Plastic Pollution in the Mediterranean:

Which role for coastal cities and their valuable ecosystems?

Plastic pollution presents a critical threat to Mediterranean population and ecosystems, driven by unsustainable consumption patterns, inadequate waste infrastructure, and weak governance. The amount of plastic leakage at sea increases over time despite the existence of legal frameworks and laws in many countries. This paper examines how urban areas (where 70% of the Mediterranean population lives in coastal cities), both key contributors to and victims of plastic leakage, can adopt ecological, institutional, and grassroot strategies to address this issue. Through multi-scale case studies, it explores how Nature-based Solutions, public engagement, and regulatory instruments can combine within integrated and circular frameworks to strengthen urban resilience and protect marine ecosystems.

1 . Plastic pollution in the Mediterranean: what's at stake?

The Mediterranean sea is among the most sensitive and affected regions by pollution. As a semi-enclosed sea, the Mediterranean is highly vulnerable to plastic pollution in particular as waste is less likely to disperse thus, forming accumulation zones over time[1] (Figure 2). As the second-largest producer after China, Europe releases an estimated 150 000 to 500 000 tonnes of macroplastics and 70 000 to 130 000 tonnes of microplastics into the sea each year (WWF France, 2018). In fact, in 2016, Mediterranean countries generated around 184 Million Tonnes (MT) of municipal solid waste (RED 2020), including 37.81 MT of plastic (WWF, 2019). Over time, accumulated plastic degrades[2] into microplastics - diverse in size, shape, and composition - which harm marine life and human health by entering food chains and leading to bioaccumulation and biomagnification.

The Mediterranean is characterized by high urbanization rates, especially on the coastlines that concentrate two thirds of the region's population which represent about 150 million people (Plan Bleu, 2024).

Tourism is one of the key pillars of Mediterranean economies. In fact, the region attracts about one third of world tourism and was the main tourist destination on the planet with more than 400 million International Tourist Arrivals in 2019 (Plan Bleu, 2022). Coastal population and tourism, associated with take-make-waste economic models, are the main drivers of plastic waste generation and marine litter in the Mediterranean. Pollution generated by human activities reaches the sea through various land-sea interactions, including surface runoff, precipitation, infiltration into soils, riverine transport, and untreated wastewater discharges. Cargo loss and abandoned fishing gear from maritime sectors further compound the issue, making plastic pollution a growing ecological, socio-economic, and governance challenge. Additionally, the agricultural sector contributes to the problem through the abandonment of single-use plastic materials used in crop production, with areas of intensive farming - such as Spain's Mar Menor - particularly affected.

