European MSP Platform

Conflict fiche 6: Aquaculture and maritime tourism

Aquaculture[1] in the sea (also termed mariculture) is a comparatively small but growing sector in many countries. In some countries, it already makes a significant contribution to the national maritime economy. Maritime tourism is an important established sector for many countries and coastal communities and has a long history in different regions. Direct competition and conflicts can arise as both sectors require similar areas and can affect each other on account of environmental impacts. As aquaculture farms may increasingly be placed further offshore, they are likely to become more relevant for MSP generally. With respect to aquaculture and maritime tourism, there are synergies that could effectively benefit both sectors.

This fiche sets out the key spatial elements of the conflict between aquaculture and tourism and what Maritime Spatial Planners can to prevent or resolve these conflicts.

1. Description of the two sectors

1.1 Aquaculture

Aquaculture (including freshwater aquaculture) has experienced steady growth over the last 10 years. It is a hugely diverse industry, with the design and location of individual farms depending on species, farming methods, environmental conditions and management techniques. A distinction is commonly made between extractive aquaculture (seaweed and bivalves) and fed aquaculture (fish). While the former is relatively low maintenance, the latter requires daily intervention such as feeding and usually involves sea cages. The main challenge to enhancing production of all types of aquaculture is the lack of available space in inshore sheltered areas[2].

The culture of marine and anadromous fish[3] in sea-cage farms is widespread in Europe (e.g. Norway, Scotland, Ireland, Denmark, Faroe Islands, Greece, Spain, Italy, France and others). In Northern Europe, salmon is the dominant species; in southern EU countries, in particular the Mediterranean, sea bream and sea bass are the main species grown[4]. With respect to shellfish,

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[1] Aquaculture covers the farming of aquatic organisms (finfish, molluscs, crustaceans, algae...). It takes place in both inland and marine areas (European Commission, no date). In this fiche, "aquaculture" refers to aquaculture taking place in the sea (mariculture), thus excluding inland areas.

[2] FAME SU under contract to DG MARE (2016). FAME is Fisheries and Aquaculture Monitoring and Evaluation under the European Maritime and Fisheries Fund (EMFF). A support unit (SU) for FAME was established in 2015. For further information on FAME see https://ec.europa.eu/fisheries/cfp/emff/fame_en

[3] fish that live in the sea but return to rivers to spawn such as salmon

[4] FAME SU under contract to DG MARE (2016).

extensive cultures exist along the Atlantic coasts of Spain, Portugal and France and in other parts of Europe. In 2015, aquaculture made up one fifth of the EU-28's total fishery production[5], generating a total value of EUR 4.1 billion. The UK, France, Spain, Greece and Italy have the largest shares of this value, although Norway is by far the biggest aquaculture producer in Europe, exceeding the EU in volume and value alike[6].

When aquaculture began in Norway in the 1960's, entrepreneurs preferred their farms close to the shore for easy access. When larger pin nets became available (5 to 50 meters depth and a diameter of 160m), farms moved to deeper waters. Stricter regulation, new feeding technology (via tubes from a floating barge) and the need for more coordinated logistics have led to the present third generation of farms. These vary in size and depth depending on the type of fish and available space. Usually, large rigid cages – each one around 51-83m in diameter[7] and able to hold many thousands of fish – are anchored on the sea floor, but can move up and down the water column. They are attached to buoys on the surface which frequently contain a mechanism for feeding and storage for equipment. This technology allows wave effects to be minimized. Autonomous monitoring and feeding can also reduce interference of aquaculture operation vessels with recreational boating and shipping[8].

Figure 1: Floating cages[9]

The majority of sea cages is clearly visible from the water surface. Mussel and seaweed farms are less visible[10]. This is because mussels and other shellfish are grown below the water, or possibly on mussel rafts, in areas with suitable salinity levels.

[5] Including freshwater species
[6] Eurostat (2017)
[7] Akvagroup (2018)
[8] Vassiliou *et al*. (2015)
[9] Norwegian Seafood Council (2011)
[10] Dempster & Sanchez-Jerez (2007)

Mussel, oyster and other shellfish cultures usually require more space than sea-cage farms. Sea cages typically occupy 1-5 ha per installation[11], although farms can vary significantly in size depending on the scale of operation. In terms of spacing the cages, enough distance is needed for maintenance vessels to pass through.

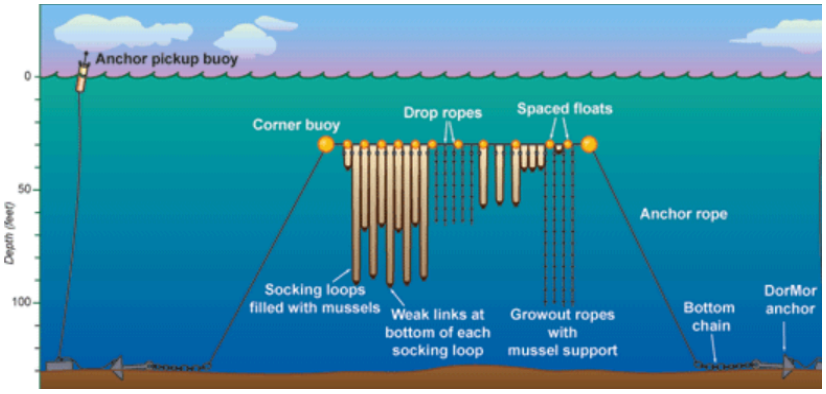

Figure 2: Longline mooring with submerged ropes and buoys for mussel farming[12]

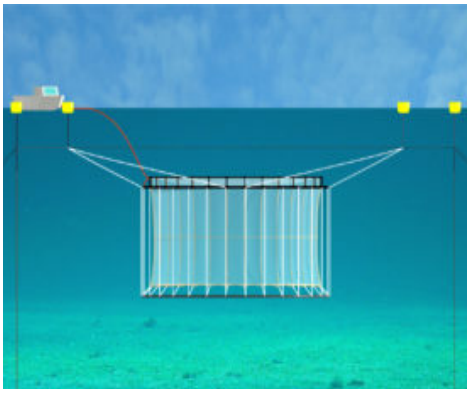

Figure 3: An example of a submersible cage - the OCEANIS submersible cage[13] system

Physical factors, such as water temperature, ocean currents, sunlight, and food and nutrient availability, have a direct effect on the growth of aquaculture species. Companies are therefore looking for physical 'super locations' for the farms. Farm location can also have a significant impact on the cost of farm operations. Factors of relevance include depth, distance from port (and associated infrastructure and processing facilities), wave conditions, and storm activity, all of which modify transport, labour, construction, and maintenance costs[14]. This makes far offshore farming quite expensive. Although they may not reduce the overall costs, the use of newer submersible cages designed for offshore use and water depths of e.g. 40 metres can allow farmers to develop aquaculture activities in more exposed and unprotected sea sites.

