

Policy Recommendations to tackle Aquaculture Debris

Deliverable 5.1 (D.5.1)



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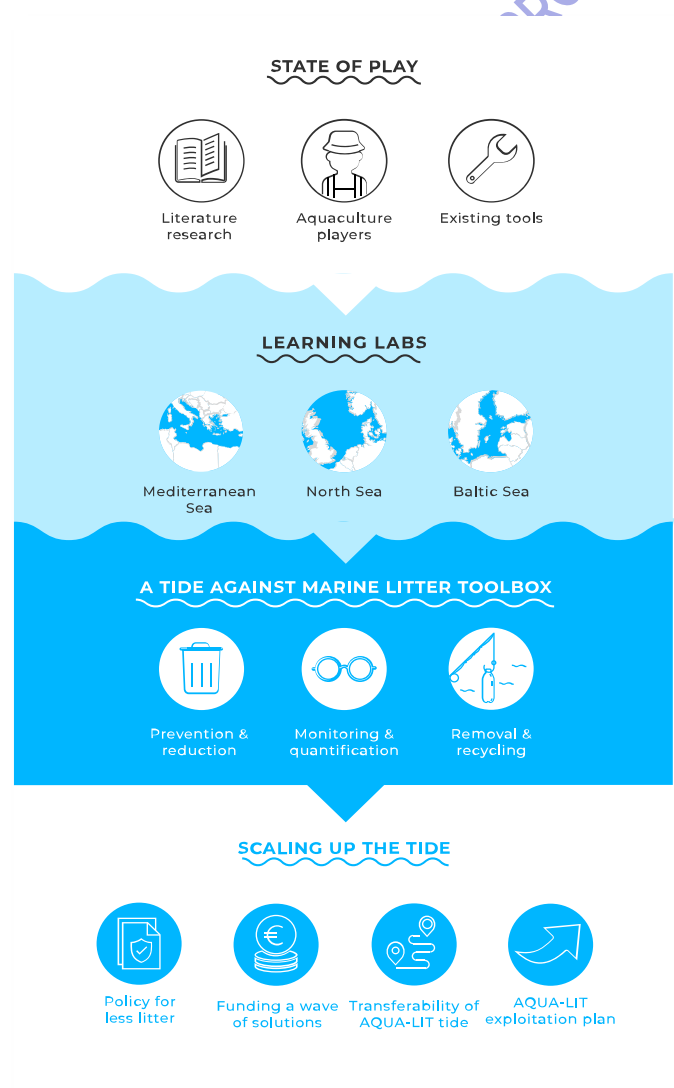
AQUA-LIT Project

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

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

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

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



Project Consortium



Geonardo Environmental Technologies
(GEO)



European Centre for Information on Marine
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Definitions

Globally, the term 'marine litter' is used 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, such as storm events, and consequently has unintentional losses of materials or equipment. To better represent the context, the word 'debris' is used instead of 'litter'.

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 being 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.

1 | Executive Summary

The 'AQUA-LIT Policy Recommendations' report examines how to avert the discarding of litter in the marine environment related to the aquaculture industry. This document provides a **set of recommendations to improve decision-making and to overcome the existing gaps**, being its main objective to provide information to support policy-making **of the marine litter problem in the aquaculture sector**. This deliverable was elaborated having in consideration the main key findings and results of each of the three sea basins AQUA-LIT focuses on (the Mediterranean Sea, the Baltic Sea and the North Sea), as well as the project's products and deliverables produced along the project, mainly the Learning Labs reports, the deliverables D.2.2. and D.2.3., and an extensive literature overview, including legislation and policy documents.

Marine litter, including plastic, is an increasing concern globally, since it causes harm to marine environment, coastal communities, and maritime activities, along with effects on economics, human health and safety. Therefore, it is considered a large challenge, which needs to be tackled.

Aquaculture and fishing activities are responsible for approximately 65% of the plastics released into the sea (Galgani, Hanke, & Maes, 2015). **However, very few measures to reduce marine litter, current and proposed, are related to aquaculture.** Aquaculture is an important economic activity under continuous expansion in many coastal and inland regions of the European Union.

Through the works developed under the AQUA-LIT Project, which included an aquaculture public participation process, it was possible to develop a **set of 58 important recommendations to be consider by the aquaculture sector** in the future. In addition, it was also possible to identify the **eight main gaps to overcome the discarding of litter in the marine environment** related to the aquaculture industry.

2 | Key Policy Recommendations



- **SUPPORT**, namely technical, financial, and organizational.
- **EDUCATION, TRAINING, COMMUNICATION** and **COOPERATION**.
- **MONITORING** losses and litter in the environment with innovative approaches and guidelines.
- **WASTE MANAGEMENT** with waste collection points, deposit schemes, incentives, upcycling processes, waste flows.
- **PRECONDITIONS FOR LICENSING**.
- **REGULATIONS** through creation and inspections perform.
- **POLICY** developing national law and incorporating and implementing policies in national laws.
- **HARMONISATION** in licensing procedures and certification systems, of decommission.
- **CERTIFICATION** including the standardisation of the labelling systems.
- Identify the **SHARED RESPONSIBILITY**.
- Identify the **PRODUCER RESPONSIBILITY**.
- Identify the **FARMER / USER RESPONSIBILITY**.
- Include criteria for **CORPORATE SOCIAL RESPONSIBILITY (CSR)**.
- **MARINE DEBRIS MANAGEMENT** through synergies among all the involved stakeholders.
- **DATA QUANTIFICATION** on aquaculture debris.
- **RESEARCH** and **INNOVATION**, enhancing knowledge and promoting interdisciplinary and international collaborations.
- New **MATERIALS** and new **DESIGNS** for aquaculture equipment.

In the present document under the chapter “[Recommendations & Gaps](#)”, the above-mentioned key policy recommendations are explained in more detail.

