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Letter to the Editor

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Bridging currents: an interdisciplinary source-to-sea approach is essential to align regional and national priorities with the future global plastics treaty ambitions

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Abstract

While it is vital to agree to a set of global objectives and targets to reduce plastic pollution as part of the Global Plastic Treaty, past negotiations have been troubled by differences in regional and national priorities and needs. To take these different priorities and needs into account, this letter proposes the adoption of an interdisciplinary source-to-sea approach. A source-to-sea approach emphasizes the connected nature between land-based sources of marine plastic pollution along the life cycle of plastic products on the one hand, and air, soil, and water cycles that determine marine plastic flows and associated sustainability risks on the other hand. It takes into account how we know more about the way in which production, use and plastic waste contribute to the pollution of rivers and seas in one location (e.g. in Europe), than we do for rivers and seas in other places (e.g. Africa). There are also regional and national differences in how much awareness exist about plastic pollution and how it is governed and regulated. These differences translate in different priorities and needs in terms of how to most efficiently and effectively reduce plastic pollution. The letter argues that these differences should be embraced and that an interdisciplinary source-to-sea approach can help to develop tailor-made regional and national targets and measures that in turn contribute to achieving the global ambitions of the Global Plastic Treaty. A key role is foreseen for existing governance institutions, such as river basin commissions and regional seas conventions (coordinated by UNEP Regional seas Programme), while the Global Plastic Treaty can become a platform for sharing of approaches, lessons and strategies between regions and countries so that over time, plastic pollution will be reduced worldwide.

Impact statement

This letter to the editor provides recommendations for the last round of negotiations of the Global Plastics Treaty (GPT) that will take place in Geneva in August 2025. Past negotiations for a set of globally unifying objectives, targets and measures have been troubled by differences in regional and national priorities and needs. This letter calls for an interdisciplinary source-to-sea approach in formulating regional and national priorities, targets and measures to contribute to achieving any global objectives of the GPT. This approach considers how plastic pollution of the (marine) environment is connected to the production, use and waste management of plastic products in a particular river basin or regional sea area. It considers differences in how much awareness and knowledge exist about sources of plastic pollution for a particular river or sea, but also how plastic production, use, waste management and associated plastic pollution are already addressed by national and local regulations and policies. The interdisciplinary source-to-sea approach can help to develop tailor-made regional and national targets and measures that contribute to achieving the global ambitions of the GPT. The GPT should, in turn, establish a dedicated forum for exchange among states and regions, which would contribute to learning from best practices and enable harmonising approaches. By fostering such collaboration at both regional and global levels, the GPT can catalyse a cohesive, interdisciplinary and source-to-sea-driven response to plastic pollution, one that is inclusive, science-based and aligned with broader sustainability objectives.

National and regional variations in addressing plastic production, use, waste management and pollution create challenges for agreeing on a set of globally unifying objectives, targets and measures in the future GPT. While a strong global ambition and overarching framework for action are essential, it is equally important to incorporate flexibility to reflect diverse regional and national needs and priorities. This letter proposes that the GPT adopts an interdisciplinary source-to-sea approach in formulating regional and national priorities, targets and measures to address the sources, flows and impacts of plastic pollution.

An interdisciplinary source-to-sea approach emphasises the connected nature between land-based sources of marine plastic pollution along the life cycle of plastic products,[1] and air, soil and water cycles, in determining marine plastic flows and associated environmental, social, economic and health risks (Granit et al., 2017). In addition, it integrates data and knowledge on sources, flows and impacts of plastic pollution, policy gaps and conflicting objectives and targets in plastic pollution governance, management efforts at different governance levels and varying awareness and interests of stakeholder groups. Regions, including extended river basins, catchments and regional seas, should be recognised as critical units of analysis and action. Considering these geographically and hydrologically defined areas is crucial for a source-to-sea management of plastic pollution and for effectively reducing plastic flows within and beyond spatial and national boundaries. In turn, this enables the establishment of regional, national and local priorities, targets and measures that will contribute to achieving the global ambition and framework of action established by the GPT.

Identifying the source-to-sea plastic flows requires integrating insights and knowledge on the production, consumption and waste management of plastics, combined with spatially explicit data on land-based activities, riverine transport and coastal and marine dynamics. Understanding these flows involves tracing the movement of plastics from upstream sources, such as production sites, urban centres and agricultural runoff, through wastewater, freshwater systems and estuaries, and into marine environments. However, the availability and quality of such data vary significantly across states and regions, often reflecting not only the transboundary nature of plastic pollution but also differences in monitoring capacity, institutional coordination and regulatory enforcement. These disparities pose challenges for harmonised assessments and prioritisation of interventions. Bridging these gaps requires transdisciplinary approaches, open data-sharing platforms and capacity-building efforts tailored to local contexts, particularly in data-scarce or under-resourced areas. This demonstrates the importance of capacity building and technology transfer from states with more advanced data management capabilities to those with greater needs, as reflected in Article 12 of the draft GPT text (UNEP, 2024).