[11] Ibid.
[12] Image source: Woods Hole Oceanographic Institution. Available at: https://www.whoi.edu/oceanus/feature/down-on-the-farm---raising-fish
[13] Image source: Badinotti Group, www.badinotti.com/productos/acuicultura/submersible-cages/
[14] Gentry *et al*. (2017)

Figure 4: Seaweed aquaculture[15]

A major concern with aquaculture is the impact it has on the environment and thereby biodiversity and water quality. Large aggregations of fish in cages can favour the occurrence of disease which may require antibiotics for treatment; both the diseases and their treatments could affect natural stocks and other organisms. Organic material released from farms is likely to fall on the seafloor, potentially leading to local oxygen depletion. Genetic pollution of wild stocks resulting from escaped fish is another concern.

But the aquaculture sector is itself dependent on high water quality for the healthy growth of cultured species. In some locations, concerns have been raised by the sector with regards to coastal tourism development as this is feared to potentially impact on water quality. It is in the sectors' own interest to reduce pollution and to decrease potential pollution coming from other sources.

1.2 Maritime tourism

The coastal and maritime tourism sector is one of the five focus areas of the Blue Growth Strategy, and is thereby a top priority for European Union policy and projects. Coastal tourism accounted for 40% of the GVA, 61% of the jobs and 41% of the profits of the total EU blue economy in 2016; in the same year, around 2.127 million persons were directly employed in the sector[16]. Areas with high coastal and maritime tourism intensity have been recorded in Greece, Spain, Italy and France; in these countries the sector is also the strongest maritime employer[17]. Maritime and coastal tourism is a hugely diverse sector, ranging from nature-based tourism and low impact recreational

[15] Chopin (2018)
[16] European Commission (2018)
[17] Eurostat (2015)

activities on the coast to mass tourism. It is also a highly competitive sector, and there is sometimes strong pressure on coastal areas and resorts to remain attractive[18].

Figure 5: Coastal tourism[19]

Typical tourist and recreational activities on the coast are very diverse. On the shore, popular activities include walking, cycling and sunbathing; water-based activities include swimming, canoeing, surfing, wind surfing, rowing, sport fishing, diving, snorkelling, whale watching, seabird watching, boating, and yachting[20]. Most water-based activities take place close to the shore, but some such as yachting and scuba diving require access to areas further offshore. Parameters that are of importance to visitors – and which can come into conflict with aquaculture - include access, safety, water quality, no litter and scenery[21].

Water quality, which is one of the most important aspects, refers to visual aspects such as the colour of water, absence of algae, absence of litter etc. Eutrophication is a main concern in this context as it can cause algal blooms which are not only unsightly but possibly toxic. Swimming is most directly dependent on good water quality, as are diving and snorkelling; the latter additionally benefit from the presence of biodiversity. Water quality and biodiversity are therefore interdependent factors that actively support some forms of maritime tourism.

Unspoilt coastal scenery is very important for users interested in natural and pristine areas[22]. Recreational and landscape-related experiences – as well as water quality - are also important to local residents; especially second home owners often choose a location because of its attractive setting.

[18] European MSP Platform (2018)
[19] Image source: European MSP Platform (2018)
[20] ECORYS (2013)
[21] Giorgio *et al*. (2018)
[22] European Commission (2015)

Recreational sea fishing is a very popular activity, and fishing tourism can contribute substantially to the local economy. For recreational fishing and boating generally, access to preferred locations from marinas is important. This includes enough safe space for navigation as well as proper moorings and anchoring places[23].

2. Conflict description

2.1 Conflicting elements

Suitable areas for the development of marine aquaculture are usually close to shore, where coastal tourism is another very active sector. In comparison to aquaculture that is considered a relatively new activity, tourism is an established sector, dominant especially in the Southern EU Sea Basins. Conflicts are more likely in places where aquaculture is not a traditional small-scale sector or has intensified over the years.

Although their relevance and intensity will vary, six conflicting elements can be identified. Conflicts can arise either way, with aquaculture potentially affecting maritime tourism and vice versa.

- **Visual impact of aquaculture sites**

Sea-cage fish farms or mussel rafts typically have large surface structures that impact on the aesthetics of seascapes viewed from the shore. As tourists (or residents) look for unobstructed ocean views, a powerful tourism sector could block aquaculture development in sea areas which would otherwise be suitable for this activity[24]. Facilities on land, for example maintenance ports and fish production facilities, may also have an effect on the coastal landscape, especially if they are close to resorts or tourist beaches.

- **Spatial restrictions for recreational fishing and boating**

Spatial restrictions are usually in place around fish farms and cages. In Norway for example, every farm has a buffer zone of 20 meters where traffic is prohibited, a zone of 100m where fishing is prohibited, and an even larger zone where anchoring is not allowed. This means that for 59 km^2 of actual farms, the non-anchoring area is actually 420 km^2 [25].

- **Decreased access to safe anchorage areas**

Recreational boaters need to have easy access to sheltered inshore harbours and anchorage areas in case of bad weather. Routes to these places of refuge are not always protected, and suitable inshore anchorage areas are often also suitable sites for aquaculture[26].

[23] Dutch Ministry of Infrastructure and the Environment and The Dutch Ministry of Economic Affairs (2015)
[24] Dempster & Sanchez-Jerez (2007)
[25] Hersoug (2013)
[26] EBA (2016)

- **Accidental damage to boats and aquaculture installations**

Underwater obstructions such as anchor chains and ropes between mussel buoys, or floating pipes that transport fish feed to the cages can be a hazard to craft that would otherwise be able to pass between the farm and the shore, for example to reach an anchorage. Collisions are more likely in areas that are hazardous already, such as areas with strong currents or tides. A collision not only affects the tourists, but also damages the fish farm, with all possible consequences to both sides.

- **Impact of aquaculture on water quality**

Feeding caged fish introduces a large source of nutrients to coastal areas which can lead to eutrophication. This eventually leads to increased algae growth, including toxic species of algae, rendering the water less suitable for certain recreational activities. Fish production can generate waste feed, faeces, medicinal substances, heavy metals and organic pollutants which can pollute the local marine environment, affect biodiversity and make the water look less attractive.

- **Impact of waste on aquaculture**

Urban development and human pressure in coastal areas resulting from tourism can affect aquaculture. Nutrients from waste water run into the sea water and cause eutrophication. When sewage treatment in coastal cities is inadequate, it can have considerable negative effects, especially during summer when water temperatures are high. Disposal of untreated sewage has also been defined as as problem associated with recreational boating: significantly higher faecal coliform levels have been found in coastal waters where recreational boating activity is high[27] . The same applies to cruise ships with respect to sewage and graywater, as well as commercial ships lying at anchor. This type of pollution has particularly negative impacts on nearby shellfish beds.

