TOWARD THE RESPONSIBLE MANAGEMENT OF THE LIFE CYCLE OF FISHING NETS

DESTINATION ZERO WASTE PROGRAMME

Untangling the Sea
Destination Zero Waste Sicily
Policy Brief – November 2025

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EXECUTIVE SUMMARY

The loss, abandonment, and improper disposal of fishing gear represent **one of the main causes of plastic pollution in the marine environment** and constitute a growing challenge for the sustainable management of fishery resources and underwater ecosystems. Among these, **fishing nets**, mostly made of highly durable plastic polymers, **can remain in the marine environment for decades**, eventually becoming "ghost nets," continuing to catch organisms and damaging sensitive habitats in the Mediterranean, such as coralligenous reefs and *Posidonia oceanica* meadows.

At the global level, it is estimated that **over 46%** of floating plastic macro-waste in ocean gyres consists of **nets and fishing gear**, and that each year **between 2% and 5.7%** of total equipment is lost[1]. In **Sicily**, a region where fishing is an activity of strong economic and social relevance, the phenomenon is intensified by structural and operational issues: lack of port infrastructure for the disposal of dismissed fishing gear; insufficient traceability and marking of equipment; high disposal costs and complexity of authorization frameworks for the removal of marine waste. On top of that, practices of **illegal or unregulated fishing**, as well as the lack of coordinated monitoring and recovery systems, further aggravate the situation[2].

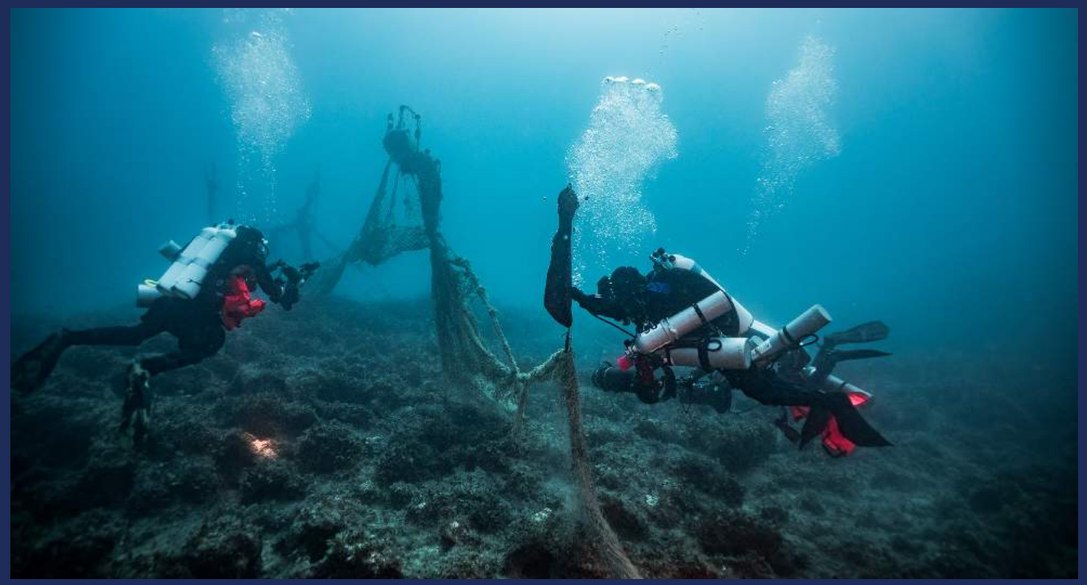

Figure 01 – *Recovery of a ghost net from the Syracuse seabed*

This document examines the life cycle of fishing nets, analysing the critical issues along the entire supply chain and identifying the obstacles that limit their proper management, the opportunities for preventing abandonment, and the prospects for valorisation within a circular economy approach. The findings presented here are the preliminary results of a feasibility study and a participatory process conducted within the project "*Liberare il Mare - Destinazione Rifiuti Zero Sicilia*", made possible thanks to *TUI Care Foundation*, implemented by *Sicily Environment Fund*, a foundation that aims to protect and restore biodiversity and ecosystems in Sicily, in collaboration with *Abyss Cleanup*, an association specialized in the identification and removal of marine waste and ghost nets, and *CNR-IGAG*, whith provides scientific support for the assessment of environmental impacts, in collaboration with *Sapienza University of Rome*.