1 State of the Mediterranean 2025. Statista. Link.
2 Between 400 to 1000 years to degrade (Medwaves, 2019).

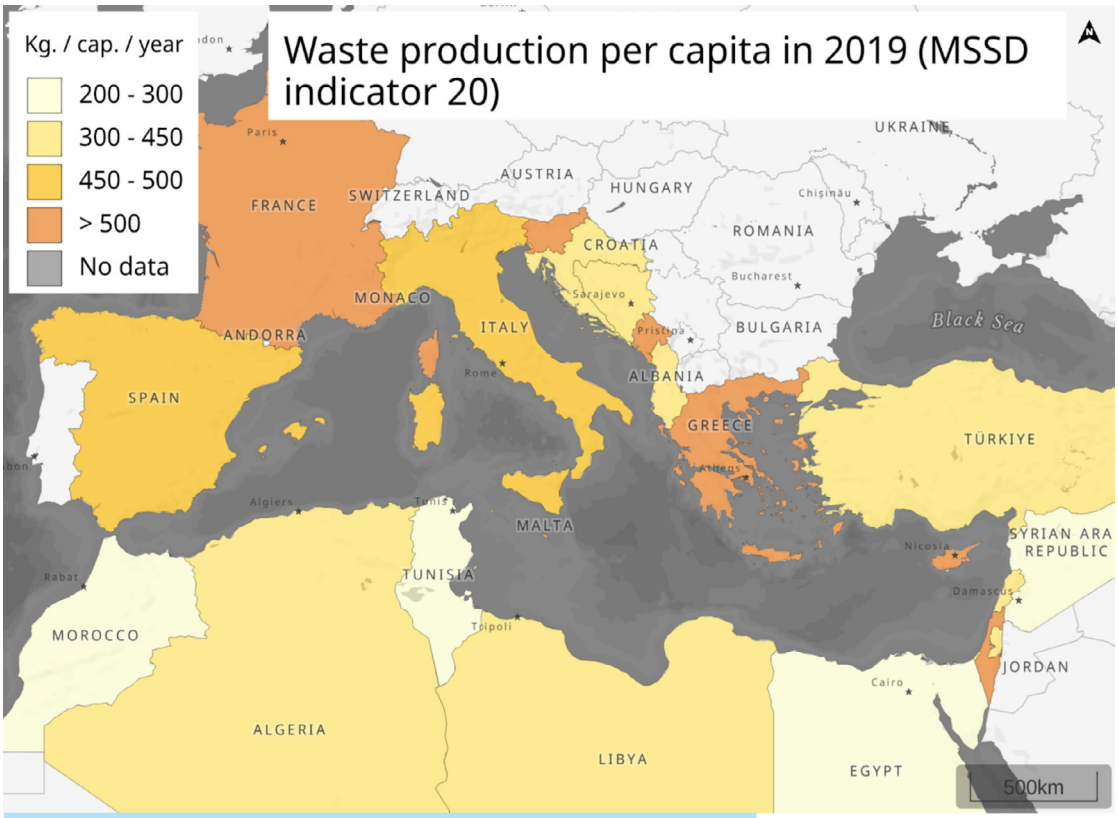

Figure 1: Waste production per capita in 2019 (MSSD indicator 20).
Source: Plan Bleu Observatory, 2025

Figure 1 shows the plastic waste production per capita in 2019 according to the indicator 20 of the Mediterranean Strategy for Sustainable Development (MSSD)[3], while chart 1 showcases that recycling rates remain critically low - under 13% in most countries - and only a fraction of plastic waste is effectively recovered. In fact, 58% of municipal waste is still disposed of in open dumps or unspecified landfills, and only 8% of wastewater is treated to tertiary level (1% in Southern Mediterranean countries) (RED 2020).

Egypt, Türkiye, and Italy alone are responsible for nearly two-thirds of plastic leakage into nature. This plastic leakage into nature has, on one hand, environmental and sanitary impacts - particularly on biodiversity and human health, and on the other hand, economic impacts on tourism (loss of €268m/year), maritime industry (loss of €235m/year) and the fishing sector (loss of €138m/year) (WWF, 2019).

Among the main sources, single-use plastics account for over 60% of beach litter, while the fishing industry contributes around 20% of marine plastic pollution (Figure 2). Finally, microplastic concentrations in the region have reached alarming levels, sometimes exceeding 64 million particles/km² (RED 2020).

3 Under the objectives: 3 - Planning and managing sustainable Mediterranean cities (strategic direction 3.4: Promote sustainable waste management within the context of a more circular economy) and 5 - Transition towards a green and blue economy (Strategic direction 5.3: Promote sustainable consumption and production patterns). For more information: **link.**