2.2 Spatial context

Aquaculture-tourism conflicts are generally nearshore conflicts. This is because both activities require similar areas, namely sheltered locations located relatively close to the coast. This may change in the future when aquaculture operations become larger and are able to move into deeper waters further offshore.

3. Drivers of conflict

Policy development for tourism is usually delegated to the regional and local level and rarely carried out at the national level. Policy can vary in importance and style depending on the specific circumstances of the region. An important driver of conflict is the diversity of the sector and the variety of needs associated with different types of tourism. The sector is largely driven by the

[27] Dempster & Sanchez-Jerez (2007)

economic power and changing tastes of tourists. Trends may shift quickly, requiring the sector to adapt. Presently, there is a tendency towards diversification, meaning more sustainable forms tourism are emerging. Experience-based tourism with focus on scenic, cultural and environmental assets, local traditions and produce attracts more affluent and discerning types of tourists. Nevertheless, mass tourism and "summer and sun" type vacations in coastal resorts are also still very popular.

Aquaculture is also one of the Blue Growth sectors predicted to keep growing in the future. The growing gap (estimated at 8 million tonnes) between the level of consumption of seafood in the EU and the volume of captures from fisheries[28] is partly expected to be filled by environmentally, socially and economically sustainable EU aquaculture[29]. The European Commission intends to boost the aquaculture sector through the Common Fisheries Policy reform, and in 2013 published Strategic Guidelines[30] presenting common priorities and general objectives at EU level. The European Commission and EU countries are collaborating to help increase the sector's production and competitiveness. EU countries have also developed Multiannual National Aquaculture Plans to promote aquaculture[31]. On a more local level, aquaculture can be a major employer in coastal communities especially in more remote coastal regions; many such regions and communities therefore actively seek investment in the aquaculture industry.

In most countries throughout Europe, coastal tourism is an economic force many times greater than aquaculture[32], leading to unequal power relations between the sectors. Sea bream and sea bass farmers along the south-western Mediterranean coast of Spain, for example, state that interaction with tourism-oriented local authorities is the greatest barrier to development of aquaculture in their region and their greatest concern for continuing existing operations in coastal areas[33]. Recreational fishing interests have also prevented aquaculture installations from being approved in Norway.

In the case of this particular conflict, space is an important driver. Water-based tourism and aquaculture often require similar areas, most prominently sheltered inshore locations protected from extreme weather. Fish and shellfish farms need to be close enough to the shore to ensure servicing costs are kept to a minimum; logistics also need to make financial sense. Shelter and clean water are particularly important for shellfish cultivation and smaller, less robust species of fish. In some countries, synergies have been found with tourism (e.g. "Aquiturismo" in Italy or "Sea Garden" concepts in Denmark; in areas where "sustainable" forms of aquaculture are practised, these can provide good-quality seafood to tourists, improving the area's attraction[34]). However, in places where aquaculture is not a traditional sector or has been intensifying throughout the years, conflicts with tourism are likely to become more eminent.

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[28] European Commission (2013a)
[29] European Commission (2016a)
[30] European Commission (2013b)
[31] European Commission (2016)
[32] Dempster & Sanchez-Jerez (2007)
[33] Ibid.
[34] Lukic et al. (2018)

Story 1: How a conflict between aquaculture and tourism was tackled with the help of multi-criteria analysis

Aquaculture and tourism are both important industries in Zadar County in Croatia. Fish farming has a long history in the county, but shellfish aquaculture is still a comparatively recent activity[35]. Coastal tourism continues to be the major blue sector in term of employment in Croatia, and has been identified as a strategic growth sector by the national authorities in the 2020 strategy for tourism development[36].

In Zadar County, the relationship between aquaculture and tourism had become problematic. Negative attitudes to aquaculture had grown among local communities and tourists on account of several incidents including:

- unpleasant odour spreading from a state-owned fish farm and processing factory to recreational/tourist areas,
- the use of a coastal walkway for re-loading large quantities of fish food from refrigerators to ships in the hours when the number of tourists there was largest.

Numerous citizens wrote to the authorities to complain; newspapers also picked up the issue. After a few months of intermittent odour, the Environmental Inspectorate ordered the company to deal with the irregularities in waste storage that had been established as a cause of the problem. But local people had other concerns regarding the impact of aquaculture installations, mostly related to the landscape and water quality. Local communities and tourists were represented in their concerns by local NGOs; local media also had an important role.

Because of the strong growth of aquaculture and unclear legislation, Zadar County decided to develop a scientific basis for the definition of aquaculture areas within the County's Spatial Plan. In 2003 a "Study on the use and protection of the sea and offshore waters in Zadar County" was prepared. The aim of the study was to initiate the process of integrated coastal zone management in the County, while creating a clearly defined framework zoning the coastal area[37].

Zadar County then began to develop a detailed zoning plan for marine space for different types of aquaculture. A "Study on the use and protection of the sea and seabed in Zadar County"[38] was carried out in order to determine suitable zones for aquaculture. The method of choice was multi-criteria analysis, where criteria for selecting suitable areas included the impact of aquaculture on the environment, the existence and interests of other actors and their interrelation with aquaculture.

[35] Zadar County (2012)
[36] Ibid.
[37] Kozulic & Franicevic (2015)
[38] Zadar County (2003)

The assessment consisted of three phases. In the first phase, so-called elimination criteria were drawn up that would exclude all those areas from further consideration that were definitely unsuitable for aquaculture (Table 1).

Biophysical elimination factors	Elimination factors related to conflicts with other activities
Pollution (from urban centres, ports and industrial centres)	Intensive maritime transport
Unsatisfactory hygienic conditions	Specially protected areas (e.g. national park, etc.)
Insufficient hydrodynamics	Uses that reduce the feasibility of other economic activities (e.g. military areas)
Eutrophic areas at risk of toxic phytoplankton blooms	Areas of higher economic importance than aquaculture
	Intensive recreational activities

Table 1: Criteria that characterize an area that is not considered for aquaculture

In the second phase, criteria relating to biophysical conditions were applied. Understandably, the set of criteria and what constituted optimal values depended on the species to be farmed and the breeding technology to be used. Therefore, this phase of spatial analysis was done separately for each potential type of aquaculture.

The last, third phase of spatial analysis examined aquaculture conflicts with other sectors. As conflicts between sectors competing for the use of the same resources are solved primarily through negotiation, the multi-criteria study could only inform this process by pointing to the advantages and disadvantages of certain development options and possible complementary relationships.

