



WP 2 Awareness raising and pilot activities

D.2.9.1 Established WASTEREDUCE pilot areas

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Document description	<p>This document describes the establishment of WASTEREDUCE pilot areas and the practical implementation of the WASTEREDUCE approach at three pilot areas: Sakarun Bay, Coastal Istria, and the Middle Brenta Area.</p> <p>Pilot areas serve as real-life testing grounds for applying an integrated, participatory, and evidence-based waste management approach adapted to protected areas, Natura 2000 sites, river basins, and coastal zones.</p> <p>The document builds on already implemented actions and activities within the WASTEREDUCE framework and translates them into site-specific strategies.</p>			



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1. WASTEREDUCE Approach

The Project developed, tested and implemented a new, integrated participatory, and holistic landscape-level WASTEREDUCE approach, adapted to the specificities of protected and Natura 2000 areas to minimize the harmful effects of waste with specific regards to rivers and coastal areas. The approach follows the impact mitigation hierarchy, working on four levels to achieve integrated waste management: Measuring, Avoiding/Preventing, Reducing, and Mitigating the impact of waste. The four levels integrate governance, socio-economic, technological, and cultural domains to achieve the expected results.

The WASTEREDUCE approach emerged from a cross-border cooperation process between Italy and Croatia, combining scientific research, participatory governance, and field implementation in three pilot sites: Middle Brenta, Sakarun Bay, and Coastal Istria.

Through the activities implemented in these pilot sites, the project built a flexible, evidence-based and participatory methodology, replicable across the pilot areas but also to other protected and coastal areas facing similar environmental pressures.

Importantly, WASTEREDUCE is not a linear sequence of phases, but a dynamic circular process: several activities act as bridges between levels, ensuring the flow of knowledge, engagement, and innovation across the entire cycle.



1.1. Measuring: Understanding Waste Dynamics

The first level of the WASTEREDUCE approach focused on measuring and understanding the drivers, patterns, and consequences of waste accumulation in protected and Natura 2000 areas.

Activities such as A1.5 (Development of the methodology for literature review on behavioural interventions and communication policies) and A1.6 (Report on the literature review) provided the conceptual and scientific foundation of the project. A1.7 (Identification of strategies, policies, good practices, and gaps in waste reduction) mapped the policy landscape, while A1.8 (Conducting in-depth interviews, surveys, and behavioural observation sessions) and A1.9 (Identifying, marking, and mapping waste accumulation locations) translated knowledge into empirical data and spatial evidence. A2.6 (Identification of waste reduction measures) and A2.13 (Surveillance and monitoring at waste accumulation sites) extended the measuring effort through continuous observation and validation in the field.

At this stage, partners established baselines on urgency and feasibility of interventions (D1.11.2) defining which issues required immediate attention and which could be addressed progressively. By integrating social analysis, environmental monitoring, and spatial mapping, WASTEREDUCE turned measurement into an active governance tool.

Bridge activity:

- A2.13 (Surveillance and monitoring) acts as a connection between Measuring and Mitigating, maintaining continuous data collection throughout implementation and after interventions, ensuring feedback for adaptive management.

1.2. Avoiding/Preventing: Building Awareness and Cooperation

The second level addressed waste prevention through awareness, governance cooperation, and education.

It began with A1.3 (Informing, training partners, and strengthening cooperation within the partnership) a crucial activity that not only improved internal communication but also set up the governance mechanisms that sustained all following phases. A1.4 (Preparation of communication and dissemination content, and informing the public) ensured transparent, consistent, and accessible information across the project's regions. A1.13 (Training stakeholders on the project's objectives and sharing the cross-border strategy) introduced a common vision and a participatory strategy that directly supported later reduction and mitigation actions. During implementation, A2.5 (Educational and training tours in protected and Natura 2000 areas) and A2.10 (Organization of public ecological days and networking) engaged citizens, tourists, and local actors, turning awareness into concrete stewardship. A2.11 (Training stakeholders on the action plan and presenting it publicly) further strengthened cooperation, while A2.15 (Informing the public about project activities and environmental education) and A2.17 (Organization of information days) ensured continuous outreach. Finally, A2.18 (Designing and setting up an exhibition and mobile application on waste in coastal and marine Natura 2000 areas) created lasting educational and participatory tools.