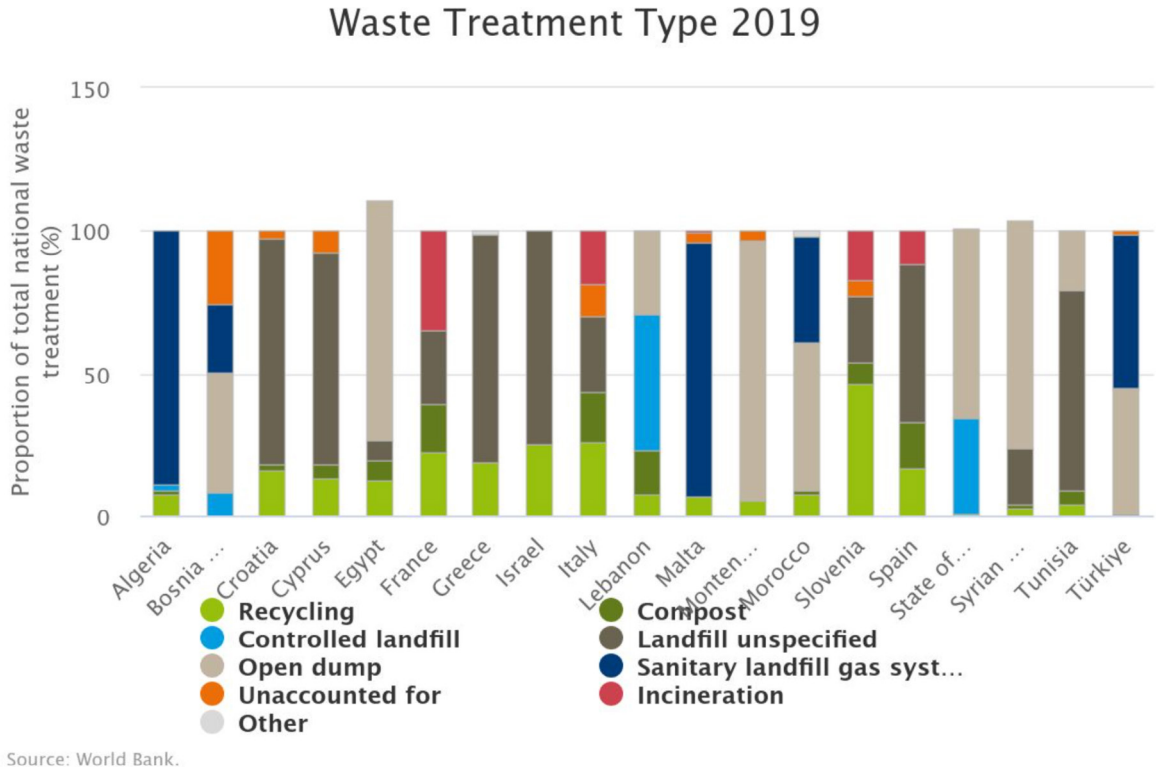

Chart 1: Waste Treatment Type 2019 (Plan Bleu Observatory, 2025).