The analysis highlights the need to develop an **integrated management model** of the life cycle of fishing gear, based on intersectoral collaboration, strengthened collection and disposal infrastructure, wider adoption of traceability practices, increased awareness among operators, and the promotion of material circularity. It is also essential to **simplify administrative procedures** and **enhance coordination** between local authorities, port authorities, and competent institutions, in order to ensure timely interventions consistent with environmental protection objectives.

At the same time, a clear opportunity to promote the **reuse and recycling** of discarded nets arises, both through **local artisanal circular-economy initiatives** and through the development of industrial recycling chains wherever quantities make such processes sustainable. The creation of **shared databases** on the abandonment, location, and management of equipment, together with a clearer **national regulatory framework**, represents a crucial step toward a policy planning and the definition of **targeted incentives.**

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[1] GIZ (2024) – Position Paper of Sectoral Department: Abandoned, Lost or, Otherwise Discarded Fishing Gear.

[2] Legambiente (2025) – Mare Monstrum: Abusivismo edilizio, inquinamento, pesca illegale. I numeri e le storie dell'aggressione criminale alle coste e al mare del nostro Paese.

UNTANGLING THE SEA

The project promotes the establishment in Sicily of a scalable, sustainable model for the responsible management of fishing nets and, inspired by circular economy principles, supports the transformation of waste into a valuable resource. Numerous local actors were involved in pilot activities toward a responsible management model, including:

- **Fishing cooperatives**, to understand the challenges of managing fishing gear and to provide assistance during ghost-net removal operations;
- **Diving centres**, to detect and remove ghost nets;
- **Researchers,** to assess the impact on marine ecosystems by applying standardised protocols that determine when and how lost fishing gear should be removed;
- **Legal consultants**, to analyse the regulatory framework governing the collection and delivery of fishing nets and other marine waste;
- **Designers and artisans**, to explore reuse and recovery solutions;
- **Local communities and tourists**, to inform and raise awareness on responsible and sustainable enjoyment of the sea;
- **Local institutions**, to authorise recovery operations and initiate procedures for a responsible management system.

During the project's first year, the following results were achieved:

- Approximately **800 kg of ghost nets**, still actively fishing and posing a threat to marine life, were recovered off the Ognina marina in Syracuse and between Scoglio del Corallo and Cala Rossa in Terrasini;
- **Stakeholder groups** were identified through a preliminary analysis of key actors, their roles, and functions in net management;
- A **life-cycle analysis of fishing nets** was conducted including **their potential circular economy pathways**, the obstacles to proper management, possible solutions for responsible management, and the stakeholders involved (infographics 1, 2);
- Three **upcycling workshops** were held to experiment with new uses for nets together with designers and artisans;
- A **regional stakeholder network** was mobilised to develop a strategy for the sustainable management of fishing nets.

STAKEHOLDER NETWORK

The stakeholder mapping in the Table below (page 5) serves as a **strategic tool** to understand and coordinate the various actors involved in the management of fishing gear, from institutions that shape environmental policies and oversee port activities, to operators in fishing, recycling, and sustainable design, as well as to research organisations and civil-society groups.

This activity enabled a **comprehensive identification** and **analysis** of key actors, defining their roles, interests, and interdependencies. The goal is to advance an **integrated and participatory management model** consistent with circular economy principles and environmental sustainability.

Figure 02 – Workshop *Oltre la forma* at Scalo 5B (PA)

