultivation Policy Document (2017)** from the Scottish Government (Scotland, 2017).

*DEPOMOD: "The DEPOMOD model is a computer model developed in Scotland. It is used to predict the effects of salmon farming on benthos in British Columbia". It is generally used to predict organic solid waste deposits from a fish farm (Canadian Science Advisory Scientific Secretariat, 2012).

**SWOT analysis**

STRENGTHS

- **A strongly regulated sector**: The Scottish aquaculture sector is well regulated by external parties, and on the whole regulates itself well internally, as the entire industry is aiming for a very high quality product.
- **IMTA standing**: IMTA currently has good standing with the various regulatory and governmental bodies in Scotland. That said, there has been little definitive legislative comment on IMTA (Scotland, 2017) but what there has been has viewed IMTA as a novel and useful component of aquaculture development, and the presumption has been for approval if the relevant planning conditions are met.

WEAKNESSES

- **IMTA strategy**: IMTA has only been on the regulatory spectrum for 2-3 years, and without continuing development within the sector, it is possible that its relevance will diminish within policy and regulatory circles.
- **Inappropriate development**: As noted in other sections, without further development, and a framework for what constitutes IMTA, it is possible that a developer may use the term IMTA to describe an inappropriate development (within an aquaculture context) that may bring negative connotation to the term, and diminish the current good standing held.

OPPORTUNITIES

- **Amelioration:** If IMTA can prove its nutrient amelioration (in diffuse or benthic settings), it has the potential to become a useful new tool for regulators in defining site licencing characteristics. If this can be carried out with operators wanting to diversify into IMTA, it may herald an interesting era of further development for the Scottish industry.

THREATS

- **Over-regulation**: At the present time, the industry has a good relationship with regulators, based on the fact that there is a high level of self-regulation and good practice. If amelioration actions were specified without industry agreement, it might turn opinion against IMTA development.

### 3.2.3 France (Atlantic coast)

**Licensing**


Figure 3: Diagram of the licensing procedure in France

*DDTM – Direction Départementale des Territoires et de la Mer – (State agency)*

A project holder can ask for the creation of an IMTA production site including fish farming, shellfish farming and seaweed cultivation at the same time, there is no law prohibiting this request. However, the different species can be subject to different regulations or legal texts regulating their location, so potential IMTA sites are scarce. Moreover, the French administration has encountered technical barriers to processing IMTA files due to software incompatibility (the software cannot implement more than two species in the description of the system).

In France, a company cannot share the exploitation of a concession with another one (personal exploitation principle of a concession from the Rural code of law). However, a company can contract with another company to exploit its concession, or create very specific mutual assistance contracts, based on reciprocity of work exchanges.

**Spatial planning**

Three texts mainly regulate the planning of marine aquaculture activities. The SDAGE and the its local version – SAGE - resulting from the application of the WFD at the French level. The SMVM (Sea Enhancement Plan) and the SDS (Structural Plan for Marine Cultures at the departmental level), are mainly designed mainly to supervise shellfish farming activities.

*SDAGE and SAGE (opposable)*

The SDAGE master plans (Water Development and Management Plan developed for each river basin) (SDAGE) and their declination at a local level, its local version called SAGE the plans of development and management of the water are two documents resulting from the application of the WFD to the French level. They set out the guidelines for six years to achieve the objectives set for the "good status of water" defined by the WFD. The constraints which apply to aquaculture activities are currently few in number, the production areas at sea being located at the extreme downstream of watersheds. (DREAL des Pays de la Loire, 2010).

*SMVM (Schéma de Mise en Valeur de la Mer* – Marine development schemes) – *(non-opposable):*

The SMVM determines the purpose of each marine area and the principles of compatibility between marine activities. It can be included in the SCoT (Territorial Cohesion Plan - non-opposable) as a maritime component. It contains a description of the current status of the area, existing activities and future prospects; but also guidelines in terms of development (hence planning), project development, and proposals to

preserve the environment. The SMVM is drawn up in association with the communities of municipalities, chambers of agriculture and commerce, professional organisations, natural parks and the public establishments concerned. In theory, this document seems to be well-adapted and contains all the information necessary for correct development of marine activities. The problem is that it is a very rigid document which has not left room for innovative or unanticipated activities in recent years, and which is very difficult to review due to the large number of stakeholders involved. (France, 2013a).

