Interreg North Sea

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TREASURE



TREASURE- Policy Informing Brief
Living Lab Nieuwpoort

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Policy Informing Brief

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Aim of the Document

This document presents the main insights, lessons learned, and recommendations emerging from the TREASURE Living Lab in Nieuwpoort. It brings together evidence from research, citizen science, stakeholder engagement and technological testing to better understand and address plastic pollution from riverine plastic litter outflow into the North Sea. The results identify opportunities to strengthen prevention, improve litter monitoring and collection, support behaviour change, and enhance governance coordination across sectors and levels of government. Rather than providing a comprehensive overview of all project activities, the document focuses on the most relevant findings for policy and practice.

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Executive Summary

The TREASURE project (Targeting the reduction of plastic outflow into the North Sea, 2023-2026), co-funded by the Interreg North Sea Programme addresses the challenging issue of plastic pollution flowing into the sea from inland waters. Fifteen partners from five North Sea countries collaborate across scientific, technological, governance and societal perspectives to develop and assess solutions for preventing and intercepting plastic litter before it reaches the marine environment.

In Belgium, one of the participating countries in the TREASURE project, the city of Nieuwpoort served as a living laboratory to investigate plastic pollution in the Yser River and explore locally relevant solutions. Here, scientists collected data on macro-litter abundance, composition, potential sources and accumulation hotspots at four locations: upstream the Ganzepoot sluice system, in the nature reserve 'IJzermonding', in the marina and at the beach. Field surveys revealed that litter accumulated primarily along riverbanks and in the harbour, while the beach showed lower levels of accumulation, potentially reflecting regular clean-ups by the municipality, volunteers and non-governmental organisations. **Common litter items included** sweets and crisps packaging, caps and lids, cigarette filters, polystyrene, dolly ropes and fishing lines. Differences between locations indicated the **influence of multiple sources**, particularly fishing, tourism and harbour activities.

Fieldwork and numerical modelling helped identify a suitable location for intercepting floating and submerged litter before it reaches the sea. Based on these findings, a litter catcher using a bubble curtain was deployed next to the Ganzepoot. Modelling determined its operational parameters, while field trials showed that the system successfully intercepted litter, but that during extreme weather events like storms, wind-driven transport can outweigh the influence of the ebb currents. Therefore, valuable insights have been learnt for the further optimisation of the catcher.

Citizen participation was an integral part of the living laboratory. Through surveys and citizen science activities, residents, teachers and pupils contributed to pollution monitoring, clean-up activities and the assessment of public perceptions. Activities undertaken with the Plastics Pirates initiative helped engage schools in investigating litter in their local environment. Survey findings showed **strong public support for preventive measures**, particularly **greater producer responsibility, deposit-return schemes, improved waste management systems and stricter regulation**.

Within the project, workshops with public authorities were also organised to help understand the challenges and opportunities of plastic litter management in Nieuwpoort. Although measures to prevent, monitor and intercept plastic litter are already in place at local and federal levels, including policies transposing European Union requirements, responsibilities remain fragmented. This fragmentation can create uncertainty over roles and hinder the development and implementation of effective, locally tailored solutions. **Stronger dialogue** and collaboration among public authorities, waste managers, producers and key economic sectors, particularly fisheries and agriculture, were identified as important priorities. Preventative measures are the preferred option to tackle pollution with the help of monitoring and collection to intercept litter already present in the environment. Therefore, insights point towards a need for **clearer responsibility roles** and **better communication across multiple sectors** starting at the pollution source. The establishment of a **central contact point** was identified as one of the possible solutions to overcome this challenge.

The approach of the project are presented in the Living Lab Nieuwpoort's Roadmap and more information can be found on the online StoryMap.

Samenvatting voor beleidsmakers

Het TREASURE-project (*Targeting the Reduction of Plastic Outflow into the North Sea*, 2023–2026), mede gefinancierd door het Interreg Noordzeeprogramma, richt zich op de complexe uitdaging van plasticvervuiling die via binnenwateren in zee terechtkomt. Vijftien partners uit vijf Noordzeelanden werken samen vanuit wetenschappelijk, technologisch, bestuurlijk en maatschappelijk perspectief om oplossingen te ontwikkelen en te evalueren die plastic zwerfvuil voorkomen en opvangen voordat het de mariene omgeving bereikt.