TABLE – STAKEHOLDER MAPPING WITHIN THE "UNTANGLING THE SEA - DESTINATION ZERO WASTE SICILY" PROJECT

Stakeholder Groups	Involved and To-Be-Involved Actors	Role / Responsibilities	Influence	Interest
Public sector and competent authorities	• Ministry of Environment and Energy Security; • Region; • Municipality; • Port Authorities / Coast Guard; • ARPA; • Managers of Marine Protected Areas.	Definition and implementation of environmental and maritime policies; issuance of authorisations and concessions; control and monitoring of port activities; oversight of safety and proper delivery of nets; normative and programmatic guidance for marine waste management.	High	Medium
Port authorities and environmental operators	• Port System Authorities; • Environmental managers and treatment plants; • Service companies for waste management.	Operational and logistical management of the collection, storage, and delivery of discarded fishing nets; coordination with public bodies, cooperatives, and recycling companies; implementation of infrastructure for the sustainable management of plastic waste in ports.	High	Medium
Private sector and production chains	• Producers and retailers of fishing nets; • Fishing companies; • Fishers cooperatives; • Trade associations; • Recycling and upcycling companies (Aquafil, Odyssey Innovation, Omega Plastic, Recy Tech); • Designers, artisans, and ethical and sustainable design brands (Ogyre).	Economic and industrial actors involved in the generation, management, recovery, and valorisation of fishing nets; active participation in the experimentation of circular economy models; development of technological and market solutions for recycling and transforming plastic materials.	Medium	High
Research, innovation, and education	• Universities; • Public and private research institutions; • Innovative start-ups; • Technology competence centres.	Applied research activities on materials and recycling processes; environmental and socio-economic impact analysis; development of technologies for monitoring and traceability; experimentation with co-design and circular innovation models; scientific support to the decision-making process.	Medium	High
Civil society and third sector	• Environmental and social non-governmental organizations (NGOs); • Volunteer associations; • Organisations for sustainable development; • Coastal communities and citizen groups.	Promotion of environmental education and citizen science; ghost net recovery activities; public awareness and communication; involvement of local communities and operational support for clean-up and monitoring initiatives.	Low	High

REGULATORY FRAMEWORK

In Italy, fishing nets that reach the end of their life cycle are classified by approximation under codes 10.13.11 or 15.02.03 of the European Waste Catalogue (EWC) and, as such, are subject to the traceability obligations established by **Legislative Decree 152/2006** (for example, the FIR - Identification Form, c/s Register, and the MUD - Single Environmental Declaration Model). Their management, however, is made complex by several factors, including the composite nature of the materials, the absence of specific rules on recovery or recycling, and the high disposal costs. In most cases, in fact, discarded nets are managed as generic plastic waste, with no opportunity for valorisation, despite containing valuable materials such as nylon or recyclable polyamides.

With Law No. 60 of 17 May 2022 (**SalvaMare Law**), Italy introduced innovative measures for the management of waste accidentally caught or voluntarily collected at sea. Recognising this waste as **municipal waste** has enabled several important **operational simplifications** for municipalities and the operators collaborating with them, including: fishing vessels transporting accidentally caught waste are not required to register with the National Register of Environmental Managers; the free delivery of waste to port facilities is considered temporary storage, avoiding additional administrative burdens; management costs are covered by a specific component of the TARI (waste tax), without creating financial burdens for fishers or divers.

The law also provides for the development of technical collection protocols, the mapping of dedicated port areas, and the possibility for municipalities to promote both awareness campaigns aimed at industry operators, as well as incentive schemes for vessel owners who recover and deliver such waste on land. However, these specific provisions have had limited practical impact, as their full implementation depends on ministerial decrees that have not yet been issued.

At the European level, the sustainable fishing gear management is addressed within a broader structure. **The Fisheries Control System 2024 defines a common framework for the control and traceability of fishing activities,** in line with the **Common Fisheries Policy (EU Regulation No. 1380/2013).** In parallel, the **Single-Use Plastics Directive (SUP Directive - 2019/904/EU)** introduces **Extended Producer Responsibility (EPR)** for fishing gear containing plastic. This mechanism requires that producers, importers, and distributors of such gear cover the costs of collection, transport, treatment, recycling, and disposal of the gear once it is discarded.

EPR represents a **paradigm shift** in approach, transferring part of the responsibility for end-of-life management from fishers to producers, thus encouraging the design of fishing gear that is more durable, repairable, and recyclable. In practice, this calls for the creation of collective collection and recovery systems coordinated at the national or European level, ensuring flow traceability and greater data transparency. The implementation of EPR for fishing nets opens up **significant opportunities for innovation** in the fisheries sector and for the circular economy. Potential developments include the regeneration of synthetic fibres (for example, for use in technical textiles or industrial materials), the creation of sectoral consortia, and the development of dedicated collection models in ports.