*The SDS (Schéma des Structures des cultures marines* – Structural Plan for Marine Cultures) – *(non-opposable)*

This document is derived from the Rural Code for Sea Fisheries which lists the areas available in the Public Maritime Domain (DPM) for various aquaculture activities. The SDS defines, in particular, the management policy and exploitation methods (maximum areas, densities, authorised materials and species) applicable to marine farms taking environmental and health aspects into account. This document is also subject to an environmental assessment and an impact assessment, thus sparing project sponsors the need to produce potentially expensive studies during their installation phase. Measures to avoid, reduce or offset the impacts of marine aquaculture have been drawn from these studies (France, 2015).

*Other documents*

Other "strategic" documents outline the development of marine activities where aquaculture appears as a priority sector (Strategic Document for the Seafront, SRDAM ...). Unfortunately, these documents have no real value and development strategies often result in a compromise between a global strategy and local territorial development issues.

**Sanitary and zoosanitary aspects**

It is important to distinguish sanitary approval, which concerns establishments processing and/or shipping molluscs and bivalves, from zoosanitary approval, which applies to any aquaculture farm rearing animals, except shellfish farms.

Zoosanitary approval only includes a risk analysis specifying the number of visits or audits of the production site, from which a health surveillance plan is derived. There are no specificities for obtaining zoosanitary approval.

As regards sanitary aspects, there is no specific text relating to the safety of IMTA products. Only "good practices" in use in aquaculture are to be implemented. It is also necessary that e-coli levels be kept below the regulatory threshold for molluscs. For algae there is very little information. The specificities of IMTA concerning the contamination of shellfish or algae or other species by discards of fish or other species must simply be indicated in the identification of the dangers and in the implementation of the means to control them in the HACCP plan.

**Environment**

No dispensation for activities falling under the Structural Plan for Marine Cultures has been granted since 2010. All shellfish farming activities are subject to a case-by-case assessment by the environmental authority which decides whether it is necessary to provide an 'environmental impact assessment'.

There are no specifications for environmental impact studies, only a “Cerfa” form for the Natura 2000 impact assessment that is sometimes not suitable. This lack of a framework for carrying out environmental studies leaves project sponsors without a reference point and with the responsibility of carrying out an environmental

study that may not meet the expectations of the services examining the application, or even local stakeholders (residents and associations)."The evaluation of the compatibility of a project with the objectives of the status of water bodies is carried out by comparing the impacts of the project with the initial status of the water bodies concerned and their objectives (achievement of good status, no degradation) and the provisions of the SDAGE. The content of an impact study or impact document and, as a consequence, the level of requirement from the examining authority, must be proportionate to the consistency of the project and the risk of impact on the natural environment." (French Ministry for the Ecology, Sustainable Development and Energy, 2012)

In addition, the notion of ICPE (classified installations for the protection of the environment) comes from a national and not a European regulation. The ICPE regulation only applies when the IMTA system is intended to produce more than 20 tonnes of fish.

The objectives of the WFD are taken into account in the various texts (SDS, SRDAM etc.) that are subject to environmental assessment. Nevertheless, any project must be studied in relation to the SDAGE and thus once again to the WFD which amounts to redoing a study of the project's compatibility with environmental standards, but with other State bodies which could be more demanding because they are less aware of the real impact of the activity. The French system leads to the successive application of different laws applying the same European directives, but which depend on several examining services that may have different interpretations of the project's impacts, depending on their own priorities and sensitivities.

**SWOT diagnosis**

STRENGTHS

- **Strong regulations in favour of environmental protection.**
- **Possibility to request the exploitation of several species** on the same concession and diversify production.

WEAKNESSES

- **No cooperation on aquaculture sites:** A license is granted to one company only on a concession.
- **Marine management tools are not adapted to these new aquaculture systems:** One additional species in an IMTA means additional regulations and additional spatial constraints.
- **Diversity of state bodies involved:** This fact results in multiple interpretation of a case, with each body willing to judge the environmental and economic relevance of the project, formally applying the specific rules they are in charge of defending.

OPPORTUNITIES

- **Willingness to simplify:** The government is involved in a process of administrative simplification for the development of companies and this includes simplifying environmental regulations (France, 2013b)
- **Polluter-pays principle:** Application of this principle may encourage the industry to adopt good practices and implement IMTA systems
- **Enhanced benefits** of IMTA and aquaculture in terms of ecosystem services in regulations.