In België, een van de deelnemende landen aan het TREASURE-project, fungeerde Nieuwpoort als een *living lab* om plasticvervuiling in de IJzer te onderzoeken en lokaal relevante oplossingen te verkennen. Wetenschappers verzamelden gegevens over de hoeveelheid en samenstelling van macroafval, mogelijke bronnen en locaties waar het afval zich ophoopt. Hiervoor werden drie locaties onderzocht: stroomopwaarts van het sluizencomplex De Ganzepoot, in de jachthaven en op het strand. Uit de veldonderzoeken bleek dat zwerfvuil zich voornamelijk ophoopt langs de oevers van de rivier en in de jachthaven. Op het strand werd minder afval aangetroffen, mogelijk dankzij de regelmatige opruimacties van de gemeente, vrijwilligers en niet-gouvernementele organisaties (ngo's). **Veelvoorkomende afvalcategorieën** waren snoep- en chipsverpakkingen, doppen en deksels, sigarettenfilters, piepschuim, touwen voor de visserij (bv. Spekking) en vislijnen. De verschillen tussen de onderzochte locaties **wijzen op verschillende bronnen van vervuiling**, met name visserij, toerisme en jachthaven activiteiten.

Veldonderzoek en numerieke modellering hebben geholpen bij het identificeren van een geschikte locatie om drijvend en ondergedompeld zwerfvuil op te vangen voordat het de zee bereikt. Op basis van deze bevindingen werd naast de Ganzepoot een zwerfvuilvanger op basis van een bellenscherm geïnstalleerd. Met behulp van modellering werden de operationele parameters bepaald. Uit veldtesten bleek dat het systeem erin slaagde zwerfvuil op te vangen. Tijdens extreme weersomstandigheden, zoals stormen, kan het door de wind aangedreven transport echter sterker zijn dan de invloed van de ebstroming. De opgedane inzichten bieden daarom waardevolle aanknopingspunten voor de verdere optimalisatie van de zwerfvuilvanger.

Burgerparticipatie vormde een essentieel onderdeel van het living lab. Via enquêtes en burgerwetenschapsactiviteiten droegen inwoners, leerkrachten en leerlingen bij aan de monitoring van vervuiling, opruimacties en het onderzoek naar de perceptie van het publiek. Dankzij activiteiten in samenwerking met het initiatief *Plastics Pirates* werden scholen betrokken bij het onderzoeken van zwerfvuil in hun eigen omgeving. Uit de enquêteresultaten bleek dat er **veel draagvlak bestaat voor preventieve maatregelen**, met name **een grotere verantwoordelijkheid voor producenten, statiegeldsystemen, verbeterde afvalbeheersystemen en strengere regelgeving**.

Binnen het project werden ook workshops met bevoegde instanties georganiseerd om de uitdagingen en opportuniteiten voor het beheer van plastic zwerfvuil in Nieuwpoort in kaart te brengen. Hoewel er op lokaal, Vlaams en nationaal niveau al maatregelen bestaan om plastic zwerfvuil te voorkomen, te monitoren en op te vangen, waaronder beleidsmaatregelen die de Europese verplichtingen ondersteunen, blijven de verantwoordelijkheden versnipperd. Dit kan leiden tot onduidelijkheid over de verschillende verantwoordelijkheden, en de ontwikkeling en uitvoering van doeltreffende, lokaal afgestemde oplossingen bemoeilijken. **Een betere dialoog** en samenwerking tussen overheden, afvalbeheerders, producenten en belangrijke economische sectoren, in het bijzonder de visserij en de landbouw, werden als belangrijke prioriteiten geïdentificeerd. Preventie aan de bron geniet de voorkeur, aangevuld met monitoring en het opruimen en opvangen van afval dat al in het milieu aanwezig is. De bevindingen wijzen daarom op de nood aan een **duidelijkere verdeling van verantwoordelijkheden** en **betere communicatie tussen de verschillende sectoren**, met aandacht voor de oorsprong van de vervuiling. De oprichting van één **centraal aanspreekpunt** werd geïdentificeerd als een mogelijke oplossing om deze uitdagingen aan te pakken.

De aanpak van het project wordt gepresenteerd in de Roadmap van het Living Lab Nieuwpoort. Meer informatie is beschikbaar in de online StoryMap.

