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AQUA-LIT

Baltic Sea Learning Lab Report

Deliverable 3.2 (D3.2)

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Name	Country	Participation to workshop (a), interview (b), or both (c)
Smart Farm	*Norway*	*a*
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Coastal Research Management	*Germany*	*a*
TTZ Bremerhaven	*Germany*	*a*
Orbicon-WSP	*Denmark*	*a*
FH Kiel for Applied Sciences	*Germany*	*c*
Institute for Marine Research, Kiel	*Germany*	*c*
Kieler Meeresfarm	*Germany*	*c*
Oceanbasis	*Germany*	*b*
BlueBioTech Int. Gmbh	*Germany*	*b*
Gesellschaft für Marine Aquakultur (GMA) mbH	*Germany*	*b*
Fiskerikontroløst	*Denmark*	*b*
Nordshell	*Denmark*	*b*
Musholm	*Denmark*	*b*
Danish Seaweed Organisation	*Denmark*	*b*
KingFisher	*Sweden*	*b*
Baltic Marine Environment Protecion Commission (HELCOM)	*All Baltic Sea States' countries*	*b*
National Marine Fisheries Research	*Poland*	*b*
Latvian Institute for Aquatic Ecology	*Latvia*	*b*
HELCOM VASAB Marine Litter WG	*All Baltic Sea States' countries*	*b*
Society for Marine Aquaculture mbH, Büsum	*Germany*	*b*
BioCon Vally GmbH	*Germany*	*b*
Landesamt für Landwirtschaft, Umwelt und ländlichen Räume, Flintbek	*Germany*	*b*
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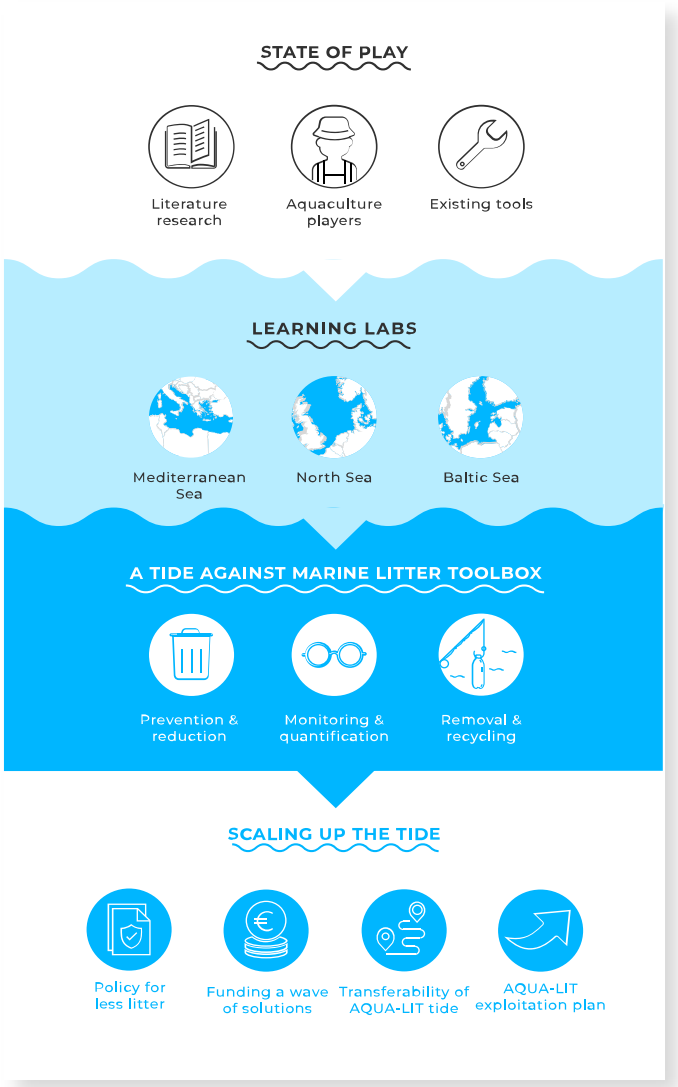
AQUA-LIT project

AQUA-LIT is an EASME-EMFF funded project that aims at providing the aquaculture sector with a sustainable **toolbox** of innovative ideas and methodologies to address the 3 main components of marine littering: **prevention & reduction, monitoring & quantification, and removal & recycling.**

To fulfill this mission, we will be working face-to-face with aquaculture farmers in three regional Learning Labs: at the **Mediterranean basin, the North Sea and the Baltic Sea regions.** In parallel, we will identify and cluster existing, upcoming and already implemented tools on marine littering, and we will further **develop a platform and an app** for providing the 'Tide against marine litter toolbox'.

Lastly, we will 'scale up the tide' by developing the '**policy for less litter**' set of recommendations, by showcasing the **'funding a wave of solutions'** available for the sector and by coming up with a **transferability plan for outermost regions.**

Through this, we expect to help all stakeholders from the aquaculture chain to increase the understanding, awareness and availability of solutions, so a potential **transformation of the aquaculture sector towards a less polluting sector** can become possible.



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Project Consortium

Geonardo Environmental Technologies **(GEO)**

European Centre for Information on Marine Science and Technology **(EurOcean)**

Vlaams Instituut voor de Zee -Flanders Marine Institute **(VLIZ)**

Sustainable Projects GmbH **(s.Pro)**

Instituto Español de Oceanografía -Spanish Institute of Oceanography **(IEO)**

Société d'Exploitation du Centre National de la Mer - French National Sea Centre in Boulogne-sur-Mer **(Nausicaa)**

Fundo Regional para a Ciência e Tecnologia -Regional Fund for Science and Technology **(FRCT)**

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Definitions

Globally, the term 'marine litter' is put forward in research and communication strategies in the context of anthropogenic debris and plastic waste in and towards the sea. Actually, 'litter' has a strong connotation pointing at carelessly discarded items: Items that have been discarded incorrectly and/or deliberately at an unsuitable location.

The AQUA-LIT project cooperates with stakeholders from the aquaculture sector. This sector deals with exceptional offshore conditions, storm events, etc. and consequently has unintentional losses of materials or equipment. To better represent the context, the word 'debris' is used instead of 'litter' for those exceptional cases, if the distinction can be made correctly. Otherwise the authors stick to the term "litter" also due to the projects' name AquaLIT.

Litter: consists of (anthropogenic, manufactured, or processed solid) items that have been deliberately discarded, unintentionally lost or abandoned, or transported by winds and rivers, into the environment. The term 'litter' has the connotation of been discarded incorrectly and/or deliberately at an unsuitable location. The verb 'to litter' means to drop and leave fabricated objects in the environment.

Waste: any substance or material which is eliminated or discarded after primary use, or is worthless, defective and of no longer useful.

Debris: rubble, wreckage, scattered remains of something that has been destroyed, pieces of rubbish or unwanted materials.

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1. Summary

The AQUA-LIT project has conducted three regional and one virtual **Learning Labs** to engage with stakeholders and to identify the existing knowledge, expertise, tools, and best practices to help the aquaculture sector tackle the problem of marine littering. The aim of this report is to provide an overview of the stakeholders' needs in **the Baltic Sea region** in preventing, reducing, monitoring, quantifying, removing and recycling aquaculture installations, gear or equipment that are lost or carried away by the sea.

This report combines the outcome of two types of stakeholder engagement: an **interactive workshop** held in October 2019 in Berlin, Germany, and 15 **targeted stakeholder interviews** from companies and organizations working and/or located in different countries in the Baltic Sea region (Denmark, Germany, Finland, Latvia, Sweden and Norway as non-Baltic country). The stakeholders represented all stages involved in the life-cycle of an aquaculture farm: aquaculture farmers, researchers, start-ups, professional platform representatives, NGOs, national authorities, plastic manufacturers, consultancies etc.

Across Europe, 27% of beach litter items can be attributed to fishing and aquaculture.[1] Among the TOP 20 items this affects all or part of the categories, e.g. lines and ropes Ø <1 cm with *rank 8* or ropes Ø > 1 cm with *rank 9 of the Baltic Sea*.

According to interview results, Baltic Sea aquaculture **farmers are already very interested to act as environmental friendly as possible**: They are taking a number of steps to reduce the

[1] https://eur-lex.europa.eu/eli/dir/2019/904/oj

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amount of litter entering the marine environment by a) actively trying to reduce the amount of packaging taken to sea, and b) bringing ashore any waste seen floating in their cages or around mussel / algae installations. Producers try to provide suppliers with minimal packaging.

For all three core aspects (Prevention and Reduction, Monitoring and Quantification, Removal and Recycling), the lack of support and knowledge gaps are commonly identified barriers. Farmers often face costly logistics for disposal caused by small amounts of waste in irregular intervals and miss strategic support by policy and administration. In most Baltic Sea countries aquaculture is regulated by several different parallel regulations, thus involving a number of authorities and having different subject areas, which makes a more systematic approach even more difficult. In addition, the lack of exchange of scientific knowledge about sustainable gear alternatives or the durability of aquaculture items is seen as barrier to change things. Also the lack of knowledge in relation to innovation (recycling of low value plastic, design of facilities, cooperation with universities) and how to implement the foreseen Extended Producer Responsibility measures on company levels have been identifiesd as barriers. Above all, standardized, integrated monitoring schemes to understand the amount of marine litter derived from aquaculture are missing.

To overcome these loopholes administrative circular design targets could be defined to extend the aquaculture installation's life cycle and multiple use of the entire installation or major parts. Legislation could be altered to incorporate the decommissioning process at the beginning and in the licensing process. Decommission could be harmonised to avoid unfair competition between Baltic Sea Region countries and reporting of losses could become mandatory.

In accordance with the Single Use Plastic Directive[2], gear producers and manufacturers will be responsible for the costs of collection, transport and treatment of old gear containing plastic (including ALDFG - abandoned, lost, discarded fishing gear)[3] *and delivered to ports* and other collection points on national basis.[4] This extended producer responsability (EPR) could include the material design for a better recyclability and the promotion of corporate social responsibility. EPR payments could be used to install cost recovery systems for aquaculture farmers. This could be - in addition to measures to improve the obligation to report lost

[2] (EU) 2019/904

[3] ALDFG includes: a) larger parts of fishing gear such as pots, traps, nets, or lines that are voluntariy abaondoned on fishing grounds or accidentally lost due to advers wehater conditions, interactions and conflicts between gear users. These may entangle marine life. B) fragments of gear (like ropes or nets) or personal equipment, packaging, monofilament lines, resulting from fragmenting, and maintenance of aquaculture gear and other equipment that are washed or thrown away.

[4] These costs shall not exceed the costs that are necessary to provide the relevant services in a cost-efficient way, and be established transparently between the actors concerned, see paragraph 4 of the SUPD.

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fishing gear - a suitable and durable solution to ensure that fishermen remain motivated and are incentivised to bring found fishing gear to shore and to hand it over to appropriate collection facilities. Instead of (pilot) projects financed by project funding, private initiatives or donors, a sustainable solution must be founded in legal grounds, moving beyond project funding in a mid-term perspective. Above all, apart from these curative measures, preventative measures are more cost-effective in reducing gear waste and ALDFG debris and its impacts and should have first priority.

In the frame of the implementation of the Common Fisheries Policy (CFP) into national law, the EU requested their Member States to develop national strategy plans for aquaculture until June 2014.[5] The revision of the CFP aimed to stronger integrate nature conservation aspects into fisheries poliy. So far, these national strategies have been mainly developed by fisheries experts, with no reference to marine litter caused by aquaculture. Therefore, during the continous revision processes of these strategies, the national working groups[6] dealing with the issue could integrate the circular economy idea as well as other aspects related to prevention, reduction, monitoring and recycling of litter derived from aquaculture.

Above all, Baltic Sea wide cooperation and capacity building on new materials, waste recycling, and research results has to be strengthened in different ways.This report will be combined with the parallel activities in the Baltic Sea (D3.1) and North Sea (D3.2) regions. The results obtained from this Learning Lab will help feed the AQUA-LIT "Tide against Marine Litter Toolbox" to be published by the end of the project (December 2020).

[5] See Council Regulation for a revised Common Fisheries Policy, Art 34 (2014)
[6] e.g. in Gerany the conferenc of the agriculture ministries, https://www.agrarministerkonferenz.de/Arbeitsgremiens.htm.

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2. What is an AQUA-LIT Learning Lab?

A learning lab is a methodology for transforming systems with local stakeholders. It develops productive partnerships by forming inclusive problem-solving teams of multiple local stakeholders. They share common values and design behavioural support systems responsive to their diverse needs, strengths, practices and goals and develop locally meaningful, socially just, mutually valued, culturally acceptable and sustainable systemic solutions to a common problem.

The AQUA-LIT' Baltic Sea Learning Lab consists of two types of stakeholder engagement (Figure *1*):

- Interactive workshop
- Interviews with stakeholders using standardised questionnaires

The AQUA-LIT interactive workshop is facilitated using a participatory method and encourages knowledge sharing and co-creation in order to develop a mutually valued and acceptable toolbox, which could become exemplary and point out the path for other sectors. Three Learning Lab workshops are organised by the AQUA-LIT partnership at three different locations. Each of them focuses on a specific sea basin: the Baltic Sea, the Mediterranean Sea and the North Sea. An additional virtual learning lab consisted of a webinar-type of stakeholder engagement that did not focus on a region specifically, but rather, on the potential solutions and ideas to tackle marine litter at different stages: prevention & reduction, monitoring & quantificantion, and removal & recycling.

The stakeholder interviews help to better understand the state of play concerning the litter management by the aquaculture sector and to identify the needs, barriers, strengths, good practices, opportunities and existing tools for preventing, reducing, monitoring, quantifying, removing and recycling the litter in the regions of the Baltic, Mediterranean and North Seas.

The mobilization of stakeholders using a positive and non-incriminating methodology paves the way for novel co-developed and inclusive solutions.

The interviews and the workshops - 'learning labs' for engagement across stakeholder groups focus on creation, observation and promotion of innovative actions. The learning labs provide a forum for mutual learning and work to aquaculture farmers, equipment manufacturers, engineering and construction compagnies, academic research groups, professional clusters and associations, NGOs, policy makers and implementers, port staff, certification bodies, waste processing compagnies and communicators.

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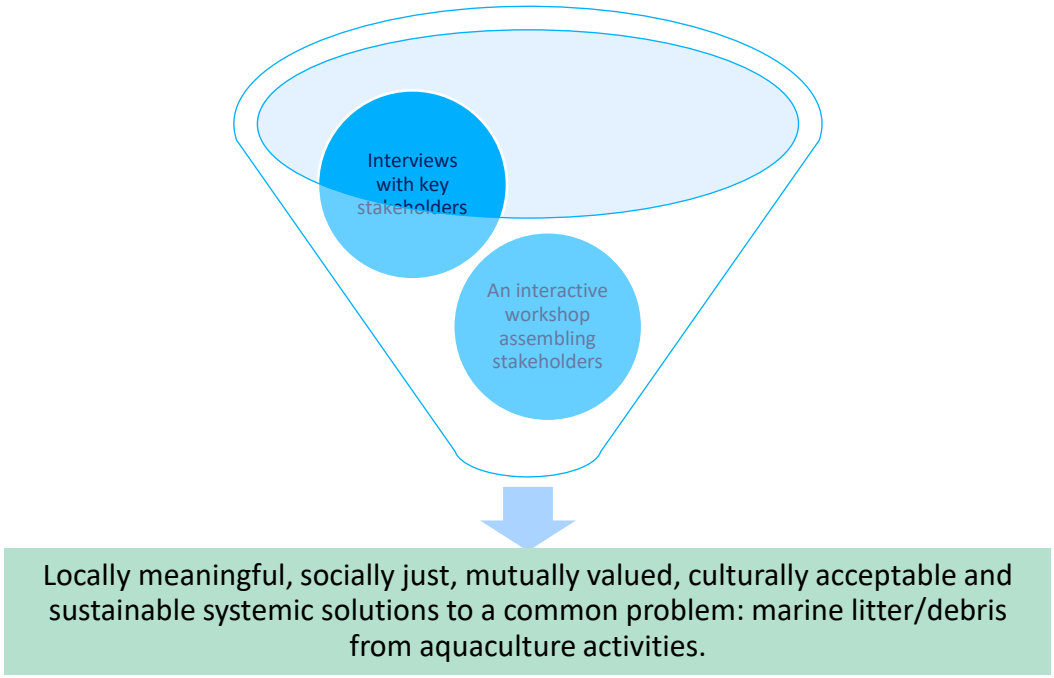

Figure 1: The AQUA-LIT' Baltic Sea Learning Lab consists of two types of stakeholder engagement which aim to pave the way for novel co-developed and inclusive solutions.

2.1 Learning Lab objectives

- Federate aquaculture stakeholder community in a joint struggle against marine litter;
- Facilitate the exchange of knowledge, expertise, tools, and best practices in preventing, reducing, monitoring, quantifying, removing and recycling aquaculture installations, gear or equipment that are lost or carried away by the sea;
- Facilitate the adoption of successful existing solutions through capacity building;
- Explore potential innovative solutions to marine litter reduction, removal and recycling;
- Improve the understanding of stakeholders' needs and maximise the project impact.

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2.2 Baltic Sea context

2.2.1 Monitored items related to aquaculture

Across Europe, 27% of beach litter items can be attributed to fishing and aquaculture.[7] Among the TOP 20 items this affects all or part of the categories:

- "Lines and ropes Ø <1 cm" or "Fishing lines Ø <1 cm" (rank 3 EU, *rank 8 Baltic Sea*, rank 1 North Sea)
- "Ropes and ropes Ø> 1 cm" or "rope Ø> 1 cm" (rank 20 EU, *rank 9 Baltic Sea*, rank 6 North Sea)
- "Nets and power supplies> 50 cm" (rank 18 EU)
- "Ball of nets, ropes and cords" (*rank 10 Baltic Sea*, rank 9 North Sea).
- In addition, other categories can be assigned to the *top 20 items* of fishing like transport boxes or cages.

2.2.2 Aquaculture facilities

Aquaculture facilities in the Baltic Sea have been described in *D2.2. Knowledge wave on marine litter from aquaculture sources*. The resulting map indicating the exact location of the aquaculture facilities (**Figure 2**) may give an indication on the origin of various types of aquaculture litter.

In the Baltic Sea fed aquaculture (fish) is not very prominent given the eutrophication increase concerns[8], and farmed fish production is more relying on land RAS (recirculating aquaculture systems). For example, to date there is one mussel farm in the German Baltic (Kiele Meeresfarm) and up to three fish farms with low profitability and unlikely future.

The extractive aquaculture (shellfish and seaweed) is gaining traction in the Baltic sea and multiple mussel farms can be identified along the Baltic coast. The main technology used is the longline. Nevertheless, the seaweed farming as well as the Integrated Multi-Trophic-Aquaculture (IMTA) are being increasingly explored. In the Baltic, it is difficult to locate the farms as these are moving often. Thus, the data point location in the map is usually a location of the company office rather than the farm itself. It is thus unclear how monitoring and assessment can be conducted or how traceable is potential litter and debris from these farms.

[7] https://eur-lex.europa.eu/eli/dir/2019/904/oj

[8] The Baltic Sea is one of the most eutrophic waters in the world. The situation is exacerbated by it being an almost landlocked sea with a water renewable cycle of over 30 years, making its waters very sensitive to any pollution and discharges.

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Figure 2: Distribution of aquaculture facilities for seaweed, shellfish and finfish in the Baltic Sea basin (Source*: EMODnet Human Activities, duplicated from D2.2*).

Also in the Baltic Sea Region **extractive aquaculture** is moving towards a wide range of commercial applications beyond human consumption (e.g. poultry and fish feed, biofuel, chemistry, pharmaceutcals, etc.). Also new approaches relatd to compensation schemes with mussel farming to reduce nutrients in heavily eutrophied Baltic Sea areas are being tested[9]. According to FAO[10], blue mussels (*Mytilus edulis)* are one of the two core mussels species of Baltic Sea production with two different culture techniques – using suspended ropers or

[9] https://www.submariner-network.eu/images/BBG_GoA53_Ecosystem_services_20190423.pdf
[10] http://www.fao.org/fishery/culturedspecies/Mytilus_edulis/en

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bottom culture.

The intra-European exchange of information and collaboration among institutions has been strong in the region. There is an emerging importance of producer organizations to provide members with information, as well as acting as fora to develop common policies on a wide range of issues. On the local level, there are initiatives organised by the local authorities, such as for example the ghost (net) fishing project in Germany and Poland.[11]

Both the current state of production and level of development differ considerably between the countries due to natural reasons and historical backgrounds. In addition, during the 1980s, aquaculture technologies have evolved to become partly detrimental for the marine environment and therefore the growth of the sector was stopped/reduced due to environmental protection activities. In order to give a complete picture, RAS and freshwater farming are also included in the section below.

Fish aquaculture in the Baltic Sea area mainly produces trout, rainbow trout and carp as well as a few other species, culminating in a limited number of species (HELCOM FISH CG Aquaculture, 2017).[12] Slow development of aquaculture in the Baltic Sea Region is neither due to a poor market situation nor to unfavourable natural conditions. The main obstacle has been environmental concerns. An increase in eutrophication is not acceptable for the Baltic Sea as it already heavily impacted by a long-lasting nutrient overload. Therefore, in some countries, marine aquaculture is missing completely.

Aquaculture production in Norway and Baltic Sea countries is summarized in the table below, according to production type. The year 2010 is chosen as the baseline value so as to enable a comparison with the latest data available. Norway is included to enable a comparison of production rates with the Baltic Sea countries, the numbers for Russia are those for the Baltic Sea only.

[11] https://marelitt-baltic.squarespace.com

[12] Nordic Council of Ministers report on Aquaculture in the Nordic and Baltic Sea countries and the BAT concept. Available at https://portal.helcom.fi/meetings/CG%20Aquaculture%201-2017-471/MeetingDocuments/4-2%20NCM%20report%20on%20Aquaculture%20in%20the%20Nordic%20countries%20and%20the%20BAT%20concept.pdf.

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TABLE 1

Overview of aquaculture production in Norway and the Baltic Sea countries for marine waters, freshwater and RAS.

