AQUA-LIT

Learning Lab Report North Sea

Deliverable 3.4 (D3.4)

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Acknowledgements to participants of the Learning lab workshop and interviews:

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Aquimer	*France*	*b*
AtSeaNova NV	*Belgium*	*a*
Brevisco bvba	*Belgium*	*a*
CERMAQ	*Norway*	*b*
Colruyt Group	*Belgium*	*a*
Comité national de la Conchyliculture (CNC) (European Molluscs Producers Association)	*France*	*b*
De Blauwe Cluster	*Belgium*	*a*
EATiP	*European*	*b*
European Aquaculture Society	*European*	*a*
ILVO	*Belgium*	*a*
FPS Health, Food Chain Safety and Environment	*Belgium*	*a*
Ghent University	*Belgium*	*c*
GMG Saumon de France	*France*	*b*
IMDC	*Belgium*	*a*
Mowi Western Europe	*European*	*c*
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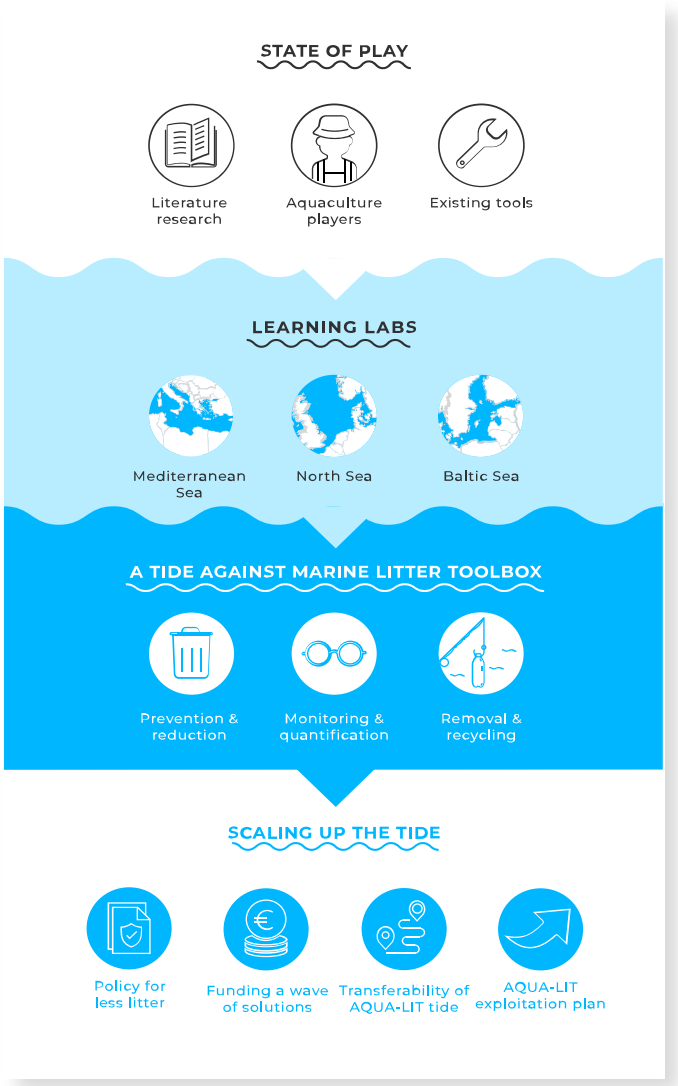
AQUA-LIT project

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 core aspects 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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AQUA-LIT North Sea Learning Lab report (D3.4)

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 North 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 on November 26th, 2019 in Ostend, Belgium, and 15 **targeted stakeholder interviews** from five different countries in the North Sea region. The stakeholders represented all stages involved in the life-cycle of an aquaculture farm: aquaculture farmers (fish, mussels and seaweed), aquaculture gear producers, researchers, start-ups, professional platform representatives, NGOs, national authorities, communicators, consultancies etc.

Most aquaculture stakeholders are slightly aware of the potential impact of plastic and other unsustainable gear and items in the marine environment, and show genuine interest in mitigating it. However, there is still a clear need for more attention regarding this issue.

Section 5 on 'Identified barriers, solutions and good practices' of this report summarises all responses of the participants of the Learning Lab, focused on the three core aspects of marine littering: **prevention & reduction**, **monitoring & quantification**, and **removal & recycling**. An assignment of efficiency and time needed for effective implementation was given by the workshop participants and presented in charts in section 6 on 'Efficiency and timeframe relevance of proposed solutions'.

Support, **legislation**, **responsibility** and **knowledge** are the overarching categories in which all identified barriers, solutions and good practices can be classified, as summarized in the conclusions in section 7. Based on these conclusions, for the combined three core aspects of marine littering (Prevention and Reduction, Monitoring and Quantification, Removal and Recyling), following recommendations and needs can be put forward:

1. Better support

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To create a sustainable aquaculture value chain and waste disposal processes, financial support for the implementation and use of alternative materials, tracking devices & monitoring technologies, better waste collection services & infrastructure should be promoted.
To implement best practices as a common approach, support is needed to enhance communication between offshore sectors and producers of offshore materials, cooperation between large and small aquaculture farms, training of staff and farmers including awareness raising.

2. Improvements in legislative framework
   In addition to voluntary agreements, policy measures and regulations (e.g. decommissioning plans) are needed to promote a sustainable and circular aquaculture sector.
   Mandatory certification, including plastic-specific indicators, for waste management and seafood products clarifies the sustainability of the seafood product and preceding processes.

3. Higher responsibility from all involved stakeholders
   To implement sustainable measures, expanding individual responsibility to a shared responsibility between farmers/users and producers is identified as crucial for success. In addition, initiatives in the context of corporate social responsibility are indispensable for awareness and innovation.

4. Encouragement of knowledge creation
   Knowledge gaps & knowledge exchange are currently major obstacles to initiating innovation in the aquaculture sector. Knowledge gaps are identified in the field of new materials/polymers & designs, new monitoring technologies, low value plastic recycling, and technical knowledge in relation to offshore conditions.

This report will be combined with the parallel activities in the Baltic Sea (D3.2) and Mediterranean Sea (D3.3) 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).

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1. 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' North 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 have been 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 specific region, 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 observation, knowledge exchange, learning, creation and promotion of innovative actions. The learning labs provide a forum for mutual learning and work to aquaculture farmers, equipment manufacturers, engineering and construction companies, 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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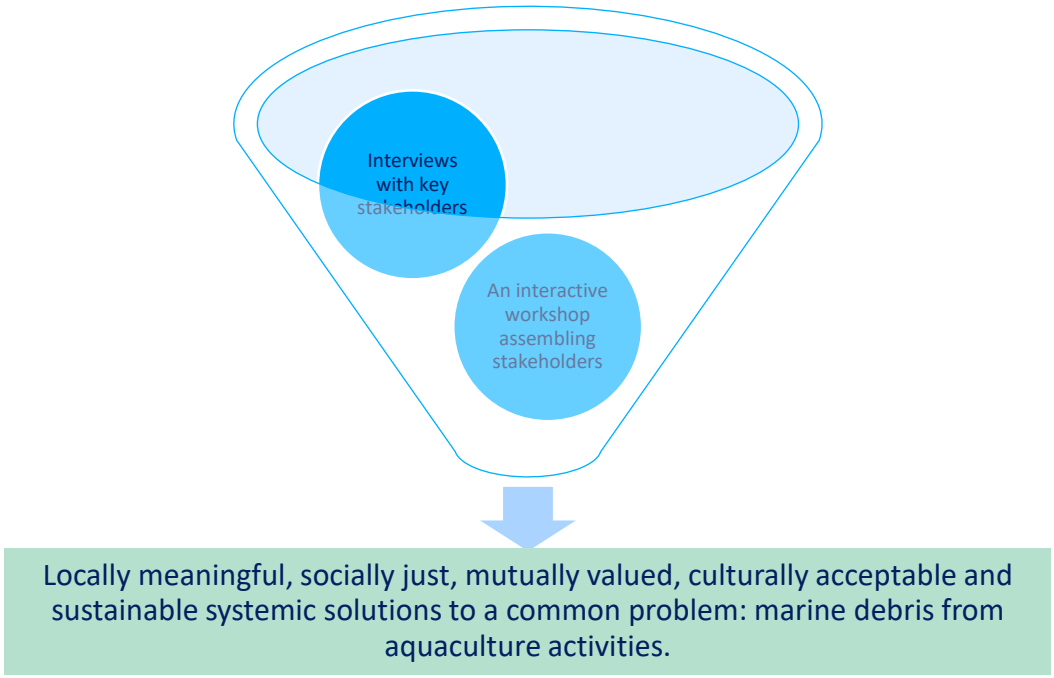

Figure 1: The AQUA-LIT' North Sea Learning Lab consists of two types of stakeholder engagement which aim to pave the way for novel co-developed and inclusive solutions.

1.1. Learning Lab objectives

The North Sea Learning Lab aims at:

- Assemble an aquaculture stakeholder community to help the sector tackle the problem of marine littering;
- Facilitate the exchange of knowledge, expertise, tools, and best practices in preventing, reducing, monitoring, quantifying, removing and recycling aquaculture facilities, 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 transferability of the projects' findings and impact.

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1.2. North Sea context

1.2.1. Aquaculture facilities

Aquaculture facilities in the North 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 North Sea, facilities for **the aquaculture of finfish** are clustered in favourable areas in the outer regions of the Greater North Sea. Atlantic salmon (*Salmo salar*) is the most important aquaculture species in Europe that benefits from natural conditions with good sea temperatures, salinity and currents in sheltered fjords. Most of the farmed Atlantic salmon are produced in floating cages at sea, while there are a few land-based farms. Norway, followed by the UK, are the most important producing countries in Europe. Rainbow trout (*Oncorhynchus mykiss*) is the second most important aquaculture species in this region. This anadromous species is grown in floating cages in the sheltered waters of the Scandinavian fjords. Today, nearly all rainbow trout on the EU market comes from aquaculture.

The extractive aquaculture (shellfish and seaweed) sector is gaining traction across the EU, with a wide range of commercial applications going beyond human consumption (e.g. poultry and fish feed, biofuel, chemistry, pharmaceuticals, etc.). In the North Sea, **mussel cultivation** (predominantly blue mussel, *Mytilus edulis*) is dominated by France and the Netherlands. Other smaller producers of the blue mussel are Denmark, Norway, Sweden and the UK. There are three different culture techniques - using poles ("bouchot"), suspended ropes or bottom culture. **Oyster farming** has a long history. After several years of decreasing production caused by the 2008 disease outbreak in French oyster farming areas, production has increased again since 2014 (European Commission, 2019). In Europe, commonly farmed oysters include the European flat oyster, Ostrea edulis, and the Pacific cupped oyster, *Crassostrea gigas*. In the North Sea, oyster culture is dominated by France, while the Netherlands and the UK have limited production capacity. **Marine macroalgae, or seaweed**, are traditionally harvested for the extraction of hydrocolloid for industrial purposes. EU macroalgae production is limited but the demand for edible algae is increasing in EU markets and new production models and new market stream are emerging. In the North Sea, seaweed aquaculture is predominant in France and Norway (brown seaweeds). The majority of the production in France is wild seaweed that is harvested. Other countries (The Netherlands, Belgium) are investing in pilot studies.

The intra-European exchange of information and collaboration among institutions has been strong in the region. There is an emerging importance of producer organisations to provide members with information, as well as to act as fora to develop common policies on a wide

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range of issues. On the local level, there are several Mirror Platforms (MIPs) organised by the local authorities, such as for example the Flemisch aquaculture platform (**Vlaams Aquacultuurplatform)** in Belgium.