TREASURE- Targeting the Reduction of Plastic Outflow into the North Sea

Living Lab Nieuwpoort, Belgium

Achieving the European Union's target of reducing **plastic litter at sea by 50%** and **microplastic pollution into the environment by 30%, by 2030,** as set out in the Zero Pollution Action Plan, will require not only ambitious policy commitments but also effective, evidence-based implementation. In Belgium, the Federal Action Plan on Marine Litter (2022-2027) and the Flemish Action Plan for Marine Litter have also set objectives and actions to enable tackling the complex issue of plastic litter, in line with EU policy.

To help understand how these ambitions could be translated into practice, **the seaside community** of Nieuwpoort, provided a real-world setting to study plastic as one of the project's selected living laboratories. The TREASURE project employs the **quadruple helix of innovation**, where science, business, society and policy collaborate to jointly develop and implement evidence-based solutions to tackle plastic pollution.

The Living Lab Nieuwpoort (LLN) follows four pillars to tackle litter (Figure 1):

- improving understanding of litter sources and composition through data collection and analysis,
- testing effective plastic waste removal methods,
- raising awareness and encouraging behaviour change to reduce plastic pollution,
- strengthening governance and policies to improve collaboration and support waste prevention.

Testing solutions and removing plastic pollution in real-life scenarios

The Interreg North Sea TREASURE project unites 15 partners from five North Sea countries to jointly tackle the problem of plastic pollution by mapping the plastic flux and suggest actions and solutions to reduce the outflow of plastic litter from rivers and inland waters into the North Sea.

The project centres on **Living Labs**, where solutions are tested through public-private collaboration at representative river-sea interfaces across the North Sea region. The ultimate goal is to feed information into the TREASURE Toolbox, a hands-on **tool to assist water managers and stakeholders** choose between observation and sampling solutions (see methodological factsheets)[2], as well as plastic-removal solutions suitable for specific areas.

This (policy) brief presents the results of LLN and recommends further action based on the lessons learnt. For more information on the LLN approach, consult the LLN Roadmap[1], methodological factsheets[2] and for more information on the LLN, see our online StoryMap



Figure 1. The four pillars to stop litter from reaching the sea in Living Lab Nieuwpoort.



Pillar 1. Data Collection & Analysis

What do we know about litter in Nieuwpoort?

Effective plastic pollution management depends not only on knowing what types of litter are present, but also where they accumulate and which human activities are responsible for introducing them into the environment. Such research informs effective litter reduction strategies and supports implementation of the Marine Strategy Framework Directive[3]. Additionally, this evidence enables local authorities to make informed decisions and to prioritise interventions where they will have the greatest impact[4].

Year-round litter surveys (Figures 2-3) at the Yser River mouth identified accumulation hotspots and linked litter to key human activities, improving understanding of how litter enters the environment[5]. Litter density in Nieuwpoort increased from 0.04 litter items/m² on the beach to 1.17 items/m² in the nature reserve, 1.07 items/m² on the slipway in the marina, and 6.17 items/m² on the Yser riverbank. **On the beach**, the most common items were tobacco products with filters, dolly ropes, and fishing strings and filaments, mainly linked to fishing, tourism, and waste collection and disposal. **In the nature reserve**, plastic fragments, crisps and sweets packaging, and fragments of foamed polystyrene were most frequent, with harbour and port activities, tourism, and fishing identified as the main sources. In the **marina**, plastic fragments, crisp and sweet packaging, and cigarette filters were most frequently found, linked to tourism infrastructure (restaurants, bars, hotels etc.), fishing, and building and construction activities. **At the riverbanks**, plastic fragments, crisps and sweets packaging, and drink caps and lids dominated, mainly originating from tourism, households and littering, and waste collection and disposal.

Insights

- Low litter densities on the beach may partly reflect intensive municipal and volunteer clean-up efforts (e.g., daily clean-up in summer), highlighting the importance of sustained community engagement in maintaining clean coastal areas.
- The higher densities of stranded macrolitter upstream suggest that litter accumulates along the riverbanks and in the harbour. Prioritising litter interception and removal in harbour and estuaries could prevent litter from entering the marine environment.
- Litter sources differ strongly between locations, with limited seasonal variation and little exchange between sites, highlighting the need for location-specific prevention and clean-up measures (Figure 3).