Italy is still in a preliminary phase of implementing EPR for fishing gear, as specific national tools and structured coordination mechanisms among producers, port authorities, and waste management operators have not yet been established. A regulatory framework, however, is already outlined by **Legislative Decree No. 196 of 8 November 2021**, which transposes the **SUP Directive** by introducing EPR obligations for certain plastic products, including fishing gear. This is complemented by **Ministerial Decree No. 354 of 30 October 2023**, which sets - for the period 2024-2025 - the national minimum annual collection rate of discarded fishing gear containing plastic destined for recycling, equal to 15% by weight of the plastic-containing gear placed on the national market each year.

Integrating the SalvaMare Law with the European EPR provisions and with forthcoming implementing decrees could, therefore, represents a turning point in the sustainable management of fishing gear, helping transform an environmental problem into a circular economy opportunity.

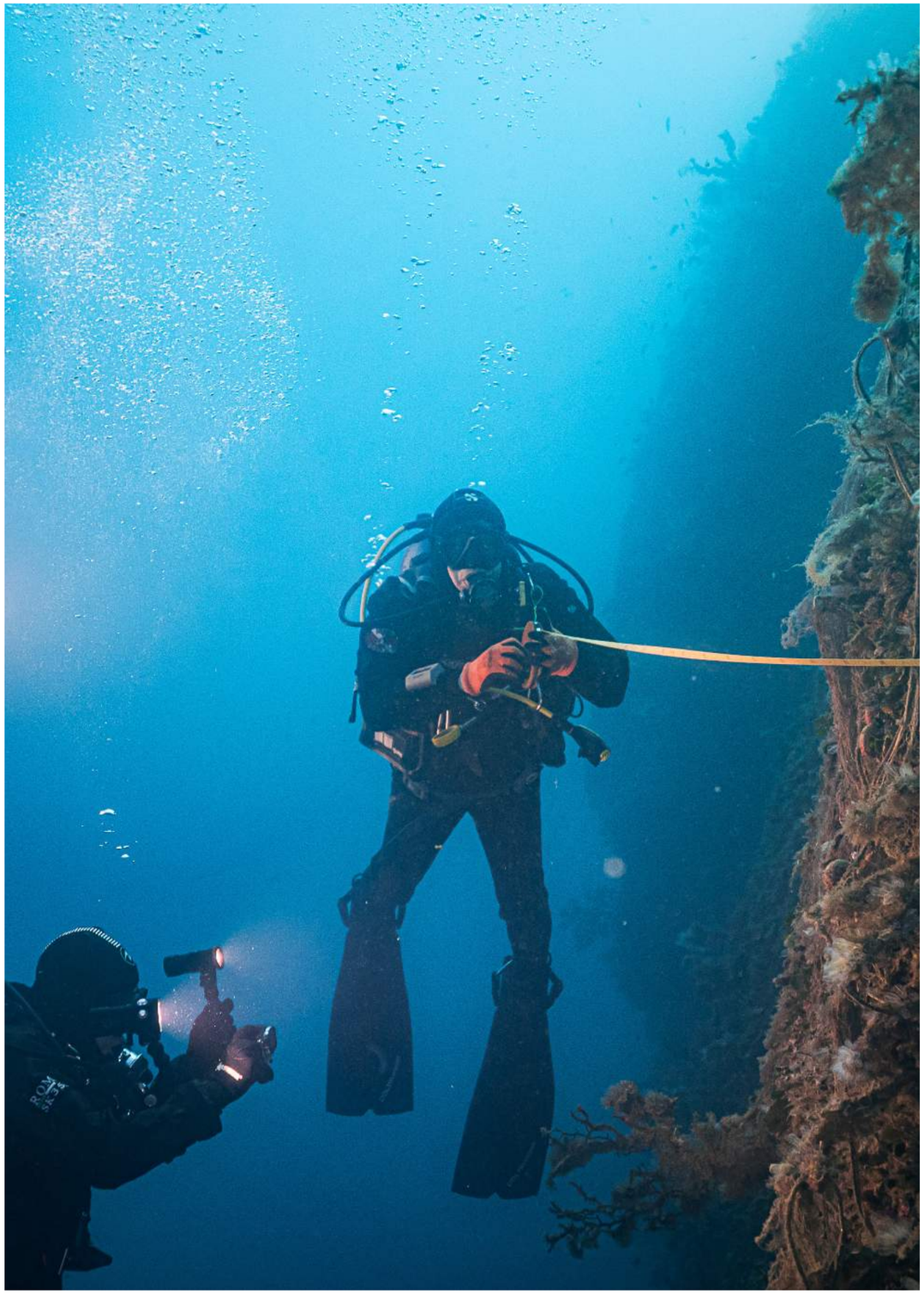


Figure 03 – *Recovery of a ghost net from the Terrasini seabed*

LIFE CYCLE OF FISHING NETS

The life cycle of fishing nets - **use, wear and tear, storage, and delivery of discarded and ghost nets** - presents numerous obstacles to proper management. Nonetheless, there are good practices and solutions that can help prevent their release into the environment, and potentially guide net management toward circular economy models.

Although made from very durable materials, fishing nets are prone to wear and tear and breakage. Fishers are familiar with maintenance and repair techniques that help prevent environmental dispersion and reduce costs associated with purchasing new nets or disposing of those at the end of their life. From a social and economic perspective, the absence of a management plan grounded in circularity generates additional burdens for fishers, who must bear the logistical costs of storage, delivery, and disposal.

When damaged nets are no longer repairable, they are not always stored and delivered correctly. Accumulations of **discarded fishing nets** often end up being abandoned, lost or otherwise discarded (ALDFG) in port areas or warehouses, while **ghost nets** left in the sea continue to trap marine life, smother seabed habitats, fragment into microplastics, and contaminate food chains. The availability and effective management of infrastructure, such as ecological islands and port containers, would facilitate proper storage of nets, preventing their release into the environment. Furthermore, the **use of incentives**, **clear procedures**, and the **application of the SalvaMare Law** would simplify the delivery of nets by fishers and their collection by municipal authorities, directing the waste toward authorised treatment facilities for disposal or recycling.