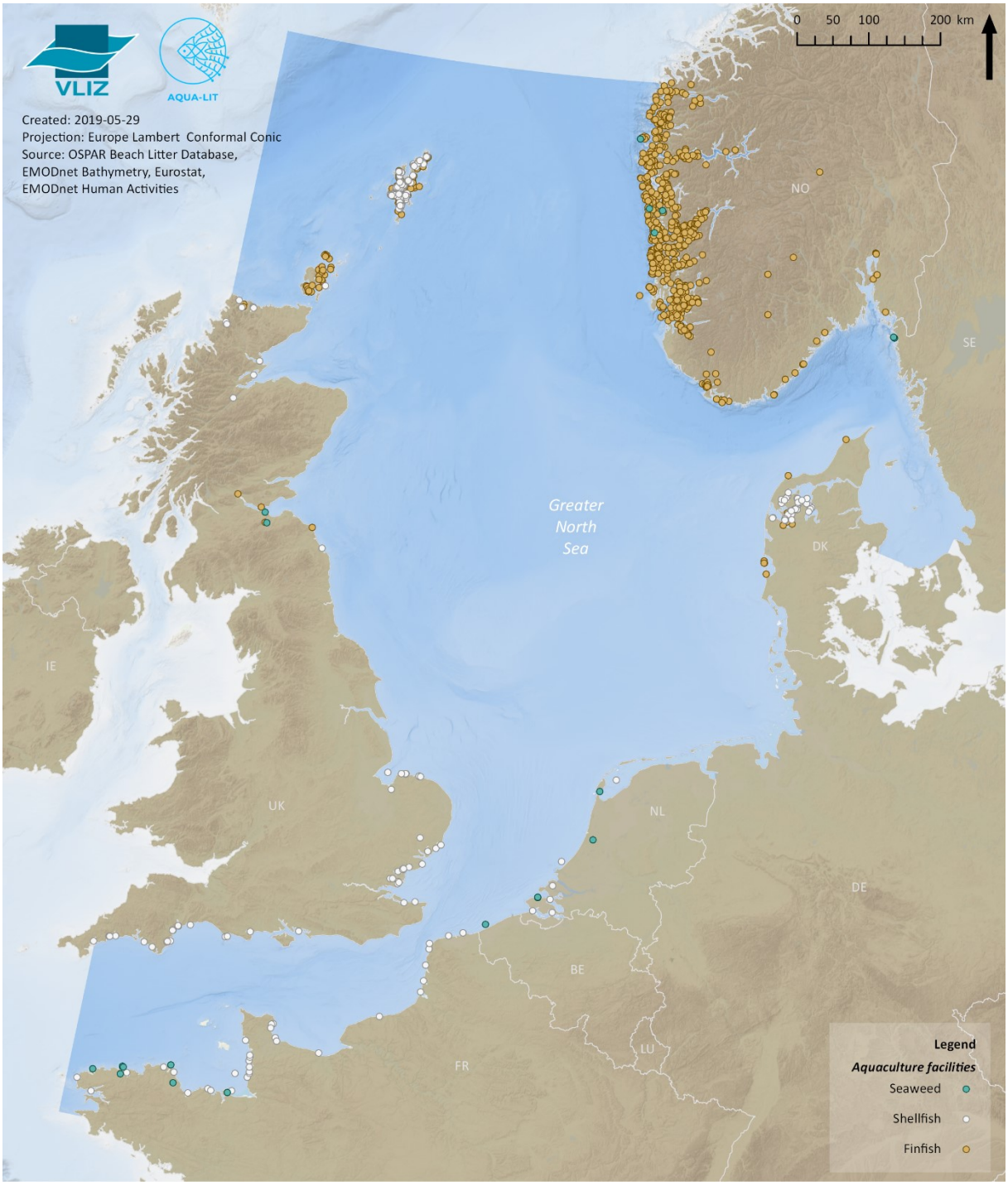

Figure 2: Distribution of aquaculture facilities for seaweed, shellfish and finfish in the Greater North Sea basin (Source*: EMODnet Human Activities, duplicated from D2.2*).

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1.2.2. The three core aspects to tackle marine littering

PREVENTION & REDUCTION OF MARINE LITTER

Each North Sea country has strict rules to be followed to make sure that there is no litter ending up in the environment. Currently, there are multiple solutions and mechanisms available, several legally binding measures in force, and various action plans published to prevent and reduce marine littering from aquaculture in Europe. In this way, an environmentally sustainable development of the aquaculture sector can be ensured.

MONITORING & QUANTIFICATION OF MARINE LITTER

In general, as in other coastal Member States of the European Union (EU), the WFD is applicable in coastal waters (up to 12 nm from baseline for chemical water quality and up to 1 nm from baseline for ecological status). Also the MSFD established an integrated management approach to the protection of the marine environment. In order to protect it, marine litter has already been included in the OSPAR targets and in the MSFD environmental targets (descriptor 10). OSPAR evaluates beach and seafloor litter data (ICES) as part of the OSPAR assessment. These assessments are also used for the reporting of the MSFD contributions of the member states. The OSPAR beach litter database contains fishing and aquaculture litter items, which are used in the AQUA-LIT project to produce the Marine Litter Inventory and several regional maps.

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 waste management and dismantling processes (already at the project application stage) before they get a permit. In multiple North 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.

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1.2.3. What are the key issues / Challenges?

The political, economic, socio-cultural, technological, legal and environmental challenges related to aquaculture developments in the North 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 North 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. In addition, Norway has his own legislation and is not part of the EU.

ECONOMIC

The commercial readiness of the North Sea aquaculture sector differs strongly across countries and types of aquaculture. In the Northern Greater North Sea, there is a strong network of international players and a high density of large-scale fed and extractive aquaculture farms, while in the Southern Greater North Sea a smaller number of extractive aquaculture facilities is located.

SOCIAL/CULTURAL

While some countries have aquaculture as a traditional activity ('Bouchot', France) some others are just initiating pilot projects (Belgium).

TECHNOLOGICAL

The North Sea region has seen many projects and initiatives focusing on innovative technologies, such as Offshore Aquaculture, Integrated Multi Trophic Aquaculture (IMTA) and Recirculating Aquaculture Systems (RAS) (on land).

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 North Sea, in general, is characterised by its strong currents and frequent storms. Hence, the meteorological and environmental conditions are not always optimal for aquaculture activities. Frequent gear loss and distant offshore farm locations can make aquaculture, in some cases, economically difficult.

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2. Learning Lab workshop for the North Sea region

2.1. General description

The second AQUA-LIT Learning Lab took place on November 26th, 2019 at the InnovOcean site (Flanders Marine Institute - VLIZ) in Ostend, and focused on the North Sea region. This interactive workshop assembled 15 stakeholders from the aquaculture sector in the North Sea region and 6 members of the AQUA-LIT organising team. Another four people were registered but could not attend and requested to be informed about the results. The save-the-date, invitation and 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'*. Participants received a certificate of participation after completion of the workshop (***Annex b***).

2.2. Participants

The stakeholder group consisted of aquaculture farmers (fish, mussels and seaweed), aquaculture gear producers, researchers, start-ups, professional platform representatives, NGOs, national authorities, communicators, consultancies etc. (***Figure 3***,

TABLE 1). Most participants joined from Belgian institutes, but a German, Dutch and French representative were also present and a few participants represented European platforms or aquaculture companies (TABLE 2). The attendance of female stakeholders (14) was higher than of male stakeholders (7) (TABLE *3*).

Figure 3: The participants of the AQUA-LIT learning Lab workshop for the North Sea region.

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TABLE 1

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

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

TABLE 2

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

COUNTRIES	#
Belgium	16
The Netherlands	1
France	1
Germany	1
Representatives from European platforms or aquaculture companies	2

TABLE 3

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

GENDER	#
Male	7
Female	14

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2.3. 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 4***), 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 c***.

Figure 4: Participants at the break-out sessions of the AQUA-LIT learning Lab workshop for the North Sea region.

During the coffee break, **Francis Kerckhof** of the Royal Belgian Institute of Natural Sciences (RBINS) gave a **demonstration on the different aquaculture litter items that end up on the Belgian shore (**

Figure 5). The majority of the recovered objects originate from the shellfish aquaculture activities in the English Channel.

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Figure 5: Francis Kerckhof (Royal Belgian Institute of Natural Sciences) at the AQUA-LIT learning Lab workshop for the North Sea region, demonstrating the different aquaculture litter items that end up on the Belgian shore.

3. Targeted Learning Lab stakeholder interviews in the North Sea region

3.1. 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 North Sea region.

The focus of the interviews 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 key information about the current situation in the industry.

3.2. Methodology of the interviews

As in the other sea basins, 15 targeted stakeholders were identified for the interviews, that were carried out following project-specific guidelines that have been consistently used in the three sea basins (Baltic Sea, Mediterranean Sea and North Sea). The questions used for the targeted stakeholder interviews can be consulted in ***Annex d***.

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Face-to-face interviews took place during workshops of other ongoing project meetings related to aquaculture or during network meetings. Other interviews were carried out by phone calls (*TABLE 4*). Every 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 4

Type of interview held with targeted stakeholders in the North Sea region.

OCCASION	#
Face-to-face interviews	3
(Skype) calls	12

3.3. Interviewees

The targeted stakeholders consisted of aquaculture farmers (finfish, shellfish and seaweed), professional platform representatives, researchers, and national authorities (*TABLE 5*). The interviewees originated from five different countries (and a European representative) in the North Sea region (*TABLE 6*). The number of female participants was higher than the male ones (

TABLE 7).

TABLE 5

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

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

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TABLE 6

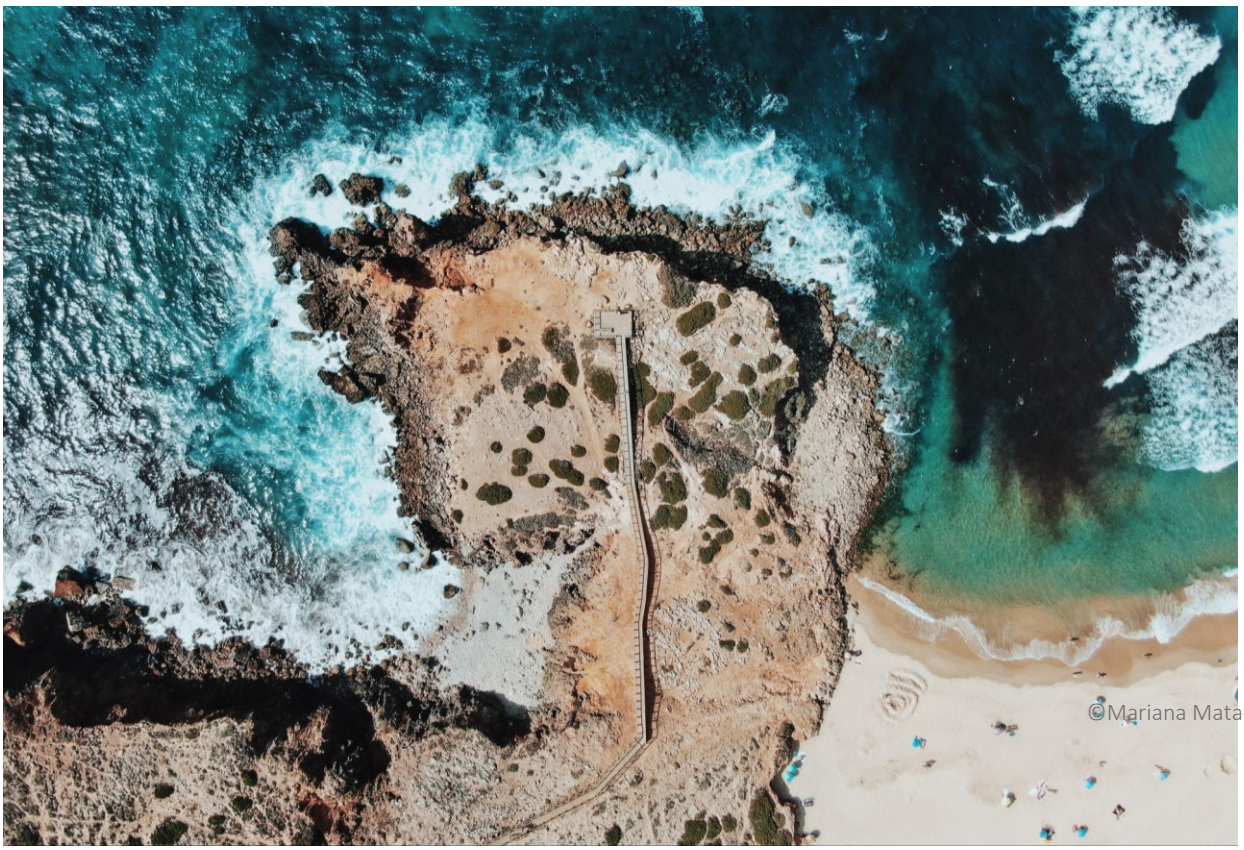
Origin of represented organisations for the interviews in the North Sea region.

COUNTRIES	#
Belgium	2
The Netherlands	3
France	5
UK	2
Norway	2
Europe	1

TABLE 7

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

GENDER	#
Male	6
Female	9



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4. 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 corresponding triggering questions used during the workshop for all three core aspects of tackling marine littering (1. Prevention and Reduction, 2. Monitoring and Quantification and, 3. Removal and Recycling). It should be noted that some of the proposed suggestions or solutions for a specific topic/ round table have been moved to another topic where 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. Good practices suggested in the workshop and during interviews have been identified and linked to the related core aspect of tackling marine littering and, furthermore, to specific solutions.

4.1. 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?

- In some countries, there is no long-term vision for offshore aquaculture production.
- Tracking devices are still too expensive for elaborate use, missing out on opportunities to prevent the loss of larger gear.
- The design of equipment is not always adapted to offshore environments or stormy weather.
- 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.
- There is not enough knowledge on the existence of sustainable alternatives for aquaculture material.