Country	Type of aquaculture and production, in *t*			Main species
	Marine	Freshwater	RAS	
Norway				Atlantic salmon, rainbow trout, cod, halibut, turbot, blue mussels, Arctic char, lobsters, spotted wolfish, macroalgae
2010	1 019 713 (FAO)	88 (FAO)	No data	
2017	1 308 387 (FAO)	97 (FAO)	No data	
Russia				
2010	N/A	No data	No data	
2018	N/A	27 000 (https://sfera.fm/editions/rybnaya/№-1-vypusk-2-23-2019)	No data	Sturgeon, salmon, carp, pikeperch, pike, silver carp
Denmark				
2010	11 780 (FAO)	23 218 (FAO)	No data	Rainbow trout, pikeperch, eel, Atlantic salmon, mussels
2017	21 723 (FAO)	15 765 (FAO)	No data	
Poland				
2010	N/A	29 260 (MIR)	No data	Carp, trout, Arctic char, brook trout, Atlantic salmon
2019	N/A	44 100 (MIR)	No data	

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Germany				
2010	4985 (FAO)	35 979 (2017, FAO)	No data	Trout, carp, mussels
2017	16 936 (FAO)	35 695 (FAO)	No data	
Iceland				
2010	5050 (Statistics Iceland)	N/A	No data	Atlantic salmon, rainbow trout, Arctic char
2017	19 077 (Statistics Iceland)	N/A	No data	
Finland				
2010	9800 (Statistics Finland)	14 300(2018, Statistics Finland)	No data	Rainbow trout, Arctic char, perch, sturgeon, crayfish
2018	11 900 (Statistics Finland)	2400 (Statistics Finland)	No data	
Sweden				
2010	3665 (FAO)	6979 (FAO)	No data	Rainbow trout, Arctic char, perch, eel, blue mussels, crayfish
2017	4870 (FAO)	9923 (FAO)	No data	
Lithuania				
2010	N/A	3190 (FAO)	No data	Carp, African catfish, bighead carp, sturgeon

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2018	N/A	3355 (Eurofish)	No data	
Estonia				
2010	N/A	573 (FAO)	No data	Trout, carp, eel, crayfish
2018	N/A	944 (Statistics Estonia)	No data	
Latvia				
2010	N/A	549 (CSB Latvia)	No data	Carp, trout, pike, sturgeon, catfish[13]
2018	N/A	830 (CSB Latvia)	No data	

2.2.3. The three core aspects to tackle marine littering

PREVENTION & REDUCTION OF MARINE LITTER

Each country in the Baltic Sea has strict rules for farms to not allow to cause impacts, inlcuding litter, to the sea; starting with noise covering electromagnetic waves and ending with toxins, plastic and any chemicals, metals or medication that may leak into the water. The Regional Action Plan (RAP) for Marine Litter in the Baltic Sea contains actions for

[13] Data retrieved from following sources:
http://www.fao.org/fishery/countryprofiles/search/en
http://www.stat.fi/til/vvilj/index_en.html
https://www.statice.is/statistics/business-sectors/fisheries/aquaculture/
https://mir.gdynia.pl/dzialalnosc-naukowa/projekty/?lang=en
http://www.jordbruksverket.se
https://www.eurofish.dk/lithuania
https://www.stat.ee/news-release-2019-062
https://www.csb.gov.lv/lv/statistika/statistikas-temas/lauksaimnieciba/zivsaimnieciba/tabulas/zvg030/pardotas-zivis-un-vezveidigie-akvakultura

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the Contracting Parties to the Helsinki Convention for joint implementation on regional scale (HELCOM, 2015). In „Voluntary national actions addressing sea-based sources of marine litter' (HELCOM, 2015), there also are some proposed national actions addressing waste related to fishing and aquaculture, e.g. Action NS7:

"Enhance resource efficiency by facilitating markets and applications for plastic waste from the fishing, aquaculture and shipping industry (e.g. by bringing together producers of waste and recycling companies) by looking at specific items and differences in materials, including giving value to waste streams by financial incentives".

In addition, in its Recommendation 37/3 (HELCOM 2016) the Commission urges parties „to foster development and innovation towards ecologically sustainable farms and aquaculture technologies, including nutrient neutral and nutrient extractive ones, to avoid or minimize, and mitigate discharges of nutrients, organic matter, litter, chemicals and handling of escapees and diseases, as relevant." These recommendations are, however, not binding so far but guidelines for countries to be implemented into national law. Also the EU Circular Economy Action Plan[14] adopted 2019 might have an impact on countries's legislation to urge aquaculture farmers to follow a strict preventive and sustainable way when planning a farm in marine waters. Possibly this fosters approaches to business model developments, e.g. moving from customer ownership to a product-as-a-service approach as well as product design, e.g. durability or modularity and ease of disassembly to enable consecutive cycles.

Most Baltic Sea countries foresee a permission system. For instance for mussel farms, a whole range of permissions is pre-condition for approval and entails a shipping police permit, fisheries permit, coastal protection installation evaluation, mussel production area classification, offshore installation permit and several impact and species protection assessments. Currently, the evaluation of possible losses of plastic litter is not taken into account. Only in case a farm wants to get an organic certification, some measures related to repair and maintenance of technical installations and a concept for waste reduction has to be taken up by the management plans of the farmers. Otherwise, the certification procedure will not be successful.[15]

In the Baltic Sea Region approximately 5 larger and 15 smaller engineering companies exist, active internationally and specialised in more than one aqaculture system or specific parts of a system. These companies are not always following sustainable and circualar economy principles.

[14] Communication from the Commission: Closing the loop – An EU action plan fort he Circular Econonomy, COM/2015/0614 final.

[15] see for example Annex II of Regulation EC/854/2004 and (EC) No 834/2007

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MONITORING & QUANTIFICATION OF MARINE LITTER

In order to protect the marine environment, marine litter has been included in the MSFD environmental targets (descriptor 10). HELCOM MONAS focus is on the monitoring and assessment of marine litter in the Baltic Sea area. Since 2013[16] an intersessional correspondence activity in form of a marine litter expert network exists. The network started its work compiling info on marine litter research and development projects in the different HELCOM Contracting Parties as well as on existing and planned monitoring activities. According to the Ministerial Declaration 2013 the Regional Action Plan ought to enable concrete measures for prevention and reduction of marine litter from its main sources, develop common indicators and associated targets, related to quantities, composition, sources and pathway of marine litter and to identify the socio-economic and biological impacts of marine litter. The first workshop took place in 2014 and since then workshops extended knowledge about monitoring issues for staekholders from administration and research on a regualar basis.

Based on these data and that of the EMODnet Baltic Sea Checkpoint[17] the AQUA-LIT project produced the Marine Litter Inventory and several regional maps.

In all Baltic Sea countries active in aquaculture (DE, DK, EE, FI, LT, LV, PL and SE) environmental monitoring is required to measure the chemical-physical and biological character of the marine area over a longer period of time. In some countries, monitoring systems can be distinguished between those a) controlling environmental indicators impacting aquaculture (O_2, temperature, salinity) and those b) having an impact on the environment caused by aquaculture (e.g. posinous algae, nutrients, bacteria like *Escherischia coli*). However, in none of these monitoring systems throughout the Baltic Sea the loss of plastic litter has to be measured and evaluated so far.

REMOVAL & RECYCLING OF MARINE LITTER

Commonly farmers implement their own disposal/waste collection procedures for their facility and – from time to time – this will have to be disposed of in an approved manner, which follows the common regulations to be adhered to by most other industries. The recycling regulation also applies for specific materials such as paper, glass, cloth, and several other materials (depending on the region). Developers usually have to think of the

[16] HELCOM MONAS 19/2013
[17] https://www.emodnet.eu/baltic

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waste management and dismantling processes (already at the project application stage) before they get a permit. In multiple Baltic Sea countries, there are very clear obligations stated in the aquaculture farming licence. All the installations and equipment need to be removed completely - everything that was brought in the water, build or put in place, has to be removed to leave the area in the same state as it was before the farm was set up. If there are doubts that the farmer does not adhere to the permissions obligations, they will not get a permit. Aquaculture systems will have to obtain a licence to operate and there are various licencing procedure in place requiring everyone to follow general waste disposal and recycling laws.

2.2.4. What are the key issues / Challenges?

The political, economic, socio-cultural, technological, legal and environmental challenges related to aquaculture developments in the Baltic Sea region are listed below. These key issues form a knowledge base highlighting the recommendations proposed by the stakeholders in the learning lab.

POLITICAL

The Baltic Sea has seen a variety of changes in aquaculture regulation across the countries, which to a certain extent reflects the high-level political support for the sector, or the lack of it. The status widely differs across the countries.

To limit the access to the market of some problematic aquaculture platic products, Baltic Sea countries are taking individual initiatives, which will lead to a fragmentation of the EU market.

ECONOMIC

The commercial readiness of the sector differs across the countries in the Baltic Sea. In general the marine aquaculture is still a small scale and developing sector in the Baltic Sea mainly focusing on the extractive species.

SOCIAL/CULTURAL

While some countries have aquaculture as a traditional activity (sea gardens in Denmark) some others are just initiating some first businesses (Germany).

TECHNOLOGICAL

The aquaculture sector in the Baltic Sea is very diverse, ranging from mainly extensive cultivation systems in ponds and marine waters to intense indoor farming. The sea region has

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seen many projects and initiatives focusing on the Integrated Multi Trophic Aquaculture (IMTA) and Recirculating Aquaculture Systems (RAS) (on land).
Still, the purchase of plastics is often easy and convenient, with only few and/or less convenient alternative options available. The aquaculture sector still considers plastic materials as being essential in reducing production costs, improving product quality and hygiene as well as producers' health and security.

LEGAL

The regulation differs widely across the countries depending - among other - on the number of authorities involved in the licensing process and proximity to the shore.

ENVIRONMENTAL

The Baltic Sea in general has concerns about the eutrophication, thus not all types of aquaculture are perceived the same. Thus, IMTA is seen as a viable option and there are also projects looking at the ability of mussels and seaweed to combat eutrophication and climate change (i.e. natural CO_2 sequestration).

The Impact Assessment[18] for the revision of the Directive on Port Reception Facilities[19] found that much waste from ships that should be delivered to port is not (up to 30%) and may end up being discharged at sea. The greater part comes from fishing and aquaculture. This is reflected in the largest single category of beach litter items being strings and cords, which largely come from gear.[20]

[18] SWD (2018)21
[19] Directive 2000/59/EC
[20] https://ec.europa.eu/environment/circular-economy/pdf/single-use_plastics_impact_assessment.pdf

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3. Learning Lab workshop for the Baltic Sea region

3.1. General description

The first AQUA-LIT's Learning Lab took place as a side event on 9th October 2019 at the Aquaculture Europe Conference in Berlin and focused on the Baltic Sea region. This interactive workshop assembled 8 stakeholders, and 4 members of the AQUA-LIT organising team, from the aquaculture sector in the Baltic Sea region, including one Norwegian participant. Another seven people were registered but could not attend due to a parallel podium discussion, which was organised spontaneously by the conference organisers. These seven people requested to be informed about the results and another group of five people who learned of the learning lab afterwards, highlighted their interest to receive more information about the outputs as well. The programme of the learning lab can be consulted in ***Annex a***. The presentations, pictures and a short news item on the learning lab are presented at the AQUA-LIT project website. All preparations of the learning lab were carried out following the guidelines documented in D3.1 *'AQUA-LIT Learning Lab's Leading Lines'*.

3.2. Participants

The stakeholder group consisted of aquaculture farmers (mussels and seaweed), aquaculture gear producers, construction companies, researchers, start-ups, NGOs, communicators and consultancies etc. (***Figure 2***, ***Table***). Most participants joined from German and Danish institutes, but Polish, Swedish and Norwegian representatives were also present and a participant representing the European, UK-based, NGO Seas at Risk. (

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Table). The attendance of female stakeholders was lower than of male stakeholders; only one female participant came from outside, three were AquaLIT partners (Table).

Figure 2: Participants of the AQUA-LIT learning Lab workshop for the Baltic Sea region discussing the efficiency of measures.

Table 2

Representation of the different aquaculture stakeholder groups at the Baltic Sea learning lab workshop.

STAKEHOLDER GROUPS		#
1	Aquaculture farmers (mussels, seaweed)	2
2	Equipment manufacturers (e.g. of aquaculture material & gear)	2
3	Engineering, system design and construction companies	1
4	Academic research groups	2
5	Professional clusters, associations and platform representatives	1
6	NGOs	1
7	Governance (including policy makers & implementers, and port staff)	
8	Classification and certification bodies	
9	Companies processing waste (including waste recycling and incineration)	
10	Communicators (media, press, science communicators)	1
11	Other (student, consultancy)	2

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Table 3

Origin of represented organisations at the learning lab workshop in the Baltic Sea.

COUNTRIES	#
Denmark	3
Poland	1
Norway	1
Germany	4
Sweden	1
Outside the Baltic Sea Region	2

Table 4

Gender representation at the learning lab workshop in the Baltic Sea.

GENDER	#
Male	8
Female	4

3.3. Round tables

The participatory method used during the Learning lab encouraged knowledge sharing, co-creation and development of mutually valued and acceptable tools from three perspectives:

1) Preventing and reducing,
2) Monitoring and quantifying, and
3) Removing and recycling of litter from the aquaculture sector.

For each of the three break-out sessions (***Figure 3***), a facilitator from the AQUA-LIT consortium was in charge of managing the discussions and activities and ensuring the quality of the results. A rapporteur from the AQUA-LIT consortium has recorded all results of the discussion. The triggering questions used by the facilitator and all helping questions used to stimulate the discussion can be found in ***Annex b***.

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Figure 3: Participants at the break-out sessions of the AQUA-LIT Learning Lab workshop for the Baltic Sea region.

Results from brainstorming and discussions around AQUA-LIT triggering questions (***Figure 4***). Many others ideas and solutions were proposed and discussed during lively brainstorming.

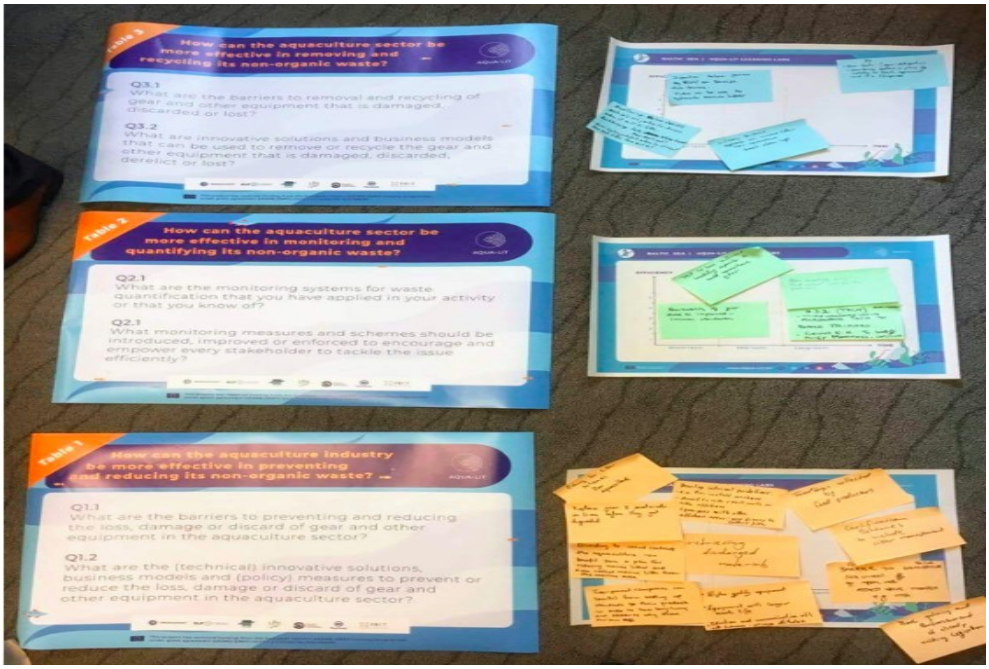

Figure 4: Material used for the Baltic Sea Learning Lab and some products developed by participants.

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4. Targeted Learning Lab stakeholder interviews in the Baltic Sea region

4.1. Purpose of the interviews

Stakeholder interviews help to better understand the state of play concerning the litter management by the aquaculture sector and to identify the needs, barriers, strengths, best practices, opportunities and existing tools for preventing, reducing, monitoring, quantifying, removing and recycling the litter in the Baltic Sea region.

The focus of this task was to obtain first-hand information on marine littering in the aquaculture sector from our existing and well- structured network of aquaculture farmers, enterprises, authorities at different levels, port responsibilities, NGOs and other relevant stakeholders. The interviews allowed us to gather first-hand information about the current situation in the industry.

4.2. Methodology of the interviews

As in the other sea basins, 15 targeted stakeholders were identified for an interview with the purpose to obtain first hand information on marine littering in the aquaculture sector. The interviews were carried out following project-specific guidelines that have been consistently used in the three basins (Baltic Sea, Mediterranean Sea and North Sea). The questions used for the targeted stakeholder interviews can be consulted in ***Annex c***.

Face-to-face meetings took place during workshops of other ongoing project meetings related to aquaculture or during network meetings. In addition, information was collected through phone calls (***Table***). The interview took on average 1 hour per interviewee. Whenever possible, interviews were conducted in the native language of the interviewee, i.e. Dutch, English and French.

Table 5

Type of interview held with targeted stakeholders in the Baltic Sea

OCCASION	#
Face-to-face meetings	4
(Skype) call	11

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4.3. Interviewees

The targeted stakeholders consisted of aquaculture farmers (finfish, shellfish and seaweed), professional platform representatives, researchers, and national authorities (

Table).

The interviewees originated from six different countries, including Norway (and one European representative) in the Baltic Sea region (*Table*). The number of female participants (4) was lower than the male ones 11) (*Table*).

Table 6

Representation of the different aquaculture stakeholder groups in the targeted interviews in the Baltic Sea region.

STAKEHOLDER GROUPS		#
1	Aquaculture farmers (fish, shellfish, seaweed)	3
2	Equipment manufacturers (e.g. of aquaculture material & gear)	1
3	Engineering, system design and construction companies	
4	Academic research groups	3
5	Professional clusters, associations and platform representatives	3
6	NGOs	1
7	Governance (including policy makers & implementers, and port staff)	2
8	Classification and certification bodies	1
9	Companies processing waste (including waste recycling and incineration)	1
10	Communicators (media, press, science communicators)	
11	Other (student, consultancy)	

Table 7

Origin of represented organisations for the interviews in the Baltic Sea region.

COUNTRIES	#
Germany	4
Sweden	2
Finland	3
Latvia	1
Denmark	3

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Norway	1
Europe	1

Table 8

Gender representation in the targeted interviews in the Baltic Sea region.

GENDER	#
Male	11
Female	4

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5. Identified barriers, solutions and good practices

This section summarises the responses of the participants in the three round tables of the workshop combined with the information collected during the personal interviews. The responses are presented under the triggering questions used during the workshop for all three core-aspects (1. Prevention and Reduction, 2. Monitoring and Quantification and, 3. Removal and Recycling). It should be noted that some suggestions or solutions proposed for a specific topic/ round table have been moved to another topic in the report if it was considered to fit better with the corresponding theme. Some identified solutions are contradictory but this reflects the different background of the respective workshop participants and interviewees.

It should be noted that the term waste does not reflect equipment or materials that have been accidentally lost during storms, maintenance works etc. In this context, waste is derived of ALDFG (abandoned, lost, discarded fishing gear)[21] as well as items that have reached end of life. Normally, waste is brought back to land by aquaculture farmers. In contrary, ALDFG is brought back on a voluntary basis as there is no ownership when coming across it.

5.1 PREVENTION & REDUCTION OF MARINE LITTER

BARRIERS

What are the barriers to preventing and reducing the loss, damage or discard of gear and other equipment in the aquaculture sector?

- There exists a range of permission systems but nothing foresees a standardized licensing procedure to prevent plastic items used for the aquaculture facilties
- Companies often lack internal cost-risk assessments related to easy-to-loose plastic materials.

[21] ALDFG includes: a) larger parts of fishing gear such as pots, traps, nets, or lines that are voluntariy abaondoned on fishing grounds or accidentally lost due to advers wehater conditions, interactions and conflicts between gear users. These may entangle marine life. B) fragments of gear (like ropes or nets) or personal equipment, packaging, monofilament lines, resulting from fragmenting, and maintenance of aquaculture gear and other equipment that are washed or thrown away.

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- Top-down (legal) approaches are absent to forbid easy to lose single-use plastic items.
- No higher taxes on small and cheap disposable plastic gear items are raised, lowering the motivation of farmers to keep and recover them or use alternative materials
- Lack of incentives to avoid complex gear products or mixed-plastic formats for better recyclability.
- Additional incentives from the government to invest in more durable materials and alternative solutions are lacking.
- The externalities of litter in the environment are not internalised into the costs of single use plastic items used in aquaculture facilities. This is one of the reasons why there is limited economic incentive to develop or choose items with a better environmental footprint.
- There is a lack of alternative materials for the aquaculture sector that have the same characteristics like the current materials but without plastics, e.g. for buoys.
- Guidelines and specifications for different types of materials and equipment are lacking. A difference should be made between consumables; single use, short use material and durables; long use material.
- Labelling of aquaculture gear and items, and CE quality standards for high quality products are lacking.
- At EU level, there is currently no accepted scientific standard (e.g. CEN) on marine biodegradability, which highlights the urgency for developing a separate standard for marine biodegradability.
- Designers and manufacturers of aquaculture equipment are not sufficiently aware and motivated to seek alternative materials that would make their products more resistant and less polluting.
- Designers of aquaculture equipment are not sufficiently encouraged by manufacturers to be innovative and seek other alternatives such as collecting and recycling services, in order to reduce the impact of their products on the natural environment.
- Especially young designers depend on the instructions of gear producers and are often not daring to test new approaches to prevent, alter or reduce gear material
- Universities dealing with alternative materials are rare and not well funded by national entities; thus, knowledge on the existence of sustainable alternatives for aquaculture material is limited and not growing.
- Tracking devices are still too expensive or not applicable for elaborated use.
- Many single items are brought to the platforms and infrastructures offshore, without being pre-installed on shore.

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- There exists no self-commitment system for farmers to remove gear in case of problems, e.g. upcoming storms.
- There is a lack of information concerning incidents at sea. If accidental losses of material and installations are not all reported to the managing authorities, the actual incidents cannot be followed up and investigated, which makes it impossible to come up with a solution for reoccuring problems.
- There is a lack of timely and efficient communication between aquaculture farmers and boat tourism to avoid accidents or other incidents, which cause the loss of material. Skippers have to be informed that it is forbidden to get close to the facilities or even take buyos etc. with them.
- Within the sector very little or no information exchange and dialogue (e.g. workshops, trainings, forums, common toolboxes, free best practice guidelines, etc.) about innovative or alternative materials, designs, labelling and standards (i.e. common research/ funding/best practice replication, etc.).