3 | Context

INTRODUCTION

This report examines how to avert the discarding of litter in the marine environment from the aquaculture industry. It provides a set of recommendations to improve decision-making and to overcome identified knowledge and policy gaps. The main goal of this report is to provide information to support policy-making of the marine litter problem in the aquaculture sector. Additionally, was elaborated having in consideration per sea basin the main key findings and results from the AQUA-LIT products and deliverables produced along the project, mainly the Learning Labs (LL) reports, the deliverables D.2.2. 'Knowledge wave on marine litter from aquaculture sources' and D.2.3. 'Available tools and measures', and an extensive literature overview, including legislation and policy documents.



Is the MARINE LITTER a problem and a threat?

Marine litter is defined as “any persistent, manufactured or processed solid material discarded, disposed of, or abandoned in the marine or coastal environment” (Galgani, Hanke, & Maes, 2015), being globally an increasing concern, since it harms the marine environment, coastal communities, and maritime activities, along with major impacts into the economics, human health and safety (G20, 2017; Veiga, et al., 2016). In the scope of AQUA-LIT Project litter consists of items that have been deliberately discarded, unintentionally lost or abandoned, or transported by winds and rivers, into the environment; while debris consist of rubble, wreckage, scattered remains of something that has been destroyed, pieces of rubbish or unwanted materials.

It is widely recognised that marine litter can have a negative impact on marine animals, through the ingestion or entanglement in the marine debris. It is broadly documented that entanglement, or ingestion of marine litter can have negative consequences on the physical condition of marine animals and may even lead to their death (OSPAR Commission, 2014). According to the authors Pham et al. (2014), van Raamsdonk et al. (2020) and Redondo-Hasselerharm et al. (2020), marine litter can cause bioaccumulation of pollutants and toxins along the web chain. Also, the adverse physiological effects that arise from ingestion of pieces of plastic, plastics in the sea may also pose an additional chemical hazard especially those containing known or suspected endocrine disrupting chemicals as additives or contaminants (e.g. POPs and EDCs) (Gallo, et al., 2018).

Marine litter has been detected in all marine habitats, and it is considered a huge and complex environmental, economic and social challenge that needs to be urgently tackled (European Commission, 2017). The majority of the litter in the ocean consists of plastic debris.

Marine Litter is a problem with no borders because of its geographic distribution...

- 🐟 Analysis to the beached fulmars stomach contents, in the **Southern North Sea**, indicates that 95% contains plastic, in an average of 35 pieces per bird (van Franeker, et al., 2011).
- 🐟 In the **Clyde Sea**, 83% of *Nephrops* sp. sampled contained plastic (mainly fibres) in their stomachs (Murray & Cowie, 2011).
- 🐟 In the **English Channel**, 36.5% of the individuals sampled (pelagic and demersal fish species) had plastic in their gastrointestinal tracts (Lusher, McHugh, & Thompson, 2013).

What do we know about AQUACULTURE DEBRIS?

According to the IUCN report about plastic debris in the Ocean (2014), the average proportion of plastic waste in the Ocean varies between 60-80% of the total debris, and it can reach as much as 90-95% (Thevenon, Carroll, & Sousa, 2014). Despite the fact that most marine plastics come from a land-based source, it is also important to tackle the ocean-based sources (e.g. commercial shipping, fisheries, aquaculture activities), since these account for 20% of the ocean plastic pollution (Eunomia, 2016). As stated by Galgani et al. (2015), the activities developed by Fisheries and Aquaculture sectors, are responsible for about 65% of the plastics released into the sea. In the litter inventory 'Deliverable 2.2 Knowledge wave on marine litter from aquaculture sources', produced by the AQUA-LIT Project, were identified items which source can be aquaculture, for example, items such as nets, floats and buoys, ropes, mesh bags, structures, antipredator netting, Tahitians, etc.

Huntington (2019) identified the ingestion and entrapment/entanglement of the marine animals on aquaculture gear as a problem, namely as a threat for marine life.



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How IMPORTANT is it to TACKLE this PROBLEM?

“Identifying the options to address key waste items from the aquaculture industry which could contribute to marine litter and implement pilot projects where appropriate”.

Priority action at global level, G7 Action Plan on Marine Litter (2015)

In the European Union (EU), aquaculture production is an important economic activity in many coastal and inland regions (Jeffery, et al., 2014). The EU is the fifth largest producer of global fisheries and aquaculture (European Commission, 2017), and boosting the aquaculture sector has been a goal for the European Commission (EC) as stated in their Common Fisheries Policy (CFP).

According to EC (2017) it is expected an increase in the aquaculture industry, targeting the provision of annual 4.5 million tons of sustainable food products by the year 2030. Fisheries and aquaculture sectors, within the European Economic Area (EEA), estimate waste losses of 3,000-41,000 tonnes per annum, from which 72% are likely to be plastic and 7% is deliberately discarded (Eunomia, 2016; Huntington, 2019).

Reliable available waste data is reduced in the aquaculture sector (Eunomia, 2016), and only a few measures to reduce marine litter, are related to this industry. Taking into account the aquaculture production leadership of the Mediterranean Sea Basin in the EU, as well as the importance of the sector in the North Atlantic and Baltic Sea regions, AQUA-LIT Project considers of extreme importance the focus on the marine litter regarding this industry.

The AQUA-LIT Project believes that in order to achieve the best results, working with the stakeholders through the whole process of waste management is fundamental, to avoid the discarding of litter from the aquaculture industry into the marine environment. According to 2012 OSPAR Convention, the public participation and stakeholder involvement is crucial to create awareness regarding the marine litter problem and to ensure a sense of public ownership, in order to build support for relevant measures.