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- Research and innovation activities do not support sufficiently the aquaculture developments, e.g. cooperation with universities doing material research including their impact on the environment.
- There is a lack of alternative materials for the aquaculture sector that have the same properties as what is currently used but don't contain any plastics, e.g. for buoys.
- A proactive approach of individual producers to change the design of their products or prevent the use of specific plastics is mostly lacking.
- Additional incentives from the government to invest in more durable materials and alternative solutions are lacking.
- Companies often lack internal cost-risk assessments related to easy-to-lose plastic materials.
- Guidelines and specifications for different types of materials and equipment are lacking. A difference should be made between *consumables*; i.e. single or short use materials and *durables*; i.e. long use materials.
- Top-down (legal) approaches are absent to forbid easy-to-lose single-use plastic items.
- Labelling of aquaculture gear and items, and CE quality standards for high quality products are lacking.
- The use of labels is sometimes too excessive and not transparent, although a good start to raise awareness. Additionally, labels may be an advantage for large producers who have more money, while small producers can be just as good but don't have the money to invest in the labelling procedure of their products.
- At EU level, there is currently no accepted scientific standard (e.g. CEN) on marine biodegradability, which highlights the urgency for developing such a separate standard [1,2].
- 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.
- 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.

[1] 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 will be the focus of a H2020 SC2 2019 research topic.

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

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- There is a lack of timely and efficient communication on new offshore installations. Therefore, seafarers (fishing boats, recreational vessels...) are not always aware of new installations at sea, for example in the case when a new zone is restricted for shipping due to aquaculture activities. In the past, this has led to the destruction of aquaculture installations when ships sailed in restricted aquaculture zones.
- A leadership within the entire sector to better implement innovative solutions of waste management (i.e. common sourcing/ funding/monitoring/best practice replication, etc.) is missing.
- The sector needs more information exchange and dialogue (e.g. workshops, trainings, forums, common toolboxes, free best practice guidelines, etc.).
- Procedures for dismantling are not sufficiently efficient and too expensive today and should be further optimized in order to prevent potential marine debris.
- In theory, EPR is an individual obligation, in practice producers and manufacturers often exert this responsibility collectively, including in how fees are set, modulated, and passed on to users. This can have negative effects on the proactive approach of producers to change, e.g. the design of their products or prevention of specific plastic uses.

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. Take preventive measures adapted to the offshore marine environment.
   - There is a need to adapt to the rough offshore conditions while making installations sea-proof and applying multi-use approaches.
   - If offshore cultivation can be replaced by nearshore production, this would be beneficial to reduce the impact of the harsh offshore environment that can cause accidental losses.
   - If offshore cultivation is needed for bigger production, as is the case for Belgium, a long-term vision for offshore aquaculture is needed specifying the infrastructure that is resistant to this environment and a handling scheme.
   - Tracking can be a solution to retrieve high-valued equipment like e.g. floating buoys using a GPS with satellite (alarm). Mostly this is the initiative of the farmer, with no support of the government. Such a tracking buoy is expensive and costs more than €1000. Electronic monitoring is not new, but can be difficult at sea (weather conditions, salty water). The tracking system works up to 12 nm from the coast. GPS signals won't cover installations further located from the coast.

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- Timely and efficient communication on new offshore installations to all seafarers is very important to avoid destruction of aquaculture installations by ships sailing in restricted aquaculture zones. When a new zone for mariculture is in place, an NTM (Notice to mariners) should be forwarded more quickly so that these aquaculture zones appear on their digital navigation chart. 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 (see also Prevention & Reduction (P&R) | GP 1.1).
- Longlines in offshore seaweed farms have to resist strong forces. In the past, these longlines did not resist these conditions and got (partly) detached. Using special ropes with a bit of stretch, similar to ropes used by the shipping sector can be a solution.
- Floats and buoys can be attached with specialised locks to avoid losses.
- The robustness of seaweed installations in offshore environments is very important. It should be constructed without the use of small loose parts and by welding all ends to prevent any loss.

2. Take additional measures adapted to stormy weather.

- Extreme weather conditions demand extra precautionary measures related to the type and design of equipment used, the location of the farms and operational procedures.
- Aquaculture facilities have changed the design of equipment already to prevent losses. The motivation is the own cost to replace it. The motivation would be stronger if there were additional incentives from the government.
- *Cost-risk assessments* related to easy-to-lose materials containing plastic should be part of the normal, internal assessments of companies, similar to the health-risk assessments or others (e.g. the EU Eco-Management and Audit Scheme (EMAS) criteria).
- Internal trainings to improve the handling and fixing of materials is needed.
- A technical study should be a pre-condition and should be carried out by all aquaculture farmers to receive a licence to set up offshore installations for seaweed, shellfish or fish farming. This technical study should also determine whether the installation is storm proof. Although there is never 100% certainty, this will likely reduce the risk of damage to the installation (see also P&R | GP 2.1).
- 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.

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- In seaweed farming, steel poles can be used that stand several metres deep in the seabed (see also **P&R | GP 2.2**).
- Farmers should use certified materials that are appropriately strong and well-functioning.

3. Improve research and innovation activities.

- Good initiatives, research and innovation should be more widely supported to aid sustainable and innovative developments during the initiation, development and operation of the farms.
- 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 the impact of different materials on the environment.
- Cooperation between gear producers and knowledge institutions can be mutually beneficial. Fouling for example is a phenomenon that should be considered in the design phase as it increases the weight of the installation. A risk analysis previous to buying specific gear is important. The type of materials and coatings used is also important and is still being understudied.
- Good initiatives, research and innovation should be more widely supported.

4. Increase the use of environmentally friendly gear and materials.

- The biodegradation issues of bioplastic materials in a marine environment should be considered. If an item is a consumable or lost frequently, it must be biodegradable. Biodegradable means that it is made of natural materials, not containing plastic in any form. See also the UNEP (2015) study about biodegradable plastic, concluding that these materials cannot be a solution for the marine environment.
- We must differentiate between *consumables* (single or short use materials) and *durables* (long use materials) and create guidelines and specifications for the two types of materials and equipment.
- Top-down (legal) approaches are necessary to forbid easy to lose single-use plastic items, such as gloves, plastic cable ties, etc. These have to be replaced by biodegradable material. The bottom culture in the Dutch part of the North Sea also uses many other plastic items, e.g. tyres, plastic onion sacks, car plates (fluorescent), lids.
- Use alternative natural materials instead of plastic wherever possible (see also **P&R | GP 4.1**).

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- Long-lasting reusable items that are not lost at sea may still generate microplastics deriving from these items. It would be interesting to cooperate with projects investigating new e.g. composite materials for offshore use. In other EU countries there are already pilot studies with biodegradable ropes. Therefore, internal performance indicators should be established to assess a) which type of uses and b) how long you need a specific item/material. This will give farmers the direct hint what material has to be ordered and could be re-defined and replaced easily after the material does no meet the expectations. For instance, the main ropes have to be replaced every 2nd year: can a natural material withstand these long uses in a harsh environment?
- Producers should opt for alternative materials. Following gear and other equipment for which alternative, sustainable and less polluting materials should be available, are mentioned:

  - Items that currently have no valuable alternative yet:
    - Nylon longlines: lines for seaweed culture are in the water all year round and are moving a lot. No suitable alternatives that could endure these forces and conditions all year round have been produced yet. Moreover, the cost of removing fouling organisms on alternative materials would be too high, and disposing of the fouling organisms by boat may damage the longlines, as there would be a lot of wear and tear when the boat scrapes along.
    - Mussel larvae collector lines (mosselzaad-invanginstallaties (MZI's)): The ropes used for collecting mussel larvae have to endure lots of handling when grown larvae are knocked off by plastic flippers and collected for socking. After this process, the woolly ropes are completely smashed and rinsed from the deck; leaving pieces of ropes in the environment. Alternative materials for mussel socks have been used in several places (see also P&R | GP 4.2)
    - Nylon fishing nets
    - Tahitians are often used in the Bouchot mussel culture in northern France.
    - Syntactic foam in buoys: This material gets fragmented once the buoys break and the small fragments easily spread and pollute the environment.
    - Feeding tubes: pieces of plastic from feeding tubes used in finfish farms have a high risk to be lost.
    - Plastic bags and containers: these items are often used by workers in the field and they can be lost easily.
  - Items that have known alternatives at specific places which could also be applied elsewhere:

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- **Mussel larvae collector lines are held afloat by buoys and other floats that are made of plastic.** These floats often come loose and then wash up on the beaches. In the Netherlands, they now replace them with long tubes of rubber plastic that stay afloat. In terms of material, this solution does not solve the problem but there is no longer any loss of the floats.
- **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. They can be lost when unpacking and attaching to bigger ropes. That is why farmers choose cotton as the loss of small twines is common.
- **Demarcation materials of mussel plots**: Mussel farmers in the Netherlands often use non-biodegradable materials for this purpose, which may disappear with storms. The Dutch sector is looking at the possibilities of working with biodegradable materials to attach to the poles.
- **Mussel pegs or plastic stoppers.** In the Shetlands, mussel farmers use continuous lines or loops instead of mussel pegs (see also **P&R | GP 4.3**)

5. Increase standards for high quality products.

- Aquaculture materials and gear should be better labelled including specification of quality standards to help farmers make informed choices when purchasing working materials. Material design must be different for e.g. high-performance items (longer re-use) or for high-risk items (short use, high risk of loss).
- With labelling, also CE standards 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 (at least in theory) – in a mid to long-term perspective, this may force non-EU countries to produce better quality as well. Tracking systems may also pose pressure on non-EU countries to produce higher quality gear with a better durability, which indirectly supports the EPR schemes.
- There should be more clarity about the label of "***alternative***": material characteristics need to ensure full *biodegradability* in marine environments, which requires criteria on material degradation and related timeframe relative to the specific environmental conditions.
- A sustainable label on seafood supports the food and consumer value chain. These labels need to be universal at EU level. Sustainability criteria still need to be examined to ensure maximum sustainability. ASC and MSC are already a step in the right direction (see als **P&R | GP 5.1**).

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- Governing bodies should compel producers of aquaculture gear to use more alternative materials. This can be done both by introducing incentives and by strict regulations but it should be clear that producers have a critical role in producing durable materials.
- Producers should add more technical information on materials for sale. E.g. when a farmer buys a rope or other gear, it should be rated in terms of durability, longevity and resistance to bad weather (preferably by the use of standard classes). The government should give financial support if farmers use durable materials (e.g. lower VAT) or implement this in more stringent regulations.
- As far as labels are concerned, incorporating certain measures into an existing label is better than creating a new label. In this way, people do not get drown in the variety of labels.
- Include a common criterion that will cover debris from aquaculture in the international ASC/MSC standards, such as e.g. the handling, disposal and managing non-biological waste from production.

6. Introduce Incentives / Taxes for the aquaculture sector.

- Working with a 'fee' or 'discount' is a better system to retrieve especially the big items used at sea and prevent their loss. This is preferred over a cost increase. A trusting relationship between producer and consumer/farmer is important.
- Taxes on small and cheap disposable plastic gear items would make them more expensive for farmers who would not be able to afford to lose them. The farmers would be worried enough to keep and recover them as much as possible. Alternatively, all companies could pay a fee to the national government, and the money could be used to remove the small litter items in the sea (see 5.3 REMOVAL & RECYCLING OF MARINE LITTER). However, if this measure is taken up for the aquaculture sector, it should also be introduced in other offshore sectors (tourism, shipping…).
- Taxes and incentives mainly benefit the big players. Instead, the entire sector (depending on the aquaculture type) should work together towards having more sustainable equipment accessible.
- Taxation is probably not a good idea, unless the tax money collected is used to invest in the aquaculture sector. Shaping taxes to stimulate innovation would be a better way, with the focus on obtaining new materials/gear and reducing the price of sustainable materials.

7. Expand individual responsibilities and/or group responsibilities

- Following the idea of Extended Producer Responsibility (EPR), also the users (mainly the farmers and their staff) should be liable for losing especially the little items as this is

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foreseeable. 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.).

- The responsibility of the individual user should be increased instead of EPR schemes possibly overtaken by a whole sector and denying individual liability (see also P&R | GP 7.1).
- Currently, producers are not responsible for cleaning-up measures related to fishing/aquaculture gear. This gap will not be closed by the new EU Single-use-plastic Directive (SUPD) until 2021 [3]. However, national legislation is free to extend the legislative frame and could include clean-up responsibilities for producers.
- More preventive measures are needed to reduce litter from the aquaculture sector. Both the producers and designers should be more active at the start of the material chain.
- Product standardization must be applied at EU level for national producers but also for imported materials (i.e. impose the same measures on producers abroad).
- Certification of materials is absent at the moment but could be implemented in a sustainability label for materials.
- With regard to EPR, the gear producer should give a certain guarantee to the farmer after analysing correct installation. After this period, it is up to the farmer to maintain the installation.

8. Improve awareness, education, and training.

- Companies can implement improved awareness with own guidelines in relation to national legislation.
- Cooperatives can also organise training sessions for offshore sectors.
- Developing labels can also be a mean of raising awareness among consumers.
- Organising awareness raising workshops may work depending on who is participating. When researchers, consumers, producers and farmers share experiences, this may increase the understanding of the position of every stakeholder. A neutral facilitator may have an important role in leading the discussions.