THREATS

- **Environmental studies:** Cumbersome and costly environmental studies are challenged by the lack of reliable knowledge.
- **Lack of an IMTA definition at national scale:** Lack of standard texts of law regulating seaweed cultivation and fish farming activities at sea.

### 3.2.4 Spain (Atlantic coast)

#### Licensing

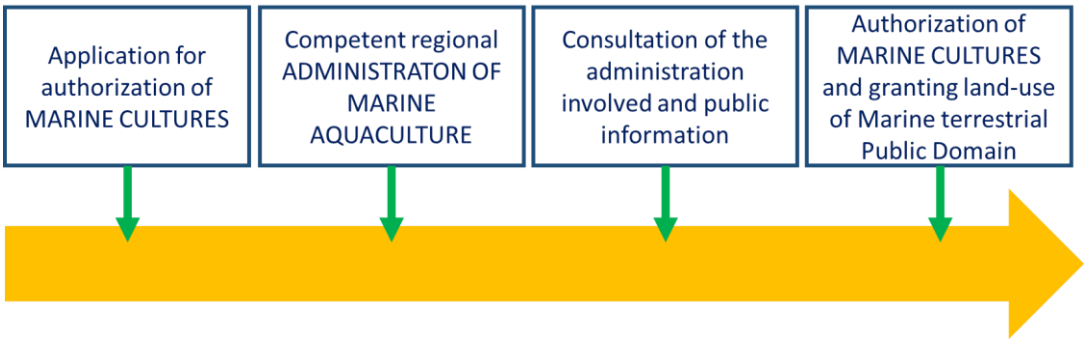


Figure 3: Diagram of the licensing procedure in Spain

In Spain, a project holder can ask to produce seaweed, fish and shellfish at the same time. The only limitation is that exotic species are not allowed. As regards cooperation between companies on the same production site, usually, a single company applies for authorisation.

#### Spatial planning

There are many legal texts depending on the area, both at national and regional levels. They include the national coastal law, and the national and regional fisheries and aquaculture regulations as well as specific regulations in certain areas with some types of environmental protection, such as natural or national parks, Natura 2000, marine reserves, etc.

All of the following regulations are important, but the most restrictive one is the national coastal law regulating the use of offshore areas in the maritime public domain.

- Ley Nº 23/1984 de Cultivos Marinos;
- Ley 2/2013 de protección y uso sostenible del litoral y de modificación de la Ley 22/1988, de Costas;
- Real Decreto Legislativo Nº 1/2001 de fecha 20 de Julio del 2000,
- Real Decreto Nº 907/2007 de fecha 6 de Julio del 2007.
- Galicia (Ley Nº 6/1993 de Pesca, Ley Nº 7/1992 de Pesca Fluvial),
- Andalucía (Ley Nº 1/2002, de Ordenación, Fomento y Control de la Pesca Marítima, el Marisqueo y la Acuicultura Marina, Decreto 58/2017, de 18 de abril),
- Asturias (Ley Nº 3/1998 de Pesca Fluvial),

**Sanitary and zoosanitary aspects**

Obtaining sanitary and zoosanitary approval is regulated by the laws on aquaculture and fishing in each region:

- Real Decreto Nº 1488/1994;
- Real Decreto Nº 3481/2000;
- Ley Nº 8/2003, de 24 de abril; and specific for shellfish: Real Decreto Nº 1043/1997;
- Real Decreto Nº 640/2006

There is no specificity for IMTA regarding the use of medicine and the monitoring of its impact on other species. Implementation of good practices and HACPP standards is sufficient.

- Ley Nº 14/1986; Real Decreto Nº 640/2006;
- Real Decreto Nº 2064/2004;
- Real Decreto Nº 1380/2002; amended by Real Decreto Nº 1702/2004;
- Real Decreto Nº 121/2004.

As regards the safety of IMTA products, the requirements are general and the same as those applied to any other aquaculture activity in the country. The use of medicine is dealt with specifically.

- Real Decreto Nº 109/1995 de fecha 27 de enero,
- Real Decreto Nº 1749/1998, de fecha 31 de Julio.

**Environment**

Aquaculture requires an environmental authorisation that depends on national and regional regulations:

- Ley 7/2007, de 9 de julio;
- Ley 3/2015, de 29 de diciembre;
- Decreto 356/2010, de 3 de agosto;
- Ley 41/2010, de 29 de diciembre; Ley 21/2013, de 9 de diciembre;
- Decreto 109/2015, de 17 de marzo, etc.