These activities built a shared cultural and governance foundation for responsible waste behaviour.

Bridge activities:

- A1.3 (Training and cooperation) connects Preventing with Reducing and Mitigating, as partner collaboration evolves from internal training into joint action and long-term governance.
- A1.4 (Communication and dissemination) serves all four levels, feeding data from Measuring, mobilizing awareness for Preventing, supporting engagement during Reducing, and sharing results in Mitigating.
- A1.13 (Stakeholder training and strategy sharing) bridges Preventing and Reducing, ensuring that participatory planning directly informs operational action.
- A2.18 (Exhibition and mobile application) links Preventing and Mitigating, merging awareness-raising with long-term citizen monitoring.

1.3. Reducing: Acting on the Ground

The third level transformed knowledge and participation into concrete actions for waste reduction.

A2.6 (Identification of waste reduction measures) initiated this stage by turning analysis into planning. A2.7 (Creation of the Waste Reduction Action Plan) formalized strategies tailored to each pilot area, integrating technical, social, and governance dimensions. A2.8 (Implementation of solutions for waste sorting and disposal adapted to protected and Natura 2000 areas) and A2.9 (Establishment of WASTEREDUCE pilot areas with the implemented approach) materialized these strategies on the ground. A2.11 (Training stakeholders on the action plan and presenting it publicly) consolidated community ownership, while A2.14 (Testing behavioural strategies to encourage proper waste disposal) provided empirical validation of interventions. Finally, A2.16 (Project partners meeting) maintained cross-border alignment and exchange of lessons among Italy and Croatia.

These activities collectively demonstrated that measurable reduction in waste production and abandonment is achievable through an integrated mix of behavioural incentives, technological improvements, and shared governance.

Bridge activities:

- A1.3 (Partner training and cooperation) and A1.13 (Stakeholder training) remain operational here, as institutional and social capacity built during Preventing becomes essential for successful Reducing.
- A2.10 (Public ecological days and networking) sits between Preventing and Reducing: awareness actions directly translate into collective clean-ups and waste removal, providing both educational and practical outcomes.

1.4. Mitigating: Sustaining Long-Term Impact

The fourth level focused on mitigating the residual impact of waste and ensuring the continuity of results.

Key actions such as A2.13 (Surveillance and monitoring at waste accumulation sites) sustained environmental observation, while A2.18 (Designing and setting up the exhibition and mobile

application) empowered citizens to participate in ongoing monitoring and environmental education. At this stage, governance and financing models developed under A1.11 (Development of a cross-border participatory strategy) and its companion deliverable D1.11.3 (Environmental and social waste costs and innovative financing strategies) were applied to secure the economic and institutional feasibility of long-term mitigation.

Mitigation thus evolved into an adaptive management system, combining continued data collection, community engagement, and innovative financing mechanisms to sustain improvements.

Bridge activities:

- A2.13 (Surveillance and monitoring) closes the loop by feeding results back into Measuring, restarting the cycle of evidence and adaptation.
- A2.18 (Mobile application and exhibition) connects Mitigating with Preventing, maintaining awareness and citizen participation over time.
- A1.4 (Communication and dissemination) reappears as a cross-cutting element, ensuring that outcomes are shared, replicated, and scaled.

1.5. A Replicable and Scalable Model

Through the integration of these four interconnected levels, the WASTEREDUCE approach establishes a replicable and scalable model for integrated waste management in sensitive natural areas.

Its coherence relies on a constant dialogue between scientific measurement, participatory governance, operational implementation, and adaptive mitigation. By explicitly recognizing bridge activities actions that operate simultaneously across multiple levels WASTEREDUCE transforms the traditional linear hierarchy of mitigation into a living circular system. Knowledge flows seamlessly from data collection to community action, from reduction to feedback monitoring, ensuring continuity, adaptability, and resilience of results. Each cycle enriches the next: Measuring informs Preventing, Preventing enables Reducing, Reducing supports Mitigating, and Mitigating renews Measuring. This circular logic, supported by shared governance and innovative financing, makes the WASTEREDUCE approach a model ready for replication across Europe's rivers, coasts, and protected landscapes.