THE LIFE CYCLE OF FISHING NETS

USE

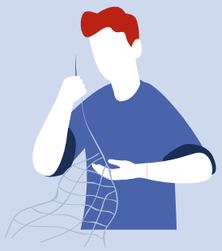
Polyamide (PA),
Polyethylene (PE),
Polypropylene (PP)

durable materials, but non-biodegradable and difficult to recycle

Average lifecycle:
(*active use*)
6–24 months

WEAR AND TEAR

Maintenance and **repair** techniques **help prevent their dispersion.**



STORAGE AND DELIVERY OF DISCARDED NETS

These are usually **stored** in ports or warehouses without being sent for disposal or recycling.

↓

Obstacles to proper management:

- Non-implementation of the SalvaMare law
- Lack of port eco-islands
- Absence of incentives for delivery

RECOVERY AND DELIVERY OF GHOST NETS

Abandonment and loss at sea occur due to adverse weather conditions, congestion in fishing areas, interactions with wildlife, and snagging.

↓

Reports can trigger recovery operations at sea, involving **fishers and expert divers.***

↓

Obstacles to proper management:

- Non-implementation of the SalvaMare law
- Lack of port eco-islands
- Absence of clear procedures

*Recovery depends on **the condition of the net** and must be carried out by experts following an **environmental impact assessment**.

A net that is too encrusted or integrated into the seabed **should not be removed** to avoid damage to habitats.

they cause:

- pollution
- entanglement of marine wildlife
- habitat damage
- microplastic release
- navigation hazards
- economic losses for fishers

ENVIRONMENTAL IMPACT ASSESSMENT

Initiatives for the identification, mapping, and removal of **ghost nets** often result from collaboration between fishers, divers, non-profit organisations, and academic institutions. Currently, there is a very limited number of standardised protocols for environmental impact assessment specifically aimed at evaluating the necessity and feasibility of removing lost fishing gear, as well as the potential impacts associated with removal operations. In this project, the protocol developed by Ruitton et al. (2020) was adopted, employing a synthetic index called **GRI - Gear Removal Index**, as a tool to assess the environmental impact of lost fishing gear and to support decision-making regarding whether or not to remove detected gear.

The calculation of the GRI requires the analysis of multiple parameters concerning the characteristics of the lost gear and the environmental context in which it is located, making it essential to collect high-quality video data from divers or remotely operated vehicles (ROVs) during underwater survey phases.

