

Recommendations for reducing the impact of aquaculture sector on marine litter

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Introduction

Aquaculture today represents an important source of marine pollution linked to the dispersion of litter at sea (marine litter). The aquaculture tools currently used consist mainly on traditional plastics such as polypropylene (PP) and polyethylene (PE), non-biodegradable materials that degrade and deteriorate producing microplastics. They represent a growing cause of concern for the degradation of marine and coastal ecosystems, potentially endangering the functionality of the ecosystem itself and reducing the quality of coastal waters for fishing and tourism. There is therefore an urgent need to act in the aquaculture sector with the aim of increasing its sustainability, to mitigate their impact on the marine ecosystem.

The action 6.6 of *MARLESS* project aimed at gathering as much information as possible on the identification and evaluation of success stories, gaps and obstacles in using new methods and materials in regional aquaculture to mitigate marine litter.

The activity, developed by University of Bologna (Unibo), included the design of a complete survey targeting strategic stakeholders in finfish and mollusks farming industry (farmers, net producers, mass-market retailers, consumers, etc.) to define the common perception on marine litter issues and role of aquaculture industry on marine litter. Then Unibo team provided to the distribution at regional level of the survey to the most important companies and stakeholders of aquaculture industry, and analysis of data collected.

Presentation of the collected survey data

By directly interviewing a dozen of stakeholders, it emerged that all of them are aware of the seriousness and urgency of the problem that marine litter represents. But only half of them connect it to activities such as aquaculture. They do not believe that aquaculture could affect the presence of litter at sea, polluting water and seabed and that, the waste resulting from this sector harms the animals and therefore decreases the catch.

In Italy the most populated coast of mussels is the Adriatic, so the type of aquaculture farming most frequently found in the areas of the interviewed is the shellfish farming mussels, consist of long-line

offshore systems with muscles rows called *reste* (Fig.1).

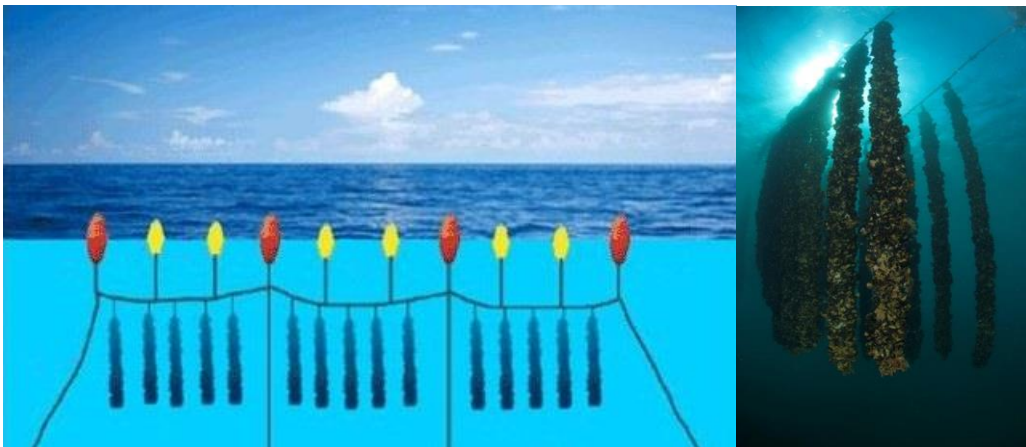


Figure 1: Representation and photo of mussel rows in a long-line farming system.

Obviously, to the question of “what type of marine waste is found most”, the answer from stakeholders was the *nets* at the first place (especially those used for resock the mussels), followed then by ropes, hoses and bands (Fig. 2).

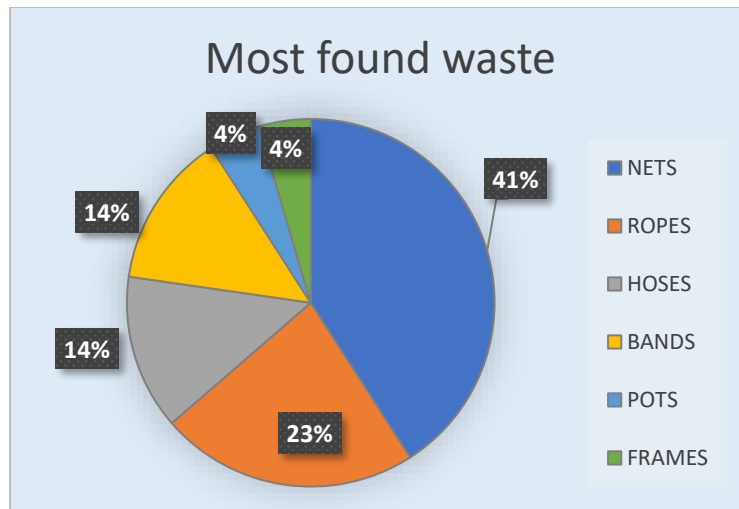


Figure 2: Percentage of the most found waste by the interviewed stakeholders.

Moreover, at the top of the places “where they have seen more this type of marine litter”, there are the beaches followed by the seabed (Fig.3).



Figure 3: Beach and marine seabed, the two place where see more waste.

3/5 of the interviewed do not know the management mode of the marine waste including those from aquaculture. The remaining have tried to define the litter management that is carried out in their municipalities:

- some have said that marine litter is caught by fishermen, generically recycled and reused in a circular economy;
- some, going into specifics, pointed out, however, that the aquaculture marine litter disposal is entrusted to special companies where it is treated as waste from economic activity, special but not dangerous;
- someone has included in the disposal management also the voluntary associations engaged in cleaning the beaches that collect the waste from the marine sites.