[3] According to Art. 8 and 10 of the SUPD, producers of fishing gear have to cover the costs for

- collection of waste fishing gear that has been delivered to port reception facilities or equivalent collection systems, including the subsequent transport and treatment;
- awareness raising measures (regarding the availability of re-usable alternatives, re-use systems and waste management options and best practices in sound waste management as well as the impact of littering) to reduce their amount in the sea.

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- The combination of education with action is the best approach to make things happen. The aim of the training should be to outline how action can be taken (possibly in a step-by-step approach).
- Increasing staff awareness of the need for re-using (rather than replacing new) equipment and fittings can be beneficial.
- Awareness raising workshops for aquaculture farmers can be beneficial, but in addition to raising awareness, they should be beneficial for the producers themselves. Solutions and good practices, for example, could be more commonly shared so that producers themselves see clear next steps to follow.
- All staff members of an aquaculture farm should learn the appropriate procedures in place to carefully clean up, making sure nothing is lost. Awareness and good attitude play a big role here, if workers are aware of the problem, they would be much more careful and conscious in not littering.

9. Improve legal procedures for initiation, operation and decommissioning of aquaculture farms

- Permits for aquaculture installations should consider the local conditions (see also **P&R | GP 9.1**).
- A decommissioning plan for aquaculture infrastructure should be developed (e.g. as included in the fisheries policy). This will probably be implemented through the upcoming transnational or national 'plastic' plans/guidelines/legislation. This way, end-of-life or outdated aquaculture infrastructure could be decommissioned with national or EU aid.
- Waste management authorities should be more involved in the aquaculture farm licence application process.
- Incidents at sea involving accidental losses of aquaculture gear and infrastructure should be reported to the coastguard and the managing authority responsible for approving the aquaculture farm. The licensing authority may discuss with the aquaculture farmer possible solutions for specific cases or the licensing authority may request the aquaculture farmer to come up with a solution within a set deadline. This procedure should be included in the aquaculture permit.
- It should be possible during the operational phase of an aquaculture farm that the licensing authority adjusts certain requirements for an aquaculture installation (e.g. to require the use of more durable materials when they get on the market). Improvements to the installation may be compulsory if new experiences are gained since setting up the farm. This should be explicitely mentioned in all aquaculture permits.
- A prerequisite for authorisation of aquaculture installations could be the provision of a list of components and materials that will be used. This will enable farmers, producers

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and manufacturers to find out if certain types of material (often) wash ashore and need alternatives.

- Logistics and decommission services should be done by an external company. This ensures uniformity and, incidentally, supports all companies within the sector.

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. Take preventive measures adapted to the offshore marine environment.

P&R | GP1.1: Timely and efficient communications on new offshore installations

The dutch Noordzeeboerdeij is implementing various preventive measures to make the seafarm pilots visible on sea maps and prevent damage from other ships sailing through the installation. They positioned a measurement buoy equiped with AIS, big cardinal buoys and they actively call the ships that are close to sailing through the seaweed farm.

2. Take additional measures for stormy weather.

P&R | GP 2.1: Technical studies to determine storm proof character of installation

In the Netherlands, 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. Although there is never 100% certainty, this likely reduces the risk of damage to the installation.

P&R | GP 2.2: Replace buoys and floats by steel poles in mussel larvae collector installations

In the dutch Wadden Sea and Oosterscheldt, the MZI's hardly ever lose a float or buoy anymore since the use of big steel poles were introduced. These metal poles are positioned a few meters under the seabed for the attachment of the horizontal lines. Over the years, the installations have been developed in such a way that they have become increasingly robust.

3. Improve research and innovation activities.

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

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4. Increase the use of environmentally friendly gear and materials.

P&R | GP 4.1: Use of alternative natural materials instead of plastic

Since 2015, Mowi processing plant in Bruges, Belgium, has reduced the weight of MAP (Modified Atmosphere Packaging) trays by 20%, which in turn has reduced plastic consumption by 96 tonnes per year. MAP trays are designed to keep food fresh. Similarly, Mowi has switched from using polystyrene boxes to Forest Stewardship Council approved cardboard boxes instead, which has further reduced their plastics use by 7 tonnes per year.

P&R | GP 4.2: Alternative materials for mussel larvae collector lines made of natural and degradable fibres

Machinefabriek Bakker from Yerseke, the Netherlands, has been awarded the sustainability award of the shellfish conference foundation for the development of a biodegradable sock for mussel suspension cultures and mussel larvae collector installations. This alternative material serves as a replacement for cotton socks that are harmful to the environment if lost or damaged during aquaculture practices.

P&R | GP 4.3: Alternative method replacing mussel pegs

In the Shetlands, mussel farmers use continuous lines or loops instead of mussel pegs.

5. Increase standards for high quality products.

P&R | GP 5.1: Improve requirements for ASC standards

A new white paper from ASC ("Marine Litter and Aquaculture Gear" – published in November, 2019) provides scientific rigour and evidence to the planned update to ASC standards to include requirements on this issue, but also includes recommendations for the wider industry. Uniquely, it gathers evidence from various sources including 60 ASC certified farms; and finds that the three main causes of plastic pollution generated by aquaculture can be classified as: mismanagement, deliberate discharge, and extreme weather.

6. Introduce Incentives / Taxes for the aquaculture sector.

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

7. Expand individual responsibilities and/or group responsibilities

P&R | GP 7.1: Specific company requirements preventing accidental losses

SSC is a company who lays power cables across Scotland. Every piece of material that goes onto the vessel gets logged in and logged out once back onto shore. It is the policy of the company, not the legislation, and reflects the environmental friendly attitude of the company as this policy is very effective that materals are not lost at sea. SSC is doing this as

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best practice but making it a legal requirement for all vessels, incl. the aquaculture sector can reduce accidental loss.

8. Improve awareness, education and training.

P&R | GP 8.1: Awareness raising workshops

Pro Sea is a foundation in the Netherlands that has a long track record of providing marine awareness courses for 20 years to maritime professionals. They develop teaching materials dealing with marine litter for the shipping industry. They also organise workshops for professionals and are very familiar with the fisheries and shipping sector. Similar work targeting the aquaculture sector would be very beneficial.

9. Improve legal procedures for initiation, operation and decommissioning of aquaculture farms

P&R | GP 9.1: Flexible permits adapted to local conditions

Mussel larvae collector lines in the Netherlands do not have the permit to remain at sea all year round, a solution to prevent potential loss. Instead they are allowed at sea from March 1st to 1 November 1st and have to be taken out of the water every winter because of the storm season and the potential loss this generates.

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4.2. MONITORING & QUANTIFICATION OF MARINE LITTER

BARRIERS

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

- There is a lack of procedures for effective monitoring of the aquaculture farms.
- The (national/regional) monitoring programmes from the government are currently not sufficient as a knowledge base for the aquaculture sector.
- 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.
- There is a need for a better view of the components used by each type of activity.
- Cameras are still not adapted to the weather/stormy conditions.
- To install any aquaculture infrastructure, you need a concession/license. To get this license, and to get it renewed, you need to follow the environmental criteria. This is mandatory for all infrastructures of all offshore sectors, but is not sufficient to monitor litter from aquaculture farms.

SOLUTIONS

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

1. Introduce better and realistic monitoring schemes of the aquaculture farm.
   - The aquaculture farmer should set up an inventory, if not done already, of all installed and acquired equipment during the life cycle of a farm. This includes the items that were put in place at the set-up of the farm and removed at the end of the life cycle, but also during the functional period of the farm. This way, the number of items that are replaced or got lost can be tracked more easily. This can easily be applied on the durable materials, such as buoys, but is more complicated for non-durables (small items, single-use plastics, etc.). Invoices of the purchased material can make the internal inventory process easier.

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- Currently, monitoring takes place after a storm. A monitoring-scheme (e.g. every 40 days) should be established in order to get standardized results.
- Not everything can be monitored and reported. The target should be defined depending on the item size, the type of material and durability. Smaller items are harder to monitor. The impact of the lost material on the environment should be decisive. Plastic is a priority (e.g. polyethylene).
- Monitoring schemes should be based on the Life Cycle Analysis, depending on the materials and the infrastructures put in place. For example, in the North Sea for seaweed industries, the Life Cycle Analysis 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 should be planned before they are too old and, therefore, more fragile in case of storm/accident.
- Aerial monitoring could be a valuable alternative/ additional to monitoring by ships (see also **(see also Monitoring & Quantification (M&Q) | GP 1.1**)

2. 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.
- Further challenging the development of innovative technological devices may help to retrieve gear more efficiently (see also **M&Q | GP 2.1**).
- Tagging lost items can help to track them. This is usually done with buoys and with essential structures (e.g. long floating pipes). Perhaps it is necessary to improve the tracking system in order to trace the material back to its owner. This should be done on a European level so that lost and found items can be exchanged between countries. This knowledge can be useful for the implementation of EPR schemes as well. Farmers can pay a fund to a European body that collects the waste and distributes it to the owners. The producer should report their lost items to the European body. Some of the items are recovered by people on the beaches/coast. By enforcing an incentive, people can be motivated to bring the items to the central body or directly to the owner. An international registration and funding 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.).

3. Use remote sensing techniques for litter monitoring.

- 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.
- Using drones in the future could possibly help to detect plastic patches.

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4. Improve waste policy of aquaculture farms.

- Regulating waste management should be much stricter. Everything needs to be declared when concerning chemical and dangerous waste, but this is not (yet) the case for other waste such as plastics.
- There is no specification on which and how much of specific materials are wasted by an aquaculture farm. Those companies mostly know the total amount of waste produced but not the amount of waste per type of material. Waste companies should provide statistics on waste types produced by companies, to help them improve their systems.
- The farmers should make an inventory of all aquaculture equipment that has been installed to easily track what gear might be lost. The inventory of all companies should be integrated and made public by local authorities.
- The waste policy (collection and depositing) on concessions should be improved, clarified and specified and a better follow-up should be granted.
- In addition, lost or abandoned items should be reported to the appropriate authorities.

5. Better cooperation between different aquaculture- and other offshore companies.

- Collaborations between companies could facilitate the monitoring and managing of the general waste and lost items. This can be collaboration between small and/or large aquaculture companies, as well as with other offshore sectors.
- In this way, monitoring costs can be shared and a feasible monitoring schedule or program can be set up for offshore facilities.
- Smaller companies can pay a fee to the larger companies to monitor the whole area (area agreements).

6. Better track the collected litter from the marine environment.

- A way to track the collected litter from the marine environment would be to bring it to the harbor, weigh it and, after that, to give a receipt of the kg that have been collected by the company. This would help to monitor how much is being collected and would encourage/facilitate the recycling, as it could be brought to/picked up by the waste manager directly.

7. Enhance scientific knowledge.

- Modelling of floating marine litter can be improved to enhance knowledge and, as a consequence, allow more efficient monitoring schemes.

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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 and realistic monitoring schemes of the aquaculture farm.

   M&Q | GP 1.1: Aerial monitoring additional to monitoring by ships

   Aerial monitoring could be a valuable alternative/ additional to monitoring by ships. From the air, certain aspects are easier to monitor than from a ship. For example, the detection of cables coming loose, the observation of an exceptional fast growth rate of cultivated organisms. In the Netherlands, this system has already resulted in the detection of a large biomass of mussel growth, which has been communicated to the mussel farmer who anticipated by harvesting earlier than originally planned.

2. Improve tracking systems of lost items.

   M&Q | GP 2.1: Tracking equipment

   The "Lost Gear Finder" from Furuno Norge is a solution to retrieve lost gear from fishermen or the aquaculture sector. A transponder is attached to the gear and a transducer is installed on board, as well as a processor connected to a monitor. In case of gear loss, the user can search for lost gear's position underwater. The effective range for the transducer is as much as 5000 meters, which makes the search very efficient. When the onboard unit receives response from the transponder, the position is calculated quickly and lost gear is easily found.

3. Use remote-sensing techniques for litter monitoring.

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

4. Improve waste policy of aquaculture farms.

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

5. Better cooperation between different aquaculture- and other offshore companies.

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

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6. Better track the collected litter from the marine environment.
   The stakeholders participating in the learning lab did not mention specific good practices for this topic.

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

4.3. 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?

- Even though the 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 required by the EU Fisheries Control Regulation[4], may be perceived as too time-consuming, complicated and very costly in practice.
- Currently, producers are not responsible for cleaning-up measures or recycling related to fishing/aquaculture gear. This gap will not be closed by the new EU Single-use-plastic Directive (SUPD) until 2021. However, national legislation is free to extend the legislative frame and could include clean-up responsibilities for producers.
- Economic issues: costs and manpower to spend time at sea.
- The collection and recovery of lost gear is difficult due to environmental conditions; the ocean is very vast and the waves and wind spread the litter fast so it is economically challenging to locate lost items and then send a vessel to collect them.
- There is a lack of efficient systems and facilities for collecting, storing and processing of used gear and equipment.
- The market for recycled products is too small.
- Recycling marine waste is difficult especially if the waste is of low value due to degradation.