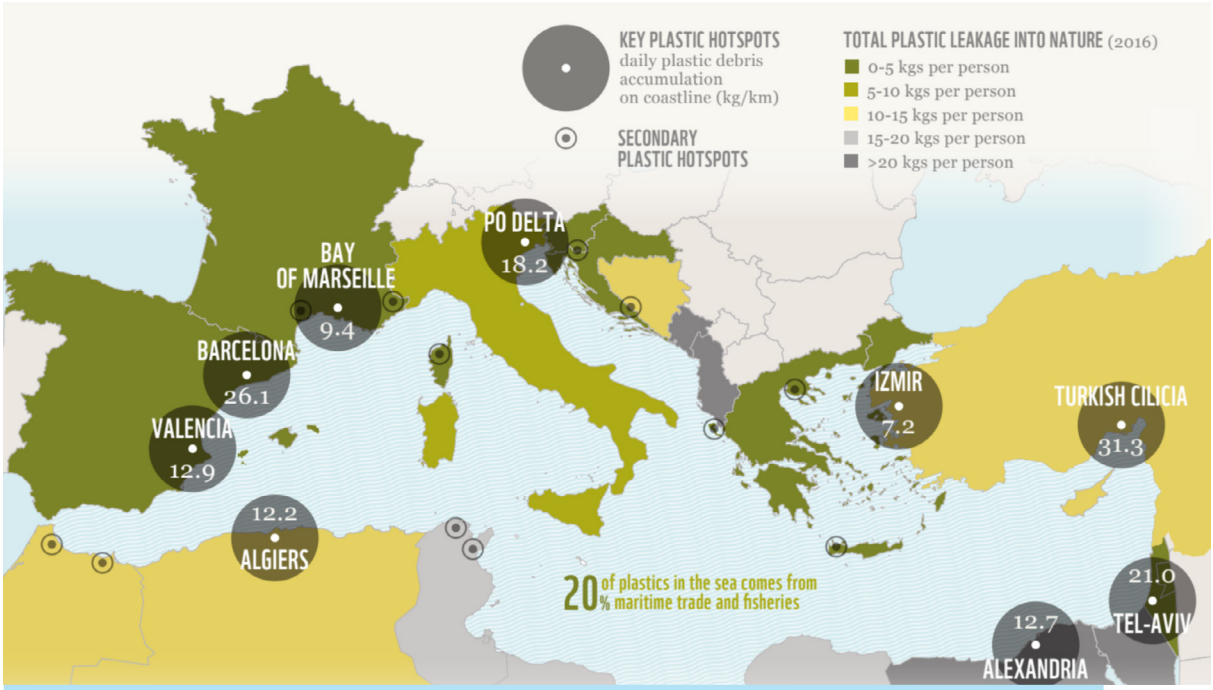

Figure 2: Coastal hotspots of plastic pollution and leakage into nature in the Mediterranean (WWF, 2019).

Waste pollution, especially plastic, thus reflects deeper structural issues linked to unsustainable production and consumption patterns, weak waste governance, and insufficient infrastructure to create a circular economy.

Against this backdrop, coastal cities are the main contributors and victims of plastic pollution. In fact, urban areas are among the main sources of plastic leakages, but it is their surrounding ecosystems (e.g., rivers, wetlands, green spaces, sea, etc) that are directly impacted by this pollution. Ultimately, cities and people depend on the good ecological status of their ecosystems, making waste production and consumption one of the main challenges for urban sustainability, health and biodiversity. Nature-based Solutions (NbS), inspired and supported by nature, offer valuable co-benefits for addressing complex societal and environmental challenges, such as air pollution and water management and flooding. However, their direct applicability to persistent, synthetic pollutants such as plastic, is generally limited, as most NbS are not specifically designed or equipped to break down these substances. Nonetheless, recent research suggests that certain nature-based processes may hold potential in mitigating some impacts of plastic pollution. For instance, bioremediation approaches involving bivalve species like mussels and oysters have demonstrated promising filtration capacities for microplastics in aquatic environments (Falkenberg et al, 2024). In this sense, while NbS are not a standalone solution to plastic pollution, they can complement broader management and educational strategies to mitigate this issue and support cities' long-term resilience.

To address plastic pollution, this brief explores a range of strategies - from awareness-raising and grassroot mobilisation to measures targeting single-use plastics (SUPs), nature-based approaches, and regulatory tools, like consumption taxes. Focusing on Mediterranean cities, it adopts a comprehensive perspective combining ecological, institutional and societal responses. The analysis builds on an adaptation of the French "avoid, reduce, compensate" (ERC)[4] principle, originally developed for biodiversity impact mitigation and reframed into three actionable axes: Prevent, Reduce and Manage. While 'compensate' is less applicable to persistent pollutants, this tripartite framework clarifies priorities: Prevent focuses on behavioral change to stop plastic leakage; Reduce addresses upstream solutions like eco-design or waste avoidance; and Manage reinforces governance for existing waste. Regional examples will illustrate how these responses can enhance urban resilience to plastic pollution.

2 . Preventing plastic from entering the environment: raising awareness and mobilising citizens

Prevention is arguably the most powerful lever in the fight against plastic pollution. Education and awareness-raising efforts play a central role in changing behaviors and shaping long-term societal attitudes toward waste.

First of all, schools and educational programmes that integrate the issue of plastic into curricula help build environmental literacy from an early age. An illustrative example of school-based education is the Eco-Schools programme in Morocco, launched in 2006 by the Mohammed VI Foundation for Environmental Protection. Based on the international framework of the Foundation for Environmental Education (FEE), the initiative promotes pupil-led actions to improve the school environment, with a strong emphasis on waste management. Students are encouraged to identify local environmental issues, plan and act to find sustainable solutions - often targeting waste reduction, sorting, and recycling. The programme, where waste management is one of three core themes (alongside water and energy conservation), adopts a participatory and inclusive approach, involving teachers, parents, local authorities and civil society actors. By integrating environmental topics into school programs and fostering civic responsibility, this initiative exemplifies how education can contribute to preventing plastic (and in general waste) leakage at the source through behavioural change and community involvement (Les éco-écoles au Maroc, pour une éducation durable, 2016).