2. Role and Objectives of WASTEREDUCE Pilot Areas

The WASTEREDUCE pilot areas play a central role in translating the project's conceptual framework into practical, tested, and transferable solutions for waste management in protected and Natura 2000 areas. By operating in real-life environmental and governance contexts, the pilot areas allow the WASTEREDUCE approach to be validated, refined, and adapted to diverse territorial conditions.

2.1. Purpose of Pilot Areas

The primary purpose of the WASTEREDUCE pilot areas is to test and validate the WASTEREDUCE approach across diverse environmental contexts, ensuring that the methodology is applicable to a wide range of protected and sensitive natural areas. By implementing the approach in an island coastal system (Sakarun Bay), an extended multi-municipal coastal zone (Coastal Istria), and a highly anthropized river corridor (Middle Brenta area), the project captures a broad spectrum of waste-related pressures and governance settings.

In addition, the pilot areas serve to demonstrate integrated waste reduction solutions specifically adapted to the constraints and needs of protected and Natura 2000 areas. These solutions combine behavioural interventions, stakeholder engagement, technological innovation, and continuous monitoring within a single coherent framework.

Finally, the pilot areas are designed to generate transferable knowledge and good practices. Through systematic documentation, monitoring, and evaluation, the project identifies which measures are most effective, under which conditions, and why. This evidence base supports replication of successful interventions in other regions and contributes to the development of policy-relevant guidance at local, regional, and European levels.

2.2. Common Objectives Across All Pilot Sites

Despite their different ecological and socio-economic characteristics, all WASTEREDUCE pilot areas share a set of common objectives aligned with the project's overall vision of sustainable waste management in sensitive environments. A key objective is to reduce waste generation and improper disposal, and to improve waste sorting, reuse, and recycling, with a strong emphasis on prevention at source.

The pilot areas also aim to strengthen participatory governance and stakeholder cooperation. By actively involving managing authorities, municipalities, waste operators, businesses, NGOs, and citizens, the WASTEREDUCE approach fosters shared responsibility and long-term ownership of waste reduction measures. Capacity building, training, and cross-border exchange further support institutional learning and cooperation.

3. WASTEREDUCE Pilot Area: Sakarun Bay

3.1. Site Context and Challenges

Sakarun Bay (HR3000069) is located on the north-western coast of Dugi Otok Island, one of the largest islands in Croatia and part of the Zadar Archipelago. The wider area was declared a Significant Landscape in 1967 due to its exceptional geomorphological, landscape, and ecological values, and it forms part of the Natura 2000 network. The bay is internationally recognized for its shallow turquoise waters, carbonate pebble beach, and sensitive marine habitats, including *Posidonia oceanica* banquettes that play an important role in coastal resilience. Despite its relatively small permanent population, Sakarun Bay experiences very high seasonal pressure. It is one of the most visited beaches on the Adriatic, attracting large numbers of daily visitors, including organized boat tours, private yachts, and tourists arriving by regular ferry services. The peak-season intensity significantly exceeds the area's ecological carrying capacity. Tourism and nautical activities represent the dominant pressures on the site. During the summer season, waste generation increases sharply, driven by beach tourism, hospitality services, and boat-based excursions. At the same time, infrastructure constraints typical of remote island locations such as limited water supply, lack of sewerage, restricted electricity access, and logistical challenges complicate the implementation of conventional waste management solutions.

Governance of the area involves multiple actors. The protected area is managed by PI Natura Jadera, while local administration falls under the Municipality of Sali, with waste collection services provided by the municipal company Mulić d.o.o. However, the absence of a county-level waste management plan tailored to protected and naturalistic areas creates structural gaps. National waste management policies focus primarily on municipal waste streams and do not sufficiently address the specific needs of high-pressure, seasonal, and ecologically sensitive coastal sites such as Sakarun Bay.