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

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- The difficulty of separating different types of materials for recycling purposes.
- Fishermen may be asked to recover the nets but it only happens on a voluntary basis (they do that when they are rewarded and they collect ghost gear and equipment that is valuable).
- There is a resistance to change attitudes or habits and a lack of awareness of the necessity to do so.
- There is not enough structural support for environmental enhancement initiatives like beach clean-ups and recycling projects.
- There is not enough technical training for staff of aquaculture farms related to the life cycle and durability of aquaculture equipment. More knowledge would improve effective material replacement before e.g. plastic degradation creates microplactic contamination.
- Designers and manufacturers of aquaculture equipment are not sufficiently encouraged 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.
- 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.

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. Raise awareness and invest in education and training activities.

- Make aquaculture stakeholders 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 upset.
- Organising clean-up activities for companies and communities (**see also Removal & Recycling (R&R) | GP 1.1 – GP 1.3**). The disadvantage of cleaning activities by the broad public or by companies is that OSPAR does not have exact figures on litter disposal on

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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.
- Improving the communication channels between the general public/consumers and the producers regarding the waste management would help to provide an extra value to the product (as a sustainable product) and a market demand at the same time as incentivizing to put in place "waste/lost or abandoned and collected items" management.

2. Improve waste collection and sorting[5].

- *Economic incentives* should be introduced for offshore workers (fishermen, wind farmers, etc.) to collect and sort waste (on board, offshore). But it is unsure what will be done with the sorted waste after it is brought on land. Offshore workers need to know if their efforts in sorting are needed or useful. There is a need to work together and communicate. There is also a need for a code of conduct and common sense. According to the revised Port Reception Facility Directive, waste brought back to the harbours should be free of charge. However, in practice, still uncertainty about costs and further treatment exists.
- Waste collection by responsible authorities is advisable because a fee can be imposed on the sector that is responsible for the items collected. However, more background data is needed in order to do this efficiently. For this reason, an exhaustive inventory of what materials each sector is using (incl. fisheries and aquaculture separately) is needed to know how to assign the correct proportion of litter to every sector. In this way, each sector could be made responsible for their litter: mussel sector; oyster sector, fish sector, etc.
- Professional collection systems are needed:
  - Specialised motor vehicles/ boats, tailor made to collect waste at sea from aquaculture equipment and installation.
  - Cleaning vessels could be a joint venture of several parties 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; sharing risk for major investments and to access skills and capabilities.
  - Cleaning vessels should target locations near aquaculture installations with high concentrations of debris and plan cleaning activities especially after storms. The

[5] 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, we included lost items as well as items that have reached end of life, when talking about *waste*.

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development of good weather forecasting and modelling of wave currents may support this purpose. Currently, fishermen check places for litter after every storm, but they only collect valuable garbage.

- Innovative passive catchers placed outside the farm (depending on currents).

- Internal platforms and working groups for exchange of best practices and information between farmers exist already.
- Trackers in/on equipment and gear is a good solution, not only for monitoring aquaculture installations but also for preventing material to get lost and facilitate the removal of lost items at sea.
- We need a point to *collect waste in each harbour*. In the framework of the new port reception facilities, this should be included. This complements the facilities offered by commercial equipment companies that provide a point of waste collection for member companies.
- A way to remove the collected litter from the marine environment would be to bring it to the harbor, weigh it and get a receipt depending on the collected weight. This would help to monitor how much litter is being collected and to encourage/facilitate the recycling, as it could be brought to, or picked up by, the waste manager directly.
- Cooperation in collecting waste with other offshore sectors or local associations (see also R&R | GP 2.1 and GP 2.2)
- Cooperation in collecting waste between several (large and small) aquaculture companies may be economically most beneficial to collect their recyclable waste and add it to their own waste streams. Large companies could take the lead, whereas small companies could pay a fee instead of doing the actual cleaning work (see also R&R | GP 2.3).
- Put in place various contractual agreements with external contractors to collect used or damaged goods (cardboards and equipment) to be recycled or upgraded (see also R&R | GP 2.4 - GP 2.6).
- Waste collection services should be better promoted, and waste collection, sorting and recycling business models should be financially encouraged by governements.

3. Improve waste management systems

- It would be beneficial to have a framework and certification for waste management in companies, managed by the farmer of as part of the official environmental procedures (e.g. Including key performance indicators (KPI's)) (see also GP3.3.1)
- Plastic Management Policy: 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.

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- There is only a decommissioning plan but no waste management plan in aquaculture in several countries. A waste management plan would reduce the loss of gear and other material at sea.
- 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 costly only for the aquaculture (i.e. economies of scale). This would make the logistics for handling wastes more attractive for specialized companies.

4. Improve waste recycling

- Introduction of *incentives to use recycled plastics* as much as possible (but: of sufficient quality) e.g. Upcycling of used nets to polyamide yarns to be used for swimwear, socks, etc.
- Introduction of a passport model to give value to material: gear and material should have a licence /Passport and when it is given away, the document accompanies it wherever it goes.
- Recycling rebate – Farmers/fishers pay levy when purchasing new nets and get money back when recycling.
- Global Certification System - Certification – criteria on plastic use and recycling to be included in the aquaculture production standards (see also R&R | GP 4.1).
- Encourage the reuse of aquaculture materials (see also R&R | GP 4.2). However, it should be noted that some aquaculture companies experienced problems giving away equipment that was replaced by alternative material in the aquaculture farm. The new owners originally used the items in other ways but on the long term they did not act responsibly and left the items to waste in the environment.
- Encourage research and innovation towards recycling programs (see also R&R | GP 4.3).
- Encourage farmers to set short, medium objectives to help them reach “Zero waste” goal.
- Improve technologies to recycle mixed materials. Technology to recycle all plastics (see also R&R | GP 4.4)

5. Expand producer responsibility and farmer responsibility

- Extended Producer Responsibility - Trace the responsibility of recycling to the producers and do not leave it at the sole responsibility of the farmer: a joint responsibility (shared responsibility).
- Producer Responsibility – gear producers should offer recycling or returning facility for farmers.

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- Include criteria in Corporate Social Responsibility of aquaculture businesses.
- Farmer responsibility: add serial number on materials (e.g. on mussel cones).
- Introduce annual maintenance contracts (AMC) between the aquaculture farmers, equipment manufacturers and other service providers to carry out regular checkups of the entire aquaculture infrastructure, to maintain, repair and collect the damaged gear and other equipment, and to recover it after a storm (even if located in another country bordering the same sea-basin).
- Implement structural changes to allow reuse of aquaculture materials (see also **R&R | GP 5.1**)

6. Improve cooperation on removal and recycling between aquaculture players and governments

- 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 is an initiative needed from the government.
- A *Deposit system* as an additional incentive to collect gear separately is needed. 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, a 'fee' or 'discount' is seen as useful by workshop participants and interviewees; however, additional extensive administrative burden has to be avoided. 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.
- The government should pay a more active role in motivationg and incentivising farmers to sort waste (see also **R&R | GP 6.1** and **R&R | GP 6.2**)
- Active work from authorities is needed to manage waste. The waste problem is under-estimated by the government, who should put more effort in managing the waste.
- 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.

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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. Raise awareness and invest in education and training activities.

R&R | GP 1.1 Organisation of clean-up activities for companies

Mowi has organised a Global Clean-up Day every year since May 2018. Mowi staff and their families, joined resources and mobilised a communal effort to clean local beaches of plastics and other marine litter. The initiative was inspired by Mowi CEO and assembled Mowi staff and their families across three continents to clean local beaches of plastics and other marine litter. Mowi gave 20 EUR to charity for every person that participates.

R&R | GP 1.2 Organisation of clean-up activities for communities

Da Voar Redd Up is the UK's most successful community litter pick, with over 20% of Shetland's population volunteering their time annually. This annual spring clean makes an invaluable contribution to Shetland's natural environment and wildlife, clearing Shetland's beaches, coastlines and roadsides of litter and the debris washed up by winter storms. The aquaculture farmers use this initiative to clean more isolated beaches or islands using the small vessels they use in their farms. This clean-up is sponsored by aquaculture producers.

R&R | GP 1.3 Organisation of clean-up activities employing young people

Every summer, CERMAQ organises a beach clean-up programme employing young people that help cleaning beaches around the farm. During this event, CERMAQ staff also make sure that no litter is left from its activities neither from other activities. This programme raises enthusiasm for cleaning up the ocean in addition to employing and training the youth.

2. Improve waste collection and sorting.

R&R | GP 2.1 "Fishing for Litter"

"**Fishing for Litter**" is a recommendation of OSPAR 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 Marine Environment service in Belgium supports VVC Equipment, a foundation of Flemish fishermen to take part in the "**Fishing for Litter**" initiative.

R&R | GP 2.2: Cooperation in collecting waste between local associations

In some regions in France, after a storm, local associations in coordination with the regional shellfish committees organise collecting activities to assist the producers in locating and

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collecting their lost materials. For instance: CAP 2000 in Brittany, Windsurf in Normandy, and Surfrider in Southern Brittany.

R&R | GP 2.3 Cooperation in collecting waste between several aquaculture companies

SeaBOS = Seafood Business for Ocean Stewardship - (10 of the top world's largest seafood companies have aligned their policies for ocean stewardship and seafood standards relating to fishing and aquaculture) – founded 2 years ago http://keystonedialogues.earth/
Their aim is to get retailers 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). They have 6 task forces that work on topics:

1. Addressing IUU and forced labour
2. Improving traceability in global seafood
3. Working with governments to improve regulations
4. Transparency and governance of SeaBOS
5. 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. Task force lead companies: Thai Union, Mowi, and Kyokuyo; lead scientific institutions: Stockholm Resilience Centre
6. Climate resilience

The members include Maruha Nichiro, Nippon Suisan Kaisha, Thai Union, Mowi, Dongwon Industries, Cermaq Group of Mitsubishi Corporation, Nutreco's Skretting division, Kyokuyo, Cargill and Charoen Pokphand Foods.

R&R | GP 2.4: Alternatives for fish bag collection and recycling

In Scotland, feed for fish farming was originally deliverd in small 25kg bags. With the new system, the feed is delivered by feed barch in a one ton bag and lifted with a crane into the barch. Feed bags are taken away by the feed delivery boat and recycled. Less opportunity for accidental loss and waste creation.

R&R | GP 2.5: Alternatives for silicon socks

In some regions in France, the damaged silicon socks are being collected for recycling and upgrading as an alternative to a costly deposit at the waste collection centre. This initiative is carried out at no cost and based on a voluntary approach.

R&R | GP 2.6: Improved dismantling procedure of worn out materials

During 2019, MOWI has established a national agreement in Norway with a waste handler to ensure a safe and standardized handling of the waste and easier access to the waste data. Also in Norway, MOWI started rolling out a new collaboration with a subcontractor, who collects their feeding pipes, cuts them in a closed process to prevent cut fragments

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and microplastics from being released to the environment. The used pipes will be recycled into new products.

3. Improve waste management systems.

R&R | GP 3.1 A framework and certification for waste management in companies

Mowi has in-house Plastic Waste Management policy - cf. Financial & Sustainability Report 2018 in the Investors section on the website: https://issuu.com/hg-9/docs/mowi_annual_report_2018_4e0dacb83168e4?e=19530043/68703955. Upcycling of used nets to polyamide yarns to be used for swimwear, socks, etc. Recycling nets: c. 302 tons of fish farming nets were upcycled for nylon yard ECONYL® in 2018 (one tonne of polyamide fishing nets = recycled yarn for 26000 pairs of socks or c. 1000m^2 of carpet. Packaging: a smaller rim of Modified Atmosphere Packaging (MAP) trays and of lesser thickness to use less plastic, stack more and weigh less while shipping. Collaboration with ASC (Aquaculture Stewardship Council) on a *certification programme* to include plastic-specific indicators in their next standards update across Mowi farms on an international level (farms in many countries all over the world).

4. Improve waste recycling.

R&R | GP 4.1 Global Certification System

Mowi collaborates with ASC (Aquaculture Stewardship Council) on a certification programme to include plastic-specific indicators in their next standards update across Mowi farms on an international level (farms in many countries all over the world).

R&R | GP 4.2 Production of horticultural plastic from the reuse of HDPE floats from salmon cages

NCDC in Shetland had been active finding alternative use for redundant equipment from the aquaculture industry, which was either sent to landfill or was littering shorelines before 2008. NCDC incorporated the waste materials in the design of the hoops to grow more fresh food locally.

R&R | GP 4.3 Recycling programs for nylon nets and ropes

Mowi invests in recycling programmes of nylon nets and ropes in Europe. In 2019, Norway and Ireland sent nearly 150 tons of farming material for recycling. The recycling process re-converts the netting into new polyamide filament, which in turn can be used in a variety of applications, such as in the manufacture of swimwear or carpet yarn.

R&R | GP 4.4 Innovative solution to our plastic recycling problem

Australian scientists may have discovered a solution to our plastic recycling problem. When China stopped taking Australia's recyclable waste in 2018, scientists have developed a technology that could make all plastic recyclable. The Catalytic Hydrothermal Reactor (Cat-HTR) does a form of chemical recycling that changes the plastics at a molecular level to turn

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them back into oil. From there, the oil can be turned into bitumen, petrol or back into different kinds of plastics (ABC news article).