There are specific regulations in marine protected areas, and implementation of the Natura 2000 network can limit the type of aquaculture activity allowed (Fundación Biodiversidad, 2017):

- Orden de 8 de febrero de 2013 (and Orden de 11 de marzo de 2011),
- Ley 2/1989, de 18 de julio; Planes de Ordenación de los Recursos Naturales,
- Specific plans for environmental protection (Planes Rectores de Uso y Gestión y Planes de Gestión)

Not specifically, but the systems are classified according to production density

**SWOT diagnosis**

STRENGTH

- **Clear regulation of aquaculture in Spain**: Most of the coastal communities in Spain have a strong normative framework.

WEAKNESSES

- **Heterogeneity of regulations in the different Spanish regions**: In accordance with the Spanish Constitution, the different regions have exclusive jurisdiction over fishing in inland waters, shellfish farming, aquaculture, hunting and river fishing (Galicia, Andalusia, Cantabria, Basque Country, Asturias, Canary Islands,).

**Associated references:**

OPPORTUNITIES

- **Consideration by governmental bodies:** Thanks to some public IMTA projects carried out in Spain (JACUMAR national plan "Integrated Aquaculture: Pilot experience for the development of multi-trophic culture systems"), the local administrations in some regions, e.g. Andalusia, are beginning to take this type of culture into account at the normative level.

**Associated references:** Decreto 58/2017, de 18 de abril, por el que se regula la acuicultura marina en Andalucía, Xunta de Galicia, 2012.

THREATS

- **There is no clear IMTA definition in Spain overall:** there is a (very general) definition of this type of aquaculture in Andalusia alone.
- **Complexity of regulations:** The Spanish regulations associated with aquaculture activity are very complex at all levels (local, regional and state) and across administrations (environment, health and hygiene, food safety, aquaculture, etc.)

### 3.2.5 Portugal

**Licensing**

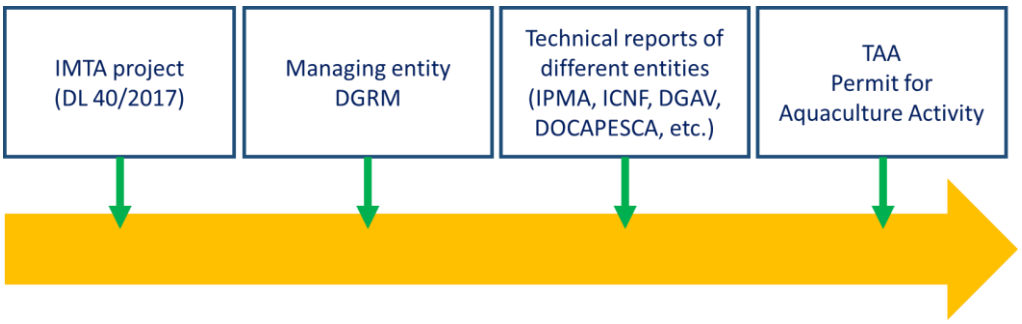


Figure 3: Diagram of the licensing procedure in Portugal

DGRM: Directorate-General for Natural Resources

IPMA: Instituto Português do Mar e da Atmosfera

ICNF: Instituto da Conservação da Natureza e das Florestas

DGAV: Direcção-Geral de Alimentação e Veterinária

Licensing for production, or "Título de Actividade Aquícola" (TAA), is preceded by a production plan listing candidate species for rearing.

The normative regulation (Decreto-Lei nº40/2017, de 4 de abril; Portaria nº279/2017, de 19 de setembro) does not distinguish, positively or negatively, any type of production, e.g. polyculture, integrated multi-trophic, or single species production. A single production unit may have a single license (TAA) for production of several species, regardless of being fish, bivalve or algae. On the other hand, if species are to be produced separately, albeit in neighbouring units, then several TAAs will be required.

A license is granted to a specific company for a specific area. There is no provision in licensing norms (Decreto-Lei nº40/2017, de 4 de abril) for shared use of a specific area.