SOLUTIONS

What are the (technical) innovative solutions, business models and (policy) measures to prevent or reduce the loss, damage or discard of gear and other equipment in the aquaculture sector?

1. Introduce and improve standardized licensing processes for initiation, operation and decommissiong

- For licensing, the municipal level is most relevant, which should be supported by guidance and enabling framework conditions from national to regional level.
- Public authorities need to use their licensing powers at all levels of the aquaculture farming process.
- Include procedures for the initation, operation and decommissioning into national and/or transnational aquaculture action plans. These plans could influence new, comprehensive licensing processes **(see also Prevention and Reduction (P&R) | Good Practice (GP) 1.1).**
- Permits for aquaculture installations should take into account the local conditions **(see also P&R | GP 1.2).**
- Circular design targets could be defined for licensing processes by policy and administration to extend the aquaculture installation's life cycle and multiple use of the entire installation or major parts.

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- Decommissioning plans should be incorporated at the beginning in the licensing process (in advance decommissioning scheme). Funds for an early integration should be put aside (see also P&R | GP 1.3).
- Common standardised licensing of various forms for aquaculture across a sea region should be introduced for a common understanding and ruling in a clear and cohesive format.
- Flexibility of the licensing processes would enable adjustments of certain requirements for an aquaculture installation during the operational phase, e.g. the use of more durable materials as soon as they get on the market or compulsory changes to the installation due to new market developments and experiences.
- Waste management authorities should be involved in the aquaculture farm licence application process to inform about and foster prevention and reduction measures.
- Before getting a license it is necessary to guarantee to the responsible municipal authority that the company will remove the infrastructure (see also P&R | GP 1.4).
- Reporting of incidents at sea involving accidental losses of aquaculture gear and infrastructure should be compulsory and should be part of the aquaculture permits. Addressees are the coastguard and the managing authority responsible for approving the aquaculture farm.
- Updated documentation of Best Available Technologies (BAT) could also support the reduction of debris since practicioners are supporting directly the responsible authority, which may not always have the necessary experience and knowledge (see also P&R | GP 1.5).

2. Introduce a tax on aquaculture equipment

- Ideally, the tax should be introduced at EU level to create a level playing field across the EU. If not at EU level, then at national level. The tax system would generate fiscal income what could be used for specific purposes like prevention measures in each Member State.
- Taxation usually evokes lack of understanding or even resistance among the affected stakeholders (producers, sellers, aquaculture farmers) to additional costs. Therefore, before a tax is introduced and in parallel to its introduction appropriate information campaigns or other communication channels (like informal consultation) should be roled out by the government to explain the reason for taxing and thus seek to create legitimacy.
- Introducing a tax provides financial incentives to sellers of SUP items used in the sector to switch to reusable items in order to avoid price increases associated with the taxed cords, clips or boxes. Farmers might not be willing to pay increased prices for single-use

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items and hence might reduce their consumption of them. This could also send signals up the supply chain to producers of plastic items to design and produce them differently, i.e. for reuse, recycling – hence to design "the most appealing, durable, safe and resource-efficient re-useable items possible to take advantage of the farmer's increased interest in taking responsibility for their waste and their habits.[22]

- Taxes for non-sustainable, short-living plastic materials and, in contrary, no taxes (like VAT) for alternative materials would lower costs when using the sustainable gear and might also foster research in finding more alternatives.
- Furthermore, introducing tax at point of sale means that all domestically produced as well as all imported single-use plastic items used for aquaculture would be taxed.
- In addition, tax reductions could be granted to sellers of SUP items when they use single-use cords etc. that prove a certain recycled plastic content. While still being single-use these items could foster the secondary plastic/polymers market because producers of plastic cords etc. that fulfill recycled content criteria could find more sellers interested in using their products vis-à-vis other producers not fulfilling these criteria.
- All tax money collected has to be used to invest in the aquaculture sector, for example to stimulate innovation to invent new materials/gear and reducing the price of sustainable materials.
- Tax money could be also spent to subsidice sustainable gear or gear made of recycled materials as they are and will be more expensive and will have problems to find their place on the market.

3. Top-down approaches like the ban of harmful material

- According to the HELCOM Regional Action Plan on Marine Litter (RAP ML 2015) where stricter, national and international legislation, provisions, criteria and guidance for marine litter prevention and sustainable management as complementary marine litter approaches are demanded, also bans of harmful aquaculture material could be part of the solution.

- Ban on import, production, sale and use of a) easy to lose SUP items used in the aquaculture sector such as gloves, plastic cable ties and b) Styrofoam containers. Examples for such bans can be derived of bans on plastic bags or non-biodegradable plastic bags worldwide (see also P&R | GP 3.1).

[22] Similar to normal consumer habits outlined in: Eunomia (2018). Reducing Household Contributions to Marine Plastic Pollution. Report for Friends of the Earth. Eunomia, Bristol, UK; p. 61

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- Also other items, which are not automatically linked to the aquaculture sector but still used in some aquaculture types like the bottom culture (plastic sacks, tyres) have to be forbidden as such or replaced by alternative material (e.g. cotton).

- Apply penalties to the companies producing gear and other items used in the aquaculture sector that do not put in place prevention measures. The producers have to acknowledge their critical role in producing durable materials.

- According to the new SUPD, also some SUP items can be prohibited, which has to be implemented by each country. HELCOM as regional sea body could support such approaches by defining recommendations. Municipalties can provide some more detailed regulations according to their local needs.

- Apart from direct bans and regulations, municipalities could also create a contract between the community and local aquaculture farmers to commit them to bring every item back to shore and to make sure that the farmers are aware that dumping is prohibited.

4. Reduction targets

- Some measures (such as product bans, design requirements etc.) would be best established at EU level, whilst for reduction targets for aquaculture products without sufficiently available substitutes or information campaigns Member States need a choice between specific implementation methods, in line with the subsidiarity principle. This follows the approach of the Plastic Bags Directive (EU) 2015/720 that sets a clear common direction at EU level, but gives Member States some choice on the measures, including the use of economic instruments.

- Reduction targets (e.g. 30% by 2025, 50% by 2030 for cords) would set legally binding reductions in consumption from a base year. Data related to the consumption of relevant items would have to be reported to the national governments. Targets are assumed to be as a percentage of the total consumption, but per capita targets could also be set as is the case under the plastic carrier bags Directive.

- However, participants highlighted that setting a recycling target would create complexities in defining such a target, administrative burden and costs of its monitoring would be considered disproportionate – in particular where setting up an EPR scheme (see point 9) in itself is already likely to stimulate the development of the current small market for the recycling of fishing gear materials.

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5. Incentives

- Member States have to establish EPR schemes as soon as possible (much before 2024), and ensure they are set in a proper way, including with eco-modulation fees, taking into account the durability, reparability, re-usability and recyclability, hereby taking a life-cycle approach.

- Modulation of fees is essential to incentivise better product design and better use of materials, as well as the reduction and elimination of hazardous substances in plastics. This approach also shares the burden with especially small ports and fishing operators who might be disproportionalety affected by the development of new port reception facilities (PRFs) and could benefit from less material and/or better re-usable material. (see also P&R | GP 5.1 and 5.2).

- There could be cooperations between ports / fishermen and recycling companies who take back the material and pay small incentives like a fee or discount (see 5.3.3 REMOVAL & RECYCLING OF MARINE LITTER, Improve waste management systems). This could foster a trusting relationship between producer and consumer/farmer.

- The new EPR scheme could participate in paying for these eco-modulation fees. A trusting relationship between producer and consumer/farmer is important.

- Install a mass-balance system in which the farmers are paying for what they leave offshore, and/or are rewarded for additional litter they bring on land (see 5.6 REMOVAL & RECYCLING OF MARINE LITTER, insurance fund). The farmers need to weigh the items they bring offshore to have comparable data. Control and weighing systems could be installed in a digital way in ports and data could be sent directly to the licensing agency.

- Businesses need a level playing field, with clarity and legal certainty, and the possibility to develop economies of scale for new markets and alternative materials. Still, many SUP elements used in the aquaculture sector do not have clear alternatives available. Therefore, incentives for producers are needed to shift towards a pro-active search for these new alternatives.

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6. Increase mandatory labelling to discourage littering and to make informed choices for environmentally friendly gear and materials.

- Whilst information campaigns may have a general, population-wide character, mandatory labelling of widely littered aquaculture items could help deliver messages more directly to users. The effectiveness of such a measure depends on how clearly the message is conveyed and how much of an impact the message has on those who currently litter the labelled items (see 5.1.13 REMOVAL & RECYCLING OF MARINE LITTER, Foster awareness and education).

- To avoid a confusing variety of labels, certain information should be incorporated into an existing label instead of creating a new label.

- Aquaculture materials and gear labels should include specification of quality standards to help farmers make informed choices when purchasing working materials. Labels should differentiate between:

    - Consumables (single use, short use materials) and
    - Durables (long use materials);
    - High-performance (longer re-use)
    - High-risk items (short use, high risk of loss).

  Guidelines and specifications should be created for these types of materials and equipment.

- Use a traffic-light system to rate products: Producers should add more technical information on materials. E.g. when a farmer buys a rope, it should be rated in terms of a set of durability, longevity and resistance to bad weather (preferably by the use of standard classes). Financial support for farmers to use durable materials (e.g. by no or lower VAT) should back this approach (see 5.1.2 REMOVAL & RECYCLING OF MARINE LITTER, Taxes).

- With labelling, also CE standards[23] for high quality products can be introduced by national legislation. In consequence, low-quality products, e.g. coming from non-EU countries/regions like Asia can be enclosed in the EPR schemes and made liable. In a

[23] The letters 'CE' appear on many products traded on the extended Single Market in the European Economic Area (EEA). They signify that products sold in the EEA have been assessed to meet high safety, health, and environmental protection requirements. When you buy a new phone, a teddy bear, or a TV within the EEA, you can find the CE mark on them. CE marking also supports fair competition by holding all companies accountable to the same rules, see https://ec.europa.eu/growth/single-market/ce-marking_en

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mid to long-term perspective, this may force non-EU countries to produce better quality as well.

- Introduce a label for "*alternative*" material. This kind of material needs to be fully *biodegradable* in marine environments, which requires criteria on material degradation and related timeframe relative to the specific environmental conditions. At EU level, there is currently no accepted scientific standard on marine biodegradability, which highlights the urgency for developing a separate standard for marine biodegradability.[24] [25] This is supported by a UNEP study.[26]

- A sustainable label on seafood supports the food and consumer value chain. These labels need to be universal at EU level. A similar approach should be taken for sustainable materials used in the sector with defined sustainability criteria. ASC and MSC have already taken a step in the right direction (see also P&R | GP 6.1 and 6.2).

7. Introduce specific requirements on product design (to increase standards for high-quality products).

- Product design measures could be taken to reduce the propensity for certain items in the aquaculture sector to be littered. For example, cords and clips could be tethered to the installation frames in advance. Cords are found more frequently than parts of the installations in litter counts, suggesting they are either more frequently littered or captured by litter clean-up services less effectively. Evidence suggests that smaller items are less frequently collected in litter clean-up processes than larger items. Moreover, it could be speculated that smaller items are also littered more frequently as farmers see smaller items as less impactful. The aim of any design measures, therefore, is to integrate smaller items with larger items such that littering is reduced. Designers could also be required to have regard to insight of a behavioural nature insofar as these help to minimise the likelihood of SUPs (and other aquaculture items) being littered.

- Using Ecodesign Directive product requirements or EU waste directives to stipulate certain product design requirements for recycled content and/or reusability appear to be a very effective measure to foster the use of reusable items, e.g. by designing the

[24] Currently, few test methods for the assessment of the biodegradation of materials in the marine environment are available from ISO and ASTM. No European CEN test method has been developed so far. Marine biodegradability pre-normative research was initiated on FP7 project OPENBIO and is the focus of a H2020 SC2 2019 research topic.

[25] The InterReg SeaBioComp evaluates the biodegradability of biobased composite materials for offshore use.

[26] http://wedocs.unep.org/bitstream/handle/20.500.11822/7468/-Biodegradable_Plastics_and_Marine_Litter_Misconceptions%2c_concerns_and_impacts_on_marine_environments-2015BiodegradablePlasticsAndMarineLitter.pdf.pdf?sequence=3&isAllowed=y

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transport boxes to ease their use for re-use: allowing for pricing/selling e.g. by weight or by developing standard volumes for re-usable containers.[27]

- Shift towards more sustainable and recyclable materials in single-use and reusable food containers, e.g. by setting *minimum recycled content* quota or standards for plastic types like lightweight plastic (PE, PP) and polymers with high density (PA, PET). The type of plastic is very relevant for the later treatment process (see REMOVE AND RECYCLE; see also P&R | GP 7.1).

- The choice of materials should be also linked to legally obliged reuse quota, deposit schemes or collection quota to ensure that the food containers designed for better reusability/recyclability are returned and collected and thus find their way into further reuse and recycling (see REMOVE AND RECYCLE).

- Apply Life Cycle Assessment (LCA) design[28] to **minimize the aggregate environmental impacts associated with the product system**. Applying LCA to early stage decision-making can inform designers of the relative environmental impact importance of installation component material and dimensioning choices[29].

- Focus the design of aquaculture facilities on creating stable and solid infrastructures to minimize losses and damages. All aquaculture gear should be designed to be as resistant as possible to harsh marine conditions and to be able to attach to other items to avoid loss or damage (this is especially important for small items made up of single-use-plastics) (see also P&R | GP 7.2).

- All plastic used for the aquaculture facilities should be recyclable (see also P&R | GP 7.3).

- Therefore, it is important to raise efforts to find and promote alternatives to cable ties, like more resistant and durable fixing systems. Any breakthrough related to eco- or sustainable designs should be integrated in the aquaculture regulation.

[27] "Determining suitable standard volumes that retailers will accept can help resolve the reported issue of portions and pricing which is said by some to deter retailers from accepting re-usable containers; having various 'volume levels' as a scale on the inside of a container could provide extra flexibility and standardisation at the same time." [1, p. 61]

[28] https://www.sciencedirect.com/science/article/pii/095965269390004U

[29] https://www.researchgate.net/profile/John_Basbagill/publication/257172108_Application_of_life-cycle_assessment_to_early_stage_building_design_for_reduced_embodied_environmental_impacts/links/5a80517a4585154d57d8f4aa/Application-of-life-cycle-assessment-to-early-stage-building-design-for-reduced-embodied-environmental-impacts.pdf

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- Seaweed installations in offshore environments should be constructed very robust without the use of small loose parts and by welding all ends to prevent any loss.

- Product design to reduce mixed-plastic products relevant for aquaculture to foster higher recycling rates (see 5.3.4 REMOVE and RECYCLE, Improve waste recycling)

- Use alternative natural materials instead of plastic whenever possible. The following gear and other equipment for which alternative, sustainable and less polluting materials should be available, have been mentioned:

  - *Items (currently) without alternatives:*
    - Nylon longlines
    - Nylon fishing nets
    - Syntactic foam in buoys
  - *Items with possible alternatives:*
    - Polysterene boxes (see also P&R | GP 7.4).
    - Mussel baskets: these baskets would be more resistant if made of stainless steel, which would avoid fragments disposing in the marine environment after continuious scraping and abrasion of the baskets.
    - Small twines from pure cotton of 1.1mm thickness are used for the delivery of small seedlings of seaweed (see also P&R | GP 7.5).
    - Demarcation materials of mussel plots: Mussel farmers could use non-biodegradable materials but it is not yet applied in the region.
    - Mussel pegs or plastic stoppers could be replaced (see also P&R | GP 7.6).
    - Re-usable mussel collectors and mussel socks (see also P&R | GP 7.7).
    - It has to be assessed whether Copper (Cu) as high quality material (better avoidance of bio-fouling, increased life span) is an alternative to plastic, especially for often-lost items and how the cost-benefit balance would be. Cu is almost 20times more expensive than plastic. To overcome the higher costs, extra funding for farmers to use sustainable materials is an option.

- Funding to support the use of environmental friendly materials: There are some European funds.[30] However, some of them are very research-oriented and not

[30] See for example the call under Horizon 2020 to develop and scale up innovative procsses to clear the sea of litter and pollutants:

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attractive for practicioners, others request high efforts for documentation. Reducing the documentation and administration procedures would help farmers and producers to apply for more funds. It was suggested to motivate the farmers in coordinating among themselves to help each other with the procedures.

- Mitigate the price impact on aquaculture gear and materials composed of more durable materials instead of cheap plastics by a gradual shift in the production of materials by gear producers to facilitate the adaptation of the aquaculture farmer. Moreover, the customer will need to make aware that the higher prices are related to a reduced environmental impact of the aquaculture product.

- Insurance companies also have a relevant role as they need to know the life time of the material/part of a system (e.g. polyester boxes and their standardised lifetime warranty. Producers want to follow these standard as they is the risk that either no insurance is given, and no loan will be given by the bank, or the insurance rate is extremely high because of high risk of operation, in case the standards are not followed.

- It is crucial to put different engineers from the production industries together to discuss how same materials can combined, as to produce standards required for any of these products.

8. Use voluntary agreements (VA), voluntary commitments and pledges

- A range of measures could be taken by industry producing aquaculture gear and other plastic items used by the sector, which require no specific legal instrument. VA are generally those actions taken by industry to bring about changes without the need for changes in policy (see also P&R | GP 8.1). However, some formal recognition can be given through gaining approval from the European Commission.
- Voluntary commitements and pledges, on the other hand, might be made by individual companies and are usually made indepently.
- The types of approaches that could be considered (one or more of these could be included in a given VA):
    - Improvements in anti-littering messages on the gear and SUP-packages
    - Switching material use to alternatives, which are demonstrated to degrade in the marine environment, e.g. the volunteer change from nylon to natural materials.
    - Supporting the provision of port container infrastructure for the collection of old gear

http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/bg-07-2017.html or https://ec.europa.eu/easme/en/information-day-blue-growth-calls-under-emff

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- Supporting and / or funding litter clean-up campaigns
- Implementing re-use schemes
- Agreeing to offer discounts for those farmers using e.g. packaging twice or bring back gear (simple return system without a deposit-scheme).

9. Implement the new EPR provisions according to Art. 8 of the SUPD into national law for prevention and better design/and expand individual responsibilities

EPR according the new SUPD provisions

- The SUPD provisions foresee EPR for fishing and aquaculture gear[31]. EPR schemes could be installed to force producers to make single-use products used in aquaculture facilities more expensive and to include indirect costs like littering or climate change.[32] So far, no EPR schemes exist for aquaculture gear but other compensation schemes could be taken as examples (see also P&R | GP 9.1.).
- National legislation needs to refer to the items mentioned in the SUPD which are also used in the aquaculture sector like caps and plastic bags - but should *extend the range* of items and include other SUP items, specifically used in this sector like cords, gloves, boxes and special packaging. With the revenues, avoidance and multi-use concepts have to be fostered.
- EPR schemes can also support the better design of unavoidable single-use plastic products to improve their recycling capability. Obligatory quota for recyclates to increase secondary raw materials that can be used to make high-quality new products.
- Within these EPR schemes, companies could pay a fee to the national / municipal responsible authority, which could be used to remove marine litter in general or with a focus on the small litter items (see REMOVAL & RECYCLING OF MARINE LITTER). However, if this measure is taken for the aquaculture sector, it should also be introduced in other offshore sectors (tourism, shipping).
- In theory, EPR is an individual obligation, in practice producers and manufacturers often transfer this responsibility to producer responsibility organisations (PROs)[33], including in

[31] The SUPD also applies to fishing gear, containing plastic, according Art. 8. The main objective is to tackle lost fishing/aquaculture gear because of its direct pathway to the sea and to incentivise its bringing ashore and improve its handling there. EPR schemes – apart from deposit schemes – are already considered as crucial to take action against marine litter caused by fishing gear in the European Strategy for Plastics in a Circular Economy

[32] This could be also achieved by the general fee of 20 cent for all typical single-use plastic packages used in the aquaculture sector.

[33] PROs, in turn, charge producers fees, which they use to organise and manage the collection, transport and treatment of waste and are responsible for achieving the recycling targets. The PROs are private companies that

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how fees are set, modulated, and passed on to users. This can have negative effects on the pro-active approach of producers to change, e.g. the design of their products or prevention of specific plastic uses.

- If a collective scheme is chosen on national level, the PRO, set up by producers or through legislation, has to be regularly (e.g. every 5 years) assessed whether they have met their responsibility for recovery and recycling obligations of the individual producers.

Individual responsibility

- Following the idea of producers' responsibility, also the users (mainly the farmers and their staff) should be liable for loosing especially the little items as this is foreseeable. The new EU Single-use-plastic Directive (SUPD), based on the Plastic Strategy, demands to prevent using plastic for single use or fisheries/aquaculture gear containing plastic. These measures and related incentives have to be extended to group-specific obligations and measures (on a voluntary basis, with a code of conduct, with new legislation etc.).
- In parallel to new EPR schemes, the responsibility of the individual user should be increased.

10. Mark gear to track it back to the owner

- *For aquaculture SUP elements* exist no marking requirements as for other single use plastic products under the SUPD. Also marking to identify *gear* like in the PRFD or the Common Fisheries Policy Control Regulation[34] is not mentioned in the new SUPD. Marking and tracking measures could support the improved finding of the so-called ghost nets and could extend the scope of the foreseen waste collection at ports towards actively seeking of ALDFG by fishermen and aquaculture farmers. Furthermore, marking could help to identify producers for single EPR measures instead of PRO and is also relevant for distributing costs of clean-ups.
- *Gear marking* helps in identifying the ownership of lost or deliberately abandoned gear. Authorities can better enforce penalties for intentionally dumping aquaculture gear and nets into the sea. It also creates an opportunity to return gear that was accidentally lost to the owner for reuse and increases the visibility of gear. For example, floating gear markings attached to stationary nets under the surface can help notify vessels about the

operate in parallel to (and to a certain degree independently of) municipal waste management of other waste fractions.

[34] Council Regulation (EC) No 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy.