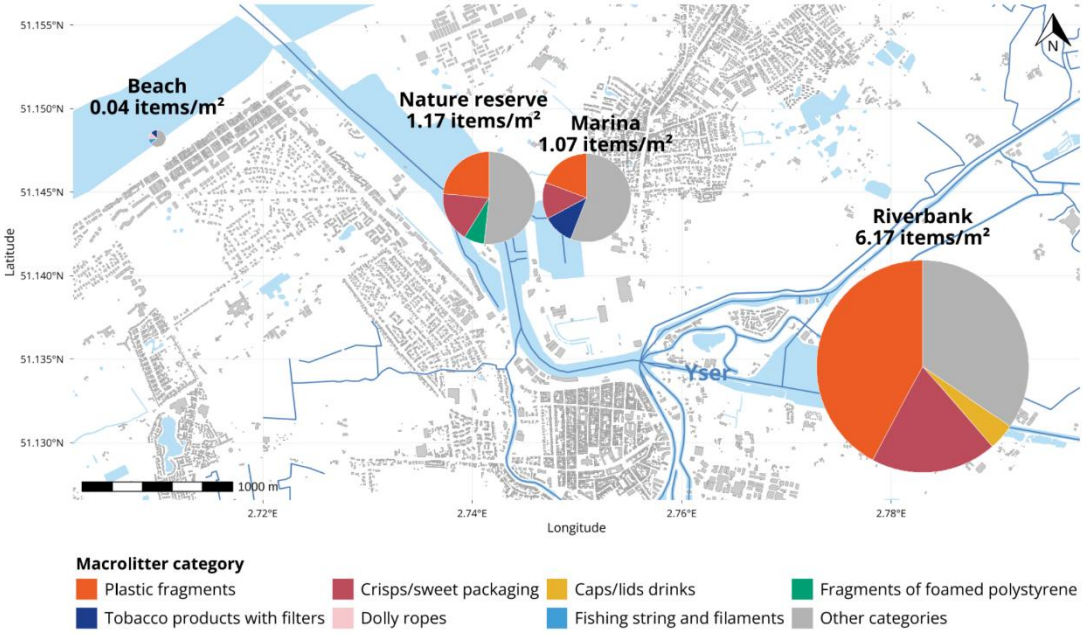

Figure 2. Mean litter density and most frequently found litter categories at the Yser river mouth. The pie charts depict the top 3 most frequently found litter categories per location (mean values across all seasons), with all remaining litter categories being summarized as 'Other categories'. Each pie area is directly proportional to the mean litter density at the beach, nature reserve, marina, and riverbank.

Insights on sampled macrolitter sources

- **Site-specific litter sources** should inform plastic litter prevention strategies and mitigation actions, as litter sources show strong spatial differences between riverbank, marina, and beach. Across all locations, tourism is one of the main litter sources;
- **Cross-sector collaboration is essential,** as multiple sectors, including tourism, fisheries, waste management, and local communities, contribute to plastic litter.

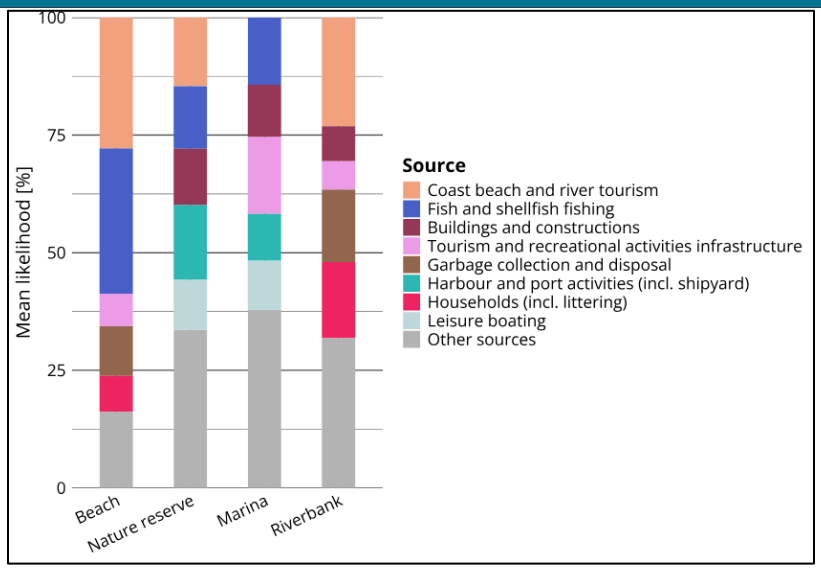

Figure 3. Mean likelihood of macrolitter sources (across all seasons) from the four sampled locations.