SNAPSHOT

Aquaculture Governance

The EU's **Blue Growth Strategy** (2012) identifies aquaculture as a sector that could boost economic growth across Europe and bring social benefits through the creation of new jobs. The reformed **Common Fisheries Policy** (CFP, Regulation (EU) No 1380/2013) places an increasing emphasis on the sustainable development of aquaculture and requires actions to improve the competitiveness of this sector, whilst ensuring its long term environmental, economic and social sustainability. The EC published the **Strategic Guidelines for the Sustainable Development of EU aquaculture** (2013), which highlighted the priority areas to unlock the potential of this sector. In order to comply with these guidelines, Member States (MS) are developing and implementing multiannual national plans for the development of sustainable aquaculture, which depend on a clean, healthy, and productive marine and fresh waters (Jeffery, et al., 2014). The **Water Framework Directive** (WFD, 2000) and the **Marine Strategy Framework Directive** (MSFD, 2008) aim to protect and enhance the aquatic environments, ensuring that the uses to which they were created are sustainable in the long term. Other environmental legislation that is relevant for the aquaculture sector includes the **Environmental Impact Assessment** (EIA, 1985) and the **Strategic Environmental Assessment** (SEA, 2001) Directives.



EU LEGISLATION to tackle MARINE LITTER

Marine litter represents a challenge in terms of target setting (Newman, Watkins, & Farmer, 2013), being currently one of the topics highlighted on the political agenda (Devriese, et al., 2019). There are already numerous EU legal instruments in operation, which could have a role in tackling marine litter, addressing the sector's litter sources diversity (Newman, Watkins, & Farmer, 2013), such as:

- 🐟 The Marine Strategy Framework Directive **MSFD**, that is the only directive dedicated specifically to the issue of marine environmental strategy and state, can be considered as the environmental pillar of the EU Integrated Maritime Policy (IMP);
- 🐟 The Water Framework Directive **WFD** addresses pollution and biodiversity concerns in inland, coastal and transitional waters and it requires Member States to attain 'good ecological status' and 'good chemical status' in these waters;
- 🐟 The **Waste Framework Directive**, which provides the basis for EU waste management legislation;
- 🐟 The **Landfill Directive**, which establish technical requirements for the operation of landfills;
- 🐟 The **Packaging and Packaging Waste Directive** limiting the amount of packaging waste going to final disposal;
- 🐟 The **Urban Waste Water Treatment Directive** to reduce the pollution of freshwater estuarial and coastal waters by domestic sewage, industrial waste water and rainwater run-off;
- 🐟 The **EC new Directive on port reception facilities for the delivery of waste from ships** was adopted with the aim to remove possible barriers for ships to bring ashore their waste streams, including fishing vessels;
- 🐟 The **Common Fisheries Policy** to ensure a Community system for fisheries control, inspection, and enforcement, and to ensure exploitation of living aquatic resources that provides sustainable economic, environmental and social conditions;
- 🐟 The **Ship-source Pollution Directive** states that ship-source polluting discharges constitute in principle a criminal offence;
- 🐟 The **European Strategy for Plastics** to transform the way plastics and plastics products are designed, produced, used and recycled (part of the **Circular Economy Package**);
- 🐟 The **Directive on the reduction of the impact of certain plastic products on the environment** (Directive 2019/904, of 5 June), foresees responsibility schemes for producers of fishing and aquaculture gear containing plastic who will have the financial responsibility to cover the costs of its separate collection, subsequent transport and treatment (part of the **Circular Economy Package**).

Who are the PLAYERS at play?

Aquaculture litter is a very diverse and complex topic, seeking a thorough understanding of the wider range of actors - individuals, groups and organisations operating in different stages of an aquaculture farm lifecycle (Initiation, Development, Operation and Maintenance, End of Life), and at a variety of spatial and governance scales (Sandra, et al., 2019)(Figure 1).

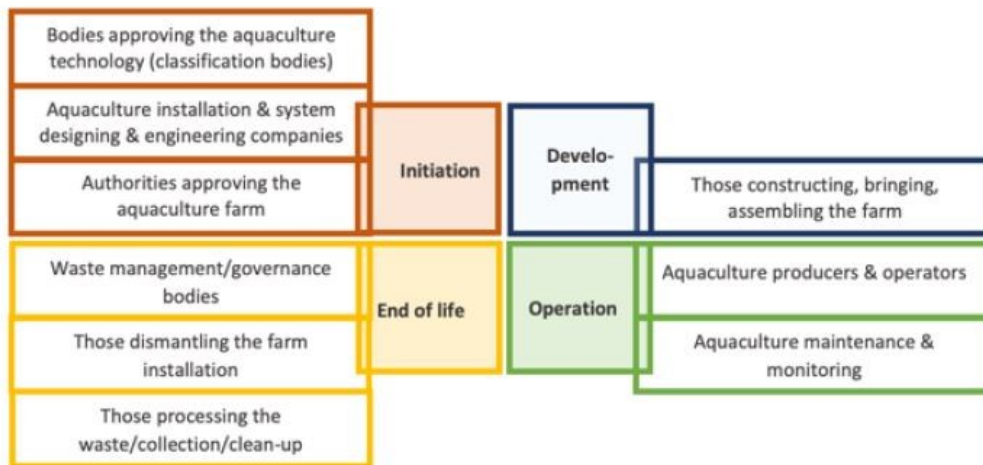


Figure 1. Stakeholder categories concerning the life cycles of an aquaculture farm (Sandra, et al., 2019).

In AQUA-LIT Learning Labs Workshops and Interviews, participated a range of stakeholders, such as: a) aquaculture farmers (fish, shellfish, seaweed); b) equipment manufacturers (e.g. aquaculture material, gear); c) engineering, system design and construction companies, d) academic research groups; e) professional clusters; f) associations and platform representatives; g) Non-governmental organizations (NGOs); h) governance, including policy makers and implementers, and port staff; i) classification and certification bodies; j) companies processing waste, including recycling and incineration; k) communicators, like media, press, science communicators; l) students and consultancy (Figure 2).