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risk of entanglement in the area (see FAO guidelines adopted in February 2018)[35] (see also P&R | GP 10.1).

- *Tracking* can foster the retrieval of high-valued equipment like floating buoys using a GPS with satellite (alarm). Mostly this is the initiative of the fishers and farmers, with no support of the government. Since such tracking buoys are expensive, support could be provided by EPR funds. Electronic monitoring, on the other hand, is not new, but can be difficult at sea due to weather conditions and salty water. The tracking system works up to 12 nm from the coast.
- In case the whole construction breaks loose after a storm, a GPS-system can be used to follow its active location with satellite. Cameras are still not adapted to the harsh weather conditions.
- *Tagging* lost items can help to track them. This is usually done with buoys and with essential structures (e.g. long floating pipes). This approach should be open for cross-border collaboration to enable an easy exchange of gear waste between countries, also related to joint recycling plants to increase the amount of waste.
- The *use of transponders* in coastal aquaculture farms or by small-scale farms is limited due to cost and technology constraints. For coastal aquaculture it is often assumed that the combination of an inshore location where landmarks can be used for bearings and more affordable GPS means that the use of transponders is unnecessary for gear location purposes. But in many aqucaculture facilities their wider adoption would provide an additional method of location to reduce gear loss through misplacement at minimal additional cost. [36]
- Cable ties, buoys, etc. get lost easily overboard. Economic lost, there is not a measure to collect the items and bring them ashore. In Denmark the objects, like buoys, are *marked and connected to the owner*. However, tourists seem to collect and sell them or bring them as souvenir. Local authorities should make people aware where the litter needs to go to once it's comes ashore.
- Using *telephone numbers*: a) Adding a general telephone to aquaculture items that could be called in case the gear is lost, to get to know if somebody has found it (e.g. "hotline"). Or: b) Marking the buoys with the telephone of the owner that the person finding the lost gear, can call the owner. Or c) There could be a phone number to call at all beaches that people can bring back the items to farmers or a municipal collection site.

[35] https://eur-lex.europa.eu/legal-content/CS/TXT/?uri=CELEX:52018SC0254
[36] http://www.fao.org/3/i0620e/i0620e05.pdf

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11. Take preventive measures adapted to harsh weather conditions.

There is a need to adapt to the rough offshore conditions while making installations sea-proof and applying multi-use approaches.

- Request technical studies during the licensing process to assure that installations are storm-proofed (see also P&R | GP 11.1).
- Preventive measures to reduce ALDFG should be increased in relation to curative measures; much of the emphasis to date has been placed on curative measures such as gear retrieval programmes and clean-up of beach litter, while preventative measures may generally be more cost-effective in reducing ALDFG debris and its impacts.
- Aquaculture facilities have changed the design of equipment already to prevent losses. The motivation is to reduce own costs. The motivation would be stronger if the governments or municipalities offer additional incentives.
- Replace offshore cultivation as much as possible by nearshore production to reduce the impact of the harsh offshore environment that can cause accidental losses.
- Preinstall the constructions onshore as much as possible to loose as little material at sea as possible.
- Longlines in offshore seaweed farms have to resist strong forces. Using special ropes with parts of stretch, similar to ropes used by the shipping sector, can avoid (partly) detachment.
- Floats and buoys can be attached with specialised locks to avoid losses.
- Each producer should provide handling guidelines for individual farmers or contracted installation companies with the aim to avoid losses as much as possible.
- Cost-risk assessments related to easy-to-loose material containing plastic should be part of the normal, internal assessments of fisheries and aquaculture companies, similar to, e.g. EMAS[37] criteria.
- Offer internal trainings to improve the handling and fixing of materials.
- Develop and implement contingency plans for extreme weather conditions, e.g. removal of vulnerable equipment.
- Farm locations should be sheltered from storms in a natural way or by artificial dykes, embankments, etc.
- In seaweed farming, steel poles can be used that stand several metres deep in the seabed.

[37] EU Eco-Management and Audit Scheme

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12. Improve research and innovation activities.

- A knowledge sharing platform for researchers studying the forces at sea or/and alternative materials resistant to these forces would be beneficial to the aquaculture farmers to aid the initiation, development and operation of the farms.
- Foster cooperation with universities doing material research including their impact on the environment (see also P&R | GP 12.1).
- Cooperation between farmers, gear producers and knowledge institutions can be mutually beneficial. Fouling for example is a phenomenon that should be taken into account in the design phase as it increases the weight of the installation. A risk analysis is important. The type of materials and coatings used is also important and is still being understudied (see also P&R | GP 12.2 and 12.3).

13. Improve awareness, education and training/consumption levies.

- *Awareness raising and information campaigns* can help foster long-term value change and pro-environmental awareness – if orchestrated well:
  - Covering all levels of the stakeholder chain, for equipment manufactorers, producers, farmers, offshore workers etc. and
  - Made to last (e.g. having more than one year duration and including long-term educational aspects in trainings organized by aquaculture farmer associations, cooperatives for offshore sectors or trade chamber organisations)
- Awareness raising and information campaigns could be rolled out with a clear and also limited public budget. In addition, if credibility issues are cleared, even industry or PROs might (pay for) be rolling out such campaigns (in the frame of the new EPR provisions under the SUPD).
- Campaigns might
  - Aim to improve aquaculture farmer's understanding of the impacts of littering with the objective of reducing litter rates
  - Aim to reduce the amount of ALDFG (see also P&R | GP 13.1).
  - Focus on broader impacts of marine plastics, with the aim of encouraging a) aquaculture farmers to take up available SUP alternatives, or start using mulit-use items instead; b) designers to increase research on alternatives and c) producers to support financially these efforts
- *Organise awareness raising workshops* with stakeholders coming from different levels of the production chain like researchers, producers and farmers share experiences and even from different sectors like aquaculture, fisheries and agriculture to understand the amount of littered SUP, its impacts on the marine environment, increasing staff awareness of the need for re-using (rather than replacing new) equipment and possible alternatives and new waste management approaches. Funds, derived of EPR measures could support the capacity building in these companies with workshops and trainings.

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- *Organise national round tables on marine litter* aiming to reduce land- and sea-based littering and discuss on a regular basis issues of different sectors, including aquaculture (see also P&R | GP 13.2).
- Technical experts and institutions (including relevant staff at HELCOM and national aquaculture organisations) could identify *training and capacity building* needs within relevant institutions Baltic Sea countries. Based on this needs assessment, a flexible, needs-based training programme consisting of two main elements could be developed:
- On-going, ad-hoc training and information sharing with relevant individuals (farmers, producers, offshore workers etc.) and institutions in each country.
- Targeted training workshops delivering formal technical training on particular topics or skills, which will be open to a wider technical audience in the aquaculture sector (see also P&R | GP 13.3).
- Solutions and good practices, for example, should be more commonly shared so that producers themselves also benefit directly.
- Create manuals to be followed by the staff and offer a certification of good practices.
- Use *nudging policies* (behavioural response policies) like special offers to push farmers to more sustainable products or products which are already smaller, more sustainable and all other products are less available.
- Timely and *efficient communication* on new offshore installations to all seafarers is very important to avoid their destruction by ships sailing in restricted aquaculture zones: a) When a *new zone* for mariculture is in place, a NTM (Notice to mariners) should be forwarded more quickly so that these aquaculture zones appear on their digital navigation chart. b) For *new installations*, the coastguards can also use an ATON (Aid to Navigation, i.e. a navigation message or warning) whereby an emergency signal is continuously sent to all ships in the vicinity to notify them of an aquaculture farm in place.
- *Consumption levies* are considered to be any economic instrument implemented at the Member State level that increases the cost of SUP items used in the aquaculture sector and placed on the market, and incentivise non-use, or substitution by alternatives and multi-use items.
- To define the consumption levies, an option analysis could be modelled to determine the exact nature of the instruments. Charges and levies are ony likely to be effective for some items (like passive fishing gear, boxes, cords), and not others, which should be researched in more detail.

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Good practices

Do you know of any good practices already in place to prevent or reduce the loss, damage or discard of gear and other equipment in the aquaculture sector?

1. Introduce and improve standardized licensing processes for initiation, operation and decommissiong

P&R | GP1.1: Include measures related to the prevention of litter in national strategy plans for aquaculture

The national strategy plan for Sweden foresees an increase of mussel production in the Baltic Sea up to 10.000 t per year and a strong increase of (micro-)algae until 2020. It also includes preventive measures to reduce marine litter derived of aquaculture, incorporated into the licensing process.

P&R | GP1.2: Flexible permits adapted to local conditions

Mussel larvae collector lines in Denmark and Germany have to be taken out of the sea between 1st of March to 1st of November to prevent potential loss due to harsh weather conditions. This is already settled during the licensing process.

P&R | GP 1.3: Incorporation of decommissioning plans at the beginning of the licensing process

In Germany, e.g. in the Federal State of Schleswig-Holstein, this is presently at least in part incorporated in licensing procedure, and can serve as a good practice example to other states/countries. Stlll there is room for improvements. In most other EU countries similar systems are not applied yet and it should be checked how complex an implementation would be. In any case, responsible authorities should try to achieve harmonization on decommissioning to avoid unfair competition between EU member states.

P&R | GP 1.4: Compulsory removal of all installations during disposal processes

In Germany those installing the farm are not allowed to leave any litter behind when de-installing a facility. Aquaculture business is considered as any other industry when it comes to disposal of broken parts or dismantled units: the aquaculture related industrial waste is not to be disposed as a general garbage (except for those elements particularly permitted).

P&R | GP 1.5: Use updated documentation of BAT

In many Baltic Sea countries like in Poland or Sweden, the utilization of updated documentation of Best Available Technologies (BAT) is considered the most efficient tool when communicating with the respective authority. Often, a municipal or communal authority has only very limited experience in dealing with aquaculture. In Germany, these documents are less frequently updated and are developed by aquaculture experts from state authorities, typically state-driven research institutions, in close connection with producers and other experienced stakeholders. Therefore, these BAT documents have the

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highest effectiveness and impact – also on the reduction of debris - when they are formulated by practitioners and other experts (including scientists), when they are publicly available and visually appealing and are also regularly referenced in other contexts (e.g. as an industry standard in a marketing context) as well as being living documents, i.e. under regular review.

2. Introduce a tax

The stakeholders participating in the learning lab did not mention specific good practices for this topic.

3. Use top-down approaches like a ban of harmful material

P&R | GP 3.1: Ban of plastic bags

Denmark and the Island of Samso have banned all plastic bags.[38]

4. Install reduction targets

The stakeholders participating in the learning lab did not mention specific good practices for this topic.

5. Provide Incentives

P&R | GP 5.1: Guarantee for removing gear

In Denmark, there are some smart farms, in which the farmer subscribes a guarantee for removing the gear if there is any problem (e.g. in case of a storm). The farmer has to pay a fee if the installation was not removed in time.

P&R | GP: 5.2: Commitment of producers of installations

Finland is testing the approach to commit the producer of installations: the producer has to provide a guarantee to the farmer during the selling process that the installation will be removed in case of problems (e.g. storms). However, companies producing such installations have taken matters to court and a judgement has not yet delivered.

6. Increase mandatory labelling

P&R | GP6.1: Improve requirements for ASC standards

A new white paper from ASC ("Marine Litter and Aquaculture Gear" – published on November 28, 2019) aims to gather evidence from various sources including 60 ASC

[38] Samsø: Entire Danish island to ban plastic bags in favour of fabric versions | The Independent, accessed 31 January 2018, http://www.independent.co.uk/news/world/europe/samso-denmark-island-plastic-bag-ban-danish- environment-recylcing-a8105046.html

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certified farms to update the ASC standards; and finds that the three main causes of plastic pollution from aquaculture can be classified as: mismanagement, deliberate discharge, and extreme weather.

P&R | GP6.2: Environmental friendly boxes

Aquaculture farmers can buy Forest Stewardship Council approved cardboard boxes.

7. Requirements on product design

P&R | GP 7.1: Ressource-efficiency programmes

Some Baltic Sea countrieslike Denmark, Schweden and Germany installed so-called resource-efficiency programmes to foster research and designers to use more re-usable, easy to recycle materials – also for fishing and aquaculture nets and other gear types.[39]

P&R | GP 7.2: The SMART FARM system

A system that is shifting to different types of mussel technique. For example, the Norwegian Smart Farm compnaniy developed mooring-buoys which are fixed on the anchor-ropes. The complete unit is designed so it only needs 2 shackles to connect into the mooring-system. It was designed to keep the system in place both in open waters and sheltered sites and also takes aspects of sustainable material use into account.[40]

P&R | GP 7.3: Use 100% recyclable material for the installation

ARTHUR KRÜGER company[41] provides a wide range of semi-finished products as well as complete manufacturing of finished parts for the aquaculture sector: from design to construction up to assembly with light weight, stable, sustainable, 100% recyclable, easy to install und long life material, even for rough weather conditions. They are also testing alternatives for glass-fiber-reinforced plastic (GRP) constructions.

P&R | GP 7.4: Use of alternative natural materials instead of plastic

Nordshell, a Danish shellfish processing plant has switched from using polystyrene boxes to Forest Stewardship Council approved cardboard boxes instead, which has further reduced their plastics use by 9 tonnes per year.

P&R | GP 7.5: Use cotton for small twines

Many seaweed farmers are using small twines from pure cotton of 1.1mm thickness for the delivery of small seedlings of seaweed. They can be lost when unpacking and attaching to bigger ropes.

[39] https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/progress_ii_broschuere_bf.pdf
[40] https://www.smartfarm.no/process/mussel-farming-solutions/intro-system-overview/
[41] www.arthur-krueger.de/en

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P&R | GP 7.6: Alternative method replacing mussel pegs

In Sweden and Finland, mussel farmers use continuous lines or loops instead of mussel pegs.

P&R | GP 7.7: Re-usable mussel collectors and socks

The farmer of a family owned mussel farm located in Kiel tries not to produce any litter. He uses reusable mussel collectors and does not use disposable mussel socks any more. A seaweed farm in Germany (located in the Kieler Förde (oceanBASIS GmbH), certified according the EU-Eco-regulation[42] is also avoiding litter with re-usable products and additionally improves the habitat by diverse structures due to the macro-algae farming.

8. Use voluntary agreements

P&R | GP 8.1: Specific company requirements preventing accidental losses

The Swedish company Baltic Offshore (formed 2006 with roots back to 1853) is offering voluntary agreements with contracting parties, related to their cable work for the offshore industry. On their big constructing ships they installed a computer programme to log every piece of material that goes onto the vessel and to log out once back onto shore. It is the policy of the company and reflects its environmental friendly attitude. The policy is very effective in avoiding losses of materials and could be extended to aquaculture vessels.

9. EPR for prevention and better design - Expand individual responsibilities and/or group responsibilities related to producers (Extended Producer Responsibility (EPR))

P&R | GP 9.1: Use compensation schemes

Within the framework of marine environmental law there are compensation schemes (i.e. Civil liability and Fund Conventions regulating compensation for oil pollution damage caused by tankers). These schemes also include subsidiary or 'top-up' liability for cases where the actual polluter is not known (such as the oil industry's IOPC Funds, 2018).

10. Marking gear to track it back to the owner

P&R | GP 10.1: Marking gear

In Denmark, the owners are marking their gear, which is currently working. It should be implemented everywhere. There are some extra problems related with the buoys being traded/removed by tourists, and this increases the difficulty for tracking the litter (sp. Considering that the buoys can be recycled nowadays).

[42] Council Regulation (EEC) No. 834/2007 on organic production and labelling of organic prodcuts and repealing Regulation (EEC) No. 2092/91

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P&R | GP 10.2: Mandatory colouring of ropes

For example, in Eastern Canada specially coloured, braided rope have become mandatory in every lobster and crab fishery to help trace gear that entangles whales in spring 2020.[43]

The rope must identify the region, species being fished and individual fishing area. The requirement is also intended to maintain access to the U.S. seafood market by demonstrating Canada has rules comparable to those in place for fishermen south of the border. The details were spelled out in a notice to fish harvesters that was issued by the Department of Fisheries and Oceans (DFO), and make good on a promise made by the federal government. Fourteen fisheries will operate with new colour schemes. The interlaced coloured strands must be a minimum of 15 centimetres in length and, at minimum, will be required at the top, middle and bottom of the vertical line, or every 27 metres.

11. Take preventive measures adapted to the offshore marine environment.

P&R | GP 11.1: Technical studies to determine storm proof character of installation

In the Danish, Finish and German licensing process, a technical study is mandatory to receive a permit for the installation of offshore seaweed farms. This requested technical study determines whether the installation is storm proof.

12. Improve research and innovation activities.

P&R | GP 12.1: Install new degree courses

The university in Halle (DE) established new degree courses to work on alternative gear materials.

P&R | GP 12.2: Support new EU projects about technical improvements in the sector

The EU project InnoAquaTech, which is specifically looking for solutions for small and medium-sized aquaculture companies in the southern Baltic region, is taking the path of knowledge transfer. The target group are producers who get informed about current technologies at events and who are to be made aware of innovative plant concepts through excursions. This includes capacity building about preventive mearsures and circular waste systems.

P&R | GP 12.3: Continue the knowledge flow of pilot projects, e.g. in the frame of the Interreg Baltic Sea Region programme

The primary goal of the Baltic-IMTA project was to convert an existing network cage system in the Baltic Sea off Rostock (type Barth from GDR times) into an integrated multitrophic aquaculture system (IMTA) and to scientifically support the material properties and selection of more sustainable products. The pilot project was funded by the EMFF.

[43] https://www.cbc.ca/news/canada/nova-scotia/canada-mandatory-gear-marking-2020-fishing-industry-1.5422962

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13. Improve awareness, education, and training.

P&R | GP 13.1: Awareness raising workshops

The Interreg project Marelitt Baltic[44] has organised workshops for fishermen aiming a deeper involvement of them while utilising their expertise related to hot spots of ghost nets (e.g. linked to wrecks and their knowdeldge of historkcal fishing effort data). In parallel, the groundwork was layd for a change in attitude towards more sensitive topics, such as prevention methods. This approach could be used for the aquaculture sector as well.

P&R | GP 13.2: National Round Table on Marine Litter

An initiative led by Federal Environment Ministry, jointly with the Lower Saxony State Ministry for Environment and the German Environment Agency established the Round Table Against Marine Litter in March 2016. The round table aims to develop measures to counteract further pollution of the oceans and to raise broad public awareness of the problem and the need for action.

The round table works along the guidelines of the Marine Strategy Framework Directive (MSFD) which states that marine litter may not cause harm. The participants develop recommendations for action to combat marine litter, focusing on specific legal frameworks or sectors, including aquaculture.

P&R | GP 13.3: Cradle to Cradle LAB

This NGO is offering labs[45] for special stakeholder groups like designers, food producers as well as other sectors to exchange ideas and gain knowledge about new ways of production cycle, also with a view to reduce marine littering comin from marine sectors like aquaculture. The aim is to not only reduce the ecological footprint of producers and consumers but even enable them to have a positive footprint due to new resource management and prevention measures.

[44] https://marelitt-baltic.squarespace.com/documentation
[45] https://c2c-ev.de/c2c-lab-innovation-education-inspiration/

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5.2. MONITORING & QUANTIFICATION OF MARINE LITTER

BARRIERS

What are the monitoring systems for non-organic waste quantification that you have applied in your activity or that you know of?

- There is a lack of well-designed, practical and short to long-term monitoring schemes.
- Integrated procedures for effective monitoring of the aquaculture farms are missing.
- Cooperation and collaboration among aquaculture farmers or different offshore economies is lacking.
- Transparency and data exchange between aquaculture companies / different sectors / Baltic Sea countries related to lost gear and SUP items is missing.
- Monitoring is not an integral part of EPR collection measures.
- The (national/regional) monitoring programmes from the national governments are currently not sufficient as a knowledge base for the aquaculture sector.
- The current national monitoring programmes are not able to assess the amount of litter derived from aquaculture, which is also a loophole to achieve a good environmental status (GES) under the Marine Strategy Framework Directive.
- There is a lack of knowledge to identify aquaculture items in marine litter collections.
- There is not enough structural support and resources available for environmental enhancement initiatives like beach clean-ups and recycling projects, which could yield a massive amount of useful information if collected in a standardised way and made public.
- Environmental risk assessments (related to biotope or species protection) are not considering the loss of plastic material and their impact on the environment.
- There is a lack of knowledge of practical tracking systems for ALDFG.
- Monitoring approaches are often not linked with research and new technologies.
- There are currently no monitoring systems available, which could assess the effects of simple return or deposit return systems.

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SOLUTIONS

What monitoring measures and schemes should be introduced, improved or enforced to encourage and empower every stakeholder to tackle the issue efficiently?

1. Install better monitoring schemes of the aquaculture farms

- *Monitoring schemes could be integrated into the management plans* of the farms. This information could provide patterns that should be used for an improved management to prevent littering in the future. The monitoring scheme would be evaluated in parallel to the management plans on a regular basis (e.g. every 2nd or 4th year):
- Aquaculture farmers should install *an inventory of all equipment* during the life cycle of a farm. It could start with the durable materials like buoys, nets and bags and be followed step-by-step for non-durables like single-use and small items. An inventory scheme (excel table or collected invoices) would provide a good overview of the amount of items that are replaced or got lost.
- During the inventory, the *life spam of aquaculture gear* and other related plastic products should be monitored by aquaculture farmers. Data could be exchanged between different farms and regions.
- *Forward the database to manufacturers* producing plastic items for aquaculture to give them the chance to improve their products and to e.g. offer a certification to add value to the companies' products.
- Licenses should be renewed only if this kind of monitoring scheme is in place.
- The integrated monitoring scheme could foster transparency of aquaculture farms if data about losses of items are *published regularly*; this could improve their image in neighbourhood communities.
- Offer incentives to those farmers who comply with monitoring efforts **(see also Monitoring & Quantification (M&Q) | GP 1.1).**

2. Improve cooperation between aquaculture farmers and/or other sectors

- Aquaculture farmers could stronger collaborate with each other in their region and in addition with other offshore companies to facilitate the monitoring and managing of the general waste and lost items:
    - Collaboration between small and/or large aquaculture companies
    - Collaboration between aquaculture farmers and the shipping, fishing or offshore renewable energy sector. This effort can be supported by national

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administration responsible for coordinating monitoring, e.g. in the frame of the Marine Strategy Framework Directive **(see also M&Q | GP 2.1).**

- Monitoring costs can be shared and a feasible monitoring schedule or programme can be set up for offshore facilities.