Does plastic litter flow into the North Sea via Nieuwpoort?

To help reduce plastic litter at sea, there is also a need to understand how litter behaves in the waterways, regarding litter pathways and potential litter accumulation areas at the Yser river mouth. This stems from the fact that these areas can function as temporary reservoirs, releasing large amounts of litter into coastal areas during extreme events such as heavy rainfall[6,7].

A numerical mathematical model[8] considered possible litter release locations and simulated floating macrolitter transport for the tidally influenced Yser river mouth. This approach helped identify transport pathways, accumulation zones, and optimal locations for litter interception. The model was validated using field data of floating GNSS-tracked plastic drifters released during 7-day and 14-day experiments (Figure 4).

Under the specific modelled conditions, the **simulations indicate that plastic export to the sea is relatively limited** but can increase depending on where it enters the system and the prevailing hydrodynamic conditions. Entry points closer to the city, spring tides, and higher freshwater discharges regulated by the Ganzepoot sluice system appear to favour downstream transport, particularly during high river discharge events when the sluices are opened more frequently to release water into the tidal river mouth and harbour area. However, **further simulations are needed** under different conditions to obtain more robust and reliable estimates.



Figure 4. In a joint effort between ULCO and VLIZ, GNSS-tracked plastic drifters were released in key areas of the Yser River mouth, to assist in understanding the effects of the tides in the transport and accumulation of litter. The results of data collection fed the mathematical model, developed by IMDC.

Insights on plastic litter flow in Nieuwpoort

- The Yser river mouth appears to act as a retention zone, where tides, vegetation, and harbour infrastructure trap floating litter, accumulating in areas of the Yser River nature reserve, an important habitat for protected bird species;
- The combination of **modelling and field observations** can provide **robust evidence** for identifying priority locations for litter monitoring and interception;
- Most tracked items remained in the harbour area and did not reach the open sea.



Pillar 2. Removal of Plastic Waste

How can we remove the litter from the "Ganzepoot" sluice system?

Reducing marine litter requires action along the entire **source-to-sea continuum**. Intercepting litter in rivers and estuaries before it reaches the sea complements upstream prevention measures and helps achieve marine litter reduction goals[4,9]. Plastic **clean-up technologies** will help reduce litter present in the environment [10].

In Nieuwpoort, the project tested **M.A.R.C. - the Litter Catcher**, a system designed **to intercept floating and submerged litter before it reaches the North Sea**. The device (Figures 5-6) uses a bubble curtain to guide plastic litter into a collection container, where it can be regularly removed, quantified, and analyseBriefBriefd.

Two types of numerical modelling were used to first inform on the optimal placement of the catcher by assessing the plastic pathways and accumulation spots. Second, to support the design of the bubble screen by optimising its placement angle and running parameters to divert litter toward the collector under varying conditions. Additional GNSS trackers were also used to further evaluate the system's effectiveness.

Insights on the litter catcher

- The system **successfully intercepted floating debris** under typical hydrodynamic conditions (Figure 6). Field trials also showed that during storm events with strong westerly winds, **wind-driven transport can dominate floating plastic movement**, outweighing the influence of the relatively weak ebb currents in the area.
- These findings provide **valuable input for the further optimisation** of the M.A.R.C. concept and its operation under a wider range of environmental conditions, such as extreme weather events.
- The successful deployment of the catcher depends on **strong collaboration between key stakeholders**, including public authorities and engineers, alongside clear communication with citizens about its purpose.