The descriptors used for assessing the impact of fishing gear and calculating the GRI are summarised as follows: **size and characteristics of the gear; type of benthic habitat affected; colonisation** (composition and density of epibiont organisms); **impacts on habitats; impacts on species; impacts on the seascape; technical difficulty of removal** (depth and degree of entanglement on the seabed); **site usage.**

By summing the scores assigned to each descriptor, a composite value is obtained determining the priority for fishing gear removal interventions, classified into five categories ranked on a scale from *high to not recommended*.

CIRCULAR VALUE CHAIN MODEL

The application of circular economy principles to the fishing net supply chain promotes the creation of a **circular value chain**, capable of integrating environmental sustainability, production efficiency, and technological innovation. This model is based on a systemic approach that **considers all phases of production and management** - from the selection of raw materials to the recovery and reintegration of materials into the production process - **as a continuous flow of value**. Key elements to optimise the resource cycle and reduce the overall environmental impact of the supply chain include **material traceability, process standardisation**, and **collaboration** among economic, institutional, and research actors.

The circular value chain is therefore an **integrated resource management system**, in which all phases - from design to reuse and recycling - are complementary within a single regenerative process.

The objectives are:

- **To maximise** efficiency in the use of polymeric materials;
- **To prevent** waste dispersion into the sea;
- **To promote** new artisanal and industrial development opportunities through partnerships and dedicated infrastructures.

This approach constitutes a replicable operational framework capable of making the fisheries supply chain more resilient, competitive, and aligned with European and national strategies promoting the circular and blue economies.

A CIRCULAR ECONOMY MODEL FOR FISHING NETS

INDUSTRIAL RECYCLING

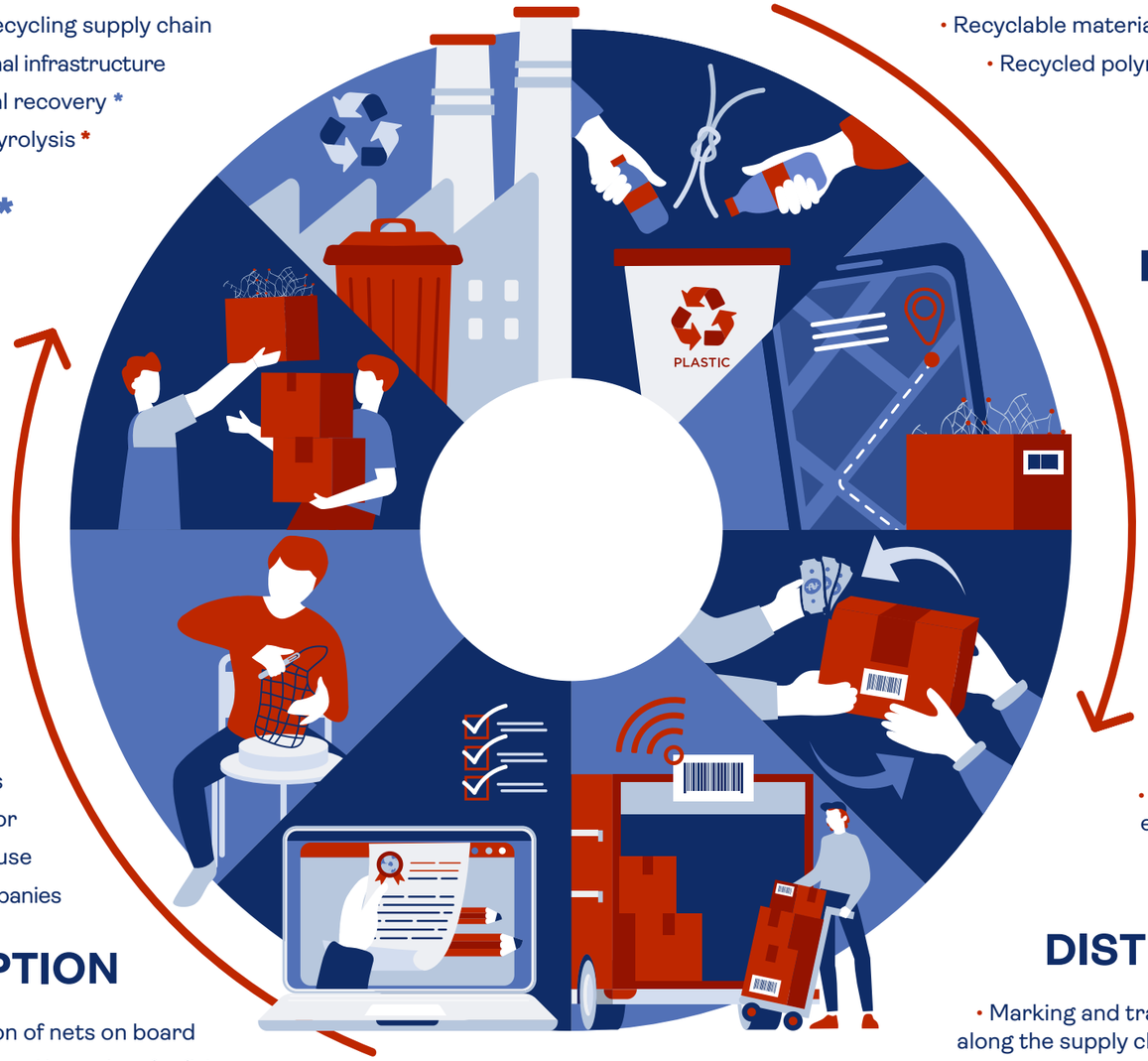
- Coordination of the recycling supply chain
- Industrial partnerships and regional infrastructure
- Material recovery *
- Energy recovery or pyrolysis *