- Smaller companies can pay a fee to the larger companies to monitor the whole area (area agreements).

3. Improve the design of monitoring programmes to better assess litter coming from aquaculture

- The Baltic region monitoring approaches have so far shown to be good at addressing multiple descriptors (e.g. of the Marine Strategy Framework Directive) simultaneously, *while coordination between countries and making good use of citizen science could be further elaborated*; this would enhance a targeted monitoring of aquaculture litter, which yet does not exist.

- Monitoring programmes should be *targeted and follow defined categories* of size, material and durability of the (gear) items; plastic is a priority (e.g. polyethylene).

- There is still the need to *improve compatibility of datasets* among countries or regions (for example, through the standardization of sampling methods and quality assurance of the data) and translating research activities into monitoring (e.g. for litter and noise).

- Increase the *frequence of data collection*:
  - Monitoring should not only take place after a storm (if at all) but shift towards short-term monitoring, e.g. every 2nd month to get standardized results.
  - Mid- to long-term monitoring schemes should be based on the Life Cycle Analysis, depending on the materials and the infrastructures put in place. For example, in the Baltic Sea the Life Cycle Analysis for seaweed facilities is estimated to be around 5-10 years. Considering this frame, the monitoring schedule should be created and adapted, and the necessity to remove and renew all the old structures can be better predicted to avoid fragile parts of the installation.

- Increase the *use of new technologies* (e.g. remote sensing, FerryBoxes, gliders) and methodologies (e.g. techniques to find microplastics):
  - Remote sensing and computer driven image analysis can be used to identify big patches of plastic in the ocean.
  - Imaging sensors on autonomous underwater vehicles (AUV's) can be used to monitor seafloor litter.

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- Installing a network of drone users or getting part of existing networks to foster the use of drones to better detect plastic patches (see also M&Q | GP 3.1).

- Maintain and/or *develop a limited number of long-term (fixed-point) monitoring sites* to monitor changes in accumulated marine litter on specific spots close to aquaculture farm installations.
- Make better use of *low-cost platforms*.
- *Improve data flows* (submission of data to centralized and/or open-access databases) and integrate municipalities to publish data about amounts of litter coming from aquaculture facilities.
- Foster more *integrated cross-disciplinary approaches*, e.g. through more coordinated monitoring across sectors.

  Create programmes which are *fit for multiple purposes*, e.g. to take into account regional or national specificities (e.g. subregions of regional seas with specific currents transporting litter; rigid baseline ecological assessment at local scales; increased monitoring in high-risk areas) and incorporate newer threats (e.g. microplastics).
- Include *flexible research* and/or investigative monitoring to increase knowledge of specific impacts (see also M&Q | GP 3.2).
- Better *link monitoring with research* and new technologies.
- *Secure funding* for long-term monitoring programmes.

4. Improve tracking systems of lost items.

- A GPS-system can be used to follow the infrastructure's active location with satellite. This can be useful when the whole construction breaks loose after a storm. Cameras are still not adapted to the weather/stormy conditions.
- Support (also financially) the development of innovative technological to retrieve gear more efficiently (see also M&Q | GP 4.1).
- Tagging lost items can help to track them. This is usually done with buoys, which are not environment-friendly by themselves. It is therefore necessary to improve the tracking system in order to trace the material back to its owner. This should be done on a Pan-Baltic level so that knowledge about littering and real 'litter' items can be exchanged between countries (see also REMOVAL and REDUCTION, 1.10).

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- To date, there is no efficient method for attaching tags or added barium sulphate to the nets for an easier detection after a loss.[46] A correct reading of the radio signal from Radio Frequency Identification (RFID) cannot be ensured to retrieve ALDFG.
- Passive RFID technology with its cost-effective production and embedding of information provides a good basis for the identification of lost aquaculture (and fishing) gear. However, this technique does not yet seem to be suitable for the requirements of retrievability, since these tags can only be read out after recovery and the radio signal only covers a minimal distance of 10 – 60 cm **(see also M&Q | GP 4.2).**
- A way to improve tracking and monitoring how much litter has been collected (e.g. by the aquaculture company, citizens, NGOs) is to weigh collected litter at the harbour and to give a receipt of the kg that have been collected. This could also facilitate the recycling, as it could be brought to/picked up by the waste manager directly.
- Aquaculture gear tracking and environmental data should be combined with an assessment of the causes of gear loss during aquaculture installations and operations to identify potential ALDFG host areas and hot spots.

5. Use mapping of special ALDFG host areas

- Until the technical methods for tracking will be improved and be further developed to recover ALDFG, more effort should be put into methods of retrieving it. The knowledge of known locations of underwater obstacles can be displayed on maps in combination with the use of ship sonars and can serve as valuable basis for a retrieving action of ALDFG. Recovering ALDFG is a good way to reduce the occurrence of fishing nets in the sea **(see also M&Q | GP 5.1).**
- Mapping of DFG host areas, developing clean-up methods and assessing the reasons why and where aquaculture farmers losoe gear are closely related.
- Successful cooperation with aquaculture companies when mapping lost gear host areas and planning retrieval activities can motivate the aquaculture farmers to further engage in the work and helps to earn their trust.
- Through a deeper involvement of aquaculture farmers while utilising their expertise can lay the groundwork for a change in attitude towards more sensitive topics, such as prevention methods.

[46] https://www.muell-im-meer.de/sites/default/files/2019-11/Höschle%202018_Wiederauffindbarkeit%20von%20Fischereigeräten_Endbericht.pdf

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6. Support return or deposit refund systems (DRS) with monitoring data

- If monitoring is an integral part of the EPR measures, the marginal cost is almost zero. This may support the idea of high recycling rates due to the EPR measures although it does not in itself reduce littering or increase the percentage of waste returned to ports.
- One indicator for checking deposit systems is the return rate. This indicator can be used to determine the effectiveness of a deposit system and to retain products in the cycle (reusable) or disposable products.
- However, the return rate is only of limited use for assessing the effect of a new deposit system for aquaculture plastic items related to the problem of marine litter. The reason is that the return rate does not indicate the whereabouts of the unrecognised products.
- Basis for well-founded assessment of a newly established DRS for aquaculture gear, packaging and/or other single-use plastic items is a solid database on the amount of non-refundable single-used items.
- These items need to well-defined related to simple return system or DRS and should be integrated into established marine monitoring programmes (in the swash zone of beaches, on the sea floor and in the stomachs of selected indicator types). Some compartiments could even be added, such as monitoring of defined aquaculture litter in aquatic systems to get the whole picture.

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GOOD PRACTICES

Do you know of any good practices already in place whereby monitoring measures and schemes are encouraging and empowering stakeholders to tackle the issue efficiently?

1. Introduce better monitoring schemes of the aquaculture farm

M&Q | GP 1.1: Incentives for compliance with monitoring and reporting schemes

The solution recommended by a Swedish participant is based on a principle by which responsible aquaculture farmers are distinguished from irresponsible ones. The core of this solution could be e.g. a voluntary "responsible aquaculture scheme" that interested farmers could commit themselves to. The scheme would expect compliance to a set of requirements (improved gear marking, better cooperation with controls, improved monitoring and reporting of gear loss) and in return the market could offer these aquaculture companies or family farms economic rewards e.g. by prioritizing their "littering – free aquaculture" and by paying a higher price. There are plans at local/regional level in Skane county (SE), within a LEADER project working to promote locally-caught fish, to include "ghost fishing-free" as one argument for consumers to choose more environmentally-friendly produced fish. This idea could be adapted to the aquaculture sector as well.

2. Improve cooperation between aquaculture farmers and/or other sectors

M&Q | GP 2.1: Round tables to foster cooperation

Round tables for In Denmark, recently and related to changed circular economy framework, round tables on marine litter – also with a view on aquaculture – have been installed on municipal level to discuss improved monitoring of specific SUP items related to fisheries and aquaculture. All national fishermen and aquaculture farmers as well as representatives of other offshore sectors are invitied to participate. Apart from improving data exchange, transparency and trust among coastal stakeholders shall be fostered. Also the reduction of costs for long-term monitoring shall be achieved.

3. Improve the design of monitoring programmes

M&Q | GP 3.1: Use drones to discover plastic patches

The DRONET[47], an international organisation founded to develop open source protocols and tools for marine surveys, is growing steadily with 17 core members (45 in total) from 26 organisations, of which 4 are from the Baltic Sea. Members contribute by sharing images they have captured from beach surveys to help train the algorithm and/or help develop and

[47] https://www.dd-drones.com/images/publications/VLS-May-2018-NJMunicipalities-magazine.pdf

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improve the survey methodology. Each member must first agree to the Marine Litter DRONET Charter, which ensures there is a common understanding of the open and collaborative nature of the network. Members on the network exchange survey findings and experiment with new approaches. They then can discuss they're surveying approach with the other members and roughly once a quarter join a coordination forum with all members. The Baltic Sea members, e.g. the municipality of the Southern Swedish islands, are discussing to move their efforts towards selective monitoring of typical litter derived of fishing and aquaculture activities. They want to use the collected data for developing a programme of measures (PoM) in the frame of the respective descriptor for litter under the MSFD.

M&Q | GP 3.2: Apply flexible survey methods

According to new Danish law (on waste management and circular design), companies that own fish cages are obliged to make a survey of the seabed to assess the amount of litter they produce. The survey is flexible and will be continuously extended to meet needs to better assess marine litter derived of this specific type of aquaculture.

4. Improve tracking systems of lost items

M&Q | GP 2.4.1 Development of a new gear marking solution

Within the project Marelitt[48] new ways of marking have been researched in laboratory and field tests jointly with engineurs and during authentic fishing and aquaculture operations. The objective was to develop a modern, practical high-tech solution for fishing gear marking allowing automatic identification and processing of recorded "in situ" data. The developed solution is a low-cost "smart tag" based on UHF RFID technology. The tag can be used with both new and existing fishing and aquaculture gear.

M&Q | GP 2.4.2: Use acoustic devices such as the PAT

The project MARELITT Baltic will also investigate other acoustic devices such as the Passive Acoustic Transponder (PAT) which can be read with its individual identification number for specific frequencies on ship sonars and of 3D-Structure Scans to retrieve ALDFG at known locations. Depending on the orientation of the net in the water column or the seabed added barium sulphate to nylon nets increased their acoustic detectability by sonar, but has also led to disadvantages for their easy operation for target species. Information of the occurrence of lost gear on the surface by high definition videos and the overview maps of underwater obstacles could provide valuable information guiding to areas where ALDFG may concentrate.

[48] https://marelitt-baltic.squarespace.com/documentation

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5. Use mapping of special ALDFG host areas

M&Q | GP 2.5.1: Mapping of ALDFG accumulation areas

The Marelitt Baltic project initiated cooperation with national institutions such as fishery monitoring centres, fisheries and aquaculture water management to obtain the required data. Various information was combined to identify conflict zones with a high amount of lost gear. GIS platforms have been used to ensure the best technological preconditions. Ideally, two maps should be developed: one showcase version and a more detailed version for planning.[49]

6. Support return or deposit refund systems (DRS) with monitoring data

The stakeholders participating in the learning lab did not mention specific good practices for this topic.

[49] https://portal.helcom.fi/meetings/WS%20RAP%20ML%204-2019-638/Documents/1_Marelitt%20Baltic%20Sea%20Blueprint.pdf

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5.3 REMOVAL & RECYCLING OF MARINE LITTER

BARRIERS

What are the barriers to removal and recycling of gear and other equipment that is damaged, discarded or lost?

- There is a lack of waste management infrastructure with, e.g. insufficient opportunities to collect, sort and reuse waste in ports or other defined collection sites.
- Market incentives for the effective participation in separate collection or for the return of special types of aquaculture gear (like cages) in the form of deposit return schemes are lacking.
- Procedures for dismantling are not economically efficient today and should be further optimized. Manual dismantling processes only exist in some Baltic Sea countries and transport across countries is expensive.
- Weak transport opportunities of gear between ports and recycling facilities.
- Lacking market incentives are directly linked with poor waste management, which is also related to complex gear products or mixed-plastic formats not designed for recyclability.
- Despite the removal of financial penalties for fishermen and aquaculture farmers to bring gear ashore under the revised Port Reception Facilities Directive, the effects of paying even indirect fees may not be sufficient as an incentive to completely exclude disposing of damaged gear at sea if storage space on board is limited. In addition, the obligation to set-up additional port reception facilities, in smaller ports in particular, may lead to an increase of overall port fees.
- The cost of collection and transport of end-of-life aquaculture gear are yet not organised with the involvement of materials producers. At present that cost is mostly left to the ports– this is particularly relevant in a sector where both ports, and the farmers are often small-scale.
- There is a lack of cooperation between different sectors like aquaculture, fisheries and agriculture to collect a needed amount of gear to assure recycling. Recycling will only be taken up on a larger scale if it is economically beneficial.
- Despite the potential value of some of the fishing gear, recycling is very limited and left to a few innovative operators. There is currently no structured approach to setting up specific mechanisms or tackling the costs of dealing with aquaculture gear containing plastic once landed in port.
- Even though loss of gear in good shape is a significant financial loss, which farmers try to avoid, retrieving accidently lost gear (e.g. by passing vessels, storms), whilst

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required by the EU Fisheries Control Regulation[50], may be perceived as too time-consuming, complicated and very costly in practice.

- Currently, the SUPD is not forseeing the responsibility of producers for clean-up measures related to fishing / aquaculture gear
- Some aquaculture farmers are both, producers of gear and farmers, e.g. mussel and shrimp farmers often produce their nets themselves and can be considered as producers as well
- There is a lack of appropriate waste management infrastructures to handle worn out aquaculture and fishing equipment.
- Recycling companies are located too far from the farm to collect, sort and recycle worn out gear and other waste, which is too costly to integrate into the lifecycle of a farm. This barrier leads to dumping the waste in the garbage without sorting it.
- Some waste collection centres do not accept to take in the non-organic waste from shellfish producers. A common waste collection policy should be elaborated and enforced.
- More research is needed concerning the recycling options from used nets.
- Very little or no information exchange and dialogue (e.g. workshops, trainings, forums, common toolboxes, free best practice guidelines, etc.) about innovative solutions of waste management (i.e. common sourcing/ funding/monitoring/best practice replication, etc.) and new materials with higher recyclability.

[50] Council Regulation (EC) No 1224/2009 of Nov. 2009

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SOLUTIONS

What are innovative solutions and business models that can be used to remove or recycle the gear and other equipment that is damaged, discarded or lost?

1. Improve waste collection, sorting, and reuse quota of plastic waste and ALDFG

Collection

- Install easily accessible, weatherproofed disposal points for the aquaculture producers, which could be used by other stakeholders like fishermen as well.
- Increase collection rates of gear, e.g. supported by sea basin wide or even international projects: The material that is supplied by aquaculture farmers and fishermen and especially in large batches from fishing ports is suitable for recycling. This statement currently relates primarily to international collection projects and suppliers of Aquafil, Antex / Ecoalf, bureo and Plastix. In the Baltic Sea Region mainly Plastix is active, although the small amount of gear is an issue (see also 5.3, cooperation, and GP 5.1.8).
- Promote further the "Fishing for Litter" initative (see also Removal & Recycling (R&R) | GP 5.1).
- Install an insurance fund for farmers to motiviate collection of ALDFG, paid by EPR schemes (see 5.6 REMOVAL & RECYCLING OF MARINE LITTER, insurance fund)
- Farmers can pay into a national, sea basin-wide or European fund, managed by a national or European body that manages the fund. At the same time, the farmers should report their lost items to this body to gain more insights for monitoring approaches.
- People visiting coasts and beaches are sometimes collecting aquaculture items. They can be motivated to bring the items to a municipal central location or directly to the owner. A sea basin wide or even international registration system could be set up to report the waste. An easy access online platform should give people information on the collected items (i.e. QR-code, number, etc.).
- Economic incentives should be introduced for offshore aquaculture farmers as well as fishermen and wind farmers to collect and sort waste (on board, offshore). It is crucial to show the offshore workers that their efforts in sorting are needed and useful.
- If national or municipal authorities are responsible for waste collection they could impose a fee on the sector that is responsible for the items collected. However, more

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background data is needed in order to do this efficiently. Only then each sector could be made responsible for their litter: mussel sector; oyster sector, fish sector, etc.

- Professional collection systems are needed:
  - Specialised motorboats, tailor-made to collect waste at sea from aquaculture equipment and installation.
  - Cleaning vessels could be a joint venture of different offshore companies based on shared ownership, shared returns and risks, and shared governance. Such a joint venture will enable parties to gain scale efficiencies by combining assets and operations.
  - Innovative passive catchers placed outside the farm (depending on currents)
- Establish networking platforms for exchange of best practices and information between farmers.
- Waste collection services should be promoted in a stronger way by ports, administration and producers.
- Collection of waste, sorting and recycling business models should be financially encouraged by governements.

Sorting

- Member States with coasts and marine waters will have to ensure that fishing gear are collected separately for recycling with a national minimum annual collection rate of waste fishing gear.51 The SUPD, however, does not provide a specific collection rate. This has to be delivered by national governments and specific commissions, dealing with detailed questions; these expert groups have also to define the group of addressees of the measures (the producers) and to concretise the way of implementation of measures.
  - **Offer a sorting system for different materials: a distinction must be made between light plastics (polyolefins, polyethylene PE and polypropylene PP) and high-density polymers (polyamide, PET). PP and PE are already being recycled into granules. Since PA and PET do not float during processing, the processes for recycling are still in development (see also R&R | GP 1.2).**

Reuse quota

- Legal obligations to use a certain share of reusable aquaculture gear items (reuse quota) force sellers of SUP items like plastic cords to comply with requirements or be sanctioned. Such coercion appears to be a very effective measure to foster the shift from single-use to reusable gear or parts of gear.[52,53]

[51] as defined in point 1 of Article 3 of Directive 2008/56/EC

[52] BEUC (2018). HOW TO BRING DOWN THE USE OF SINGLE-USE PLASTICS? A consumer perspective. BEUC, Brussels.

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- The quota could be staged over time, i.e. progressively designed to increase at certain intervals, thus further driving single-use food containers out of market relevance.
- The reuse quota should be set at national level in order to create a level playing field within a Member State and to accommodate for different national contexts across the EU.

2. Improve waste managemen systems through internal companies' policy

- Policies should install a framework and certification for waste management in aquaculture companies (e.g. Including key performance indicators - KPI's).
- The integration of the management of plastic waste in the company's policy on reduction of plastic waste is essential (incl. KPIs for implementation) – e.g. banning of single use plastics, use of recycled plastics, recycling of used plastics.
- So far, in many Baltic Sea aquaculture companies, only a decommissioning plan exists but no waste management plan. The loss of gear and other material at sea remains therefore mainly undiscovered.
- Decomissioning should be harmonised to avoid unfair competition between Baltic Sea Region countries.

3. Improve waste management systems through cooperation along the life-cycle-chain

- Avoid market fragmentation: Member States are often taking individual initiatives, notably to limit the access to the market of some problematic products, which will lead to a fragmentation of the European market. Therefore more cooperation between the BSR countries is necessary to achieve a more comprehensive policy framework.
- Facilitate cross-border partnerships to save costs – for instance to deal with waste fishing and aquaculture gear.
- Cross-border activities could result in joint efforts to install a recycling plant for fishing gear between two or three neighbouring countries or to avoid patchwork approaches of different Member States.
- Aquaculture should not be singled out as an industry that needs special regulations when it comes to waste material (non-biological, construction, equipment, etc). There are many other small-scale industries with similar materials appearing from time to time or regularly as wastes, so disposal and recycling should be linked up, not to be

[53] DUH (2018). Single-Use Plastics Directive. Avoid Loopholes and keep ambitious Objectives. Position Paper, DUH Berlin

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costly only for the aquaculture (i.e. economies of scale). This would make the logistics for handling wastes more attractive for specialized companies.

- Certainly, with the growth of the industry it would be advisable to have the aquaculture specific non-biological waste disposal and material recycling systems in place (i.e. standards, solutions and procedures). Thus, a viable solution might be in coupling together different small-scale industries which use the same type of materials; e.g. aquaculture combined with fishing or agriculture – so that a larger amount of waste (i.e. same material) may be collected. This way a critical mass of such material may be reached to then be collected and processed by recycling companies, thereby gaining an incentive to develop procedures. This would create a win-win situation as very small amounts occurring in irregular intervals require costly logistics and individual farmers may – despite tight regulations – be unable to afford the costly disposal and seek quietly illegal routes of disposal. Standards for material and equipment (including for some the lifetime limit or no-use conditions) in other industries are there already (see also R&R | GP 3.1).
- Worn out gear and other requipement collection and recycling services should be better promoted, and the business models based on their recovery from the sea, upcycling and repurposing should be financially encouraged by governements.
- Put in place various contractual agreements with external contractors to collect used or damaged goods (cardboards and equipment) to be recycled or upgraded.

4. Improve waste recycling

- EPR measures could support the development of local or regional recycling/reuse schemes to require better data collection on fishing net waste handling and to implement national marine recycling targets.
- Technically, gear must be thoroughly washed to comply with national antifouling regulations and must be separated/sorted manually, which is time-intensive. Therefore, some countries like Germany have outsourced the sorting of fishing gear to countries with lower labour costs. In a mid- to long-term perspective, it seems to be more efficient, cost effective and climate friendly, to support national recycling companies in adding or specialising on recycling nets (see also R&R | GP 4.1).
- Recycling targets have been discussed as beneficial to divert end-of-life gear from landfill or incineration to recycling facilities. However, stakeholders described that better market uptake for recycled materials from fishing and aquaculture gear is required and that it was necessary to allocate parts of an EPR funding or government

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subsidies to create a competitive position for recycled materials from the packaging industry. [54]

- Aquaculture farmers should include recycling plans when applying for a new farm
- Apply recycling rebates and pay farmers levy when purchasing new nets and get money back when recycling.
- Encourage farmers to set short, medium objectives to help them reach the "Zero waste" goal or a positive footprint (**see also P&R | GP 13.3**).