5. Expand producer responsibility and farmer responsibility.

R&R | GP 5.1 Design of an Eco-anchor: scaling up sustainably

The Noordzee boerderij is working on a sustainable anchoring system that holds the sea farm in place, is nature-friendly and built from safe materials. The anchoring system is an essential part of the sea farm and important for upscaling the seaweed sector. During the dismantling of the installation, the eco-anchor can be left in place and be reused in the next season. In the meantime, the anchor can function to create nature. This initiative comes from the farmer and proves that structural changes can be implemented to allow reuse of aquaculture materials, as is the responsibility of the farmer.

6. Improve cooperation on removal and recycling between aquaculture players and governments.

R&R | GP 6.1 Blue Deals - Belgium

Blue Deals are a voluntary agreement between aquaculture actors and the government (in Belgium). It is a voluntary collaboration and supported by the federal state of Belgium.

R&R | GP 6.2 Blue Deal – The Netherlands

Blue Deal is an international programme of the Dutch Ministry of Foreign Affairs, the Ministry of Infrastructure and Water Management and all the Dutch water authorities. They work on three essential elements to improve water management:

A. Sufficient knowledge & expertise
B. Well-functioning organisation
C. Cooperation with key stakeholders

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5. 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 would make these solutions feasible and acceptable for the aquaculture sector to tackle the marine litter problem.

Efficiency and time were defined as:

Efficiency: a subjective estimation of the relative degree to which the identified solutions, business models and (policy) measures will contribute to the Prevention and Reduction, Monitoring and Quantification and Removal and recycling of marine litter by the aquaculture sector. Classification ranges from 1 (low efficiency level) to 5 (high efficiency level),

Time: a subjective estimation of the time needed to effectively implement the identified solutions, business models and (policy) measures contributing to the Prevention and Reduction, Monitoring and Quantification and Removal and recycling of marine litter by the aquaculture sector. Classification ranges from short term: <1year, medium-term: 1-5 years and long-term: >5 years.

This assignment was carried out in every break-out session related to the three core aspects of tackling marine litter and results were presented on big charts with post-its (Figure 6 - Figure 9).

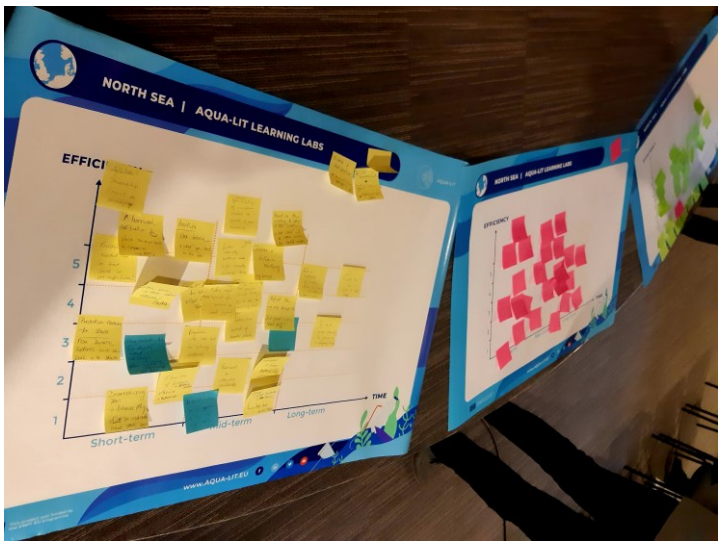

Figure 6: Results of the break-out sessions in which participating stakeholders ranked the solutions they proposed in terms of their expected efficiency and timeframe so that they would become feasible and acceptable for the aquaculture sector to tackle the marine litter problem.

PREVENTION AND REDUCTION OF MARINE LITTER

S1: Take preventive measures adapted to the offshore marine environment.
S2: Take additional measures adapted to stormy weather.
S3: Improve research and innovation activities.
S4: Increase the use of environmentally friendly gear.
S5: Increase standards for high quality products.
S6: Introduce Incentives / Taxes for the aquaculture sector.
S7: Expand individual responsibilities and/or group responsibilities.
S8: Improve awareness, education and training.
S9: Improve procedures for initiation, operation and decommissioning of aquaculture farms.

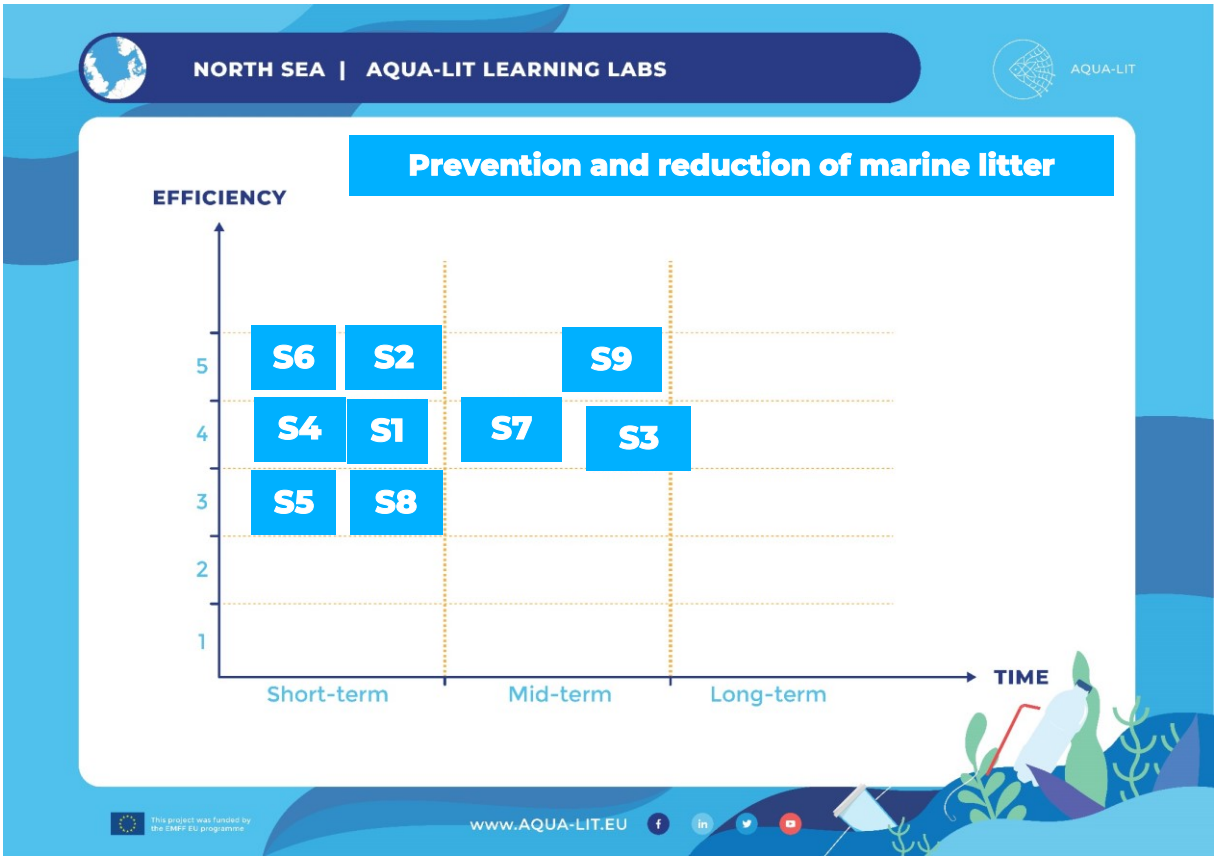

Figure 7: Efficiency and time of the proposed (technical) innovative solutions, business models and (policy) measures given by worshop participants (see § 2.3) to prevent or reduce the loss, damage or discard of gear and other equipment in the aquaculture sector.

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MONITORING AND QUANTIFICATION OF MARINE LITTER

S1: Introduce better and realistic monitoring schemes of the aquaculture farm.
S2: Improve tracking systems of lost items.
S3: Use Remote sensing techniques for litter monitoring.
S4: Improve waste policy of aquaculture farms.
S5: Better cooperation between different aquaculture- and other offshore companies.
S6: Better track the collected litter from the marine environment.
S7: Enhance scientific knowledge.

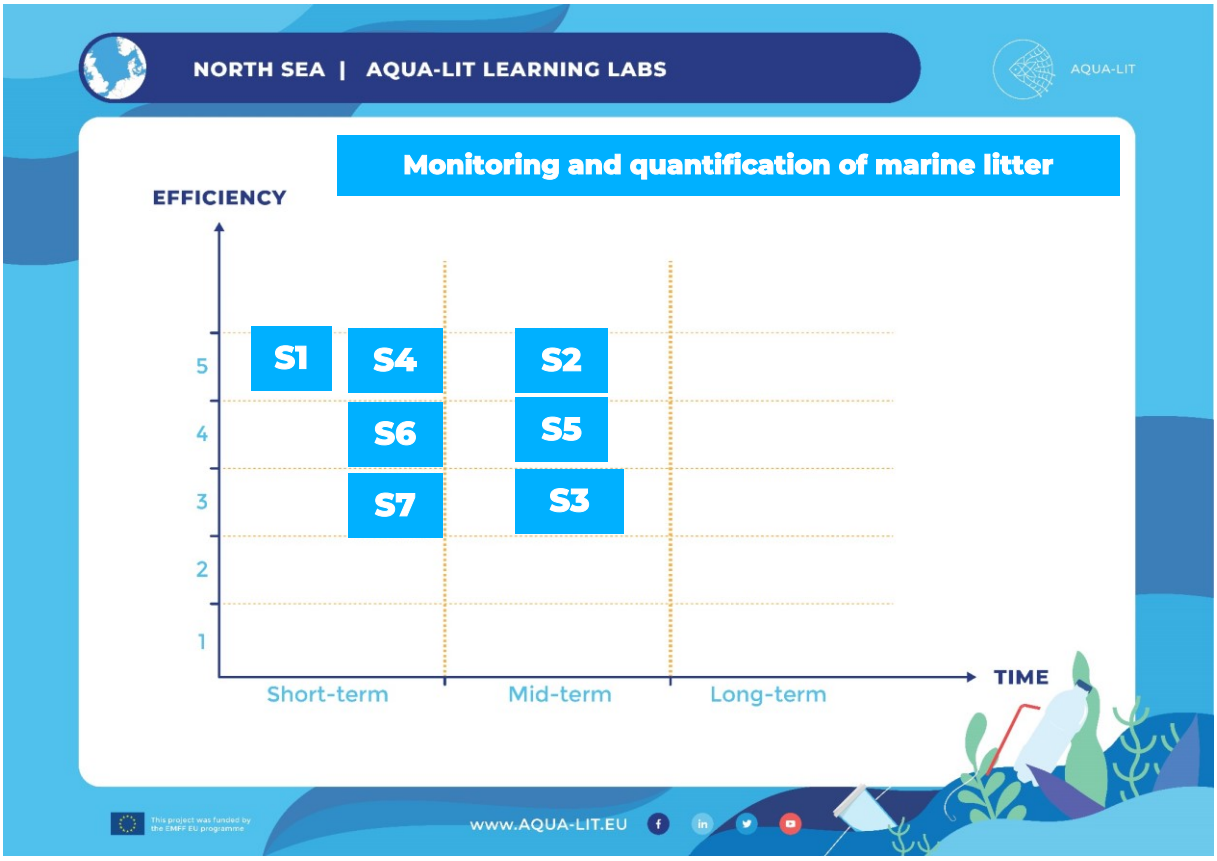

Figure 8: Efficiency and time of the proposed (technical) innovative solutions, business models and (policy) measures given by worshop participants (see § 2.3) to monitor and quantify the loss, damage or discard of gear and other equipment in the aquaculture sector.

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REMOVAL AND RECYCLING OF MARINE LITTER

S1: Raise awareness and invest in education and training activities.
S2: Improve waste collection and sorting.
S3: Improve waste management systems.
S4: Improve waste recycling.
S5: Expand producer responsibility and farmer responsibility.
S6: Improve cooperation on prevention, reduction, monitoring, quantification, removal and recycling between aquaculture players and governments.