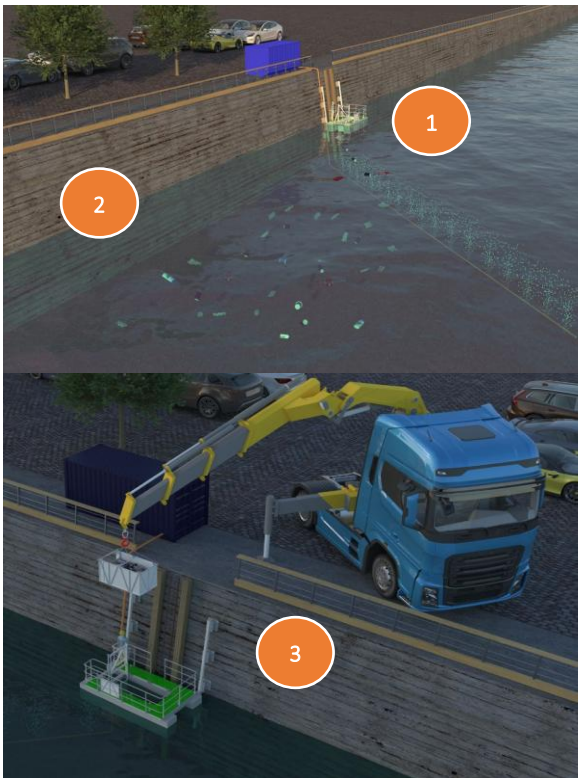

Figure 5. Schematic of the M.A.R.C. the Litter Catcher. 1: tube on the bottom of the river that blows air bubbles; 2: litter is guided towards a collection container; 3: container is removed to be emptied.



Figure 6. Picture of M.A.R.C.- the Litter Catcher, the stream of bubbles visible in the water and the collecting cage placed by the bank.



Pillar 3. Prevention & Behaviour Change

How can citizen science contribute to litter management?

Achieving lasting reductions in plastic pollution requires active participation across society. Since much of this pollution originates from human behaviour, effective prevention depends not only on technological and regulatory solutions but also on involving citizens.

This pillar focused on how stakeholder engagement and citizen participation can support plastic litter prevention at source. Activities included stakeholder engagement across sectors (e.g. tourism), perception surveys among residents, clean-up initiatives, and participation in citizen science campaigns such as Plastic Pirates. In parallel, a Key Performance Indicator (KPI) framework was developed to assess the efficiency and impact of citizen and participatory science initiatives for litter observations[11].



Public support for prevention measures

A perception survey among Nieuwpoort residents (n= 46) found broad support for reducing plastic pollution. Overall, results show that while motivation is already high, behaviour change depends on providing accessible alternatives, clear guidance, and targeted communication through trusted channels.

Key results from the survey indicate stronger support from residents for **system-level measures** than for behavioural campaigns alone, especially:

- Producer responsibility and deposit-return schemes;
- Improved waste management systems;
- Stricter regulation.

Environmental protections, human health, and safeguarding future generations were stronger motivators than financial incentives.

Citizen science strengthens engagement and evidence

Engaging young people in hands-on research within their local environment raises awareness and fosters environmental stewardship (Figure 7). The accompanying KPI framework provides a practical tool for evaluating the quality, efficiency and societal impacts of citizen science projects, supporting long-term sustainability, better project design and resource allocation.

Plastic Pirates- Go Europe

Under the European citizen science initiative, **Plastic Pirates**, children and teenagers go out with their class to conduct research experiments collecting and analysing plastic pollution (both macro and micro) of rivers or the coast. Since its launch **in Belgium** in 2022, approximately 1500 students participated over the course of the project in hands-on research on local litter pollution.



Figure 7. Plastic Pirates in action in Nieuwpoort. ©VLIZ

Insights on prevention and behaviour change

- While citizen science is a valuable complement to conventional monitoring, robust quality assurance and evaluation frameworks (e.g. KPIs) are needed to ensure reliable data and measurable impact.
- Citizen participation can generate valuable environmental data and while creating opportunities to engage the public on support for plastic pollution policies, making it a valuable component of integrated marine litter governance;
- Experiential learning is a powerful driver of behaviour change; direct participation in monitoring and clean-up activities helps translate awareness into sustained engagement and a sense of ownership;
- Behaviour change initiatives are most effective when supported by enabling structural conditions, such as accessible waste infrastructure, clear guidance, and supportive policy measures.



Pillar 4. Policy & Governance

How can policy and governance support effective plastic litter management?

Local authorities play a central role in implementing marine litter policies, but effective action depends on coordination across sectors and governance levels.
This pillar[12] explored authorities and stakeholder cooperation, governance, regulatory requirements, and implementation barriers for plastic litter management in Nieuwpoort, through workshops and interviews with key stakeholders (see full report[12], Figure 8, Figure 10 and Figure 11).