Tourism is intensive in the narrow coastal area; large marinas and the majority of accommodation are located there. Figure 6 shows potential aquaculture zones (in yellow) that had not been excluded by any previous criteria but that were subsequently excluded due to conflicts with the tourism sector (areas of intense tourist activity).

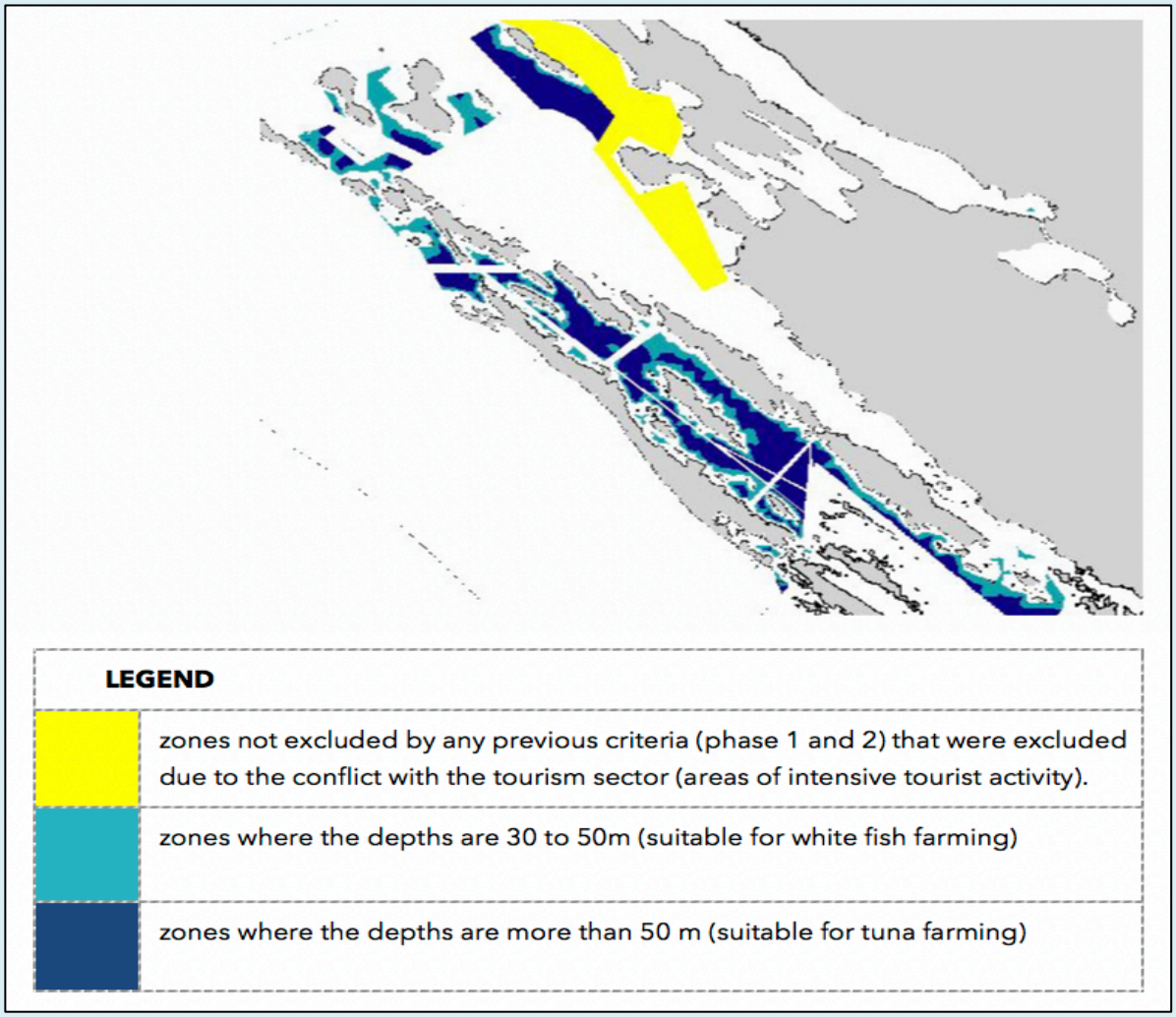

Figure 6: Remaining area for aquaculture development, after considering the spatial needs of the tourism sector (white areas excluded in phase 1 and 2) [39]

Apart from defining general aquaculture zones, the study also made recommendations to:

- develop detailed studies of smaller areas (macro zones and locations), in order to be able to issue concessions for aquaculture establishments,
- establish a monitoring system as a necessary precondition for adaptive management of the coastal area.

[39] Zadar County (2012)

Story 2: How conflicts between recreation and oyster farming were resolved by means of risk control measures in Whitstable, England

Whitstable on the north-east Kent coast (England) is a popular seaside resort with a high density of holiday makers and recreational water space users. It is also a world-famous area for traditional oyster farming. Commonly adopted methods of oyster farming in the area have involved trestles placed intertidally (to provide periodic wetting and drying) that are used to hold mesh bags in which the oysters are grown. The Whitstable Oyster Fishery Company (WOFC) owns the oyster farm under an historic Royal Charter allowing them to conduct shellfish cultivation on the foreshore at Whitstable. Shellfish cultivation is one of the activities exempted from marine licensing and statutory consultation with relevant stakeholders[40]. This allows the owner or user to self-declare that the proposed activity does not cause an obstruction or risk to navigation. However, the exemption only applies if "the deposit does not cause or is likely to cause obstruction or risk to navigation". Where this qualifying criterion is not met, a licence is required.

In the past couple of years members of the public in Whitstable had become concerned that oyster farm activities posed risks to recreational users; they also questioned the legality of the oyster farm activities. Their main concern was that the number of trestles and metal racks – which are submerged during high tide - posed a hazard to water space users navigating nearby as they "could trap an unsuspecting capsized sailor, windsurfer or kayaker by their clothing under the water."[41]

In July 2017 the Maritime and Coastguard Agency commissioned independent experts to produce a report on the navigational risks arising from oyster farm activity in the Whitstable area[42]. The report recommended mitigation measures to reduce the risk, acknowledging that some of these measures had already been adopted. It also concluded that the farm's operations were acceptable as a low risk to recreational activities and marine navigation. The following solutions and recommendations were proposed:

Solution 1: Trestle Design Modification. Trestles were adapted by removing vertical steel rods that could have endangered human life and posed a risk to vessels.