Furthermore, local associations and citizen-led initiatives are key drivers in environmental protection and diffusion of sustainable ideas and behaviors, especially through activities such as community cleanups, Zero-waste events, and DIY workshops, that contribute to mobilising people at grassroots level. Many existing initiatives around the Mediterranean basin are operating to clean public spaces and contribute to creating a healthier environment. In Marseille (France), Clean my Calanques[5] and Mer Terre[6] are two associations that organize community cleanups and raise awareness about plastic pollution through both public events and school outreach. It promotes civic engagement and collaborates with local partners to sort and repurpose collected waste. Mer Terre is also known for the development of waste characterization methods and for supporting local actors through data-driven prevention strategies and citizen science platforms. Clean my Calanques has already organised 183 outdoors activities, collected approximately 66,210 kg of waste until now and around 15 500 young people have been sensitized.

4 For more information: **link.**
5 Clean my Calanques: **https://cleanmycalanques.fr/**
6 Mer Terre: **https://mer-terre.org/**

Consumer-targeted information campaigns have been found to be effective in raising awareness on the plastic pollution issue (Medwaves, 2021). Campaigns can provide accessible information on consumption alternatives, while also supporting individuals in understanding how their purchasing patterns can influence, on the one hand, industries to shift toward more sustainable packaging and, on the other hand, governments to implement policies that ban or tax unsustainable items (Moss, 2021).Moreover, innovative approaches leveraging technology offer promising pathways to raise awareness and actively engage citizens in waste management.An illustrative example is the Bitter Orange Project in Attica, Greece, which demonstrates how Information and Communication Technologies (ICTs) can encourage citizens to get involved and mobilize urban residents in waste collection through a direct reward system (Neofotistos et al., 2022). By allowing users to track their contributions, earn points, and access discounts at local businesses, the app transforms passive awareness into active participation.

Initially designed to address the challenge of managing 40,000 tonnes of fallen bitter oranges annually, this approach not only fosters circular (bio)economy practices but also shows promising potential for adaptation to non-biodegradable waste streams, like plastics, offering a scalable and replicable model for urban waste governance across the Mediterranean.

3 . Reducing plastic production: institutional, technological and nature-based measures

In their guidelines for phasing out SUPs bags in the Mediterranean region, MedWaves[7] outlines eight measures to reduce SUPs highlighted in table 1 below (Medwaves, 2019).

	Measures	Description
Preliminary measures	1- Assessing the current situation and raising awareness	State of Play, i.e. starting point to have a clear vision, from production to waste generation in the country
	2- Evaluating policy options (voluntary agreements, economic instruments or bans)	Socio-economic and policy/institutional analysis to assess the national capacity to enforce instruments such as bans and/or levies, as well as the impact on populations, especially those most vulnerable
	3- Promoting alternatives	Assessing alternatives in terms of production capacity and national needs, i.e. supply and demand
Adopting and Implementing a policy approach	4- Implementing policies	Taking a policy approach in close coordination with impacted sectors, from 'soft policies (voluntary agreements) to 'hard' ones, i.e. full bans

7 MedWaves was established under the legal framework of the Mediterranean Action Plan (MAP) under the Barcelona Convention, belonging to the United Nations Environment Programme (UNEP). The Stockholm Convention on Persistent Organic Pollutions was later linked to the centre. Tying together a regional framework with a global agreement, MedWaves establishes a platform to develop joint solutions addressing shared environmental challenges.

Supporting measures	**5- Incentivizing industry sectors**	**Setting priorities and means of incentivizing (e.g. eco-taxes) for industry actors to bring change into supply chains**
	6- Improving waste management	**Using means of implementation to improve the current waste management system (from collection to elimination)**
	7- Fostering communication and participation	**Communicating campaigns to actively inform citizens about ongoing waste management changes and the phase out of certain day-to-day plastic items**
	8- Ensuring review and adaptation	**Setting up an evaluation and monitoring framework to promote ongoing improvements to the system**

Table 1: 8 measures for progressively phase out SUPs (MedWaves, 2019).