AQUA-LIT aquaculture stakeholders

Learning Labs & Interviews



- Aquaculture farmers (fish, shellfish, seaweed)
- Equipment manufacturers (e.g. of aquaculture gear)
- Engineering, system design and construction companies
- Academic research groups
- Professional clusters, associations and platform representatives
- NGOs
- Governance (including policy makers, implementers and port staff)
- Classification and certification bodies
- Companies processing waste (including waste recycling and incineration)
- Communicators (media, press, science communicators)
- Other (students, consultancy)
- Unknown

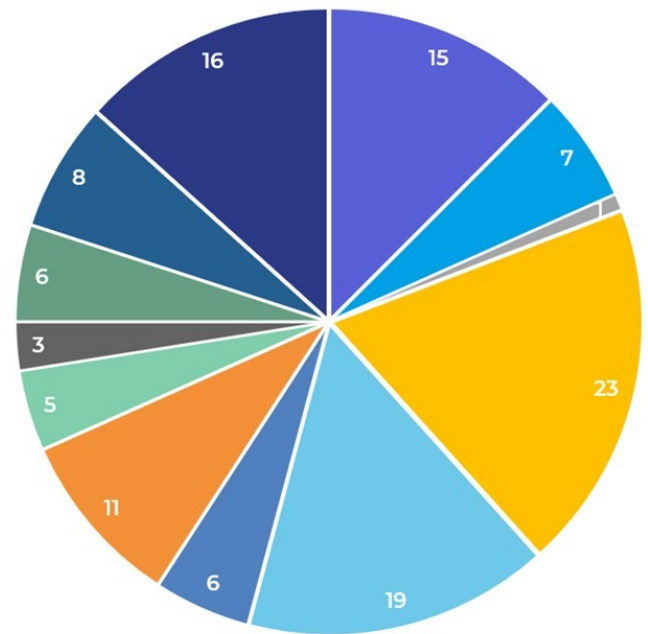


Figure 2. AQUA-LIT Learning Labs Workshops and Interviews stakeholders (Source: AQUA-LIT Project, Deliverable 3.5 'Learning Labs Outcome').

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4 | Main Findings

MARINE LITTER from AQUACULTURE sources

In Europe there are many aquaculture activities, however, currently, it is not possible to display all aquaculture facilities due to a lack of data from several countries (Sandra, et al., 2019). In the regions of the North Sea, Baltic Sea, and the Mediterranean Sea, according to the data collected through the AQUA-LIT Project, the main species farmed are (Figure 4):

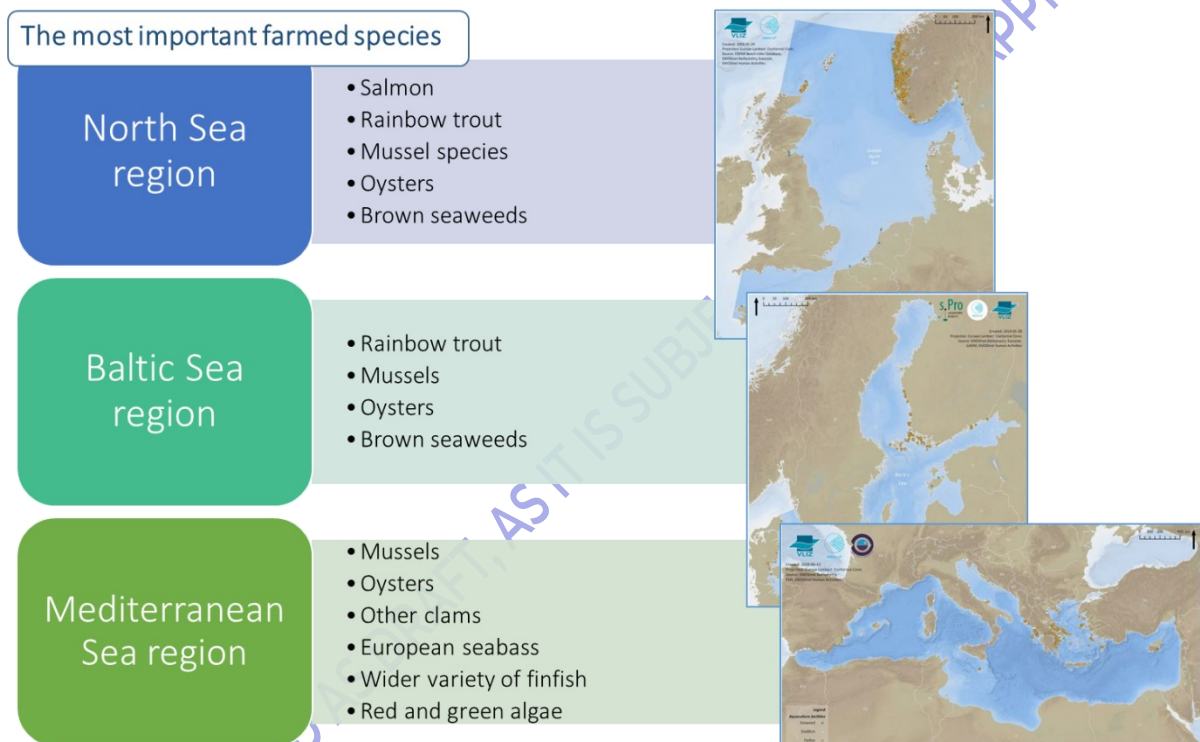


Figure 3. The main farmed species in the North, Baltic and Mediterranean Seas (Adapted from Sandra et al., 2019).

Depending on the type of aquaculture facility, different categories of debris can be expected. The '[AQUA-LIT Marine Litter Inventory](#)', contains the aquaculture items that are currently found as marine/beach debris (19 of the 31 items listed are exclusively linked to the aquaculture sector). Most of the litter items from the litter inventory are plastic (22 items), being the majority (~19) specific items, which source is the aquaculture industry, showing the importance of taking measures to tackle plastic litter from this sector (Sandra, et al., 2019). Figure 4, shows some examples of marine litter items coming from aquaculture activities.



Figure 4. Marine litter items from Aquaculture activities (Adapted from Sandra et al. (2019)).