RAW MATERIALS

- Recyclable materials
- Recycled polymers

COLLECTION OF DISCARDED* AND GHOST* NETS

- Temporary storage for transformation or disposal **
- Standard protocols for data collection and assignment of EER codes **
- Coordination among local actors **
- Economic incentives and port eco-islands *
- Facilitation and approval of authorisations *



DESIGN

- Single-component materials
- Marking and traceability to identify origin, manufacturer, and batch

REUSE, REPAIR AND UPCYCLING OF DISCARDED NETS

- Local circuits among fishing cooperatives
- Reuse for secondary applications in the fishing sector
- Artisanal reuse
- Partnerships between artisans, designers, and companies

PRODUCTION

- Environmental protocols and sustainability certifications
- EPR systems for the supply chain
- Development of nets that are easily repairable and recyclable

USE AND CONSUMPTION

- Digital registration of nets on board
- Training and incentives for fishers
- “Responsible Fishing” certification

DISTRIBUTION

- Marking and traceability along the supply chain
- Deposit-return systems or collection of used nets

ARTISANAL REUSE AND UPCYCLING

Discarded fishing nets have been reused during two **prototyping and redesign** workshops. The initiative provided the opportunity to explore the potential of net reuse, experimenting with their integration with other materials and fostering collaboration between **artisans, designers**, and **small businesses,** also through the exchange of know-how. **Artisanal techniques**, sewing machines, 3D printers, and semi-industrial machinery were employed for material transformation. The workshops highlighted both the opportunities for valorising a complex and durable material and the operational challenges related to the hardness of the fibres and the need for specialised skills in processing.

Figure 04 – Workshop *Oltre la forma* at Scalo 5B (PA)