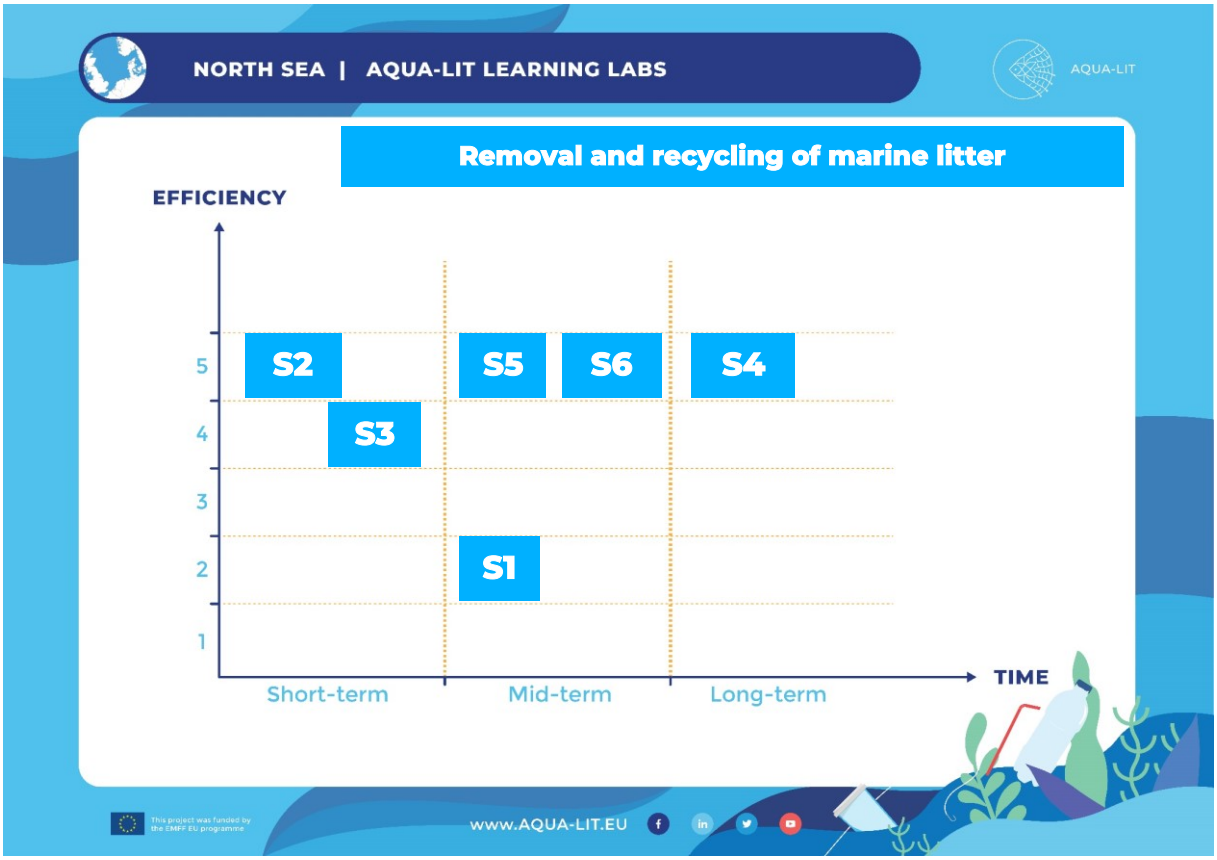

Figure 9: Efficiency and time of the proposed (technical) innovative solutions, business models and (policy) measures given by worshop participants (see § 2.3) to remove or recycle the loss, damage or discard of gear and other equipment in the aquaculture sector.

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6. Conclusions and recommendations

6.1. 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 North Sea region. In this conclusion the three core aspects of tackling marine litter (1. Prevention & Reduction, 2. Monitoring & Quantification, and 3. Removal and Recycling) are combined. Throughout these conclusions, infographics summarising the outcomes of the Learning Labs in all three regions (North Sea, Baltic Sea and Mediterranean Sea) are integrated and showing the parallel thoughts across regions.

BARRIERS

What are the barriers with regard to the prevention & reduction, monitoring & quantification, and removal & recycling of litter from the aquaculture industry?

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

- **SUPPORT**, e.g.
  - Lack of financial support for the use of tracking devices, the development of innovative and sustainable gear (especially for small companies), etc.
  - Lack of technical support, including the development of sustainable material design criteria for engineering companies to stimulate the development of alternative gear.
  - Weak support from governments and decision-makers for the implementation of incentives or taxes, effective waste management systems, the use of durable materials, the development of guidelines for labelling and quality standards, etc.
  - Limited initiatives to support education, communication and awareness, including communication on new facilities and accidents at sea, workshops and staff training on marine debris management, awareness-raising on the problem of marine litter, etc.

- **LEGISLATION**, e.g.
  - Legal procedures for the application of a license often lack inclusion of adequate technical studies, analysis of local conditions, a list of materials used, a waste management plan, a decommissioning plan etc.
  - Lack of regulations regarding the production of durable materials, use of alternative aquaculture gear, industrial waste materials, etc.

- Weak implementation of monitoring related to non-biological waste.
- So far, no national legislation to implement EPR measures in place.
- Heterogenous labelling systems for aquatic and food products, lacking indicators on materials used in aquaculture facilites.

RESPONSIBILITY, e.g.

- Lack of role and responsibility of all stakeholders regarding the aquaculture marine litter and/or debris issue. This includes lack of responsibility to manage the lost, abandoned and broken items as well as waste items that reached the end-of-life.

KNOWLEDGE, e.g.

- Lack of specific data related to material losses from aquaculture activities, including (1) which items are most frequently lost, broken or abandoned and (2) an estimation of their environmental impact in the North Sea. A standardised quantification protocol is also lacking.
- Lack of scientific knowledge related to response of equipment to offshore conditions, sustainable gear alternatives, durability of aquaculture items etc.
- Lack of knowledge in relation to innovation, including recycling processes of low value plastic, design of facilities, anti-fouling characteristics, waste valorisation, upcycling and recycling opportunities, etc.
- Limited knowledge exchange through interdisciplinary and international collaborations.
- Lack of knowledge how to implement foreseen EPR measures on company levels.

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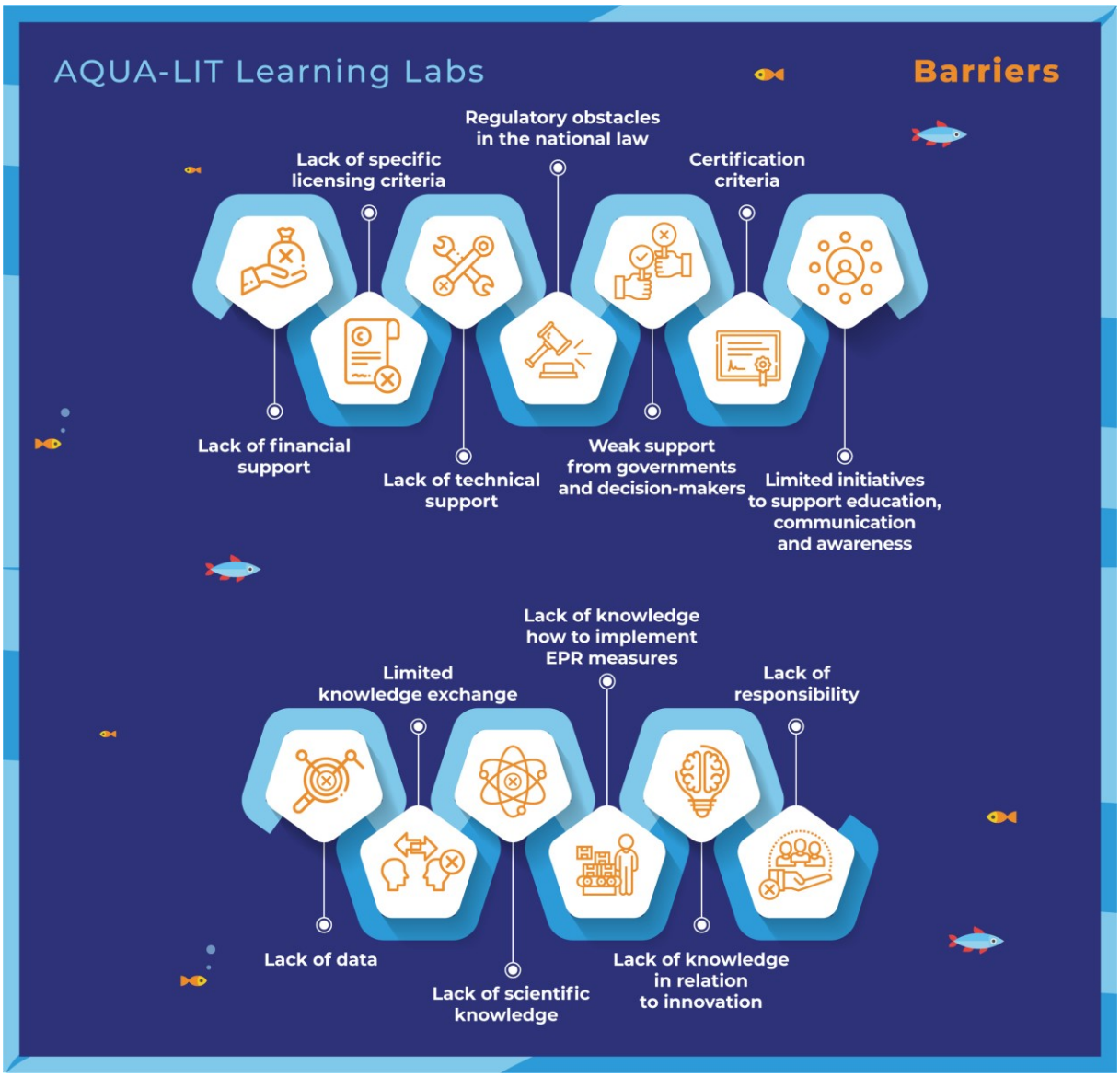

Figure 10: Infographic summary of the identified barriers to tackle the marine litter problem during the AQUA-LIT Learning Labs in the North Sea, Baltic Sea and Mediterranean Sea.

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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.
  - Increase financial support for the development and implementation of sustainable innovative design of materials and equipment, waste collection services, recycling initiatives, etc.
  - Increase technical support for the development of sustainable material design criteria for engineering companies, marine litter quantification protocols around the aquaculture facility, etc.
  - Increase support for monitoring of aquaculture installations, including monitoring programmes based on the Life Cycle Analysis of the materials and infrastructure put in place, technologies for monitoring, etc.
  - Increase support for waste management including the introduction of waste management involvement in licence application process, efficient waste collection systems, generation of more infrastructures, inclusion of waste management in policy of companies, etc.
  - Increase support for education, communication and awareness-raising including technical trainings for aquaculture staff, communication between public/consumers and farmers/producers on good practices applied by the aquaculture sector, promotion of clean-up volunteering programmes, cooperation between offshore sectors, cooperation between large and small aquaculture farms, etc.

- **LEGISLATION,** e.g.
  - Include, as a precondition in the license application process, the identification of potential sources of waste, the estimation of non-organic marine litter related to the facility, preventive measures, the technical study, waste management plan etc.
  - Enforce regulations regarding the production of durable materials, the use of alternative aquaculture gear, industrial waste materials, permits, etc.
  - Compile clear policies to reduce debris and stimulate the circular economy (waste policy, harbour facilities, Plastic Strategy, …).
  - Compile clear measures to motivate users to handle materials in a sustainable way (preventive measures, coupled to incentives, imported materials, …).
  - Elaborate certification programmes to include quality standards of materials used, plastic-specific indicators.

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- RESPONSIBILITY, e.g.
  - Identify the shared responsibility of individual farmers and producers involved in the waste management process/EPR scheme.
  - Identify the producer responsibility regarding recycling or returning facilities for farmers.
  - Identify the farmer/user responsibility regarding group-specific obligations and measures for waste management processes.
  - Include criteria for Corporate Social Responsibility (CSR) of aquaculture businesses.

- KNOWLEDGE, e.g.
  - Create synergies among all aquaculture stakeholders to (1) increase the knowledge related to the aquaculture marine debris and, (2) to improve and increase the current marine debris data quantification and methodologies.
  - Enhance scientific knowledge on new materials and new designs for aquaculture equipment, including detailed analysis of technical characteristics and the life time of aquaculture gear and equipment etc.
  - Enhance knowledge in relation to innovation, including waste recycling processes, low value plastic recycling, material design in function of improved longevity to aid sustainable and innovative developments during the initiation, development and operation of the farms.
  - Promote interdisciplinary and international collaborations by funding R&I projects between companies and academic partners. Good initiatives, research and innovation should be more widely supported.
  - Create synergies among all aquaculture stakeholders to identify (1) the farmer's needs regarding the aquaculture marine debris management, (2) the necessities to create a functional EPR scheme and (3) the market value of the recycled and upcycled products, with the aim to create a feasible EPR scheme.