40 Marine Licensing (Exempted Activities) Order 2011, as amended in 2013

[41] Comments from members of the public. Available at: https://publicaccess.canterbury.gov.uk/online-applications/applicationDetails.do?activeTab=neighbourComments&keyVal=_CANTE_DCAPR_117205

[42] Hall & Blair (2017)

Figure 5: Whitstable oyster trestle[43]

Solution 2: Inform Local Users. Information signs were installed on the foreshore at Whitstable on all groynes and public notice boards. A periodic (annual) stakeholder meeting was recommended to ensure a regular review of the risk assessment, and to enable stakeholders to discuss the placement of the trestles, their marking and other risk control measures as identified.

Figure 6: WOFC signage on site[44]

[43] Ibid.
[44] Hall & Blair (2017)

Solution 3: Increasing the height of the withy navigation markers. The trestle array is currently well marked by withy navigation markers (vertical sticks) which are placed at the corner of each trestle block. However, the withies are submerged at high tide and therefore not always visible. The report recommended that the WOFC increase the height of these withies such that they are visible at all states of tide.

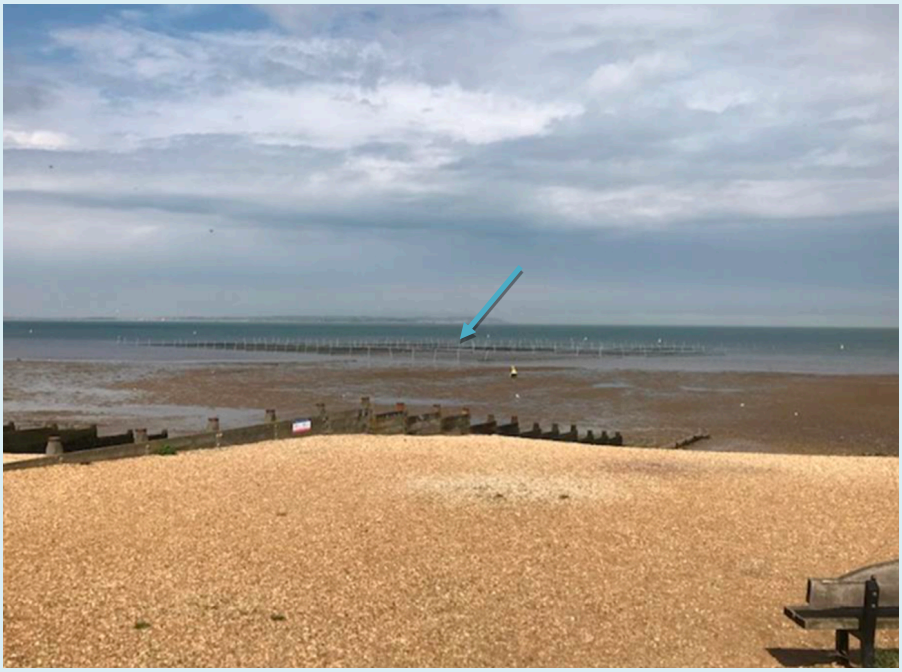

Figure 7: WOFC withies installed on site[45]

Solution 4: Buoyage layout to reflect trestle location in a broadly repeating pattern. It was recommended that buoyage layout is modified to clearly mark the relative location of the trestles and allow recreational users and navigation authorities enough space to carry out search and rescue.

Figure 8: WOFC Buoy on site[46]

[45] Ibid.

The MMO provided a further update on its investigation in February 2018 clarifying that after careful consideration it had concluded there was insufficient evidence to prove a criminal offence in relation to its remit under the Marine and Coastal Access Act 2009[47]. The MMO considered the oyster farm's activities to meet the requirements of the exemption relating to shellfish propagation and cultivation under the Marine Licensing (Exempted Activities) Order 2011 as amended (Article 13).

In March 2018 the MMO received further contact from members of the public, alleging that additional oyster trestles had been placed on the beach. This, they felt, increased the risk to swimmers, sailors and navigators. The official estimate of the number of trestles on Whitstable beach in 2010 was 250; this had risen to approximately 2,400 in 2016. Additional concerns were related to the propagation of non-native oysters.

Canterbury City Council conducted an independent investigation and eventually decided that a planning permission and a certificate of lawful existing use or development (CLEUD) was needed after the 10-fold increase in the number of trestles. The firms' CLEUD application was refused by the council who ruled that 300 WOFC trestles on the beach are unlawful[48]. Currently, the firm has been ordered to remove all 300 trestles, bags and buoys from the land within two calendar months.

Story 3: Aquaculture legislation in Turkey

Marine aquaculture began in Turkey in 1985 with the breeding of sea bream and sea bass in closed and sheltered bays using traditional, small size wooden cages. Soon after its establishment problems arose on the Aegean and Mediterranean coast; especially coastal sectors such as tourism, environmental protection and recreation were concerned. In response to these concerns, marine aquaculture zones were introduced in 1988, moving the farms further offshore. Unfortunately, these zones did not consider the rapid development of mariculture technique, cage production and fish feed technology and were soon unable to meet increasing demands[49]

[46] Ibid.
[47] Marine Management Organisation (2018)
[48] Decision by Canterbury City Council. Available at https://publicaccess.canterbury.gov.uk/online-applications/applicationDetails.do?activeTab=summary&keyVal=_CANTE_DCAPR_117205.
[49] Deniz (2018)

Figure 11: First sea fish farms in Turkey in 1985[50]

As a result, new zones were designated and new legislation was put in place. In 2004, the MoFAL Aquaculture legislation was implemented, followed by a Communique on Site Selection and Zoning for Marine Aquaculture (MEU) in 2007 and a Communiqué on the Monitoring of Marine Fish farms (MEU) in 2009. These new regulations stimulated further development of the sector. Over the last decade, mariculture has become the fastest growing Turkish economic sector, achieving over 293% of growth. Turkey thus became the largest fish producing country in the Mediterranean and the second largest fish producer in Europe after Norway.

To deal with the rapid growth of mariculture, the Turkish Ministry of Reconstruction developed a National Marine Aquaculture development plan in 2017 (NMADP). The plan aims to minimize conflicts with other uses and provide a solid basis for future growth. The plan contains guidelines on distances, and a specific set of criteria for tourism and recreation, including also a provision aimed at the impacts of tourism-related pollution on mariculture operations[51]:

- Shellfish culture should be placed at least 1 km from tourist hotels and holiday homes.
- Cages, hatcheries and tank farms should be at least 1 km from tourist centers.

[50] Ibid.
[51] Myles (2017)

- In scenic areas, cage aquaculture, hatcheries and tank farms should be kept at distances of 0.5 km, 0.75 km and 1 km respectively
- Cage and raft culture should be restricted in heavily used recreational waters as a safety precaution but should be permitted in waters with light, irregular traffic.
- Fish farm operators should be encouraged to clearly mark the boundaries of farms sites.
- Hatcheries should have their intakes and outfalls clearly buoyed.
- Tourists should not be permitted within farm and hatchery areas.
- Tourism development should be subject to the same controls relating to pollution of the sea as other industries.