This comprehensive approach highlights that tackling plastic pollution requires more than just education or end-of-pipe solutions, it demands upstream action to reduce plastic production and a conducive policy framework. In this context, a combination of institutional, technological, and nature-based measures provides promising avenues to reduce plastic production at the source and build a more circular, low-impact system.

For example, urban gardens and community vegetable patches help shorten food supply chains, reducing reliance on plastic packaging while fostering awareness of sustainable consumption. These local, nature-integrated practices can contribute to the broader goals of a circular economy, where resource loops are closed and materials use is optimized. One illustrative example is the Carthage Edible City initiative in Tunisia, which integrates urban agriculture into local planning to strengthen food resilience and reduce environmental pressures (Plan Bleu, 2024). Developed under the EdCitNet Horizon 2020 project[8], the initiative established the 3000 m² Amilar Garden based on permaculture principles, engaging local authorities and communities to promote sustainable food production. Beyond supporting biodiversity and ecological services such as soil improvement and climate regulation, the project helps reduce dependence on industrial food systems and associated plastic packaging, while fostering local awareness and participation in circular, low-impact urban food practices.

An example that includes institutional and technological innovation is the Zumárraga Hospital initiative in the Basque Country (Spain), where dialogue with catering providers led to replacing single-use plastic packaging with compostable paper-based alternatives, better aligned with local waste collection systems (MedWaves, 2019). This approach enabled to reduce plastic consumption and favour sustainable alternatives while matching procurement practices and waste management practices.

Meanwhile, plastic-eating bacteria[9] such as *Donellea skaiensis,* recently discovered, and bivalve filtration offers a promising nature-based approach to mitigating microplastic pollution in coastal waters. Recent experimental research has shown that mussel species such as *Brachidontes variabilis* and *Xenostrobus securis* can uptake and incorporate microplastics into their biodeposits under controlled conditions, confirming their potential as natural bio-remediators. The efficiency of microplastic removal varied with concentration levels and seasonal changes, while environmental factors like temperature and ecosystem composition further influenced uptake rates. Although their effectiveness is constrained by local ecological dynamics - and may be compromised by extreme events such as marine heatwaves - these findings suggest that mussels could play a complementary role in broader microplastic reduction strategies, particularly within site-specific, nature-based frameworks (Falkenberg et al, 2024).

8 For more information: **link.**
9 For more information: **link.**

4 . A conducive and integrated policy framework for managing plastic pollution at different scales

To effectively reduce and manage plastic pollution in the Mediterranean, a coherent and robust policy framework is essential. While technical solutions - such as waste sorting, collection systems, and treatment infrastructure - remain necessary, their success ultimately relies on strong governance at all scales. At the international level, ongoing negotiations under the auspice of the United Nations' Intergovernmental Negotiating Committee (INC) aim to finalize a legally binding global treaty on plastic pollution by the end of 2025, signaling growing multilateral momentum for coordinated action[10]. In the Mediterranean, existing guidelines made by MedWaves can further help inform decision-makers to reduce and manage plastic pollution (MedWaves 2019, MedWaves 2021). In addition to key EU Directives on waste[11], single-use plastics[12], and packaging[13], policy instruments like Extended Producer Responsibility (EPR), Deposit-Refund System (DRS), targeted fees, and stricter enforcement mechanisms are crucial for regulating plastics flows in urban contexts and encouraging systematic change (MedWaves, 2021).

In fact, Extended Producer Responsibility (EPR)[14] is an environmental policy that makes producers responsible for the entire life cycle of their products, particularly post-consumer waste. By transferring responsibility from municipalities and taxpayers to producers, EPR encourages sustainable design and reduces environmental and health impacts. Recognizing its role in the circular economy, UNEP's International Environmental Technology Centre (IETC) has promoted EPR through regional workshops in South America and West Asia, supporting knowledge exchange and national capacity building. In January 2025, Algeria passed a new waste management law that integrates EPR and eco-design principles to support a circular economy (Merle, 2025). The law redefines waste as a resource, makes producer responsibility for waste recovery mandatory, and promotes sustainable design. Key measures include phasing out single-use plastics, improving selective collection, raising public awareness of waste reduction and launching a national digital platform for materials exchange.