5. Implemement EPR schemes: full cost coverage for aquaculture gear collection, transport and treatment / Expand producer responsibility and farmer responsibility

EPR schemes

- The SUPD has to be implemented into national law until 2021. In most Baltic Sea countries the exisitng packaging and circular ecoonomy laws have to be amended and adapted to meet this aim. Producers would be responsible to bear the cost for the collection, transport and treatment of gear containing plastic. The costs have to be transparent and reasonable and could be shared in so called PROs.
- The SUPD's intention is to increase the recycling rate of gear. EPR could lead to stronger ambitions of producers to use less mixed-plastic material to facilitate the recycling process
- EPR measures should foresee the upgrading of waste handling facilities, especially in the small fishing ports that many vessels use.
- EPR measures should enclose the improvement of transport of gear.

Expand individual responsibility:

- Some aquaculture farmers are both, producers of gear and farmers, e.g. mussel and shrimp farmers often produce their nets themselves and can be considered as producers as well: develop national / Federal State recommendations with clear definitions of a producer; when developing a national / Federal State law to implement the SUPD provisions clearly define who is addressed by the law and differentiate between small and large-scale fisheries.
- Farmer responsibility: add serial number on materials (e.g. on mussel cones).

[54] https://eur-lex.europa.eu/legal-content/CS/TXT/?uri=CELEX:52018SC0254

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6. Install an insurance fund for aquaculture farmers when collecting ALDFG

- The revision of the Port Reception Facilities Directive is a step in the right direction in terms of lessening the disincentive for fishers to return ALDFG to shore, but there are two issues remaining. First, the revision does not focus specifically on ALDFG, and second, there are no direct incentives for fishermen to return ghost gear. In addition, Member States are free to design their national cost-recovery systems, and therefore a discrepancy and confusion remains for fishermen operating in EU waters. Also the SUP Directive in its preamble 23 states that 'the existing legal requirements laid down in Regulation (EC) No 1224/2009, Directive 2000/59/EC and Directive 2008/98/EC do not provide sufficient incentives to return such fishing gear to shore for collection and treatment'.
- Abandoned or discarded aquaculture gear is not seldom yet. Even though full implementation of existing rules such as MARPOL or the EU Control Regulation would imply that fishing gear should not be abandoned or discarded intentionally, there is evidence that this is happening at a significant scale, including because of lack of incentives to handle gear waste differently. This is mostly an issue of cost, of the burden of bringing broken gear back, and of retrieving lost gear. Given the near-impossibility of controlling whether gear is discarded or abandoned, improving on this issue is considered to be mostly a question of enhancing compliance through incentives and/or facilitation.
- Install a cost recovery systems for aquaculture farmers: In addition to measures to improve the obligation to report lost gear, a suitable and durable solution must be found to ensure that aquaculture farmers remain motivated and are incentivised to bring their gear and also ALDFG to shore and to hand it over to appropriate collection facilities. Several examples of such initiatives can be found across Europe and beyond, but these have mainly been organised by (pilot) projects financed by project funding, private initiatives or donors like "Fishing for Litter". A sustainable solution must be based on legal grounds, moving beyond project funding. An insurance fund could provide the base for such a standardised volunteer system and takes the financial risks away from farmers to have to pay for the retrieved gear by themselves.

7. Extend the scope of the EPR provisions under the SUPD for clean-ups

- Currently, producers are not responsible for cleaning-up measures related to fishing/aquaculture gear: the new SUPD is not forseeing their responsibility for clean-up measures. This gap can be closed by national legislation when implementing the SUPD until 2021.
- A way could be extending the legislative frame and including clean-up repsonsibilties for producers. EPR schemes for fishing gear should involve obligations to cover clean-

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up costs, which is in line with the principle of producer responsibility for post consumption, but contributions would be spread across the sectors concerned and under established rules of financial and operational transparency. Basis for national expansion of the SUPD could be the so-called „safeguard clauses" for Member States laid down in the Treaty on the Functioning of the European Union (TFEU).

- On the other hand it has to be considered that payments of producers for clean-up measures in the frame of EPR could lead to unexpted developments in the production chain: if producers have to pay anyway they might be tempted to use the cheapest material instead improving it in an innovative way.

8. Implement a deposit refund system (DRS) for the aquaculture (and fishing) sector or simple return systems (without DRS)

- Introduce a national deposit system with subsequent, mandatory recycling of those nets and gear, which are not too dirty, whereas non-recyclable parts have to be incinerated.[55]
- A Deposit system would be an additional incentive to collect gear separately. Not only for farmers (e.g. to bring back old used aquaculture gear), but also for suppliers to bring back e.g. big bags. Therefore, working with a 'fee' or 'discount' has been seen as useful the LL participants and interviewees.
- A deposit system can work very effectively for larger items, whereas small items that are lost very frequently (because these are light, cheap and their retrieval is considered to be a waste of time) should be replaced by alternatives and, in case this is not possible, their use should be closely linked to awareness-raising and training of the e.g. staff responsible for installation.
- Producers and retailers who want to create new products or plastic granulate from the recycled product have an interest in predictable material flow and qualities for their calculation. Producer could already be interested in implementing a deposit scheme simply related to the material value of the gear.
- The deposit system could be a graduated **system for single or multi-use,** which is interested in the material of the deposit item. It ensures the return of a high percentage of unmixed material. A **multi-use system** concentrating on specific brands does not seem practical in most of the cases. However it could foster the systematic repair of gear in specific cases. The single and multi-use system could be linked to the existing national deposit systems, overtaking technical requirements related to

[55] According tot he EPA Network, there exist DRS for one or more product groups in 16 EU countries (including Iceland and Norway), of which Denmark, Germany, Estonia, Finlad are from the Baltic Sea Region. Those DRS are mainly for SUP plastic bottles and multi-use glass bottles or drinking cans.

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product identification. Correctly conceptualized it would provide desired incentives for the structured return of fishing gear with high response rates.

- Due to the complexity of **active fishing gear** like nets (many kinds of materials, individual adaptations during production), alone the option of a multi-use deposit system seems reasonable. As active aquaculture gear is assembled, sewed and many times patched by farmers according their needs during many years, a deposit systems seems to be practical if the aspect of long-term use has been included – this is also relevant for an ecological assessment.
- For **passive fishing gear** like cages, boxes, cords of regional production the situation is different. Here a national deposit system with all its modifications (single-use, re-use, multi-use) seems feasible. Under certain conditions also imported aquaculture gear can be integrated. Fish cages or transport boxes are often adapted to own needs by farmers and could be included in a multi-use system (**see also R&R | GP 8.1**).
- To assess the success rate of DSR, adequate monitoring systems have to be installed (**see 4.6 MONITORING AND QUANTIFICATION,** Support of DRS through monitoring).

Some possible loopholes of a national deposit scheme:

- It costs money and needs intensive preparation – in contrary to easy return systems (favoured by aquaculture farmers). Above all, the expenditure to implement a complex deposit system in relation to the relatively small amount of nationally disposed fishing nets and gear might be too high.[56]
- Deposit systems for certain fishery products are theoretically conceivable, but in practice some factors, such as the long-term use of nets and fish traps (tied up capital), the international procurement market and losses at sea due to international professional fishing, speak against a national or European deposit system.

Alternatives to a national deposit scheme:

- 1) Similar to a national deposit system also an implementation of **regional and municipal deposit systems** are thinkable, which can be adjusted according to the individual needs of the aquaculture sector and producers.
- A deposit scheme costs money and needs intensive preparation – in contrary to easy return systems favoured by the aquaculture sector. Above all, the expenditure to

[56] As there are no secure numbers regarding the amount of nets and other fishing/aquaculture gear found in Baltic Sea waters and of their spatial distribution, available data can be derived, for example from the Fishing for Litter reports. Additionally, data from Swedish coastal municipalities provide a rough direction. Altogether a range from 0,5 to 30 tons of nets and other fishing/aquaculture gear per port reception facility occurs, assuming that already 10 tons can be profitable for establishing return schemes and even recycling (Altvater 2018).

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implement a complex deposit system in relation to the relatively small amount of disposed fishing nets and gear might be too high.

- In some areas e.g. for recreational fishing, privately organized deposit systems are already existing and basically conceivable at the *local level* (see also R&R | GP 8.2).
- Local deposit systems have the advantage over nationwide deposit systems that they can be adapted to the special local conditions. For example, they can be (partially) financed through advertising revenue from local companies on the products that are given a deposit. On the other hand, there are ecobalance advantages due to very short transport routes, in contrast to nationwide and non-decentralized deposit systems, especially for individual products such as beer bottles with embossings.
- Local return options can, however, also increase user convenience and the response rate influence negatively. There are numerous examples of local deposit systems in the Baltic Sea Region, in particular for environmentally problematic products such as coffee-to-go cups or disposable tableware. This approach could be applied to aquaculture SUP gear items.
- Local deposit systems are an effective means of reducing exposure to the environment and entry into the sea, particularly in the critical areas of relevance, such as beach restaurants. Political funding opportunities for (local) reusable deposit systems arise, for example, via tax regulations.
- Tax benefits for reusable systems would also further goals, such as waste prevention, resource conservation, reducing cleaning costs and avoiding the pollution of coasts and beaches regardless of the type of packaging and thus avoid potential conflicts of interest. This could be also achieved by a graded taxation of SUP items or the aquaculture sector although so far this approach is only applied for some kind of food packages (see also R&R | GP 8.3).
- 2) Return systems ***without*** deposit collection organized by the business community have already proven themselves in other countries like Iceland (see also R&R | GP 8.4). Also, Japan has had established take-back and recycling systems for decades.

9. Raise awareness and invest in education and training activities

- Make people feel they are part of the solution and not part of the problem. Raising awareness will have effect on a long term, it is important to make people active and do not make them depressed.
- Organising clean-up activities for companies and communities (see also R&R | GP 9.1). The disadvantage of cleaning activities by the broad public or by companies is that HELCOM and national environment authorities do not have exact figures on litter

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disposal on beaches anymore. Only the data collected in the past when the clean-up initiatives did not happen yet are accurate.

- Long-term jobseekers may be involved in clean-up activities in coastal towns.

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GOOD PRACTICES

Do you know of any good practices already in place involving the removal or recycling of gear and other aquaculture equipmebnt that is damaged, discarded or lost?

1. Improve waste collection and sorting of plastic waste and ALDFG

R&R | GP 1.1 "Fishing for Litter"

"Fishing for Litter" is recommended by HELCOM and national environmental agencies to stimulate fishermen to keep the fished litter on the vessel and to bring it to the shore with the aim to monitor the types of litter that are being fished. The project was developed by KIMO (Local Authorities International Environmental Organisation), an association of coastal local authorities whose goal is to eliminate pollution from the Northern Seas. The German NABU[57] supports the collection, sorting and monitoring of waste in many Baltic Sea ports and fosters the involvement of fishermen in the initiative. So far, aquaculture farmers are not part of the project.

R&R | GP 1.2: Separate collection to facilitate recycling

Plastix (Denmark) tests the installation of different containers to facilitate the collection of different materials already at collection points. The company names the following steps for recycling: Cutting, washing to remove salts, separation by flotation of PE and PP from PA. Plastix recycles only PE and PP itself, other companies like Antex recycles PA, and flotation itself is not a problem unless clean material is processed without sediment. A first result of the Plastix pilot project for separate collection is that separation does not always work and needs training of the farmers and fishermens. Therefore, in their normal processes, the material types are still sorted out by hand before they were processed; flotation is not used so far.

2. Improve waste management systems through internal companies' policies

The stakeholders participating in the learning lab did not mention specific good practices for this topic.

3. Improve waste management systems through cooperation along the life-cycle-chain

R&R | GP 1.3 Cooperation in collecting waste between several seafood companies

SeaBOS (Seafood Business for Ocean Stewardship), one of the top 10 world's largest seafood companies (founded 2 years ago[58]) has aligned its policies for ocean

[57] https://www.nabu.de/natur-und-landschaft/aktionen-und-projekte/meere-ohne-plastik/fishing-for-litter/index.html
[58] http://keystonedialogues.earth/

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stewardship and seafood standards relating to fishing and aquaculture.

Their aim is to get retailers – also from the Baltic Sea Region - to adopt those policies, which consequently would force the entire supply chain to introduce new standards and to have a visible impact on the seafood industry as a whole within the next year (2020). One of their 6 task forces works on the topic of reducing ocean plastics – to ensure that SeaBOS members map the sources, presence and type of plastics in their seafood production, as well as identify ways to improve ocean health by removing plastics from the ocean environment. The task force will contribute to the development of a strategy, based on scientific knowledge, existing best practices and the frontiers of innovation. A stronger involvement of aquaculture farmers is planned.

4. Improve waste recycling

R&R | GP 4.1: Waste companies testing regional approaches of net recycling

Large waste companies like the German ALBA[59] have started pilot projects to test the ability to recycle nets, even if they are very dirty due to a long period in the sea (this is relevant for ALDFG in many cases). These regional approaches could act as promising models for other recycling companies, supported by start-up funding derived of EPR measures.

5. Implement EPR schemes for collection, transport, and treatment

The stakeholders participating in the learning lab did not mention specific good practices for this topic.

6. Install an insurance fund for aquaculture farmers

The stakeholders participating in the learning lab did not mention specific good practices for this topic.

7. Extend the scope of the EPR provisions under the SUPD for clean-ups

The stakeholders participating in the learning lab did not mention specific good practices for this topic.

8. Implement a Deposit return system (DRS) or simple return systems

R&R | GP 8.1: DRS for multi-use boxes provided by a German sea fish company

The Deutsche See-Frischfisch-multi-use box is a role model within the fish industry. We provide this means of transport to suppliers and customers on a deposit basis. Traditionally, even today, the fish industry works with transport materials made of polystyrene, which have been used for intercooling for many years. As early as 2006,

[59] https://www.alba.info/en/?navanchor=2110032&cHash=7e14a6ae3f5051ad088a27fde71806a0

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Deutsche See decided to develop a new pioneering system that relies on an environmentally friendly, reusable basis in its daily fish business.

R&R | GP 8.2: Local deposit for regional fishing association members

A German specialist dealer for fishing equipment, whose owner is a member of a regional fishing association (KAV), is taking a deposit of 50 cents on the plastic fishing bait boxes when selling baits (Breitbarth 2013). When the banks of the river Fulda in Kassel were inspected in 2013 by the waste technology department of the University of Kassel at the time, no such bait boxes could be found in the river section of the KAV's lease area at the fishing spots in the bank areas, while in the adjacent lease area of another fishing association such bait boxes were very common on - and found in the water. The deposit system is based on trusted identification within the fishing association, the members of which are authorized to fish in leasehold waters or issue licenses for this.

R&R | GP 8.3: Graded taxation

In Norway, all manufacturers of beverage bottles and cans have to pay taxes on the products. This taxation is graded according to the return rate of the products and does not apply to a return rate of 95% complete [Osterath 2018]. The approach could be applied to some passive fishing gear.

R&R | GP 8.4: Take-back-system for fishery equipment

A take-back system for Icelandic fishery equipment was established in 2005/2006 Fishing industry. Mainly power supplies from trawls and purse nets are collected. These are mechanically recycled. No proceeds will be made from the material collected. The motivation of the fishing companies to establish the take-back system lies in Avoidance of import taxes on new goods in a bill in the event of failure of the take-back system was decided.[60]

9. Raise awareness and invest in education and training activities

R&R | GP 9.1 Organisation of clean-up activities for communities.

The Baltic Sea Challenge[61] is one example of several existing iniatives to cooperate on beach cleaning. Within this iniative several cleaning events are organised every year in e.g. Helsinki, Turku, Tallinn and St. Petersburg. Additionally Baltic Sea Challenge and Clean Beach campaign invite the Union of the Baltic Cities (UBC) member cities to organise their own events in other cities in the region.

[60] Fisheries Iceland 2017

[61] http://www.itamerihaaste.net/en/news_and_events/events/other_events/2018_clean_beach_events

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6. Efficiency and timeframe relevance of proposed solutions

The stakeholders who participated in the Learning Lab workshop were asked to rank the solutions they proposed in terms of their expected efficiency and the most realistic implementation timeframe that these solutions would be feasible in tackling the litter problem from the aquaculture sector.

Efficiency: the relative degree to which the solutions, business models and (policy) measures will contribute to improve prevention/monitoring/recycling of marine litter in the aquaculture sector.

Time: the time needed for the effective implementation of the solutions, business models and (policy) measures contributing to improve prevention/monitoring/recycling of marine litter in the aquaculture sector. Short term: <2yrs, mid-term: 2-7 yrs, long-term: >7yrs.

This assignment was carried out for every breakout session and results were presented on big charts with post-its (Figure 5).

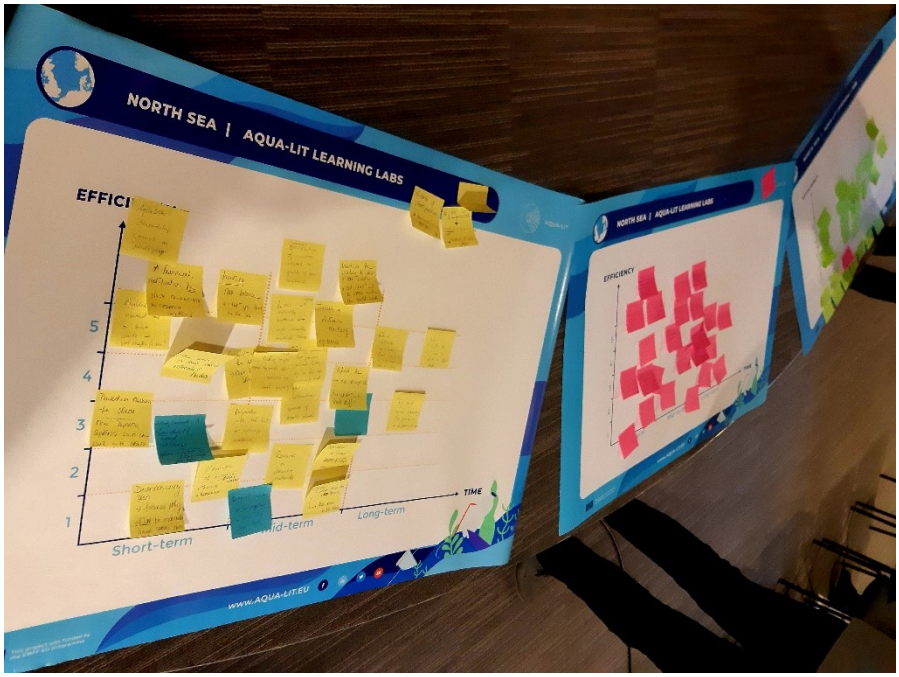

Figure 5: Results of the breakout sessions in which participating stakeholders ranked the above solutions proposed in function of their expected efficiency and the timeframe that these solutions would be feasible in tackling the litter problem from the aquaculture sector.

PREVENTION AND REDUCTION OF MARINE LITTER

S1: Introduce and improve standardized licensing processes for initiation, operation and decommissiong.
S2: Introduce a tax on aquaculture equipment.
S3: Install top-down approaches like ban of harmful material.
S4: Define reduction targets.
S5: Introduce incentives.
S6: Increase mandatory labelling.
S7: Introduce specific requirements on product design.
S8: Use voluntary agreements.
S9: Implement the new EPR provisions into national law for prevention and better design.
S10: Mark gear to track it back to the owner.
S11: Take preventive measures adapted to harsh weather conditions.
S12: Improve research and innovative activities.
S13: Improve awareness, education and training/consumption levies.

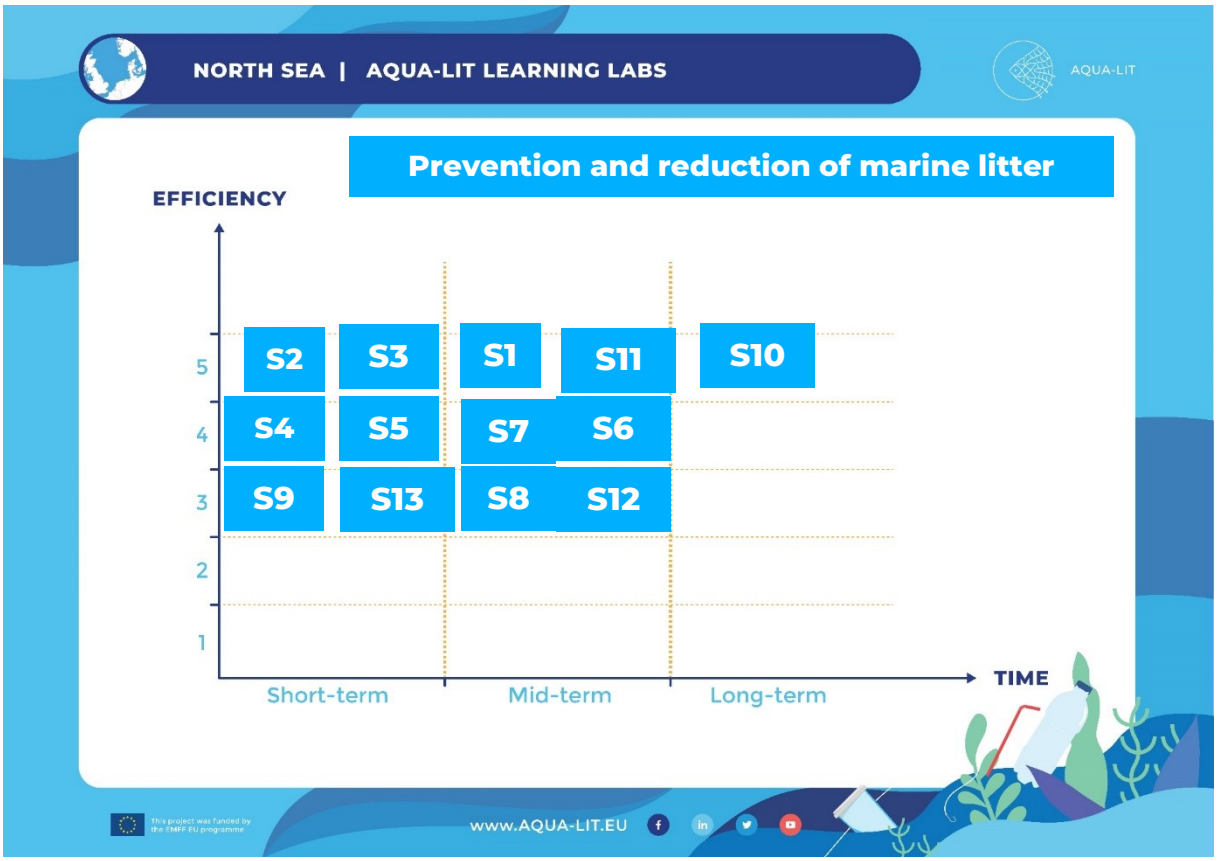

Figure 6: Efficiency and time of the proposed (technical) innovative solutions, business models and (policy) measures given by worshop participants (see § 3.4) to prevent or reduce the loss, damage or discard of gear and other equipment in the aquaculture sector.