Aspect / Story	Story 1: Croatia	Story 2: England	Story 3: Turkey
Main causes of conflict	Some complains from the local communities and feeling that the conflict could progress in the future given the plans for further development of aquaculture in the County	Strong objection by local stakeholders and members of the public about the risk posed by oyster trestle to recreational users and the legality of the oyster farm activities	Rapid growth of the aquaculture industry and inadequate legislative framework
Role of stakeholders	Undefined	Sent a representation to the public and local authorities about the risk posed by the increase in oyster trestles	Undefined
Escalating factors	Inappropriate handling of the fish leaving the unpleasant smell and physical traces	Increase in the number of oyster trestle	Encroachment of aquaculture on tourism installations close to the shore; scenic impacts; impacts on recreation
Solution(s) found	Zoning scheme	Mitigation measures were proposed however this was deemed as still existing due to increase in the number of trestles	Zoning scheme
Solution accepted by stakeholders	Undefined	Ongoing process	Yes

Table 2: Short analysis of the conflict stories related to aquaculture and tourism

4. MSP solutions

This section presents examples of solutions that have been applied by EU countries. Preventative solutions are designed to stop the conflict from becoming acute in the first place, e.g. by means of a balanced spatial policy or zoning regime. Mitigation is designed to alleviate the impacts of ongoing operations. Both spatial and technical solutions are included.

1.1. Preventative solutions

Solution 1: A Regional Master Plan for Coastal Aquaculture in Spain

The Master Plan for Coastal Aquaculture (Plan Director de Acuicultura Litoral in Spanish or PDAL) is now in place to guide planning and management for aquaculture until 2030. The Master Plan sets criteria for compatibility of aquaculture installations with the environmental, natural and landscape characteristics; it also establishes criteria to make aquaculture compatible with other coastal traditional activities such as fisheries and tourism[52]. In the Spanish region of Galicia, Fisheries Protected Zones host aquaculture sites with a specific focus on bivalves. Implementing the PDAL, the regional government has elaborated sectoral policy that is compatible with environmental protection and other uses.

Solution 2: Zoning for aquaculture and tourism

An obvious preventative solution is to use zoning schemes to prioritise specific activities (or combinations) in certain areas (see story 3). Zones could either be single-use or multi-use, depending on the local situation and needs (e.g. bivalve vs. fish farming). Zones can be defined through processes of elimination (e.g. determining zones that are unsuitable and potentially suitable for both activities and then narrowing them down in dialogue with the sectors), or by assigning political priority to one sector over the other. It is also possible to locate aquaculture sites away from tourist hotspots by means of licensing regulations only. In Norway, the trend of moving salmon farms further out to sea is partly due to the aesthetic impacts of installations[53]; where possible, aquaculture sites are being located to avoid interference with hotels[54]. Ideally, any zoning schemes would be developed in a participatory manner involving the respective sectors and local communities.

Solution 3: Specifying a minimum distance from the shore for aquaculture installations

It is possible to set a minimum distance for fish or shellfish farming operations from the coast, as exemplified by the Zadar Spatial Plan which specifies a minimum distance of 50m from the coast for shellfish farming (see story 4). Feasible minimum distances, however, depend on the type of organism grown. A general rule would be that larger farms are placed away from those parts of the coast that are most intensively used by tourists. Cages with larger fish can be placed in more open, exposed seas as these cages tend to be larger, more robust and more resistant to waves, and because they have mesh with larger eyelets, so the stresses when moving through the waves are smaller. A species that requires more continuous monitoring and service, on the other hand, needs to be placed closer to the coast as constant care in the open ocean is not feasible.

[52] Xunta de Galicia (2012)
[53] Ibid.
[54] Hofherr et al. (2015)

Solution 4: Promoting Aquiturismo as synergy between the sectors

In the Italian region of Emilia Romagna, *"Aquiturismo"* refers to aquaculture-related tourism, i.e. hosting tourists in aquaculture for recreational, educational and cultural activities. Aquiturismo is enshrined in regional legislation as a multi-use concept which is to be developed to sustain the aquaculture sector and increase the revenue for its operators. Rather than a means of addressing existing conflicts, Aquiturismo is considered a preventative approach in that it actively promotes synergistic development. An example is the Cavallino-Jesolo mussel plant in the northern Veneto region in Italy, where sport and recreational fisheries and guided tours are taking place within an area used for aquaculture[55]. In Slovenia, tourist and education-related activities are offered by aquaculture farmers in Piran Bay. The same site in Piran Bay is also located in a protected fishing area and natural park, with farmers participating in environmental and biological research projects.

Story 4: Swimming with caged tuna in Spain

In the Catalunia and Murcia regions in Spain, a unique and innovative system has been developed to farm bluefin tuna. The fish are caught in the waters surrounding the Balearic Islands and then moved to an aquaculture operation where they are fattened for around a year in large offshore cages. This aquaculture operation is also being used as a tourist attraction, more specifically, to offer the opportunity to swim with the tuna in the open ocean cages. The fish farm is located about 2.5 miles from the coast, consisting of 7 pools with a diameter of 50 meters and a depth of 35 meters. More than 500 bluefin tuna live there in captivity. Educational elements (relating the history, life and fishing of bluefin tuna during the boat trip to the farm) are combined with the real experience of swimming or diving and selling tuna products[56].

Story 5: Zoning as a means of conflict prevention in the Zadar County Spatial Plan

The Spatial Plan of Zadar County[57] is an integrated land and sea use plan that uses spatial policy to strategically guide aquaculture development. The plan's zoning scheme either prioritises aquaculture over other maritime uses, or defines it as supplementary, in other words secondary to other uses including tourism. The purpose of the zoning scheme is to ensure licensing decisions fit with long-term sustainable and optimal use of existing resources.

The zoning scheme was developed in response to the findings of a ***Study on the use and protection of the sea and seabed in Zadar County*** (see story 1). In the study, tourism was described as strongly seasonal and dependent on world market changes; as such, the authors concluded it should not impede the development of all other sectors. Aquaculture provided employment throughout the

[55] Castellani, C. et al. (2018)
[56] https://tripkay.com/destination-guides/puntos-interes/tuna-tour-nadar-atunes-rojos-alta-mar/
[57] Institute for Spatial Planning of Zadar County (2001)

year, and ultimately enriched provisions that could be made by tourism. The study found that negative impacts of aquaculture on tourism were possible, but that higher overall benefits could be derived from multi-sector development. It also concluded that additional planning and spatial management would be necessary to allow such development to take place.