When it comes to consumption taxes at national level, DRS[15] has gained significant traction in recent years in Europe to reduce plastic waste and increase recycling rates. Following the 2019 EU Single-Use Plastics Directive, many European countries and Türkiye have either implemented or expanded DRS schemes for single-use plastic bottles and cans. Historically adopted by countries such as Germany or Sweden, these systems have proven effective in achieving high return rates and cleaner public spaces with more EU countries following in their steps (Schwizgebel et al., 2022). This policy solution would greatly benefit Mediterranean countries if combined with adequate waste management strategies and infrastructures. More permanent taxes, such as Spain's Plastic Tax[16], which entered into force in 2023, may shift consumer behaviours by raising the price of single-use products and making sustainable alternatives more attractive. This novel tax imposes a €0.45/kg fee on non-recycled plastic used in new plastic packaging, reducing the production and consumption of resources.

At a regional scale, the Marine Litter MED initiative, funded by the EU since 2016[17], supports the implementation of the Regional Plan on Marine Litter Management under the Barcelona Convention, with a focus on Southern Mediterranean countries. It contributes to achieving Good Environmental Status (GES) by aligning regional efforts with EU Directives and promoting coordinated action across institutions. Its continuation, the Marine Litter MED PLUS project (2024-2027)[18], aims to broaden the geographical scope and strengthen the impact of key prevention and reduction measures, while reinforcing interregional cooperation with bodies such as the Black Sea Commission and the General Fisheries Commission for the Mediterranean. The project highlights the importance of multi-scale governance and coordinated action in managing plastic pollution in the Mediterranean. It shows that addressing plastic pollution involves more than isolated measures - it requires an integrated approach across local, national, and regional levels, combining policies, technical actions, and stakeholder coordination.

Effective management on a local scale also requires rethinking how policies are designed and implemented. This also involves identifying plastic accumulation hotspots - often areas where debris is trapped by natural ecosystems such as dunes, wetlands, or rivers mouths (hence the importance of protecting and restoring them, in addition to the many co-benefits they can offer) - and coupling them with targeted cleanup operations before waste reaches the sea. Integrating such site-specific interventions into local waste management strategies

10 For more information on the International Negotiating Committee to Develop a Legally Binding Instrument on Plastic Pollution Process : **link.**
11 Directive (EU) 2008/98/CE and revised by Directive (EU) 2018/851.
12 Directive (EU) 2019/904.
13 Directive (EU) 94/62/CE.
14 For more information: **link.**
15 For more information: **link.**
16 For more information: **link.**
17 **Marine Litter MED 2016.**
18 **Marine Litter MED PLUS project (2024-2027)**

enhances both ecological protection and operational efficiency. Moving beyond top-down approaches, there is a growing recognition of the importance of engaging local stakeholders and communities to ensure policies are responsive to local realities (Woldesenbet, 2021; Musiana et al., 2024). This also means better understanding how different urban populations interact with waste - an issue often marked by environmental inequalities, particularly in terms of access to services and exposure to pollution. Addressing these disparities can help improve policy targeting and effectiveness, especially in the context of vulnerable or underserved areas.

5 . Conclusion

Tackling plastic pollution in the Mediterranean requires integrated, multi-level strategies that involve all stakeholders to address the problem at its roots. This publication shows that coastal cities, as both key contributors to and victims of plastic leakage (particularly due to their ecosystems degradation), are uniquely positioned to drive change. More research is needed on NbS solutions to tackle plastic pollution as they provide valuable co-benefits in prevention, awareness-raising, and supporting transformative change.

Through a threefold lens - prevent, reduce, and manage - this analysis has highlighted the importance of combining citizen engagement, institutional innovation, and regulatory mechanisms. Local initiatives such as the ICT-based citizen reward systems in Greece, or urban agriculture in Tunisia show that context-sensitive, inclusive approaches can be both cost-effective and environmentally impactful. At the same time, regional and national measures - such as the EPR, DRS, and targeted taxes - are essential to reinforce and scale these efforts, ensuring that upstream production and consumption patterns are also addressed.