**Spatial planning**

For the marine environment the Lei nº17/2014 de 10 abril defines the National Spatial Plan for the Maritime Space, later expanded by the Decreto-Lei nº38/2015 de 10 de Março (amended by Decreto-Lei nº139/2015 de 30 de julho). For transitional waters, and specifically focussed on aquaculture development, the Plan for Aquaculture in Transitional Waters (Despacho nº 1608/2018, de 15 de fevereiro) identifies existing and potential areas for aquaculture development, as well as the legal framework, and environmental status of each area.

In these documents use of the marine area is prioritised according to the strategic options currently adopted.

"Opposable" texts can be identified in different areas, such as:

- licensing (TAA)
- spatial planning (overlapping of uses, non-permitted uses)
- species produced (invasive, protected)
- nature conservation

- water contamination (effluents)
- public vs. private domain
- maritime safety and navigation

An example of "non-opposable" text is the "Plano Estratégico para a Aquicultura Nacional". In this document, the current status of the sector is presented and the future objectives defined. It also provides recommendations that can be used to improve total production nationwide.

**Sanitary and zoosanitary aspects**

Shellfish:

- Regulation (EC) Nº 853/2004 of the European Parliament and of the Council of 29 April, 2004, OJ L226, 25/06/2004, p. 22
- Regulation (EC) Nº 854/2004 of the European Parliament and of the Council of 29 April, 2004, OJ L226, 25/06/2004, p. 83
- Regulation (EC) Nº 1881/2006 from the Commission, of 19 December 2006, OJ L364, 20/12/2006, p. 5
- Regulation (EC) Nº 1021/2008 from the Commission, of 17 October, 2008, OJL277,18/10/2008, p. 15
- CEFAS. (2017). Microbiological Monitoring of Bivalve Mollusc Harvesting Areas - Guide to Good Practice: Technical Application. European Union Reference Laboratory for Monitoring Bacteriological and Viral Contamination of Bivalve Molluscs
- Despacho do CD IPMA Nº 69/2013 de 5 de novembro de 2013
- Despacho Nº 3996/2018 de 19 de abril de 2018, DR-2ª série, Nº 77 de 19/04/2018, p. 11232-11239

Aquaculture production: “Decreto-Lei nº 152/2009, de 2 de junho” transposes into national law the Council Directive 2006/88 / EC of 24 October on animal health requirements for aquaculture and products thereof and on the prevention and control of certain diseases in aquatic animals

The same law applies to other fish farming production. However, it should be considered that in some fish treatments the other organisms being produced can also be affected.

**Environment**

In the licensing process (Decreto-Lei nº40/2017, de 4 de abril) TAAs can only be obtained provided all mandatory technical reports are positive.

When a production unit project is located in a Natura 2000 area, then the national conservation institute (ICNF) will have special jurisdiction.

No species considered invasive, or listed as endangered or vulnerable, can be reared. Also physical modifications of the production unit, namely infrastructure construction, are severely limited.

Projects are evaluated on an individual basis, and are therefore dependent on the technical assessment of the administrative agent in charge.

Impact surveys depend on the size and scope of the production project.

In Portugal there is the "Rede Nacional de Áreas Protegidas" that establishes National, Natural and Reserve Parks boundaries. These Parks are subject to Specific Spatial Planning: "Plano de Ordenamento de Área Protegida" (POAP). Examples of such texts include:

- RNSCMVRSA : Resolução do Conselho de Ministros nº181/2008, de 24 de Novembro
- PNRF: Resolução do Conselho de Ministros nº78/2009, de 2 de Setembro
- PNSACV : Resolução do Conselho de Ministros nº11-B/2011, de 4 de Fevereiro (Retificado pela Declaração de Retificação nº10-B/2011, de 5 de abril)
- RNES : Resolução do Conselho de Ministros nº182/2008, de 24 de novembro

IMTA is not a common system and therefore is not considered as such in the legal framework.

**SWOT diagnosis**

STRENGTHS

- Licensing framework is favourable to different species production in the same unit, in which IMTA can be a feasible option.
- IMTA systems can reduce the impact of effluents on the environment, therefore increasing regulatory acceptance of new IMTA projects implementation.
- Existing regulatory conditions in environmentally-protected areas only allow extensive to semi-extensive aquaculture in polyculture systems, which can be adapted to IMTA principles.

WEAKNESSES

- There is still a lack of legislation that would support different farmers (companies) working in the same production unit under a single license (TAA) per area.
- Many regulatory authorities lack knowledge about IMTA principles and how they can be distinguished from aquaculture practices commonly established in Portugal.
- In environmentally-protected areas such as transitional waters, aquaculture is severely limited. Only the conversion of inactive units is permitted, under strict conditions.