For the North, Baltic and Mediterranean Seas regions, aquaculture debris maps were elaborated to illustrate the occurrence debris (based on the available data). The collected data points are mainly located in the Mediterranean Sea, especially in the Adriatic and Ionian Seas. It is notable that the proportion of aquaculture litter in relation to the total amount of litter found on beaches (4%) is much lower than at the sea surface and at the seafloor (Sandra, et al., 2019). The proportion of aquaculture litter in relation to the total amount of litter might be an overestimation regarding the published data, and an underestimation regarding the data from the OSPAR, HELCOM, and the Marine Litter Watch data. The aquaculture debris maps also give an indication regarding data gaps in the different parts of the three sea regions (Sandra, et al., 2019). The already existing seafloor litter-monitoring programme (e.g. OSPAR) does not provide a categorization scale for the aquaculture debris.

ACTION PLANS and POLICY DOCUMENTS on marine litter

From a vast overview, with different scales ranging from global to regional passing through the European and national levels, the action plans, needs, measures, tools or strategies to reduce or avoid marine litter from the aquaculture sector in the three AQUA-LIT Sea areas, deliverable D.2.3 'AQUA-LIT Available tools and measures', demonstrate that:

- 🐟 **High-level policy requirements should be translated into concrete actions**

Marine litter is nowadays a topic under the political agenda. The global and EU framework for the prevention and management of marine debris exists, however, needs to be translate into tailor-made actions and measures to be implemented, depending on the source of the marine debris (Devriese, et al., 2019).

- 🐟 **Actions and measures at regional and sub-regional scales allow a more targeted approach**

According to Devriese et al. (2019), the identified European Requirements focus mainly on seeking or implementing solutions and particular policy engagements for mitigation strategies,

involving the litter from aquaculture activities. Therefore, at the EU level, clear targets were elaborated under the framework of the MSFD and the Plastic Strategy, and should be further specified by means of measures at the EU Member States. At the regional scale, actions and measures proposed are more specific and tailored to the aquaculture sector.

More research is needed to support the evidence base for decision-making

The research needs, presented in the deliverable D.2.3 'AQUA-LIT Available tools and measures', shows the quantities and relative importance of various sources of plastics (also from the aquaculture sector), and that their ocean entry point needs to be investigated with greater detail (Devriese, et al., 2019).

Work with all stakeholders along the value chain is needed to find appropriate solutions

The national requirements identified, show the need for working with all stakeholders along the value chain, in order to find appropriate solutions to avoid littering in the aquaculture sector. Thus, very specific actions and measures can be proposed to achieve the environmental targets set by the policy-makers. Concrete measures, already proposed, contemplate the use of alternative materials for mussel socks, and aquaculture gear tagged (Devriese, et al., 2019).

With the overview compiled in this deliverable (D.2.3) was possible contribute to the knowledge base needed for the development of AQUA-LIT Project Work packages 3 'Learning Labs' and 4 'Toolbox for integrated approaches', and for the present document, affecting the transferability of tools (Work package 5). Mitigation measures overview was complemented with tools and methods learned during the face-to-face approach with the aquaculture farmers during the development of Work package 3.

STAKEHOLDER's face-to-face approach

The AQUA-LIT Learning Labs (within the AQUA-LIT work package 3) provided the opportunity of a forum of face-to-face work with the aquaculture stakeholders - farmers, policy-makers and other relevant actors along the aquaculture value chain. As a result of these initiatives, through the workshops and interviews it was possible to identify the barriers, solutions, and good practices for the aquaculture sector on the three case studies (North, Baltic and Mediterranean Sea regions). With these information's and the information collected in the D.2.3 'AQUA-LIT Available tools and measures', it was possible to develop a crosscutting analysis in order to achieve a set of recommendations for less marine litter. Table 1 ([Annex I](#)) presents the crosscutting analysis performed, explaining the sources of each of the policy recommendations.

5 | Recommendations & Gaps

In this chapter, a set of recommendations for less marine litter is presented, and the main gaps identified to be overcome. These recommendations and gaps are a result of an extensive literature review and of the AQUA-LIT Project outcomes, which focused on the aquaculture activities in the North, Baltic, and Mediterranean Seas regions. These recommendations and gaps were compiled and combined for the three core aspects of tackling marine litter - Prevention & Reduction, Monitoring & Quantification, and Removal & Recycling.

RECOMMENDATIONS

The set of recommendations presented below was subdivide in categories according to the LL reports initiatives: Support, Legislation, Responsibility, Knowledge and Others.



Section A. SUPPORT

A.I. TECHNICAL SUPPORT

- A.I.I. Develop tailor-made standards, guidelines and procedures for different types of companies working on sustainable design / engineering solutions for de-commission, re-use, re-purposing to be considered early on in the design stages of a system;
- A.I.II. Develop circular design targets to extend the aquaculture installation's life cycle and promote multiple use of the entire installation or major parts;
- A.I.III. Improve marine litter quantification protocols around the farms.

A.II. FINANCIAL AND ORGANIZATIONAL SUPPORT

- A.II.I. Increase financial support to incentive the development and implementation of sustainable innovative design of materials and equipment, waste collection services, and recycling initiatives;
- A.II.II. Propose new financial mechanisms appropriate to the specificities of this sector;
- A.II.III. Improve resource productivity in the sector through funding/tendering of competition with prize money to accelerate closed loop approaches;
- A.II.IV. Increase organizational support to establish a specific aquaculture Extended Producer Responsibility (EPR) system to circular economy approach/cycle.

A.III. SUPPORT FOR MONITORING

- A.III.I. Foster innovative approaches for monitoring (seabed), using specific technologies, like underwater drones, robots, and aerial monitoring;

- **A.III.II.** Develop guidelines for monitoring programmes based on the Life Cycle Analysis of the materials and the infrastructures put in place.