It emerges that there is not much clarity about the whole process and the actors involved in the seizure

of waste from the sea, the arrival on land and the entrustment to disposal companies.

2/5 of stakeholders were also aware of specific actions/projects/activities aimed at the recovery of aquaculture marine litter, some of them will be mentioned below as practical activities in place, with suggestions to reduce the impact of aquaculture sector.

Moreover, the 70% of the interviewed showed their willingness to help to solve the problem of this litter, proposing several possible ways to take and suggestions to prevent and/or reduce this form of pollution.

Experimentation of new methods or material in the aquaculture industry

Using advice from stakeholders, a way to reduce marine litter would be to increased safety system of fish aquaculture cages to prevent leakage of construction material at sea. In this regard, it could increase the checks on the state of the structures, replacing in time the worn or damaged parts and training operators for a more effective waste collection system.

There are other gaps in the aquaculture farms to focus on. Poor management of organic waste (feed and manure) that alter the ecosystem: more precise feeder machineries could be used in the amount of food delivery, or it could be defined more precisely the food ration to be administered to biomass; sustainable biomass could be assessed with also new licensing related requirements.

The interviewed consider fundamental, for a trend reversal, the sensibilization activity to raise awareness: -those who work in the sector to avoid waste dispersion; also of the fishermen to encourage them to fish for litter by cleaning the sea and bring back the waste they collect; of citizens, children who can reduce the presence of waste on the beach (Fig.4).



Figure 4: At the top, fishermen who collect waste from the nets; at the bottom; children involved in beach cleaning activities.

The biggest and practical contribution that could come from stakeholders is to replace the plastic materials used with other alternative materials and systems biodegradable/recyclable that is a target of many projects.

Some projects, according to an ongoing CNR study, are testing nets made from natural fibres, such as sisal and hemp (Fig.5). The net produced with these materials, however, has shown criticalities, mainly linked to their rapid fragmentation and degradation, or to the high price linked to the need to develop a technological process not yet existing for their production.



Figure 5: A sock in sisal to grow mussel.

Another viable alternative for replacing traditional plastics in the production of these applications is biodegradable and compostable plastics. Some biodegradable thermoplastic plastics can be processed with the same technology used for traditional plastics, making their production from an industrial point of view relatively simple. At the end of their life cycle, net made from compostable material could be collected and sent to composting plants for the production of quality compost for agricultural use. Moreover, their inherent biodegradability represents a mitigation of the ecological risk in case of dispersion at sea. Pilot studies have been launched in several European countries to reduce the marine plastic pollution generated by the aquaculture sector through the development of innovative biodegradable materials.

The *BIOGEARS* project aims to develop socks for the farming of mussels and algae with compostable plastics from natural components derived from renewable biomass to replace or supplement current

petroleum-based plastics. The aim of the project is to obtain bio-plastics that do not degrade at sea but turn into compost at the end of life.

INDIGO project, part of the Interreg France (Channel) England programme, aims to reduce marine plastic pollution generated by fisheries and aquaculture, develop the first biodegradable fishing gear with a finite lifespan to benefit the marine environment and identify fishing gear already lost and

improve the recycling of fishing gear at the end of its life.

Life_Muscles is a project that aims to contribute to the reduction of the impact related to the use of polypropylene stockings, increase the sustainability of the sector by replacing PP socks with biopolymer (BP) biodegradable and compostable socks, demonstrating the feasibility of their mechanical and organic recycling, and providing mussel farmers with a mobile recycling plant capable of operating directly at farms (Fig. 6).

DeFishGear and *Interreg MI-Repair* aim to provide a first global assessment of the quantities and types of marine solid waste in the Adriatic Sea, applying the same monitoring protocols and methodologies throughout the basin, raising awareness of the parties involved in the problem (fishermen, authorities, population, etc.) to prevent the production of marine litter and implement practical actions to reduce it.

An *EMFF* funded European project carried out by Unibo in the Emilia Romagna Region consisted of validating an oyster production protocol in off-shore shellfish farms using bioplastic supports printed by 3D printer and made of PLA polylactic acid and PHB poly- β -hydroxybutyrate that have replaced the common baskets used in oyster farms made by polypropylene (Fig.7).



Figure 6: Mater-Bi or biopolymer materials produced by *Novamont* company partner of the *Life_Muscles* project.



Figure 7: Bioplastic baskets for oyster farming, produced by *WASP* company during the *FEAMP* project.

To buffer the problem of marine litter from aquaculture, in addition to these practical solutions upstream of the use of materials in aquaculture with the aim to replace existing ones, there is another point on which action can be taken, downstream of their use: improving the management of marine waste at municipal level.

It is essential to define a management of the waste found at sea or aquaculture material at the end of its life. This marine litter could be brought to the port by fishermen, encouraged to do this because the cost of disposal would not fall on them, but it could be taken care of by the company responsible for the collection of municipal waste.

The feasibility of such management was confirmed during the project *FLAG coast of Emilia Romagna*. In fact, this project has seen the collection, characterization and disposal of marine litter from the Catholic Navy by some fishing boats that, every week, delivered in port waste recovered from the nets. These were placed in special bags labelled with information on type, collection site and quantity. The material collected was destined to the *Hera* company for disposal. So, a service of cleaning of the waters and a decrease of the dispersion of material in sea has been obtained (Fig. 8).



Figure 8: Fishermen landing marine litter at the port of Cattolica and bins intended for the collection of this waste used during the *FLAG* project.

The suggestions provided by the interviews and the examples of possible solutions in the testing phase and/or already tested, collected in this report could be used design potential strategies and policies to improve the awareness of marine litter and sustain initiatives in finfish and mollusk supply chain aimed to reduce the impact of aquaculture sector on marine litter.

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