The governance landscape

Litter management is governed through a complex multi-level structure, involving actors and responsibilities across European, national, regional, and local levels[13]. While numerous authorities and organisations contribute to addressing marine and freshwater litter through existing policy (Figure 9), responsibilities remain distributed across multiple governance structures (Figure 8) leading to ambiguity and difficulty in reaching effective solutions. **The findings also highlight** that effective implementation depends on solutions adapted to the local context as a one-fits-all solution may face challenges.

Collaborative structures

A wide range of formal and informal coordination mechanisms already support marine litter governance, including federal and Flemish working groups, coastal partnerships, and stakeholder consultations. However, stakeholders also identified challenges related to fragmented responsibilities, unclear points of contact, limited strategic communication across governance levels, and difficulties engaging certain sectors.

Opportunities for policy implementation

Interviews with policymakers and practitioners explored opportunities for improvement. They **highlighted the importance** of communication, stakeholder engagement, and multi-level governance in preventing plastic pollution. Stakeholders emphasised that visible interventions, such

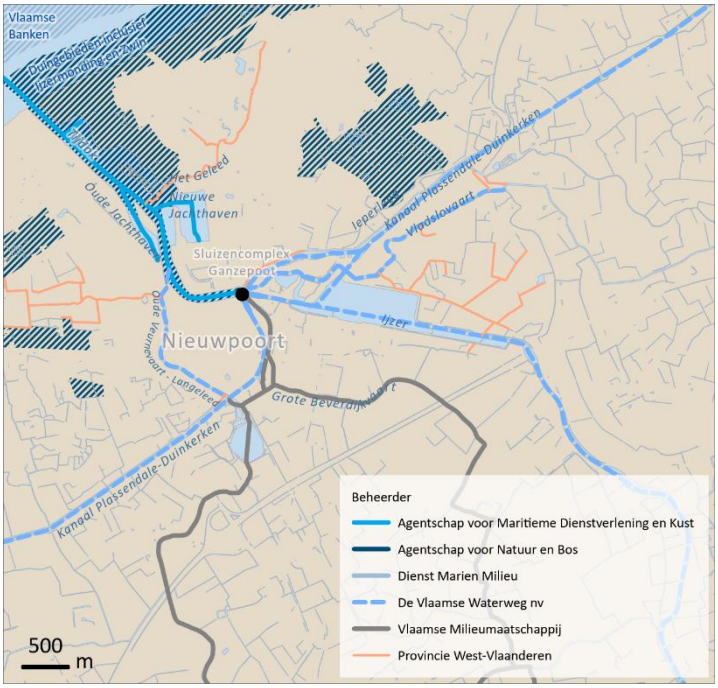

Figure 8. A mapping of the most important authorities for the Yser estuary (from De Buyser et al., 2024)



Figure 9. Key policy governing plastic litter in Nieuwpoort in addition to the European Marine Strategy Framework Directive and Water Framework Directive.

as plastic catchers and visitor centres, can increase public awareness and support behaviour change. They also identified the **need for stronger dialogue** with producers and key sectors (agriculture, construction, tourism), alongside more strategic and context-specific communication to improve engagement, particularly in sectors that are difficult to reach (e,g, agriculture and fisheries). Finally, participants stressed that fragmented responsibilities and the absence of a central point of contact **hinder effective collaboration**, while stronger policy frameworks prioritising source reduction over litter removal would **better support long-term plastic pollution prevention**, especially as removal options are often mandatory but the costs are high.

To this end, TREASURE project partners have been involved in the establishment of the Belgian Plastic Pollution Research Community[14]. Recognising the need for a central point, the network brings together scientists across Belgium, working on different aspects of plastic pollution. It provides a platform for interdisciplinary collaboration, knowledge exchange and coordination across fields, while providing access to policymakers and other stakeholders to state-of-the-art evidence.

Insights on policy and governance

- Strong **communication**, clear **responsibilities**, and improved **collaboration across governance levels and sectors** can enhance the effectiveness of existing policy instruments.



Figure 10. Workshops and with key stakeholders revealed that litter management is governed through a complex multi-level structure.

- Stronger **engagement of producers, businesses, public authorities, and local stakeholders** is essential to support coordinated action and achieve lasting reductions in plastic pollution.
- Plastic litter policies should **prioritise prevention at source** over downstream clean-up, with greater emphasis on reducing plastic leakage through product design, packaging, and sector-specific prevention measures.
- Effective marine litter governance depends on **reliable monitoring and evidence generation**, enabling authorities to target interventions, evaluate policy effectiveness, and adapt management strategies over time.