A.IV. SUPPORT FOR WASTE MANAGEMENT

- **A.IV.I.** Establish waste collection points for aquaculture gear disposal in the port reception facilities, while cooperating with other sectors to achieve larger amounts of waste;
- **A.IV.II.** Create deposit schemes for aquaculture items, like cages, passive aquaculture gear, tags, ropes, and gloves;
- **A.IV.III.** Support valorisation trajectories of the waste market and creating incentives for recycling companies to develop sustainable procedures;
- **A.IV.IV.** Promote upcycling processes to ensure the economic viability of the 5 R's' approach - Reduce, Re-use, Recycle, Recover, Refuse;
- **A.IV.V.** Develop waste flows, which include as many different types of polymers as possible.

A.V. SUPPORT FOR EDUCATION, TRAINING, COMMUNICATION AND COOPERATION

- **A.V.I.** Increase/develop technical trainings for aquaculture staff with gear production companies;
- **A.V.II.** Increase/develop trainings to identify non-organic marine litter from the aquaculture sector;
- **A.V.III.** Develop staff environmental awareness training to promote better practices;
- **A.V.IV.** Develop management and staff awareness regarding the need to re-use equipment and fittings, even if it requires extra training;
- **A.V.V.** Increase communication on good practices applied by the aquaculture sector;
- **A.V.VI.** Increase promotion of clean-up volunteering programs, including promotion and awareness in media;
- **A.V.VII.** Increase cooperation between offshore sectors and between large and small aquaculture farms.

A.VI. SUPPORT FOR CAMPAIGNS ORGANIZED BY THE PUBLIC ADMINISTRATION

- **A.VI.I.** Focus on good practices applied by the aquaculture sector and the certified products related to those good practices.



Section B. LEGISLATION

🐟 B.I. ESTABLISH PRECONDITIONS FOR LICENSING

- **B.I.I.** Include information on quality standards of materials, technical studies, and waste management plans in the license application processes;
- **B.I.II.** Include the identification of potential sources of waste, the estimation of non-organic marine litter related to the facility, and the monitoring of the litter in the license application processes;
- **B.I.III.** Incorporate the decommissioning process in the licensing processes, including funds for farmers, and ensure compatibility with plastic waste legislation and mandatory reporting of losses.

🐟 B.II. REGULATIONS

- **B.II.I.** Create a specific European/sectorial Single-Use-Plastic regulation and Extended Producer Responsibility scheme regulation for fisheries and aquaculture;
- **B.II.II.** Perform inspections to enforce regulations and deny concession renewals if criteria are not in conformity.

🐟 B.III. POLICIES

- **B.III.I.** Incorporate the European Directive 2019/904 on the reduction of the impact of certain plastic products on the environment into national law's;
- **B.III.II.** Expand the current environmental objectives of the Marine Strategies to include the criteria of monitoring marine litter (related to descriptor 10 - MSFD) in the Compatibility Reports;
- **B.III.III.** Develop national aquaculture law with clear guidelines for the procedures in marine coastal or offshore farms, as well as different farming systems;
- **B.III.IV.** Transposition of the Port Reception Facility Directive into national laws with a focus on easy to handle container systems free of charge.

🐟 B.IV. FLEXIBILITY

- **B.IV.I.** Need of flexibility in the adaptation of rules within the aquaculture sector, since there are different types of aquaculture/different systems of production that produce different types of litter.

🐟 B.V. HARMONISATION

- **B.V.I.** Establish common standardised licensing procedures for various types of aquaculture across the EU, in a clear and cohesive format to especially support small-scale farmers;

- **B.V.II.** Harmonise certification systems, including waste management plans;
- **B.V.III.** Harmonise, as much as possible, the criteria of the multiple autonomous communities regarding waste management;
- **B.V.IV.** Harmonise decommission to avoid unfair competition between countries; mandatory reporting of losses.

🐟 **B.VI. CERTIFICATION**

- **B.VI.I.** Standardise the labelling systems for aquatic and food products to inform consumers about the environmental impacts of the products; allow labellers to expand on specific requirements or criteria for specific clients;
- **B.VI.II.** Create specific certification schemes, which must ensure sustainability, quality, and social responsibility.



Section C. RESPONSIBILITY

🐟 **C.I. SHARED RESPONSIBILITY**

- **C.I.I.** Identify the role and responsibility of all the stakeholders involved in the waste management process.

🐟 **C.II. PRODUCER RESPONSIBILITY**

- **C.II.I.** Identify the producer responsibility regarding recycling or returning facilities for farmers;
- **C.II.II.** Good practice certification control points should be feasible to be implemented by producers, based on the official regulations and feasible to be verified by the certification bodies;
- **C.II.III.** Encourage the adoption of good practices by positive economic stimulus, such as tax reduction or fiscal incentives.

🐟 **C.III. FARMER / USER RESPONSIBILITY**

- **C.III.I.** Create surveillance plans, which include checking the state of the aquaculture facilities regularly;
- **C.III.II.** Keep track, in a logbook, of the bought items, installed and/or used items, major events happened and any gear loss or break;
- **C.III.III.** Financial incentives, e.g. to the companies that have a higher proportion of gear recycling and re-using;
- **C.III.IV.** Apply penalties to the companies that do not put in place prevention measures and/or do not discard properly the gear that has reached the end-of-life.

C.IV. CORPORATE SOCIAL RESPONSIBILITY (CSR)

- C.IV.I. Include the circular economy approach when designing and producing any aquaculture gear and facility or when choosing any material.



Section D. KNOWLEDGE

D.I. DATA QUANTIFICATION ON MARINE DEBRIS

- D.I.I. 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;
- D.I.II. Quantify microplastics occurrence would help focus on hot spots to collect more detail information and identify suitable solutions.

D.II. MATERIALS AND DESIGN

- D.II.I. Enhance scientific knowledge on new materials and new designs for aquaculture equipment, including detail analysis of technical characteristics and the lifetime of aquaculture gear and equipment.

D.III. RESEARCH AND INNOVATION

- D.III.I. Enhance knowledge in relation to innovation, including waste recycling processes, low value plastic recycling, material design in function of an improved longevity;
- D.III.II. Promote interdisciplinary and international collaborations, by funding R & I projects between companies and academic partners.