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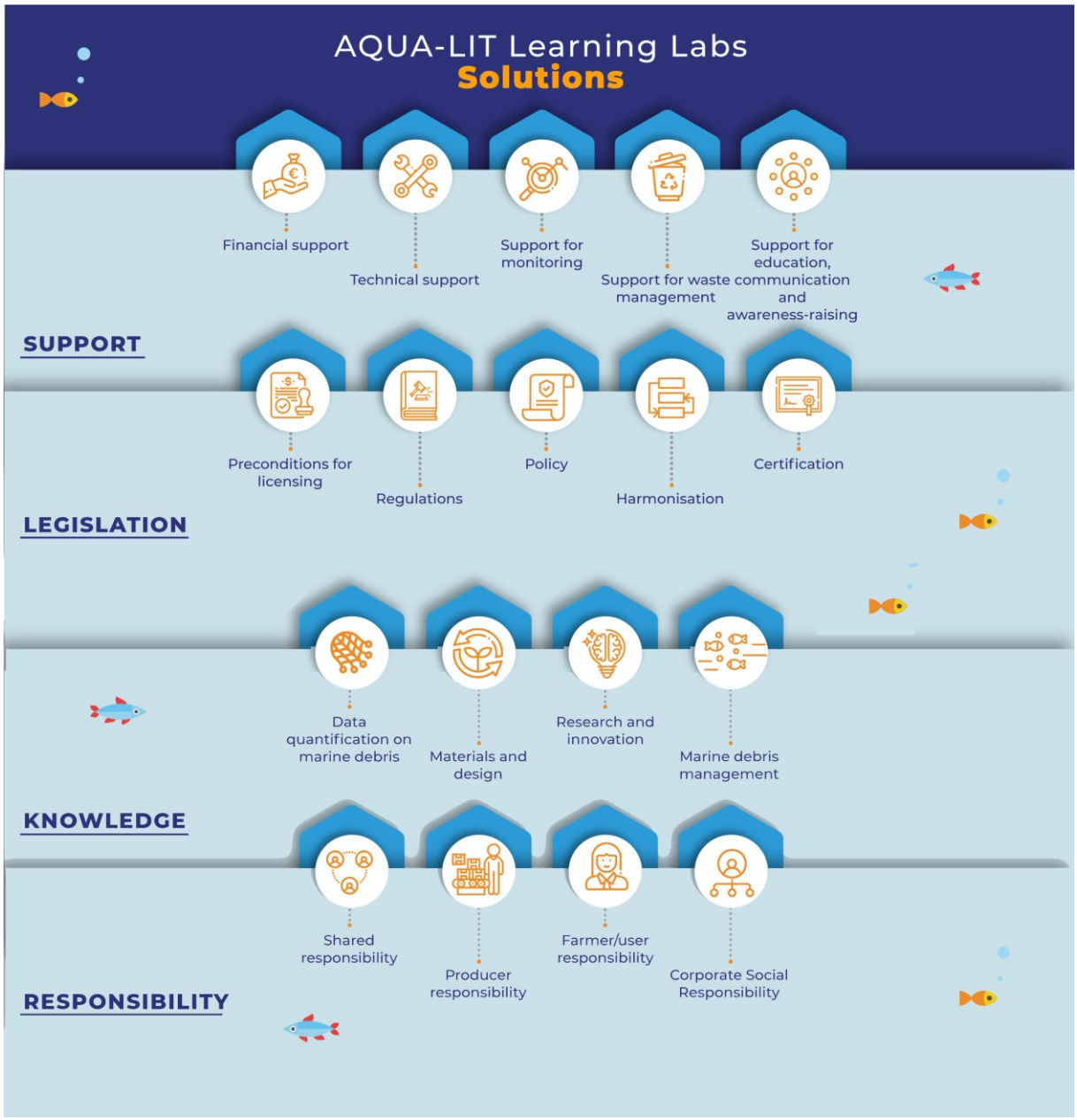

Figure 11: Infographic summary of the identified solutions to tackle the marine litter problem during the AQUA-LIT Learning Labs in the North Sea, Baltic Sea and Mediterranean Sea.

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GOOD PRACTICES

Do you know of any good practices already in place involving the prevention & reduction, monitoring & quantification, and removal & recycling of litter from the aquaculture industr?

Aquaculture facilities in the North Sea greatly vary with regards to cultivated species and farming techniques. Regardless these differences, the variety of good practices provided by North Sea aquaculture stakeholders show that many aquaculture companies and local authorities are taking initiatives to prevent the loss of gear and other equipment and to reduce waste. The Good Practices identified by the stakeholders are grouped under the same topics as the 'solutions' section:

- **SUPPORT,** e.g. on own initiative:
  - Monitoring (tracking equipment for lost gear)
  - Waste management (cooperation between companies for collecting waste)
  - Education, training, communication and cooperation (communication between offshore sectors on new facilities, awareness- raising workshops for aquaculture sector, staff awareness on re-use, clean-up activities for companies, communities and young people).
- **LEGISLATION,** e.g. company policy:
  - Licensing criteria (technical studies to determine storm-proof character, include equipment inventories to control sustainability and facilitate monitoring).
  - Regulations (flexible permits adapted to local conditions, improve requirements for high quality products labelled by ASC standards).
  - Measures (voluntary agreements between the aquaculture actors, other offshore sectors and the government)
  - Certification (certification for waste management in companies, plastic-specific indicators).
- **RESPONSIBILITY,** e.g.
  - Shared responsibility (development and use of eco-anchors and alternative natural materials instead of plastics).
  - Farmer/user responsibility (alternative materials: use of biodegradable sock for mussel suspension cultures, use of steel poles in mussel larvae collector installations, use of MAP trays, alternatives for fish bag collection and recycling, continuous lines, set company requirements to prevent accidental losses, improve dismantling procedures of worn-out materials).

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- Corporate Social Responsibility (Fishing for Litter, recycling programmes for nets and ropes, reuse of floats in other sectors)

KNOWLEDGE, e.g.

- Knowledge in relation to innovation (sustainable anchoring systems, solutions to our plastic recycling problem).

6.2. Recommendations

Existing barriers and possible solutions that help tackling marine litter in the North Sea region were identified during the knowledge exchange by the aquaculture stakeholders. Based on the conclusions above, for the combined three core aspects of marine littering (Prevention and Reduction, Monitoring and Quantification, Removal and Recyling), following recommendations and needs can be put forward:

1. Better support

To create a sustainable aquaculture value chain and waste disposal processes, financial support for the implementation and use of alternative materials, tracking devices & monitoring technologies, better waste collection services & infrastructure should be provided.

To implement best practices as a common approach, support is needed to enhance communication between offshore sectors and producers of offshore materials, cooperation between large and small aquaculture farms, training of staff and farmers including awareness raising.

2. Improvements in legislative framework

In addition to voluntary agreements, policy measures and regulations (e.g. decommissioning plans) are needed to enforce a sustainable and circular aquaculture sector.

Mandatory certification, including plastic-specific indicators, for waste management and seafood products clarifies the sustainability of the seafood product and preceding processes.

3. Higher responsibility from all involved stakeholders

To implement sustainable measures, expanding individual responsibility to a shared responsibility between farmers/users and producers has been identified as crucial for success.

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In addition, initiatives in the context of corporate social responsibility are indispensable for awareness and innovation.

4. Encouragement of knowledge creation

Knowledge gaps and insufficient knowledge exchange are currently major obstacles to initiating innovation in the aquaculture sector. Knowledge gaps are identified in the field of new materials/polymers & designs, new monitoring technologies, low value plastic recycling, and technical knowledge in relation to offshore conditions.

6.3. 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.

This project has received funding from the European Union's EASME-EMFF funding programme under grant agreement EASME/EMFF/2017/1.2.1.12/S2/04/S12.789391.

7. References

European Commission (2019). Species analyses 2018. Publications Office of the European Union: Luxembourg. ISBN 978-92-79-82075-5. 111 pp.

Sandra M., Devriese L., De Raedemaecker F., Lonneville B., Lukic I., Altvater S., Compa Ferrer M., Deudero S., Torres Hansjosten B., Alomar Mascaró C., Gin I., Vale M., Zorgno M., Mata Lara M. (2019). *Knowledge wave on marine litter from aquaculture sources*. D2.2 Aqua-Lit project. Oostende, Belgium. 85 pp.

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8. Annexes

8.1. Annex a: Save-the-date, invitation and programme of the *AQUA-LIT North Sea Learning Lab*

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INVITATION

Dear,

VLIZ has engaged in the AQUA-LIT project funded by the European Union, aiming at providing the aquaculture sector with a toolbox of preventive measures for averting the discard of litter in the marine environment.

Considering that aquaculture is the fastest growing food-producing sector with an expansion rate of 8% per year, it is now the time to act in order to prevent the increase of marine litter and to support the removal of the already existing one.

Thus, the AQUA-LIT project is working on finding solutions and measures for preventing, reducing, removing and recycling marine litter coming from the aquaculture sector in the Mediterranean, North Sea and Baltic regions.
To achieve this, we believe it is essential to **work and cooperate** with the entire range of aquaculture stakeholders.

We are therefore pleased to invite you to the

North Sea Learning Lab
"How can the aquaculture sector contribute to reducing marine litter?"

that will take place **on 26 November** at the Conference Hall of the Flanders Marine Institute (VLIZ) in Wandelaarkaai 7, 8400 Oostende, **from 9:00 to 14:00**

In order to directly involve stakeholders in the process and get their valuable insights and contributions, the lab will be an interactive workshop where participants will work in groups to identify and assess solutions and methodologies from three perspectives:

We strongly believe that your active engagement and valuable feedback are essential to shape the best strategy to prevent, reduce and recycle the aquaculture non-organic litter in the North Sea.

The Lab will offer many opportunities for discussion, brain-storming, knowledge transfer, bright idea exchange and networking. Its outcomes will contribute to the next step of the project, which is the development of a toolbox of tangible solutions and measures enabling the aquaculture sector to tackle marine litter and they will be communicated to the European Union.

Please find the programme of the Learning Lab here.

We would be grateful if you could register here to confirm your attendance **before 15 November 2019**.

For further information please contact Fien De Raedemaecker.

We very much look forward to seeing you on board!

Best regards,

Lisa Devriese, Matthias Sandra, Fien De Raedemaecker

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PROGRAMME

AQUA-LIT

AQUA-LIT's North Sea Learning Lab

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

26 November 2019, 9:00-14:00
Conference Hall, VLIZ, Wandelaarkaai 7,8400 Oostende

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 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

09:00-09:30 Welcome + Coffee
09:30-10:20 Plenary Session

- Introduction to AQUA-LIT (*Fien De Raedemaecker, VLIZ*)
- State of play of non-organic litter from the aquaculture sector (*Matthias Sandra, VLIZ*)
- Policy measures that help reduce marine litter (*Senne Aertbeliën, FPS Health, Food Chain Safety and Environment, Marine Environment Service*)
- Objectives of the Learning Lab and expected outcomes (*Fien De Raedemaecker*)

10:20-11:00 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?

11:00-11:30 Coffee break
+ demo session on aquaculture litter (*Francis Kerckhof, RBINS*)

11:30-12:00 Round table Part 2

12:00-12:30 Round table Part 3

12:30-13:00 Plenary Summary Session

- Presentation of results by 3 rapporteurs
- Discussion & wrap-up

13:00-14:00 Lunch break

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8.2. Annex b: Certificate of participation

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8.3. Annex C: Triggering questions used by facilitators of the interactive workshops

PREVENTION & REDUCTION OF MARINE LITTER

Q1.2 Triggering sub-questions

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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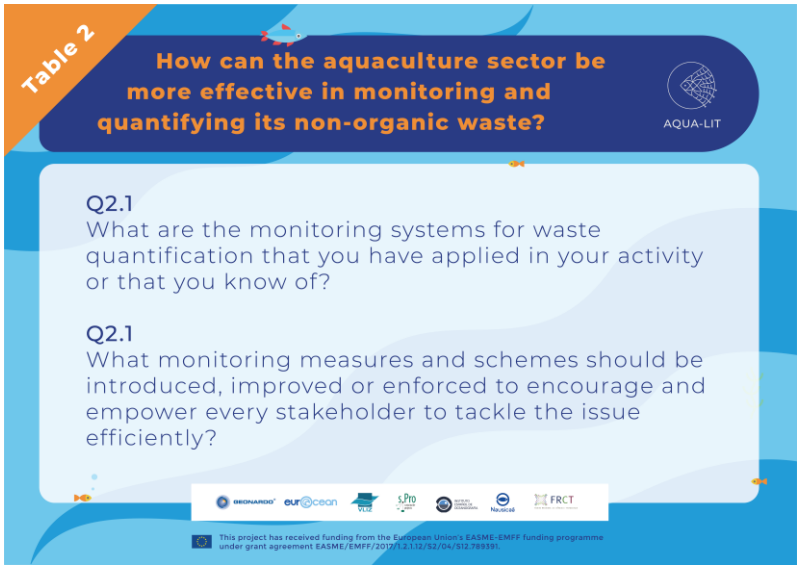
MONITORING & QUANTIFICATION OF MARINE LITTER



Q2.2 Triggering sub-questions

a. *Monitoring frequency: in your company/organization, is there any kind of monitoring after storms? Or do you conduct 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?*

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

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REMOVAL & RECYCLING OF MARINE LITTER

Q3.2 Triggering sub-questions

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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8.4. Annex d: 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? (coast-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[6].
     - ***Life Cycle Assessment (LCA) design***
       The aim of a life cycle assessment design[7] 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[8].
   - 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**?

[6] https://www.researchgate.net/publication/313771263_Circular_Design_-_Design_for_Circular_Economy
[7] https://www.sciencedirect.com/science/article/pii/095965269390004U
[8] 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**[9] 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**[10] 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:

[9] *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.

[10] *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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