Ultimately, responding to plastic pollution in the Mediterranean calls for a paradigm shift: from reactive waste management to proactive, circular, and justice-oriented governance. Cities must be empowered not only as implementers, but as co-creators of solutions - working in tandem with civil society, private actors, and regional institutions to protect their ecosystems, safeguard public health, and build long-term resilience in the face of growing anthropogenic and environmental pressures.

Bibliography:

WWF. (2019). Mediterranean Marine Initiative. Dalberg Advisors. "Stop the Flood of Plastic: How Mediterranean countries can save their sea"

Falkenberg, L. J., Cornet, J. E., & Joyce, P. W. S. (2024). Nature-based solutions to the management of legacy plastic pollution : Filter-feeders as bioremediation tools for coastal microplastics. The Science Of The Total Environment, 956, 177237. https://doi.org/10.1016/j.scitotenv.2024.177237

IUCN Global Standard for Nature-based Solutions : first edition. (2020). IUCN. https://doi.org/10.2305/IUCN.CH.2020.08.en

Les éco-écoles au Maroc, pour une éducation durable. (2016). construction21.org. https://www.construction21.org/france/articles/h/les-eco-ecoles-au-maroc-pour-une-education-durable.html

Medwaves. (2019). Guidelines to address single-use plastics through public procurement in the Mediterranean. https://www.medwaves-centre.org/wp-content/uploads/2022/05/200221_guidelines_en_0-5.pdf

Medwaves. (2019). Guidelines to phase out single-use plastic bags in the Mediterranean. https://www.medwaves-centre.org/wp-content/uploads/2022/05/Guidelines_PlasticsBags_Updated_FR_compressed.pdf

Medwaves. (2021). Guidelines to tackle single-use plastic products in the Mediterranean region. https://www.medwaves-centre.org/wp-content/uploads/2022/05/211214_guidelines_fr-5.pdf

Merle, B. (2025). Projet de loi adopté pour une gestion plus durable des déchets en Algérie. circemed.org. https://www.circemed.org/articles/h/projet-de-loi-adopte-pour-une-gestion-plus-durable-des-dechets-en-algerie.html

Moss. (2021). Reducing Plastic Pollution: Campaigns That Work. https://www.campaignsthatwork.org/

Musiana, M., Ishak, S. N., Soamole, M. S., & Surasno, D. M. (2024). Analysis of Community-Based Waste Management Policies to Achieve Clean and Healthy Environment. West Science Interdisciplinary Studies, 2(04), 749–753. https://doi.org/10.58812/wsis.v2i04.784

Neofotistos, M., Hanioti, N., Kefalonitou, E., Perouli, A. Z., & Vorgias, K. E. (2022). A Real-World Scenario of Citizens' Motivation and Engagement in Urban Waste Management Through a Mobile Application and Smart City Technology. Circular Economy And Sustainability, 3(1), 221-239. https://doi.org/10.1007/s43615-022-00155-z

Plan Bleu. (2022). State of Play of Tourism in the Mediterranean. https://planbleu.org/en/publications/state-of-play-of-tourism-in-the-mediterranean/

Plan Bleu. (2024, July). Solutions Fondées sur la Nature pour les villes méditerranéennes. Plan-bleu : Environnement et développement en Méditerranée. https://planbleu.org/publications/solutions-fondees-sur-la-nature-pour-les-villes-mediterraneennes/

RED 2020 : Rapport d'état de l'environnement en Méditerranée. (2020). Plan-bleu : Environnement et développement en Méditerranée. https://planbleu.org/soed/

Schwizgebel, C., Govers, S., & Govers, C. S. and S. (2022, September 14). La course vers la consigne en Europe. Fair Resource Foundation. https://fairresourcefoundation.org/fr/course-vers-la-consigne-en-europe/

Woldesenbet, W. G. (2021). Stakeholder participation and engagement in the governance of waste in Wolkite, Ethiopia. Environmental Challenges, 3, 100034. https://doi.org/10.1016/j.envc.2021.100034

WWF France. (2018). La Méditerranée, une "mer de plastique"? https://www.wwf.fr/mediterranee-pollution-plastique

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