D.IV. MARINE DEBRIS MANAGEMENT

- D.IV.I. Create synergies among all the involved stakeholders to identify the farmer's needs regarding the aquaculture marine debris management.

D.V. RAISE AWARENESS

- D.V.I. Improve public awareness and stakeholder involvement on marine litter issue. Businesses/enterprises have to be actively involved and recognise as important stakeholders with capacity to influence the earliest stages of the 'product to waste cycle'.

D.VI. COMBINE DIFFERENT KNOWLEDGE/TRANSFER KNOWLEDGE

- D.VI.I. Combine scientific knowledge/expertise of farmers and material producers' in the development of new aquaculture items/gears. Their knowledge is essential at this earlier stage;
- D.VI.II. Transfer of knowledge's and adoption of the good practices, from other regional Seas, at all stages of cycle and across the waste hierarchy.

D.VII. INCREASE DECISION-MAKERS' KNOWLEDGE

- D.VII.I. Improve decision-makers' knowledge regarding the aquaculture sector, namely the diversity of existing aquaculture systems.



Section E. OTHERS

E.I. CREATE/IMPROVE BEST PRACTICES

- E.I.I. Best practices need to be adapted to each reality; they cannot be equal from country to country. Countries are not working at the same aquaculture industry sector level since some are more developed than others.

E.II. CREATE POSSIBLE SYNERGISTIC BENEFITS FROM JOINTLY ADDRESSING SECTORS WITH SIMILAR LITTER ISSUES

- E.II.I. Under some policies, aquaculture as a sector has not been specifically addressed (e.g. port reception facilities Directive). Possibly, due to the small sector size and capacities of several EU Member States. Therefore, littering needs to be facilitate through incentives (Devriese, et al., 2019).

GAPS

Throughout the development of the AQUA-LIT Project, main gaps within the scope of this theme were identified. They were:

- Quantitative and qualitative monitoring data.
- Standardised methodologies.
- Clear role and responsibility assignment on the waste management.
- Knowledge base for policy-makers to formulate defined targets.
- Decision-makers knowledge regarding all the existing aquaculture systems.
- Knowledge of value associated to the plastics recycling.
- Awareness regarding the impacts of lost plastics.
- Microplastic impacts at the population and species assemblage levels. Research on this thematic would help to better understand the implications for fisheries and aquaculture resources.

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6 | Conclusion

Effective governance and better support are needed to create a sustainable aquaculture value chain, and a waste disposal process in order to implement best practices as a common approach. The legislative and organizational framework needs to be improved to enforce a sustainable and circular aquaculture sector. A higher responsibility from all the stakeholders involved is needed for the implementation of the sustainable measures to be a success. Scientific evidences must continue to play a central role in the aquaculture industry, supporting and informing best practices.

NEXT STEPS

This report will be combined with parallel activities from Task 5.2 'Funding a wave of solutions'. The results achieved will be shared with stakeholders during the development of Task 5.3 'Transferability of AQUA-LIT tide' and will feed the AQUA-LIT 'Tide against Marine Litter Toolbox'. This toolbox will be focused on the three core aspects of marine littering (prevention and reduction, monitoring and quantification, and removal and recycling), providing integrated frameworks, offering ideas, solutions and facilitating the matching of stakeholders in the aquaculture sectors, to foster more sustainable services, connections and cleaner aquaculture practices.

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ANNEX I. Crosscutting Analysis

Table 1 presents the policy recommendations crosscutting analysis subdivided into categories according to the LL reports initiatives: (A) Support, (B) Legislation, (C) Responsibility, (D) Knowledge, and (E) Others. This analysis allows consulting the information sources, from which we were able to achieve the policy recommendations set, being in accordance with the three core aspects of tackling marine litter studied throughout the AQUA-LIT Project - Prevention & Reduction (P&R), Monitoring & Quantification (M&Q), and Removal & Recycling (R&R), and per sea basin: Baltic Sea, North Sea, and the Mediterranean Sea.

Table 1. Policy recommendations - Crosscutting analysis (P&R - Prevention & Reduction, M&Q - Monitoring & Quantification, and R&R - Removal and Recycling; (-) not found for this recommendation).

POLICY RECOMMENDATIONS	SOURCES										
	Learning Labs Workshops									Interviews	Relevant Bibliography
	Baltic			North			Mediterranean				
	P&R	M&Q	R&R	P&R	M&Q	R&R	P&R	M&Q	R&R		
A. SUPPORT											
A.I.I. Develop tailor-made standards, guidelines and procedures for different types of companies working on sustainable design/engineering solutions for de-commission, re-use, re-purposing to be considered early on in the design stages of a system	X										European Strategy for Plastics Circular Economy Package Directive 2019/904, of 5 June
A.I.II. Increase financial support to incentive the development and implementation of sustainable innovative design of materials and equipment, waste collection services, and recycling initiatives	X										European Strategy for Plastics Circular Economy Package Directive 2019/904, of 5 June
A.I.III. Improve marine litter quantification protocols around the farms					X						Marine Strategy Framework Directive
A.II.I. Increase financial support to incentive the development and implementation of sustainable innovative design of materials and equipment, waste collection services, recycling initiatives	X			X							European Strategy for Plastics Circular Economy Package Directive 2019/904, of 5 June
A.II.II. Propose new financial mechanisms appropriate to the specificities of this sector										X	-
A.II.III. Improve resource productivity in the sector through funding/tendering of competition with prize money to accelerate closed loop approaches	X										-

[illegible]