3.2. Waste audit

In line with the Measuring level of the WASTEREDUCE approach, a detailed waste audit was carried out to assess waste sources, accumulation patterns, and behavioural drivers in Sakarun Bay.

Field observations, local knowledge, and cleaning activities consistently identified the entire beach of Sakarun Bay as the primary waste accumulation hotspot on Dugi Otok. The bay's distinctive "hook-shaped" morphology, combined with prevailing sea currents flowing from the southeast toward the northwest, causes marine litter to be transported along the island's southwestern coast and trapped within the bay. As a result, Sakarun acts as a natural sink for marine litter, with accumulation intensifying after periods of strong winds and currents. These qualitative findings were reinforced by quantitative data from specialized databases. This confirms that waste accumulation at Sakarun is not incidental but recurrent and structurally driven by both natural dynamics and human activity.

Behavioural observations and visitor surveys conducted within the WASTEREDUCE project further revealed that, while visitors generally perceive Sakarun as highly attractive and restorative, cleanliness is consistently rated lower. Littering, occasional waste, and accumulations of natural material mixed with human-generated waste are perceived as common issues. The most frequently observed waste

items include plastic packaging, single-use food and beverage containers, smoking-related waste, and waste originating from nautical tourism.

Stakeholder assessments highlighted additional contributing factors, including insufficient waste bins, inadequate placement and design of collection points, and limited enforcement mechanisms. Sea currents were identified as a particularly significant driver of waste accumulation in Sakarun compared to other pilot areas, reinforcing the need for site-specific solutions rather than generic waste management measures.

3.3. Avoiding, Preventing, and Reducing Waste

Building on the waste audit results, the Avoiding, Preventing, and Reducing levels of the WASTEREDUCE approach were implemented in Sakarun Bay through a combination of behavioural, structural, and governance-based actions.

A central element of prevention efforts was stakeholder engagement, involving concessionaires, boat operators, local authorities, PI Natura Jadera, and Sunce. Through workshops, direct consultations, and on-site collaboration, stakeholders were actively involved in co-designing waste reduction ideas and measures adapted to the constraints of a protected island environment. Public education and awareness-raising activities targeted both visitors and service providers. Surveys showed that visitors possess a high level of environmental awareness and are willing to engage in correct waste-related behaviours, particularly when clear instructions and supportive infrastructure are provided. Consequently, practical guidance on how and where to dispose of waste, combined with visible messaging promoting “leave no trace” principles, became a core preventive strategy.

Waste reduction actions focused strongly on reducing single-use plastics, particularly in the hospitality and nautical tourism sectors. Building on earlier initiatives under the Plastic Free Croatian Islands project, and further developed within WASTEREDUCE, Sakarun Bay served as a pilot site for introducing reusable cups for beach bars, camps, and excursion boats. These measures directly addressed one of the most significant waste streams identified during the audit.

The implementation of reusable systems revealed important structural and behavioural challenges, including limited washing infrastructure and initial misunderstandings among visitors regarding reuse; visitors on boats believed that the reusable cups were souvenirs rather than cups intended for repeated use to reduce the generation of single-use plastic waste. However, through continued education, cooperation with concessionaires, and logistical adjustments, a reduction in single-use plastic waste was achieved over the tourist season. Additional measures included improved waste sorting practices, cooperation with the municipal waste company, and stricter requirements for boat operators to return all generated waste to their port of departure.

Complementary actions such as targeted clean-up initiatives, monitoring of waste hotspots, and adaptive adjustments to infrastructure supported the overall reduction strategy. Together, these interventions demonstrate that effective waste prevention and reduction in Sakarun Bay requires an integrated approach, combining behavioural change, tailored infrastructure, stakeholder cooperation, and continuous monitoring, which fully aligns with the WASTEREDUCE approach.