The Spatial Plan of Zadar County defines four types of zones for aquaculture (Figure 12):

Zone Z1 - areas designated for aquaculture. Any other activity carried out there should not be detrimental to the conditions required for fish and shellfish farming.

Zone Z2 - areas where aquaculture has high priority, but other activities are also allowed. Z2 zones exist for fish (here it is also possible to grow bivalve molluscs in fish polyculture) and shellfish cultures. In zones Z1 and Z2, capacity is determined on a case by case basis, guided by special regulations that govern environmental protection.

Zone Z3 - areas where limited forms of aquaculture can be allowed under certain conditions but where it is secondary to other dominant activities. In zone Z3 an Environmental Impact Study is mandatory for

- fish production of more than 100 tons
- fish production of less than 100 tons if the distance between two farms is less than 1 km.

Zone Z4 - areas not suitable for aquaculture

Permits for individual farms within the defined zones can be obtained through compliance with special regulations including food safety, water quality standards, control of animal feed origin, regulations for environmental protection, etc.

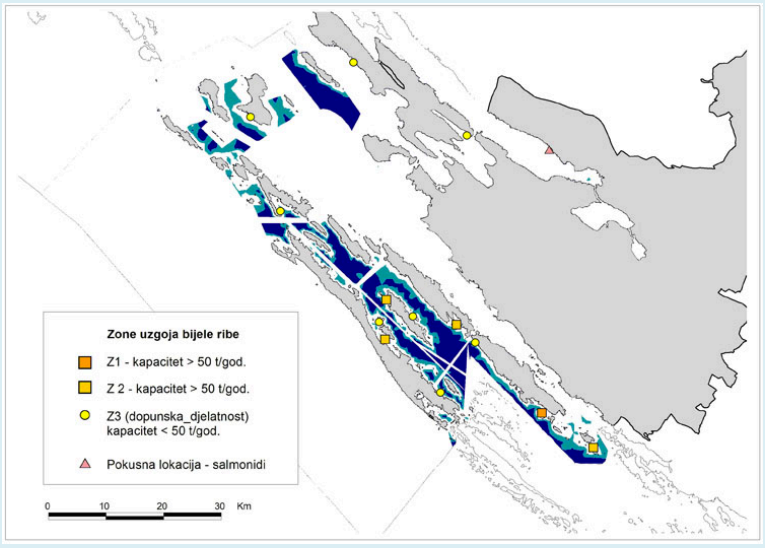

Figure 12: Zones suitable for fish cage farming of sea brass and sea bream[58]

[58] Škunca (2006)

The zoning plan also establishes the obligation to relocate existing aquaculture farms which are not in accordance with the plan within 18 months of its date of adoption.

Aquaculture is expected to grow in Zadar in the coming years, which implies that new farms will likely be established and existing farms expand. The spatial plan stipulates that such expansion should be monitored, and that the most appropriate response to emerging problems should be given in accordance with integrated coastal zone management practice. For example, if it is shown that a particular location is not suitable for further growth, it is possible to relocate a farm within the permitted zones.

4.2 Mitigation

Solution 5: Supporting tourist activities in sea gardens

In Denmark, sea garden projects are making it possible for people to develop small-scale sustainable aquaculture operations (shellfish and seaweed) to grow locally produced marine products in their 'back yard'. Examples of sea garden locations in Denmark include Horsens Fjord, Ebeltoft Vig, and Limfjord – Alborg, Løgstør, Nykøbing Mors and Lemvig harbours. Possible future developments in relation to sea gardens are the establishment of floating shelters/platforms, which could be used for attaching production units but also for camping, snorkelling or fishing, or the establishment of an artificial reef on the seafloor that can (among other benefits) support recreational diving. Sea gardens in the Limfjord were established through the cooperation[59] between local authorities, an aquaculture network and specialised research consultancies.

Solution 6: Stimulating aquaculture developments with less visual impact

At present, surface cage technologies are cheap and dominate the marketplace. However, their aesthetic impact on coastal seascapes can be the source of conflict with coastal populations and tourism stakeholders. The use of submersible sea-cages may reduce this problem. Another advantage of submersible structures is that they avoid the strong physical forcing on the water surface caused by storms. This means they may be suitable for sites further offshore. They could also reduce the number of escapes of cultured fish which is caused by storm damage on the cage. There are still some technological and operational obstacles to overcome for submerged cage technology to thrive: Proof is needed for the aquaculture industry, for example, that these new cages do not lead to reduced growth rates, lower food conversion ratios or lower welfare of the cultured fish in comparison to current surface systems. Another solution – also dependent on technology and suitable sites – is to simply move aquaculture operations further offshore.

[59] Andersen *et al*. (2015)

Solution 7: Use obstacle markers

An obvious solution in cases of conflict with recreational vessels and bathers is to ensure that any potential impediments to navigation are clearly marked. This particularly applies to underwater cages and associated installations which are not visible from the surface or submerged at high tide. This can be done using simple buoys. Ideally, this would be supported by information provided to tourists and local residents, such as leaflets or information panels.

Solution 8: Restricting aquaculture licenses in certain environments

County governors in Norway are especially restrictive when recommending salmon farms in or near the mouths of salmon rivers. The ecological influences of these salmon farms were found to have a direct negative economic effect on recreational fishery in rivers[60]. One way of dealing with such sensitive environments is to give priority to conservation or tourism in the affected area, which would naturally restrict applications for aquaculture development.

Solution 9: Information to increase the acceptance of sustainable forms of aquaculture

Aquaculture generally can have a negative image because of its environmental impacts. However, its actual impacts strongly depend on the form it takes (e.g. whether it is fish, bivalve or seaweed cultivation), the size of operations and the technological modalities chosen. Targeted information could increase the acceptance of more sustainable forms of aquaculture by tourists and local residents. This in turn could increase the demand for safe and more environmentally friendly seafood, benefitting tourism and coastal communities alike.

5. Outlook: Future trends and developments in the sectors (with a view to the likelihood of conflicts arising in the future)

5.1 Future trends in the maritime tourism sector

Already the largest maritime sector in terms of gross value added and employment, a 2013 Blue Growth Study[61] estimates that maritime and coastal tourism is likely to grow by 2-3% by 2020, continuing to grow exponentially in all EU sea basins. Growth of so-called niche tourism (characterised by specific added-value services or locations) will strongly depend on holiday accommodation in the respective areas (e.g. accommodation in areas with rare sea birds). In turn, niche tourism is likely to affect areas with limited facilities and of high sensitivity, hence requiring specific infrastructures and innovative, yet spatially limited, solutions in e.g. natural and protected areas[62].