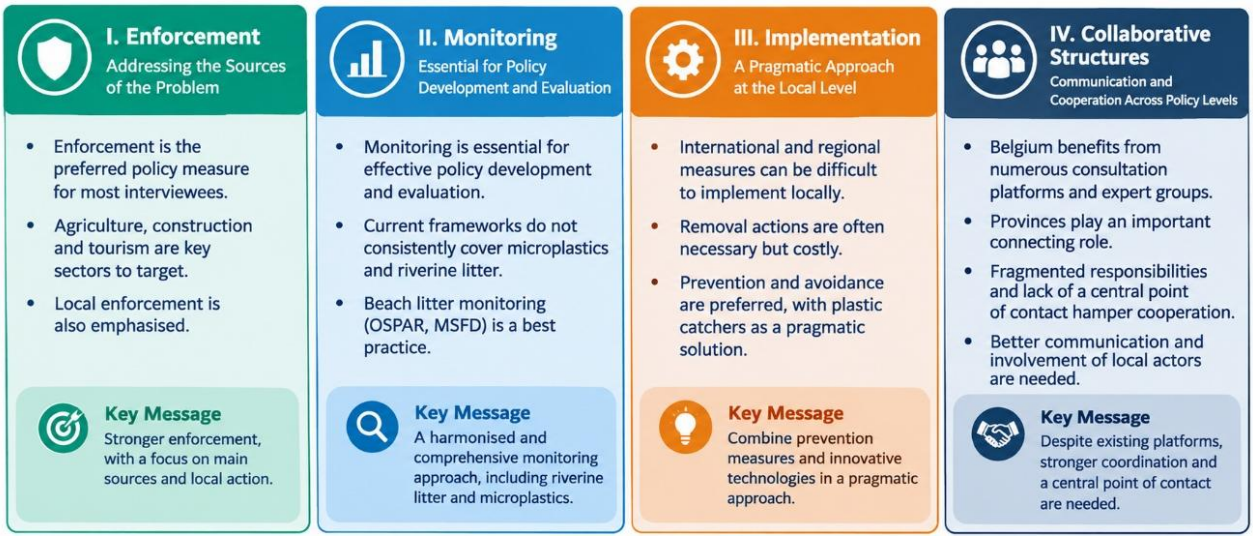

Figure 11. Results of the key stakeholder interviews.

The way forward…

Long-term measure: Adopt location- and evidence-based litter management by using **long-term monitoring** to identify persistent accumulation hotspots and trends, to optimise prevention, interception, and clean-up measures.

Local intervention measure: Estuarine retention zones, such as the **Yser river mouth and identified hotspots including the nature reserve**, should be prioritised as strategic intervention points **to prevent plastic litter** from reaching the North Sea.

Supporting monitoring requirements: Integrate quality-assured **citizen science initiatives** into local and regional litter monitoring programmes to generate environmental data, increase public awareness, and **strengthen community ownership of plastic pollution prevention**. The use of evaluation frameworks (e.g. KPIs) should ensure data reliability and measure societal impact.

Pragmatic approaches: Plastic litter policies and management should **focus on a combination of prevention measures and pragmatic environmental removal solutions. Priority** should be given to preventing leakage at the source through improved product design, packaging choices and sector-specific prevention measures that address locally relevant sources of litter. **Clean-up efforts and innovative solutions** (e.g. litter catcher) complement these measures and help prevent litter from reaching the marine environment or accumulating in nature.

Local mitigation measures: Based on the Nieuwpoort perception survey results, respondents support **prioritising upstream plastic prevention by strengthening system-level measures** such as producer responsibility, deposit-return schemes, improved waste management systems, and stronger regulation and enforcement.

National need: Establish and maintain a **centralised coordination mechanism** or contact point for **plastic litter management** to strengthen collaboration between authorities, waste managers, tourism operators, fisheries, businesses, researchers, and local communities. This central point should facilitate information exchange, clarify responsibilities, and support the development of coordinated, sector-specific prevention measures.

Long-term support: Establish **long-term financing mechanisms,** to support (local) authorities in delivering coordinated plastic litter prevention, environmental monitoring, evidence-based policy evaluation and clean-up activities in line with European and national policy objectives.

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