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MONITORING AND QUANTIFICATION OF MARINE LITTER

S1: Install better monitoring schemes of the aquaculture farm.
S2: Improve cooperation between aquaculture farmers and/or other offshore sectors
S3: Improve the design of monitoring programmes
S4: Improve tracking systems of lost items
S5: Use mapping of special ALDFG host areas
S6: Support return or deposit refund systems with monitoring data

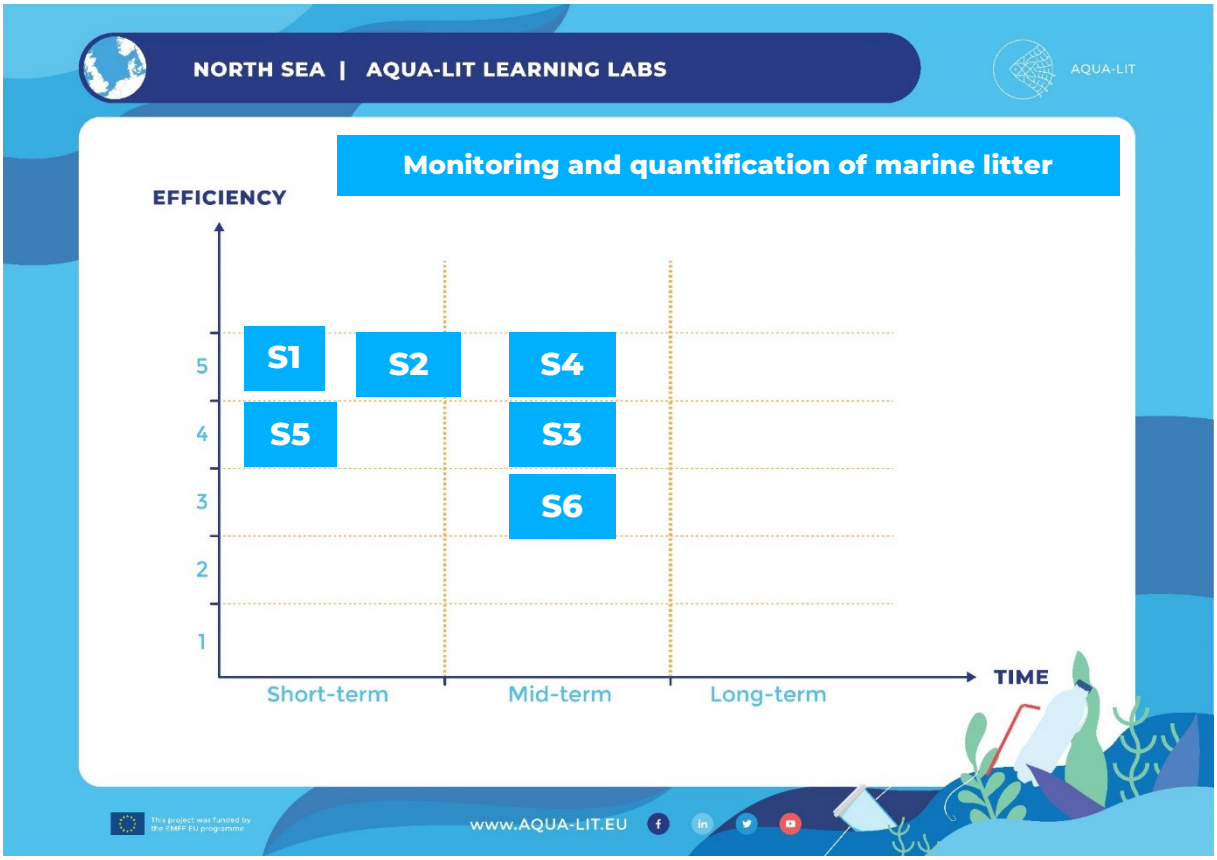

Figure 7: Efficiency and time of the proposed (technical) innovative solutions, business models and (policy) measures given by worshop participants (see § 3.4) to prevent or reduce the loss, damage or discard of gear and other equipment in the aquaculture sector.

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REMOVAL AND RECYCLING OF MARINE LITTER

S1: Improve waste collection and sorting of plastic waste and ALDFG.
S2: Improve waste management systems through internal companies' policy.
S3: Improve waste management systems through cooperation along the life-cycle chain.
S4: Improve waste recycling.
S5: Implement EPR schemes: full cost coverage for collection, transport and treatment / expand individual responsibility.
S6: Install an insurance fund for aquaculture farmers.
S7: Extend the scope of the EPR provisions under the SUPD for clean-ups.
S8: Implement a DRS for the aquaculture sector or simple return systems
S9: Raise awareness and invest in education and training activities

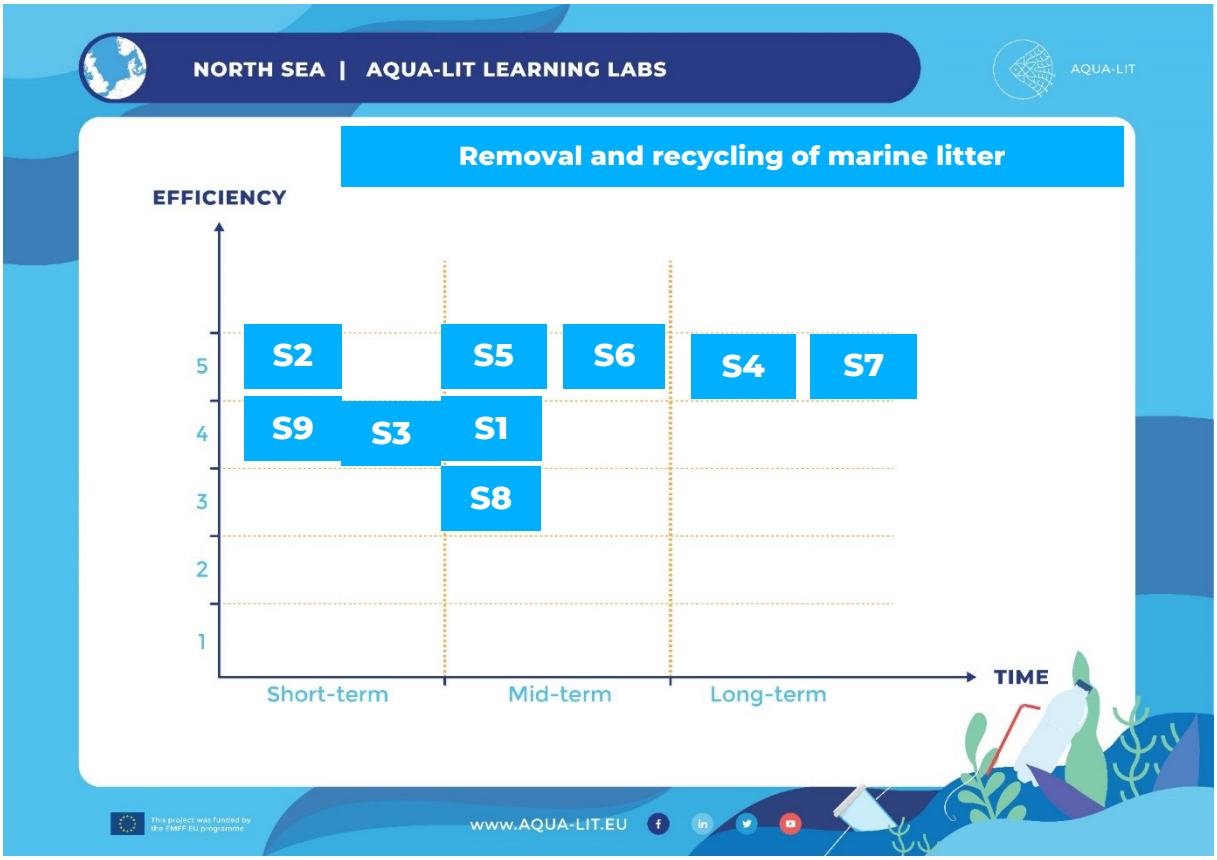

Figure 8: Efficiency and time of the proposed (technical) innovative solutions, business models and (policy) measures given by worshop participants (see § 3.4) to prevent or reduce the loss, damage or discard of gear and other equipment in the aquaculture sector.

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7. Conclusions and recommendations

7.1 Conclusions

This report combines the information received from the aquaculture stakeholders during the AQUA-LIT Learning Lab initiatives and focuses on aquaculture activities in the Baltic Sea region. In this conclusion the three core aspects of tackling marine litter we dealt with are combined: 1. Prevention & Reduction, 2. Monitoring & Quantification, and 3. Removal and Recycling.

BARRIERS

What are the barriers with regard to reducing the input of litter from the aquaculture industry?

The barriers identified by the stakeholders could be grouped in the following main topics:

- **SUPPORT**, e.g.
  - Lack of sustainable design criteria for engineering companies specialised in aquaculture systems or specific parts of equipment and system components
  - Lack of administrative support of farmers' own non-biological disposal/waste collection procedures and disposal in an approved manner according to industrial guidelines
  - Lack of strategic support for farmers facing costly logistics for disposal caused by small amounts of waste in irregular intervals.
  - Lack of financial support for small companies to develop alternative gear
  - Support from government & decision-makers (incentives or taxes, durable materials, guidelines for consumables and durables, labelling and quality standards)
  - Support for education, training, and communication (information on accidents at sea, communication on new facilities, workshops and staff training, awareness-raising)

- **LEGISLATION,** e.g.
  - Several regulatory obstacles have been identified in the national law concerning aquaculture. Aquaculture is regulated by several different parallel regulations, thus involving a number of authorities and having different subject areas.
  - Lack of common recycling regulations for small and large-scale companies, including various, confusing licencing procedures.
  - Weak implementation of monitoring and legislation related to non-biological waste

- A range of over 350 labels for aquatic and food products, which causes confusion by consumers and does not help to avoid littering by the sector.
- So far, no national legislation to implement EPR measures in place

- **RESPONSIBILITY,** e.g.
  - Financial support (devices or own initiatives are too expensive, alternative gear is too expensive for small companies)
  - Support from government & decision-makers (incentives or taxes, durable materials, guidelines for consumables and durables, labelling and quality standards)
  - Support for education, training and communication (information on accidents at sea, communication on new facilities, workshops and staff training, awareness-raising)

- **KNOWLEDGE,** e.g.
  - Lack of information/standards given by insurance companies dealing with aquaculture related to the life time of material/parts of the system; thus, producers have no standards to follow with the risk that no insurance is given or no loans by the bank, or only extremely high insurance rates are available.
  - Scientific knowledge (offshore conditions, sustainable alternatives)
  - Knowledge in relation to innovation (recycling of low value plastic, design of facilities, cooperation with universities)
  - How to implement EPR measures

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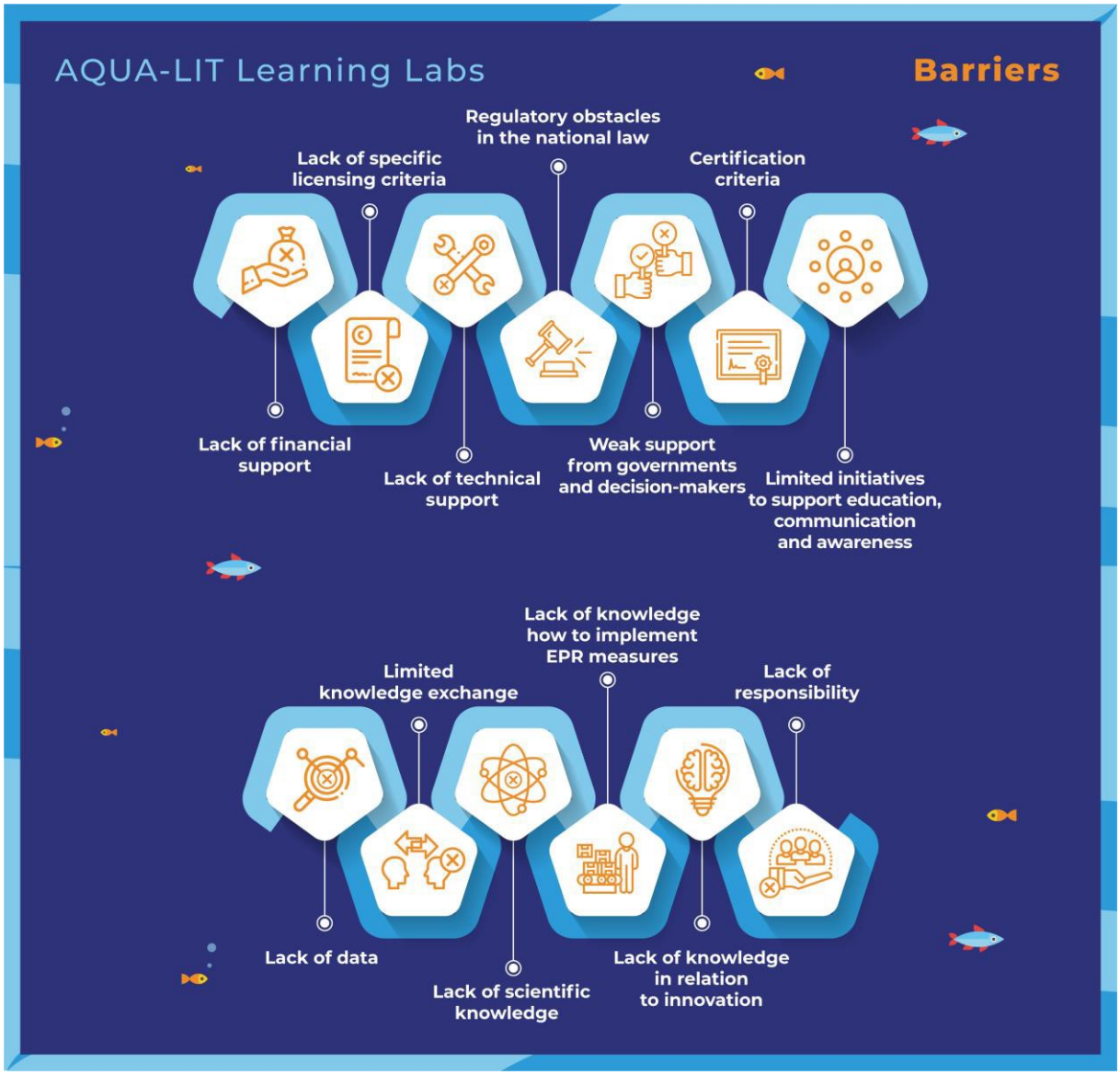

Figure 10: Infographic summary of the identified barriers to tackle the marine litter problem during the AQUA-LIT Learning Labs in the North Sea, Baltic Sea and Mediterranean Sea.

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SOLUTIONS

What are innovative solutions and business models that can be used to reduce the input of litter from the aquaculture industry

The solutions identified by the stakeholders could be grouped in four main topics:

- **SUPPORT**, e.g. by
  - Tailor-made standards, guidelines and procedures for different types of companies working on sustainable design / engineering solutions for decommissiong, re-use, re-purposing to be considered early on in the design stages of a system; these guidelines could be provided by the aquaculture sector itself or administration / licensing units,
  - Administrative circular design targets to extend the aquaculture installation's life cycle and multiple use of the entire installation or major parts,
  - Combination of the fishing, agriculture, and aquaculture sectors to achive larger amounts of waste (i.e. of the same material) for collection and processing; creating incentives for recycling companies to develop procedures.
  - Funding / tendering of competition with prize money to accelerate closed loop approaches and improve resource productivity in the sector,
  - Implemented national recycling regulations for all BS countries and offer of regular collection of non-biological waste of smaller aquaculture companies (and other industrial sectors) by communities,
  - Financial support (waste collection services, lower VAT for durable materials, recycling initiatives, financial incentives
  - Support for education, training, communication, and cooperation (internal training, communication between public/consumers and producers, cooperation between offshore sectors, cooperation between large and small aquaculture farms
  - Support for monitoring (own installations, monitoring programmes, technologies for monitoring
  - Support for waste management, management involvement in licence application process, more infrastructures, include waste management in policy of companies

- **LEGISLATION,** e.g.
  - Development of national aquaculture law with clear guidelines for the procedures in marine coastal or offshore farms as well as different farmsing systems.

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- Establishment of common standardised licensing of various forms for aquaculture across the Baltic Sea Region (or across the EU) in a clear and cohesive format to especially support small-scale farmers in preventing and recycling marine litter.
- Incorporation of the decommissioning process at the beginning, in the licensing process, including funds for farmers.
- Harmonisation of decommissiong to avoid unfair competition between Baltic Sea Region countries.
- Certain standardisation of the labelling systems for aquatic and food products to inforrm consumers about the environmental impacts of the products; allow labellers to expand on specific requirements or criteria for specific clients.
- Regulations (production of durable materials, use of alternative aquaculture gear, industrial waste materials, permits…)
- Measures (preventive measures, coupled to incentives, imported materials)
- Policy (waste policy, harbour facilities, Plastic Strategy)
- Certification (labelling, quality standards, include technical study and waste management plan in licence application process)
- Decommissioning (decommissioning plan for aquaculture facilities, compatibility with plastic waste legislation, mandatory reporting of losses)

RESPONSIBILITY, e.g.

- Shared responsibility (expand individual responsibilities, expand responsibilities of producers, farmers, and staff)
- Producer responsibility (gear producers & manufacturers, material design, …)
- Farmer/user responsibility (group-specific obligations and measures)
- Corporate Social Responsibility (CSR, include criteria for aquaculture sector)

KNOWLEDGE, e.g.

- Insurance companies need to know the lifetime of materials to be able to provide standards for their clients, the aquaculture farmers
- By collaboration of different engineers from the production industries to discuss product standards and how to combine materials in terms of long-livity.
- Scientific knowledge (new materials and new designs for aquaculture equipment, new methods for monitoring, …)
- Knowledge in relation to innovation (waste recycling, low value plastic recycling, R&I projects with academic partners, …)

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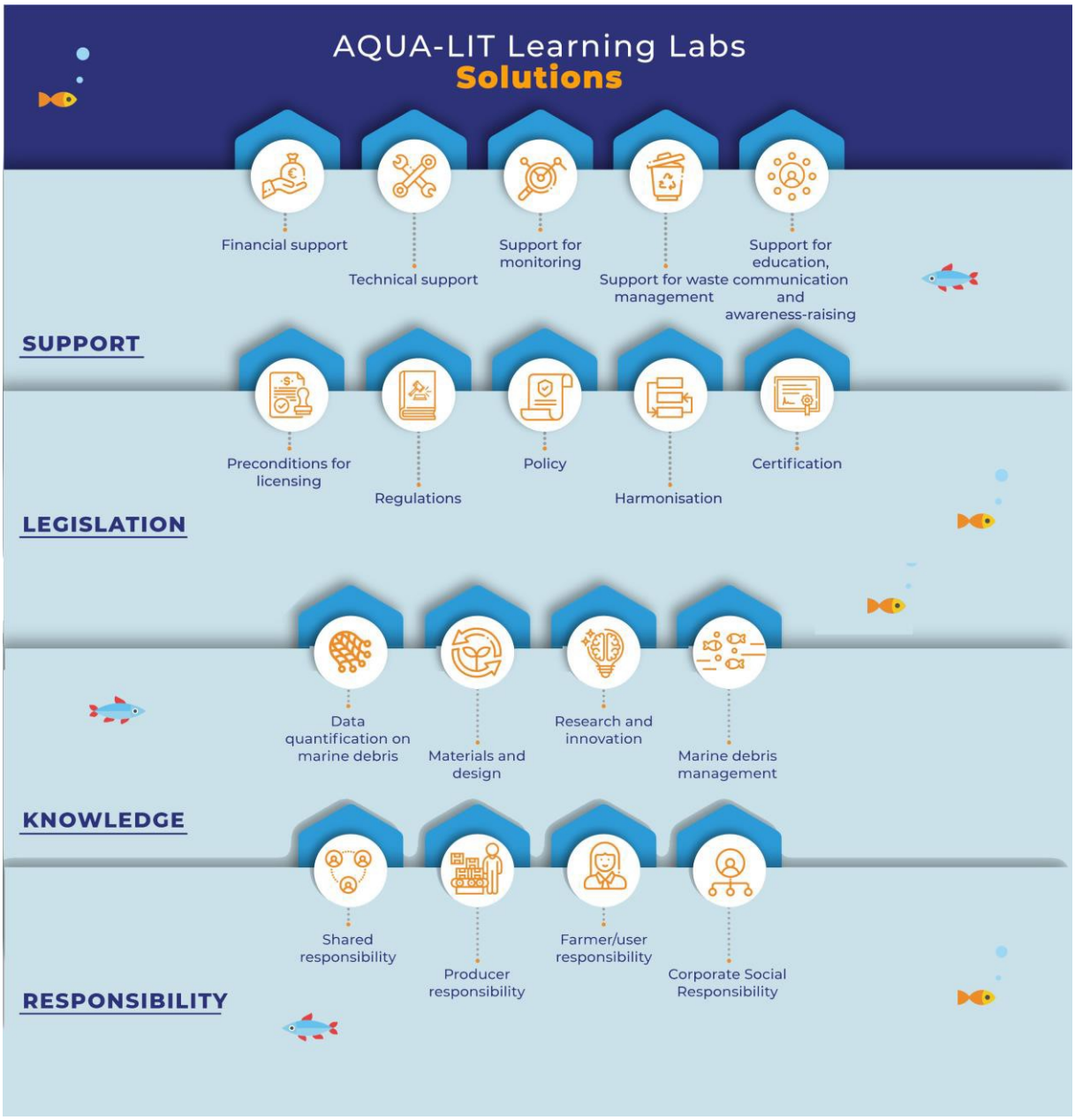

Figure 11: Infographic summary of the identified solutions to tackle the marine litter problem during the AQUA-LIT Learning Labs in the North Sea, Baltic Sea and Mediterranean Sea.

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GOOD PRACTICES

Do you know of any good practices already in place involving reducing the input of litter from the aquaculture industry?