POLICY RECOMMENDATIONS	SOURCES										
	Learning Labs Workshops									Interviews	Relevant Bibliography
	Baltic			North			Mediterranean				
	P&R	M&Q	R&R	P&R	M&Q	R&R	P&R	M&Q	R&R		
B.I.I. Include information on quality standards of materials, technical studies, and waste management plans in the license application processes				X							Waste Framework Directive
B.I.II. Include the identification of potential sources of waste, the estimation of non-organic marine litter related to the facility, and the monitoring of the litter in the license application processes					X			X			Waste Framework Directive
B.I.III. Incorporate the decommissioning process in the licensing processes, including funds for farmers, and ensure compatibility with plastic waste legislation and mandatory reporting of losses			X			X					European Strategy for Plastics Circular Economy Package
B.II.I. Create a specific European/sectorial Single-Use-Plastic regulation and Extended Producer Responsibility scheme regulation for fisheries and aquaculture							X				Directive 2019/904, of 5 June
B.II.II. Perform inspections to enforce regulations and deny concession renewals if criteria are not in conformity							X				-
B.III.I. Incorporate the European Directive 2019/904 on the reduction of the impact of certain plastic products on the environment into national law's									X		Directive 2019/904, of 5 June
B.III.II. Expand the current environmental objectives of the Marine Strategies to include the criteria of monitoring marine litter (related to descriptor 10 - MSFD) in the Compatibility Reports								X			Marine Strategy Framework Directive
B.III.III. Develop national aquaculture law with clear guidelines for the procedures in marine coastal or offshore farms, as well as different farming systems	X										-
B.III.IV. Transposition of the Port Reception Facility Directive into national laws with a focus on easy to handle container systems free of charge	X										New Directive on Port Reception Facilities
B.IV.I. Need of flexibility in the adaptation of rules within the aquaculture sector, since there are different types of aquaculture/different systems of production that produce different types of litter										X	-
B.V.I. Establish common standardised licensing procedures for various types of aquaculture across the EU, in a clear and cohesive format to especially support small-scale farmers	X										-
B.V.II. Harmonise certification systems, including waste management plans	X										Waste Framework Directive
B.V.III. Harmonise, as much as possible, the criteria of the multiple autonomous communities regarding waste management							X				Waste Framework Directive
B.V.IV. Harmonise decommission to avoid unfair competition between countries; mandatory reporting of losses	X										-

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POLICY RECOMMENDATIONS	SOURCES										
	Learning Labs Workshops									Interviews	Relevant Bibliography
	Baltic			North			Mediterranean				
	P&R	M&Q	R&R	P&R	M&Q	R&R	P&R	M&Q	R&R		
B.VI.I. Standardise the labelling systems for aquatic and food products to inform consumers about the environmental impacts of the products; allow labellers to expand on specific requirements or criteria for specific clients	X										Waste Framework Directive Packaging and Packaging Waste Directive
B.VI.II. Create specific certification schemes, which must ensure sustainability, quality and social responsibility	X			X			X				Summary of the 27 Multiannual National Aquaculture Plans (DG MARE, 2016)
C. RESPONSABILITY											
C.I.I. Identify the role and responsibility of all the stakeholders involved in the waste management process				X			X				Waste Framework Directive
C.II.I. Identify the producer responsibility regarding recycling or returning facilities for farmers				X			X				Waste Framework Directive
C.II.II. Good practice certification control points should be feasible to be implemented by producers, based on the official regulations and feasible to be verified by the certification bodies							X				-
C.II.III. Encourage the adoption of good practices by positive economic stimulus, such as tax reduction or fiscal incentives										X	-
C.III.I. Create surveillance plans, which include checking the state of the aquaculture facilities regularly							X				-
C.III.II. Keep track, in a logbook, of the bought items, installed and/or used items, major events happened and any gear loss or break							X				-
C.III.III. Financial incentives, e.g. to the companies that have a higher proportion of gear recycling and re-using			X			X					-
C.III.IV. Apply penalties to the companies that do not put in place prevention measures and/or do not discard properly the gear that has reached the end-of-life									X		-
C.IV.I. Include the circular economy approach when designing and producing any aquaculture gear and facility or when choosing any material							X				Circular Economy Package
D. KNOWLEDGE											
D.I.I. 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				X	X		X	X			-
D.I.II. Quantify microplastics occurrence would help focus on hot spots to collect more detail information and identify suitable solutions											Microplastics in Fisheries and Aquaculture: what do we know? Should we be worried? (FAO, 2017)
D.II.I. Enhance scientific knowledge on new materials and new designs for aquaculture equipment, including detail analysis of	X			X			X				-

POLICY RECOMMENDATIONS	SOURCES										Interviews	Relevant Bibliography
	Learning Labs Workshops											
	Baltic			North			Mediterranean					
	P&R	M&Q	R&R	P&R	M&Q	R&R	P&R	M&Q	R&R			
technical characteristics and the lifetime of aquaculture gear and equipment												
D.III.I. Enhance knowledge in relation to innovation, including waste recycling processes, low value plastic recycling, material design in function of an improved longevity				X							European Strategy for Plastics Circular Economy Package Directive 2019/904, of 5 June	
D.III.II. Promote interdisciplinary and international collaborations, by funding R & I projects between companies and academic partners				X							-	
D.IV.I. Create synergies among all the involved stakeholders to identify the farmer’s needs regarding the aquaculture marine debris management				X							-	
D.V.I. Improve public awareness and stakeholder involvement on marine litter issue. Businesses/enterprises have to be actively involved and recognise as important stakeholders with capacity to influence the earliest stages of the ‘product to waste cycle’											A Portfolio of Marine Litter Policy Options (Altwater et al., 2015)	
D.VI.I. Combine scientific knowledge/expertise of farmers and material producers’ in the development of new aquaculture items/gears. Their knowledge is essential at this earlier stage										X	-	
D.VI.II. Transfer of knowledge’s and adoption of the good practices, from other regional Seas, at all stages of cycle and across the waste hierarchy										X	-	
D.VII.I. Improve decision-makers’ knowledge regarding the aquaculture sector, namely the diversity of existing aquaculture systems										X	-	
E. OTHERS												
E.I.I. Best practices need to be adapted to each reality; they cannot be equal from country to country. Countries are not working at the same aquaculture industry sector level, since some are more developed than others										X	-	
E.II.I. Create possible synergistic benefits from jointly addressing sectors with similar litter issues											AQUA-LIT Project - Deliverable 2.3 ‘Available tools and measures’	