4. WASTEREDUCE Pilot Area: Coastal Istria

4.1. Site Context and Challenges

The Coastal Istria represents an extended and environmentally diverse coastal zone characterized by multiple administrative jurisdictions and varying levels of human pressure on the environment. Within the WASTEREDUCE project, three key Natura 2000 sites were selected as pilot areas: Akvatorij zapadne Istre (HR1000032) - Limski zaljev, Ušće Mirne (HR3000433), and Ušće Raše (HR3000432). These sites encompass a wide range of geomorphological, ecological, and socio-economic characteristics, making Coastal Istria an exemplary testing ground for the WASTEREDUCE approach. Limski zaljev is a fjord-like marine inlet of high geomorphological and ecological value, protected at both national and EU levels. It experiences intense seasonal pressure due to its proximity to major tourist destinations. Ušće Mirne is a wide estuarine system surrounded by agricultural land and tourism infrastructure, where summer visitation significantly increases waste generation. Ušće Raše, located in eastern Istria, is less populated but faces pressures from maritime activities and nearby port infrastructure, including risks of industrial pollution and oil spills.

Across the pilot areas, mixed pressures from tourism, fisheries, urban settlements, agriculture, and nautical activities converge. Seasonal tourism represents the most significant driver of waste generation, often overwhelming local infrastructure and services. These pressures result in diffuse sources of marine and coastal litter, including plastic packaging, single-use items, fishing-related waste, and floating debris transported by sea currents. Marine litter accumulation is particularly problematic in sheltered bays, estuaries, and port areas, while illegal dumping occurs in more remote and accessible zones.

Governance challenges further complicate waste management in Coastal Istria. Although the Natura 2000 sites are managed by Natura Histrica, the public institution responsible for protected areas in Istria County, coordination between national, regional, and local levels remains fragmented. Existing national waste management policies focus primarily on municipal waste streams, with limited adaptation to the specific needs of Natura 2000 and other protected coastal environments.

4.2. Waste audit

In line with the Measuring level of the WASTEREDUCE approach, a comprehensive waste audit was conducted through Activities 1.8, 1.9, and 1.11 to understand waste generation patterns, accumulation hotspots, and behavioural drivers across the Coastal Istria pilot area. The audit combined field surveys, behavioural observations, stakeholder consultations, and analysis of existing databases. Given the extensive size of the pilot areas, on-field investigations focused on priority zones identified through preliminary analysis. PI Natura Histrica conducted targeted surveys that identified 14 waste accumulation points, classified into coastal macro-litter zones and inland illegal dumping sites. Marine litter was found to consist predominantly of plastics, fishing nets, ropes, and other non-biodegradable materials, often concentrated in areas influenced by sea currents and nautical traffic. Illegal dumping sites were typically located along unpaved roads, abandoned quarries, and easily accessible inland areas. Littering data collected during observation days in the pilot areas in summer

2024 revealed worrying levels of littering in the pilot areas, particularly in Ušće Mirne and Limski zaljev. The most frequent waste categories included smoking-related items and plastic packaging, alongside fishing-related materials and organic food waste. Natural accumulations such as seaweed were present across all sites, often masking improperly disposed human-related waste. These findings were corroborated by visitor surveys and stakeholder assessments, which consistently rated cleanliness lower than other aspects of site quality and identified illegal dumping as a particular concern in Istria.

Furthermore, in collaboration with local diving clubs, PI Natura Histrica conducted an assessment of seabed pollution and waste in pilot areas, selecting three key locations for clean-up actions within the pilot areas. Through deliverable D2.13.3 Development and testing of methods for marine environment monitoring by analysing satellite images, detailed marine litter monitoring was carried out in Limski zaljev for the period from May to September 2024. High-resolution satellites allowed fine detection of seasonal and spatial patterns and enabled recognition of local anomalies in a sensitive semi-enclosed coastal ecosystem. Key findings showed that due to weak hydrodynamics and geomorphological majority of floating litter originates from internal sources within the bay.

Policy and practice gap analysis highlighted several systemic weaknesses: inconsistent implementation of separate waste collection systems across municipalities, insufficient infrastructure (bins, recycling points, collection frequency), weak enforcement mechanisms, and limited integration of waste management policies into protected area governance. Ongoing surveillance and monitoring were therefore identified as critical tools to support adaptive management and evidence-based decision-making.