The examples of Good Practices provided by Baltic Sea aquaculture stakeholders show that many aquaculture companies and local authorities are taking the initiative to prevent the loss of waste. The Good Practices identified by the stakeholders are grouped according the order under "barriers" and 'solutions':

- **SUPPORT,** e.g. on own initiative:
    - Education, training, communication and cooperation (communication between offshore sectors on new installations, workshops for shipping industry, staff awareness on re-use, clean-up activities)
    - Monitoring (tracking equipment for lost gear); first financial assessments of costs of these tracking systems
    - Waste management (cooperation between companies for collecting waste), also cross-border
    - Installation of a rapid alert system (similar to the systems against contaminant residues) among producers and farmers to inform each other about easy-to-loose items or barriers to prevent marine litter

- **LEGISLATION**, e.g. company policy:
    - Flexible permits for specific weather conditions and stormy weather)
    - Specific acts on aquaculture for clearer and more transparent procedures like "one-stop-shop" approach for licenses and permits in Norway
    - Clear guidelines for administration how to conduct a strategic environmental assessment related to aquaculture and causes of littering
    - Pilot legislation for some regions / Federal States in the Baltic Sea Region to test extended producer responsibility systems and their funding
    - Measures (voluntary agreements between the aquaculture actors and the government)
    - Certification (certification for waste management in companies, plastic-specific indicators)
    - Decommissioning (logging procedure for accidental losses, dismantling and recycling of worn materials)

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- **RESPONSIBILITY**, e.g.
  - Shared responsibility (development and use of eco-anchors, alternative materials like copper)
  - Corporate Social Responsibility (Fishing for Litter, recycling programs for nets and ropes, reuse of floats in other sectors)
  - Institutionalisation of responsibility for the deposits by insurance funds for aquaculture farmers and clear guidance through the administration; these funds shall assure farmers to bring back all litter (also ghost nets) without being liable for the disposal costs.

- **KNOWLEDGE**, e.g.
  - Pilot projects (funded by Interreg Baltic Sea Programme) to support research and engineering companies in finding alternative materials, procedures and strategies to reduce littering.
  - Individual company approaches to extend the internal knowledge of their staff to avoid littering; some of these initiatives are supported by NGOs.
  - Increased cooperation with administration responsible for aquaculture and acceptance of still existing problems related to littering.
  - Starting cooperation between farmers in the Baltic Sea Region and other sea regions to exchange information about technologies to avoid losses of parts of aquaculture farms due to storms etc.

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7.2 Recommendations

The results obtained from all three Learning Lab Reports – for the North Sea, the Baltic Sea and the Mediterranean Sea - will help feed AQUA-LIT's "*Tide against Marine Litter Toolbox*" to be published by the end of the project (December 2020), inlcuding a mobile app. Such a toolbox will be centred on helping on the three core aspects of marine littering (prevention and reduction, monitoring and quantification, and removal and recycling) by providing integrated frameworks, offering ideas, soulutions and faciltiating the matching of stakeholders in the aquaculture sectors to foster more sustainable services, connections and cleaner aquaculture practices. The good practices collected in the Learning Lab reports will be evaluated of what has worked best; this knowledge will flow into the toolbox as well.

So far, the awareness about littering is varying among Baltic Sea farmers accoring to the national legal and licensing context and the communication and awareness-raising between administration and production. Nevertheless, many aquaculture farms are working very local and have a strong interest to keep the environment clean due to economic losses caused by marine litter and the damage of image of the seafood due to litter near aquaculture cages.[62] New EU legislation like the EPR Directive is supporting growing awareness and seems to foster information and data exchange among industry as well within expert networks, e.g. within HELCOM and their national Baltic Sea members.

Accordingly, first steps have been taken within the aquaculture sector to limit the loss of litter during the life-cycle of an item. For example, producers and designers are **testing less-mixed recycling materials** to easen a better treatment process of gear. In addition, increased cooperation and communication between different stakeholders will help to overcome existing gaps in the system. For instance, **cooperation between different ports** and collection sites as well as different sectors like aquaculture, fisheries and agriculture may lead to higher amounts of gear which makes it economically more beneficial to recycle instead of incinerate them. Higher amounts of less-mixed material may also **foster new business models** focusing on the upcycling of gear.

Harmonised efforts to avoid the loss of gear material and to foster the retrieval of lost or abondoned gear could be supported by **eco-modulation systems as well as a new insurance fund for aquaculture farmers**. This fund can reduce uncertainty of farmers if they come across ALDFG and may increase the willingness of them to collect ALDFG. It supports a systematic, well-organised management of several passive and active gear types in very diverse conditions.

[62] https://ec.europa.eu/environment/circular-economy/pdf/single-use_plastics_impact_assessment.pdf

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New regulations on port reception facilties and common fisheries policies will foster the marking and identifying of gear and awareness among aquaculture farmers. Last but not upcoming national waste and circular economy laws can strongly support a structured approach for waste management systems on land and reduce marine litter significantly.

Aquaculture as an industry is still small in most Baltic Sea countries and a large portion of the production originates from traditional small-scale mussel and finfish farming, gradually developed over centuries, imbedded into natural landscapes and coastlines. Gradual intensification considering coasts as a dynamic ecosystem has also occurred as well as a transition to more intensive flow-through systems.

Certainly, with the growth of the industry it is advisable to have the aquaculture specific non-biological waste disposal and material recycling systems in place (i.e. standards, solutions and procedures). Thus, a viable solution might be in coupling different small-scale industries, which use the same type of materials. E.g. Aquaculture combined with fishing or agriculture and a larger amount of waste (i.e. same material) is to be collected this way. Thus, one may reach a critical mass of such material for being collected and processed by recycling companies, thereby gaining an incentive to develop procedures, systems. This would create a win-win situation as very small amounts occurring in irregular intervals require costly logistics and individual farmers may – despite tight regulations – be unable to afford the costly disposal and seek illegal routes of disposal. Standards for material and equipement, including for some of them the lifetime limit or no-use conditions, already exist, like the DIN-norm is other industries.

Insurance companies also have a relevant role (there are approx. 3, 4 major ones in Europe dealing with aquaculture) as they need to know the life time of the material/part of a system (e.g. polyester boxes and their standardised lifetime warranty) – thus, producers want to follow these standard. If no standard is followed, the risks might be high, that either no insurance is given, and no loan will be given by the bank, or the insurance rate is extremely high because of high risk of operation and thus interferes with the competitiveness of the aquaculture business. It is crucial to put different engineers from the production industries together to discuss how same materials can combined, as to produce standards required for any of these products.

There is a need for common standardised licensing of various forms for aquaculture across the EU, common and understanding and rulings in a clear and cohesive format. This is especially relevant for the smaller farmers, who do not have capacities to apply and wait for licenses for years and lack the knowledge on the complex multi-agency licence requirements, which are often not connected with each other. A pilot project may bring the various regulatory sectors together for cross-communication, identifying issues that are overlapping, also with regard to avoid marine litter. Thus double handling of the same procedures by different authorities can be minimized. The common standardized licensing has therefore to

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include aspects of how to deal with plastic debris and how to monitor losses of aquaculture installations or gear.

Decommissioning process should be incorporated at the beginning in the licensing process (in advance decommissioning scheme). Funds for an early integration should be put aside. In Germany, e.g. in the Federal State Schleswig-Holstein, this is presently at least in part incorporated in licensing procedure, and can serve as a good practice example to other states/countries. Stlll there is room for improvements. In most other EU countries similar systems are not applied yet and it should be checked how complex an implementation would be. In any case, responsible authorities should try to achieve harmonization on decommissioning to avoid unfair competition between EU Member States.

Above all, the legal framework should be predictable also on the level of permitting authorities and not influenced by the political situation.

7.3. Next steps

This report will be combined with the parallel activities in the Baltic Sea (D3.2) and the Mediterraniean Sea (D3.3) regions. The results obtained from all three Learning Lab Reports – for the North Sea, the Baltic Sea and the Mediterranean Sea – and from the Virtual Learning Lab will help feed the AQUA-LIT "*Tide against Marine Litter Toolbox*" to be published by the end of the project (December 2020), inlcuding a mobile app. Such a toolbox will be centred on helping on the three core aspects of marine littering (prevention and reduction, monitoring and quantification, and removal and recycling) by providing integrated frameworks, offering ideas, soulutions and faciltiating the matching of stakeholders in the aquaculture sectos to foster more sustainable services, connections and cleaner aquaculture practices. The good practices collected in the Learning Lab reports will be evaluated of what has worked best; this knowledge will flow into the toolbox as well.

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9. Annexes

Annex a: Programme of the *AQUA-LIT Baltic Sea Learning Lab*

AQUA-LIT's Baltic Sea Learning Lab

"How can the aquaculture sector contribute to reducing marine litter?"

9 October 2019, 9:00-12:30
Aquaculture Europe 2019, Exhibition Hall,
ESTREL Congress Center, Room 30541, wing3
Berlin, Germany.

The AQUA-LIT Learning Lab is an **interactive workshop** that will assemble stakeholders from the aquaculture sector. The Learning Lab will be facilitated using a participatory method (World Café) in order to encourage knowledge sharing and co-creation and to develop a mutually valued and acceptable toolbox, which could become exemplary and point out the path for other sectors.

The objectives of the Learning Lab are to:

- Federate and engage stakeholder communities in preventing, reducing, monitoring, quantifying, removing and recycling marine litter from aquaculture operations;
- Facilitate the adoption of successful existing solutions through capacity building;
- Explore the potential of innovative solutions to marine litter reduction, removal and recycling;
- Improve the understanding of the specific needs of stakeholders to maximise the impacts of the project.

Learning Lab expected outcomes

Participating stakeholders will co-design tools for preventing, reducing, monitoring, quantifying removing and recycling marine litter (e.g. polystyrene floats, plastic ropes, food sacks, buoys, etc.). They will make use of their experience, best practice, lessons learnt to share, assess and select the existing tools or design new ones.

Agenda

09:00-09:10 Welcome + Coffee
09:10-10:00 Plenary Session
- Introduction to AQUA-LIT (Susanne Altvater)
- State of play of non-organic litter from the aquaculture sector (Matthias Sandra)
- Objectives of the Learning Lab and expected outcomes (Susanne Altvater)

10:00-10:45 Round table Part 1
Interactive workshop where participants will work in groups to identify and assess solutions and methodologies from three perspectives:
- **Table 1** – How can the aquaculture industry be more effective in preventing and reducing its non-organic waste?
- **Table 2** – How can the aquaculture sector be more effective in monitoring and quantifying its non-organic waste?
- **Table 3** – How can the aquaculture sector be more effective in removing and recycling its non-organic waste?

10:45-11:00 Coffee break

11:00-11:30 Round table Part 2

11:30-12:00 Round table Part 3

12:00-12:30 Plenary Summary Session
- Presentation and discussion of results by 3 rapporteurs
- Q&A

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Annex b: Triggering questions used by facilitators of the interactive workshops

PREVENTION & REDUCTION
MARINE LITTER

Q1.2 Triggering subquestions

a. What is your opinion about following a Circular Economy Design?

b. What are reusable product alternatives for cages, gear?

c. What kind of cooperation between research and aquaculture business is in place in your area? Please list them.

d. What do you think of the Life Cycle Assessment Design?

e. Which best practices are the most efficient for your business?

f. Please list the measures for a sustainable aquaculture production (including farm & technology approvals) that you know of.

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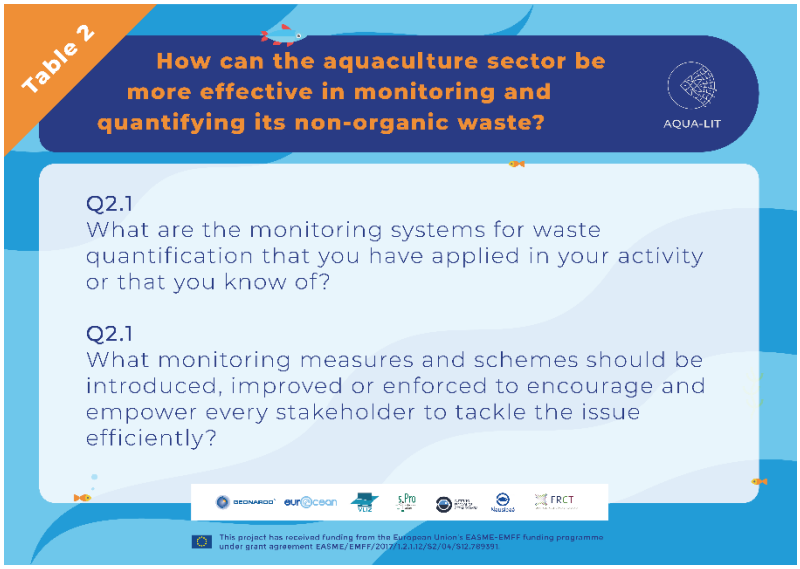

Q2.2 Triggering subquestions

a. Monitoring frequency: in your company/organization, is there any kind of monitoring after storms? or is it seasonal-monitoring?

b. Type of monitoring/quantification: is it done categorising products or materials or type of gear?

c. Is your company reporting to any organism/institution? If yes, do you receive any feedback from this institution?

d. Is your company/institution keeping that information in a database/excel/...? Do you make any analysis on that?

e. Is your monitoring/quantification system standardized? (using international/national indicators?) If yes, do you think that harmonizing the scope (regional/sea basin/national) and the monitoring/quantification methodologies would help to improve the system/would it make the system more useful/would it be more useful for environmental purposes?

f. Are you monitoring the carbon-water footprint regarding the energy usage? (this is not about litter, anyway)

g. Is there any national/sea basin/international regulation that is being applied by your company/institution regarding the monitoring/quantification tasks? Do you need any (kind of) support to apply it?

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h. Which best practices are the most efficient for your business?

REMOVAL & RECYCLING
OF MARINE LITTER

Q3.2 Triggering subquestions

a. Where do you see the need for improvement of your internal processes or administrative procedures?

b. What impact does the new Port Facility Directive have on your interest in recovering the gear and other equipment that is damaged, discarded, derelict or carried out by the sea?

c. What is your opinion about including the aquaculture in the Extended Producer Responsibility (EPR) Directive?

d. What are the recycling facilities or plants in your area? Please list them.

e. What do you think of an insurance fund for aquaculture farmers?

f. Which best practices are the most efficient for your business?

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Annex c: Questions used for targeted stakeholder interviews

1. **Background of the interviewee**

For a correct interpretation of your answers, we would like to ask some questions about the activities of your institution/company.

- What type of aquaculture are you connected with? (coastal-offshore, type of species,…)
- What are the technologies used in your own company?
- In which parts of the life cycle of an aquaculture farm are you involved?
- In which countries are you active?

2. **Those approving the aquaculture farm** (i.e. public authorities):

Purpose of this set of questions is to describe the aquaculture governance structure and major actors on all the levels of governance.

- Who is responsible for **approval of aquaculture** incl. EIA (*Environmental Impact Assessment*) procedures?
    - Is it a **centralised system** or is approval required from **many different authorities**?
    - Is there a **separate authority for each type of aquaculture** (both fed and extractive) or (Seaweed, shellfish and fish)?
    - Are there **differences in regards to available procedures and guidelines** in respect to **different aquaculture types** (fish, shellfish..)?
    - Describe the **role of aquaculture authorities** on various scales depending on the governance system applied in a given country.
      Note that in some cases there are differences in governance systems in regards to distance from shore i.e. coastal vs EEZ aquaculture. While there might be no aquaculture farm currently in the EEZ it is relevant to examine this since the trend is to have them further offshore in the years to come.
- Are the aquaculture litter **prevention/mitigation/monitoring measures** somehow considered **in approval procedures**?

3. **Aquaculture production and operation**:
    - In general, **how many** aquaculture producers are there in your country?
        - What **type** of companies are these (i.e. **mainly small family** companies owning artisanal business, or **larger industrial scale** or international large companies)?
        - Are there **associations** representing them?
    - What is **your experience with aquaculture gear** that can be **lost** most often? **Which items**?
    - Have you devised or **applied inventive solutions** for this? What would you **recommend**?
    - Are there **procedures/sustainable techniques/measures** in place to prevent and control litter from aquaculture?
        - Are these voluntary or binding?
        - Which ones do you use?
    - Do you implement the **three R's (Reduction, reuse and recycling)** in your company?
    - Do you think you could **improve the waste management of your company**?

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- What **type of support is lacking in regard to litter management** (i.e. clear procedures and requirements from relevant authorities, good practice guidelines, financial or other incentives for conducting such activities)?
- Do you think that the **aquaculture activities** also experience some **negative impact from marine litter**? e.g.: production losses due to floating plastic items?

4. **Aquaculture gear, installation and system designing and engineering companies**:
   - In general, **how many of aquaculture designing and engineering companies** are there in your country?
     - Are these **large** international corporations or **small** national ones?
     - Is there an **association** representing them?
     - Do you **directly work** with any of them?
   - Is the issue of **aquaculture litter** considered in the **design** stages?
   - Do these companies also work on the **sustainable design/engineering solutions** for the **decommissioning, re-use, re-purposing** of an aquaculture system? *For example, the technical proposal for an aquaculture farm can also include suggestions/or plans for after-life handling of the installation (decommissioning, re-use, re-purposing).*
   - Are the following design principles/approaches used and how?
     - ***Circular design***
       Circular design aims to keep the aquaculture installation materials circulating in closed loops. These loops, such as **reuse, repair, remanufacture, refurbishment or recycling**, extend the aquaculture installation's life cycle, improve the resource productivity[63].
     - ***Life Cycle Assessment (LCA) design***
       The aim of a life cycle assessment design[64] is to **minimize the aggregate environmental impacts associated with the product system**. Applying LCA to early stage decision-making can inform designers of the relative environmental impact importance of installation component material and dimensioning choices[65].
   - Are you **aware of any reusable product alternatives** for cages, gear (e.g. nets, mussel socks or longlines)? Please provide details.
   - **Awareness** should be raised on the **existence of sustainable alternatives** for certain items. Do you agree?
   - What is or could be **producers' role** in regards to prevention of the marine litter from aquaculture?
   - Are there **differences in amount of litter** in regards to what **aquaculture type** (fish, shellfish, seaweed..) technology or production system is used ?

5. **Approving the aquaculture technologies** (i.e. classification/certification bodies):
   - What is the role of **classification bodi**es such as **DNV GL, Bureau Veritas**?
   - Are there some specific **national guidelines or requirements from classification bodies**?

[63] https://www.researchgate.net/publication/313771263_Circular_Design_-_Design_for_Circular_Economy
[64] https://www.sciencedirect.com/science/article/pii/095965269390004U
[65] https://www.researchgate.net/profile/John_Basbagill/publication/257172108_Application_of_life-cycle_assessment_to_early_stage_building_design_for_reduced_embodied_environmental_impacts/links/5a80517a4585154d57d8f4aa/Application-of-life-cycle-assessment-to-early-stage-building-design-for-reduced-embodied-environmental-impacts.pdf

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6. Constructing, logistics, assembling the farm:
   - In general, describe **how many** they are in the country?
   - Are there **associations** representing them?
   - According to what **procedures** do they manage litter that can occur during their activities?

7. Questions related to Extended Producer Responsibility (EPR):
   - **Which producers and users** of aquaculture gear should fall under the EPR directive?
     - How should aquaculture gear imported from countries outside Europe be treated?
     - How should aquaculture plants owned by companies outside Europe be treated?
   - Is it **unfair to burden all producers equally** because some are located in landlocked countries and do not contribute to marine litter to the same extent as producers based in coastal areas? Please explain.

8. Monitoring of aquaculture littering (i.e. enforcement of correct waste disposal measures)?
   - **Who** does the **monitoring** related to aquaculture?
   - Do they also deal with **waste/litter**[66] issues?
   - What **procedures** are implemented? Are these voluntary or binding?
   - What **type of support is needed** to improve monitoring ?
   - Are there **national/international good practices** in regards to aquaculture monitoring that could prevent aquaculture littering?
   - What do you understand under monitoring?
   - Has **your company** undergone a monitoring of this kind?

9. Governance of the aquaculture (non-biological) waste management:
   - **Who** is **managing marine waste**[67] in your country, who is responsible for managing waste that is coming from the aquaculture farm?
   - What **waste management measures/good practices** are in place? Are these voluntary or binding?
   - Would you see a **tax on single-use aquaculture products** at point of sale more promising than the EPR system?
   - Would you support the idea of a (voluntary or binding) **deposit scheme for cages and passive aquaculture gear to raise the return rate** of these products? Please explain.

10. Dismantling process:

[66] *Litter* – defined as waste that has not been collected & disposed in a proper way, or an item that was lost (i.e. installation/gear drifted overnight), *Debris* – floating litter (usually unintentional i.e. after a disaster). Waste can be managed; litter is unmanaged waste that can only be collected.

[67] *Waste management* refers to correct waste collection and disposal thus preventing littering and debris appearance.
Debris recovery or litter collection would be defined as a corrective measure for unintentional or purposeful littering (improper waste disposal).

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- **Who** is in charge of the **dismantling** process in the country?
- What **procedures** are followed? Are these voluntary or binding?

11. **Processing the aquaculture (non-biological) waste (collection, recycling, clean-up):**
    - Who is responsible for **aquaculture waste processing** in a given country?
    - What **procedures** are followed? Are these voluntary or binding?
    - When is **net recycling economically viable**? Which material amounts are required?
    - Which **material pathways** can be used to facilitate retrieved aquaculture gear recycling?
    - Will a **mix of end-of-life nets**, derelicted lost aquaculture gear, marine litter e.g. from initiatives similar to the fishing-for-litter approach, facilitate recycling pathways for handed-back and derelicted aquaculture gear, or is mixing of different types of materials counter-productive?
    - Question related to Extended Producer Responsibility (EPR):
        - In what way should sold and collected **aquaculture gear be registered**?
        - Instead of **EPR**, do you see **alternative measures** as more suitable for reducing aquaculture litter like a) fine littering persons with a penalty or b) publicly finance the measures by taxes

12. **Awareness-raising**
    - Would you agree that a key awareness-raising measure could be **product marking/labelling**? *(Product marking requirements corresponding to Art. 7 SUP could focus on appropriate disposal of aquaculture litter to prevent them from being littered. This would need better messaging on the aquaculture products (on packs or on individual items if individually packaged), including pictures of impacts and icons for disposal guidance).*
    - Do you think that **workshops for awareness-raising** for employees and managers are useful? Would you want to participate?

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