RECOMMENDATIONS AND CONCLUSIONS

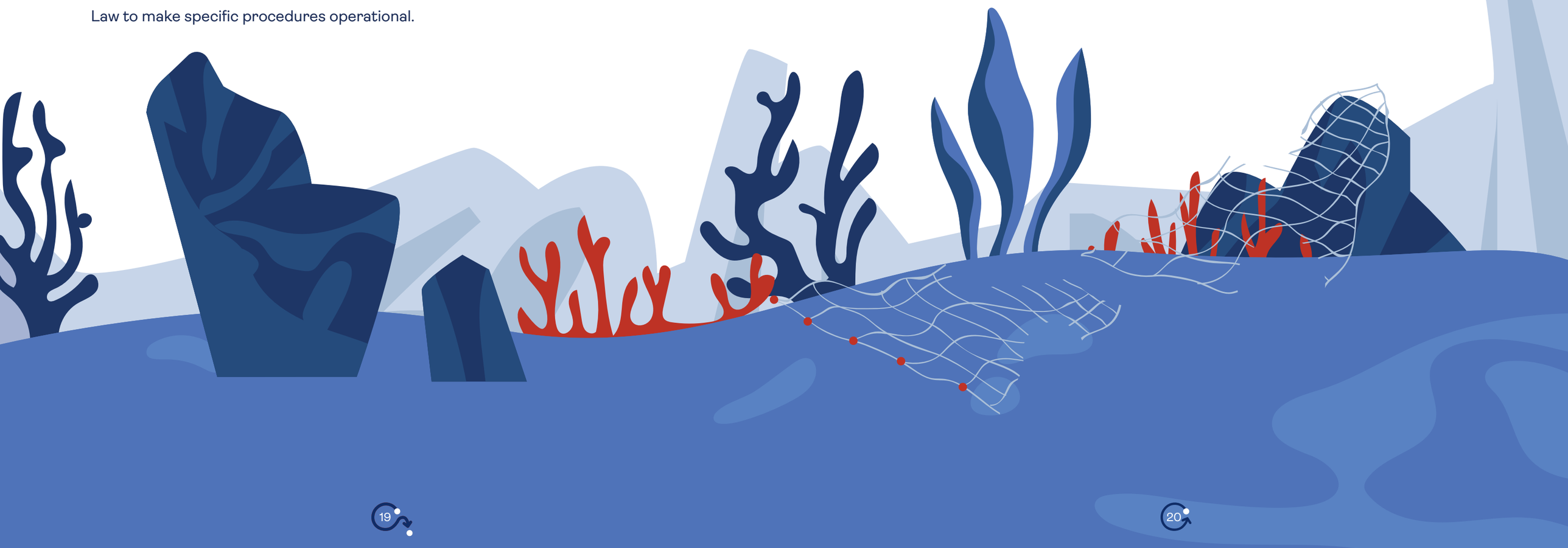
Based on the findings of the *Untangling the Sea – Destination Zero Waste Sicily project*, the following operational recommendations have been formulated to support more effective management and valorisation of fishing nets within a circular economy framework.

At the regional level

- **Prevention of dispersion**: strengthen measures to prevent the loss and abandonment of fishing gear, reducing the formation of ghost nets, which cause serious impacts on marine ecosystems and generate high recovery costs.
- **Dedicated infrastructure**: set up dedicated collection and delivery facilities (ecological islands, port containers, equipped areas) to enable efficient collection and disposal of discarded nets and accidentally caught waste.
- **Regional database**: develop an open-data platform to monitor the distribution, use, and disposal of nets in Sicily, also integrating ghost net reports, to support the planning of circular economy models.
- **Streamlining authorisations**: simplify and standardise procedures for ghost net removal, currently fragmented and complex, to ensure timely interventions.
- **Local circular economy**: encourage initiatives for reuse and artisanal valorisation of discarded nets, supporting new forms of local and social entrepreneurship.
- **Industrial recycling**: where significant volumes exist, promote the creation of a regional recycling supply chain capable of ensuring continuity of supply to sector businesses and reducing transport and disposal costs.
- **Multi-stakeholder coordination**: establish permanent working groups among fishers, port authorities, local entities, associations, and industry for the development of a circular fishing net supply chain.
- **Application of the SalvaMare Law**: promote awareness and implementation of the law at the municipal level to facilitate the collection free of charge of ghost nets.

At the national level

- **Regulatory clarity**: update the legal framework regarding the classification of fishing nets, particularly multi-component ones, and the management of waste resulting from maritime activities to resolve current interpretative uncertainties.
- **Administrative simplification**: promote greater interministerial integration (Environment, Agriculture, Infrastructure, Made in Italy) to standardise procedures and responsibilities concerning marine waste and fishing gear.
- **Implementation of EPR**: accelerate the implementation of a national Extended Producer Responsibility (EPR) system for fishing nets, consistent with the SUP Directive and Ministerial Decree 354/2023, providing dedicated funds to municipalities for collection and recycling, following the model of the Sustainable Fisheries Fund.
- **Recognition of regeneration supply chains**: include recovery and transformation processes of discarded nets among innovative production sectors, facilitating access to tax incentives, long-term contracts with the recycling industry, and demand-support mechanisms.
- **Implementation of the SalvaMare Law**: issue the implementing decrees of the SalvaMare Law to make specific procedures operational.



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