4.3. Avoiding, Preventing, and Reducing Waste

Building on the waste audit findings, the Avoiding, Preventing, and Reducing levels of the WASTEREDUCE approach can be jointly applied in Coastal Istria pilot areas through a combination of governance measures, public engagement, education, and on-the-ground actions.

Stakeholder involvement played a central role. PI Natura Histrica, in cooperation with Istria County, local municipalities, waste management operators, port authorities, NGOs, and scientific partners, engaged stakeholders through workshops, training sessions, and public events. A key milestone was the Workshop “Raising awareness about waste issues in protected and Natura 2000 areas” held in January 2025, which validated the WASTEREDUCE strategy and informed the development of the Waste Reduction Action Plan. Public education and awareness-raising activities targeted both residents and visitors. These included information campaigns (A1.4, A2.17), educational tours, and promotion of “leave no trace” principles. Deliverable D2.13.1 identified plastic pollution risk zones in Limski zaljev, particularly the bay entrance and its end, and Valalta marina (due to dense vessels, low water flow). Proposed reducing measures consisted of clean-up actions and tighter monitoring of high-risk areas, while prevention measures consisted of education and regulation for visitors/maritime activities to reduce plastic input.

Waste reduction actions were complemented by community-based clean-up initiatives and eco-day events (A2.10). Notably, underwater clean-up actions carried out by divers from local diving clubs removed significant quantities of waste from Ušće Mirne, Limski zaljev, and Ušće Raše during 2025.

These actions not only reduced existing pollution but also served as awareness events, strengthening community engagement and cross-sector cooperation.

Innovative reduction measures were also implemented, such as the deployment of the D-POL floating pollution collection device in the Santa Marina harbour, organised by the County of Istria. This pilot solution directly addresses floating marine litter and hydrocarbon residues in port areas, generating valuable monitoring data and offering a replicable model for other marinas within protected coastal zones. Together, these measures reflect a shift from reactive clean-up toward preventive, behaviour-oriented, and structurally supported waste reduction, aligned with the long-term vision of the WASTEREDUCE approach.

5. WASTEREDUCE Pilot Area: Middle Brenta

5.1. Site Context and Challenges

The Middle Brenta area (IT3260018) is located along the Brenta River in the Province of Padua, where the river exits the alpine valley and flows through the upper Veneto plain. The area forms part of the broader Medio Brenta territory, extending from Bassano del Grappa to Padua, and is designated as the Natura 2000 site to its high ecological, hydrological, and cultural value. The Natura 2000 site is characterized by a long and narrow morphology (approximately 64 km in length and 3 862 ha), embedded within a highly anthropized landscape. The river corridor is surrounded by urban centres, industrial zones, intensive agricultural land, and infrastructure networks. The presence of wetlands and accessible riverbanks makes the area particularly attractive for bathing, walking, cycling, equestrian tourism, picnicking, and informal beach use, especially during spring and summer months. Despite its attractiveness, the area faces significant environmental pressures. For many years, the lack of a unified management authority and coherent strategy led to land-use conflicts, inconsistent enforcement of regulations, and insufficient protection of habitats and species. This situation has begun to improve following the LIFE Brenta 2030 project.

Waste-related challenges in the Middle Brenta differ from those in coastal pilot areas. The riverine context combines visitor-generated litter, illegal dumping by residents and businesses, and waste transported or redistributed by river dynamics. The linear and accessible nature of the riverbanks makes them particularly vulnerable to both recreational littering and abandonment of bulky waste, posing risks to biodiversity, landscape quality, and ecosystem services.

5.2. Waste audit

In accordance with the Measuring phase of the WASTEREDUCE approach, a comprehensive waste audit was conducted to identify waste sources, accumulation patterns, and behavioural drivers specific to the Middle Brenta riverine system.

Unlike marine environments, waste accumulation in the Middle Brenta is primarily driven by direct human activities along riverbanks rather than long-distance transport by currents. The core dataset for this pilot area was generated through systematic cleaning actions and on-field surveys carried out over several years by the local waste management utility ETRA S.p.A. These activities resulted in the identification and cataloguing of 27 distinct waste accumulation points along the middle section of the river.