[60] Liu *et al*. (2010)
[61] European Comission (2013)
[62] ECORYS (2016)

5.2 Future trends in the aquaculture sector

Estimations are that the aquaculture sector will grow in the coming years, feeding the increasing demand for fish and mussels. Shellfish producers in the EU are predicted to increase their output by 30 percent, by 2030, while the current annual growth rate is just 1.3 percent[63]. For fish, a 4% annual growth trend is anticipated for marine fish aquaculture[64]. Seaweed, the newest kind of aquaculture, is expected to grow in importance, especially as part of Integrated Multi-Trophic Aquaculture[65]. But there are also limiting factors, such as animal welfare issues[66] and public acceptance. Questions also concern the energy balance of aquaculture production which may be markedly different in the case of fish and shellfish production: Some fish species require protein-rich feed which is often derived from smaller fish such as anchovies or sardines, with associated ecological impacts[67],[68]. It is estimated that public acceptance will increase in line with decreasing costs of production and people simply getting more used to aquaculture[69].

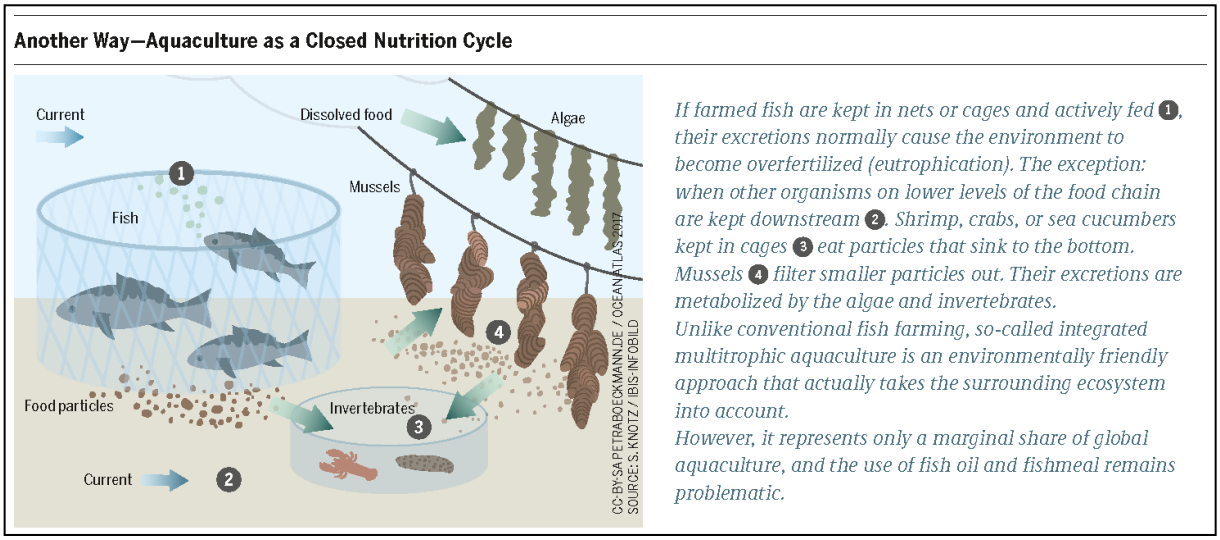

Figure 13: The principle of multi-trophic aquaculture[70]

The expansion of aquaculture into deeper and farther offshore waters is likely to remain a contentious issue. Offshore aquaculture brings with it a requirement for remote operations, automated feeding and monitoring, increasing costs at least in the short term. Not all finfish species

[63] European Parliament (2014)
[64] Ibid.
[65] Ibid.
[66] Ibid.
[67] Lenzi (2013)
[68] Heinrich Böll Stiftung (2017)
[69] Black & Hughes (2017)
[70] Heinrich Böll Stiftung (2017)

would be economically and physiologically feasible for offshore production. Species of shellfish and seaweed may be more suitable, but the economic viability of such operations is uncertain. Apart from new technologies, a new regulatory environment will also be required for offshore operations[71].

In line with these demands, the industry is expecting to innovate with respect to technology. Innovation can be triggered because of the need to reduce costs in production or distribution, but also to reduce the environmental impact of production, or to decrease the chance of diseases spreading[72]. Digitalisation also plays a key role in the development of the sector. Examples for new concepts include closed systems to reduce contaminants, or "supertanker" farms or aquaculture ships in the ocean. Developments such as these which will also have spatial consequences, such as a redistribution of sites, as well as new logistical routes – and possibly new conflicts with other offshore activities such as shipping.

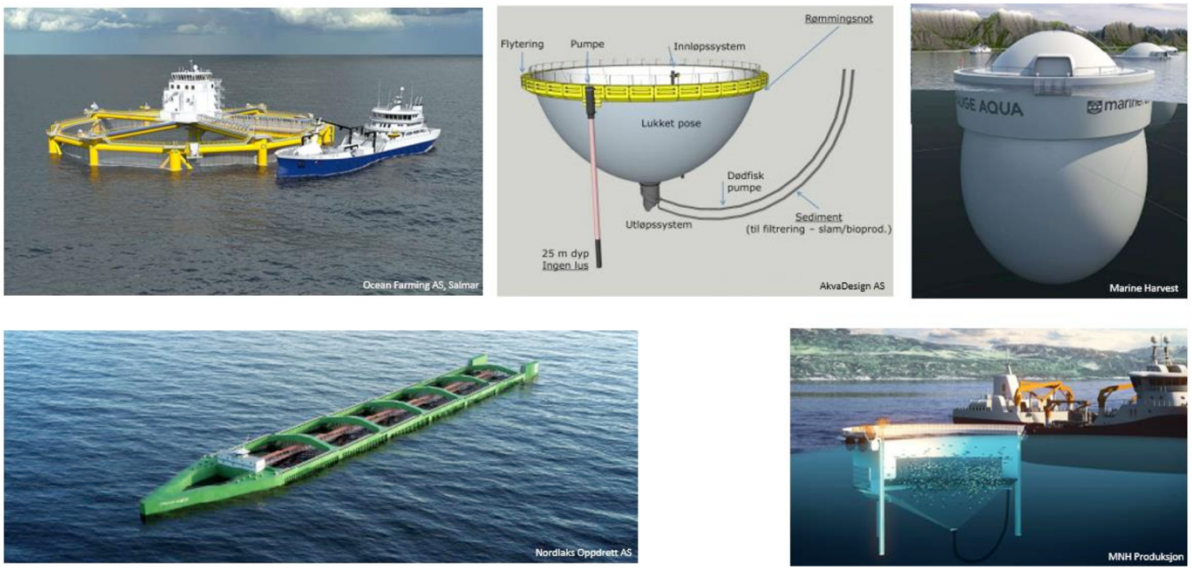

Figure 14: Overview of technologies in development in coastal and marine aquaculture

[71] FAO (2010)
[72] Ernest & Young (2018)

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