OPPORTUNITIES

- The blue economy concept has been introduced in recent regulations for Aquaculture and there is now a “Blue licensing” programme that incorporates that approach and reduces licensing time. IMTA systems could benefit from this new platform.
- Recent meetings with different regulatory authorities have helped to strengthen the IMTA environmental benefits for more conservative regulators, especially for IMTA implementation in environmentally protected areas.

THREATS

- The IMTA approach could lead to greater regulatory requirements, which could put off some investors or already established farmers.
- Prolonged abandonment of currently inactive units further decreases regulators’ willingness to accept the conversion of earthen ponds into productive aquaculture sites, especially in environmentally-protected areas

# 4 Conclusion

The main strengths and constraints of IMTA systems in each country have been highlighted in this report. The diversity of these systems and country-specific development contexts made analysing them even more productive and more complex. It was necessary to take a step back from these results in order to identify the bottlenecks common to all partner countries of the project. The study of the regulatory context in each country also contributed significantly to the analysis and opens up new pathways for studies.

This document has made it possible to review and summarise the results of the surveys carried out in the different partner countries. WP6 interviews and case studies, as well as WP4 workshops, formed the basis for this analysis.

However, the analysis proposed in this document remains incomplete and specific recommendations need to be made. The main stakeholders to involve in this process must also be identified, along with concrete actions to be taken to develop the IMTA sector in the Atlantic Area.

The next and final phase of the INTEGRATE project WP6 will therefore consist of drafting an action plan, including a development strategy for the IMTA sector in the Atlantic Area. The recommendations proposed here will be used as a basis for joint work with key aquaculture stakeholders in each of the project partner countries.

**General diagnosis for developing the IMTA sector in the Atlantic Area**

STRENGTHS

- Good mastery of the different aquaculture species in monoculture and numerous tests to integrate them into IMTA systems
- Improvement of the total productivity of the system under certain conditions, for several IMTA systems
- General positive perception of IMTA
- Proven environmental benefits (pond systems) - nutrient emissions
- Opportunity to diversify with increased resilience
- Access to new markets (depends on the scale of the production, maybe only local consumption for small producers)
- Strong regulatory sector and no regulations prohibiting the cultivation of multiple species in the same area.

WEAKNESSES

- High environmental constraints in open-sea or loch-like systems
- Concerns about salmon diseases hosted by bivalves
- Current IMTA models do not suit national aquaculture specificities. There is a need for designing new IMTA systems. Thought and discussion must be pursued on how to convert current aquaculture systems into IMTA systems
- Limited public knowledge about IMTA and aquaculture in general
- Difficulty to communicate about such a varied concept, and often 'academic' = "multi-trophic". There is no single IMTA model
- Variability of environmental benefits (open-sea systems) - difficulties to monitor these effects
- Investment - issues to convert existing systems to IMTA systems, need to find answers to these constraints
- Complexity of licensing which puts off current license holders from applying for diversification or for new concessions. Need to speed up licensing time, as in Ireland where the Blue licensing programme has been implemented to solve these issues.
- Lack of visibility about IMTA impacts for the regulators. Difficulties in processing the files since there is no robust model.

OPPORTUNITIES

- Increasing interest for IMTA and technical improvements
- Development of new markets (sea cucumbers, seaweeds) will help IMTA
- Support from the administration and research organisations for the promotion of sustainable aquaculture
- Job creation, upskilling, diversification, importance of aquaculture in sustainable territorial development
- Modelling improvements would lead to better monitoring and new proofs of IMTA benefits.
- Polluter-pays principle or valuation of ecosystems services
- Higher market value with or without Eco certification, marketing strategy to be developed

THREATS

- Poor understanding of species interactions - possibility of disease spread raising concerns
- Concerns about global warming consequences which are already perceivable
- Increased development of aquaculture could be perceived as a negative event, unless an effective public consultation and participatory process is implemented
- Threats of using IMTA for greenwashing by certain companies due to the lack of definitions
- Current commercial difficulties in the aquaculture industry (collapse of salmon industry in Scotland, commercial difficulties in Spain, lack of interest in Portugal)
- Risk of disappointment for the public and regulators if IMTA is just a brand without real environmental benefits (greenwashing)

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