The waste audit revealed a dual waste dynamic. On one hand, there are illegal dumping sites, often located along embankments accessible by vehicles, where household waste, construction debris, inert materials, and bulky items are deliberately abandoned. On the other hand, widespread litter from recreational activities such as plastic packaging, cans, bottles, disposable barbecues, and food waste, accumulates in areas frequently used by visitors. Quantitative data collected in 2023 across the Brenta River Park basin indicate that 34 277 kg of waste were collected, with 67% originating from recreational activities, 19% from domestic sources, and 14% from industrial activities. These figures are considered underestimated due to the difficulty of accessing all river sections. Waste accumulation peaks during the summer months, when visitor numbers are highest.

The waste audit also highlighted gaps in external monitoring systems. Unlike coastal areas, no geolocated data for the Middle Brenta were found in international or citizen-science databases, underscoring the importance of localized, field-based monitoring. Patrols using electric vehicles, citizen reports, and targeted inspections represent the primary sources of information on waste dynamics.

Surveys conducted under WASTEREDUCE showed that visitors perceive the Middle Brenta as highly attractive and restorative, but rate cleanliness lower, with littering and occasional waste considered common issues. Stakeholders identified visitors as the main source of recreational litter, while illegal dumping was more frequently attributed to residents and economic activities, reinforcing the need for differentiated management responses.

5.3. Avoiding, Preventing, and Reducing Waste

Building on the waste audit findings, the Avoiding, Preventing, and Reducing phases of the WASTEREDUCE approach were implemented through a combination of behavioural, structural, technological, and governance-based measures, tailored to the Middle Brenta's riverine and visitor-pressure context. Waste avoidance and prevention efforts focused on reducing improper disposal by visitors and discouraging illegal dumping. Information and education strategies emphasized clear, practical instructions on correct waste behaviour, as surveys showed that visitors are generally willing to behave responsibly when supported by appropriate infrastructure and guidance. Volunteer associations, local groups, and municipalities played an important role in awareness-raising, event management, and distribution of waste bags in parking and access areas.

From an operational perspective, the **Wastereduce approach in the Middle Brenta area** was developed along three levels:

1) Governance level: a dialogue was initiated with the municipalities in the area and with the **Basin Council for water and waste management**, as well as with the managing authority of the **Natura 2000 site**, through the organization of two workshops and several bilateral meetings. This exchange highlighted the need to strengthen a governance level above individual municipalities, reinforcing the role of the managing authority in terms of coordination of interventions and proposed measures.

2) Infrastructural level: a flagship preventive measure introduced under WASTEREDUCE was the installation of video-surveillance systems at selected high-pressure locations along the river. Implemented by ETRA in cooperation with municipalities and this technology-based intervention serves both as a deterrent against littering and illegal dumping and as a monitoring tool. By making waste-related behaviour visible and traceable, the system supports enforcement, improves data collection on hotspots, and informs adaptive management decisions such as bin placement and cleaning schedules. Structural measures complemented surveillance and education efforts, and the creation of **multifunctional hubs for waste disposal** was proposed. These hubs are intended to be developed in areas identified as particularly critical, in order to encourage users of the area to properly sort and responsibly manage their waste.

3) Communication and awareness-raising level: a communication campaign was proposed, currently under discussion and development, which will include **appropriate signage in the most critical locations**.

Waste reduction actions also addressed the downstream handling of collected waste, ensuring that residual waste, special waste, and hazardous materials are managed in accordance with regulations. While

much of the waste is currently sent to waste-to-energy facilities, the pilot highlighted opportunities for future improvements in sorting, prevention upstream, and reduction of waste generation at source.

Overall, the Middle Brenta pilot demonstrates that effective waste reduction in riverine Natura 2000 sites requires an integrated approach, combining monitoring technologies, stakeholder cooperation, behavioural insights, and adaptive infrastructure. The experience provides a replicable model for other densely populated river corridors and recreational landscapes, complementing the marine-focused interventions of the WASTEREDUCE coastal pilot areas.