To effectively assess the environmental and health risks posed by plastic pollution, it is essential to understand both the nature and extent of exposure and the hazards associated with that exposure. In some regions, such as the European Union, data on plastic (macro-, micro-) exposure is increasingly available, harmonised and reliable, being driven by monitoring programmes that facilitate assessments across various spatial scales (e.g., European, regional sea, national); however, there remains a pressing need for long-term datasets to enhance our understanding of exposure patterns. From a hazard perspective, progress is hindered by a shortage of environmentally relevant toxicity data. This is largely due to the use of test materials that do not represent environmental plastics and limited knowledge about additive chemicals and non-intentionally added substances contributing to plastic toxicity. As a result, comprehensive risk assessments for all forms of plastic pollution, particularly microplastics and nanoplastics, are currently not feasible. Addressing this urgent need requires the development of harmonised methodologies and access to environmentally representative test materials. Compounding the issue is the uneven availability of data across regions and within individual states, which further complicates efforts to generate reliable and comparable risk assessments.

Stakeholder analysis helps to clarify who contributes to plastic pollution, who is most affected and who holds the capacity and influence to drive change (Cowan et al., 2021). Inclusive, evidence-based policy-making, supported by tools such as public consultations and participation, can strengthen legitimacy and outcomes. While numerous stakeholders have attended the ongoing GPT negotiations, including representatives from industry, civil society, research, youth and Indigenous Peoples, they lack direct access to provide input during the closed session negotiations (UNEP, 2024). Nonetheless, stakeholders can play a critical role in influencing or supporting the position of individual states when given the opportunity.

Taking a source-to-sea approach provides a framework for recognising how actors and stakeholder group interests relate to reducing plastic pollution of river catchment areas and regional seas, as well as those involved in the life cycle of plastic products. As no one-size-fits-all solution can adequately address plastic pollution, some aspects of the GPT implementation will require approaches that are tailored to specific regional and local contexts. National, regional and local consultation and participation processes then become essential for developing context-specific targets, priorities and measures. This aligns with the proposed Article 14 of the draft GPT (UNEP, 2024), which highlights the need for stakeholder inclusion and consultation to facilitate the development, implementation and updating of national plans. Such engagement strategies are already being piloted as part of the SOSZEROPOL2030 project,[2] where participatory workshops grounded in a source-to-sea framework revealed how regional and local actors can co-design plastic pollution targets and measures to reduce plastic flows from source to sea. Understanding who holds influence, whose voices are included and who can act across the system is critical for designing equitable and effective governance arrangements under the future GPT.

Scientific information is most effective in guiding meaningful responses to environmental challenges such as plastic pollution when stakeholders view it as credible, relevant and legitimate (Grünzner et al., 2023). However, plastic pollution is a complex and deeply interconnected environmental issue, with far-reaching impacts on ecosystems and human health. Its full scope can be difficult to grasp, making it one of the most pressing and wicked problems of our time. Furthermore, communicating information about plastic pollution to the wider public faces challenges such as misinformation, conflicting and inconsistent messages and a perceived lack of transparency (Agnew et al., 2024). Strengthening evidence-based science communication at the science–policy–society interface requires increasing the accessibility and reach of scientific information and improving the communication around risks, uncertainties and local aspects of plastic pollution to enable

[1] As per UNEA resolution 5/14, the future GPT must address the full life cycle of plastics (UNEA, 2022). The full life cycle of plastics, which is not yet defined under the GPT, may include: extraction of raw materials, polymer production, product design, use and the end-of-life (and end-of-pipe) stage (OECD, 2024).

[2] See for more information https://cordis.europa.eu/project/id/101060213 and www.soszeropol2030.eu

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informed decision-making and foster broad societal support for effective mitigation strategies, policies and legislation (Agnew et al., 2023). Ultimately, translating scientific knowledge into clear, accessible and actionable messages helps bridge the gap between research, policy and public understanding. This is particularly important given the regional variations in the sources, impacts and solutions to plastic pollution, which require communication strategies sensitive to local contexts to foster inclusive, informed responses.

Addressing plastic pollution requires coordination across overlapping and fragmented jurisdictions and institutions at local, national, regional and global scales and between freshwater and marine environments. The future GPT will need to build on and work through this complex web of governance rather than starting anew (Maes, et al., 2023). A key challenge is not only aligning interests but streamlining implementation through existing legal, regulatory and institutional frameworks (Devriese et al., 2025). This calls for an analysis of how responsibilities, capacities and authority are distributed across governance levels, and how these structures can be leveraged to deliver the GPT objectives.[3] Applying a multi-level governance lens facilitates identifying how current policies address pollution sources, flows and impacts. Rather than creating new institutions, the GPT can enhance coherence by building on established mechanisms at the regional sea level (e.g., Abidjan Convention, Nairobi Convention, OSPAR, HELCOM, Barcelona Convention). The GPT can support vertical integration of policies and measures by encouraging implementation through subnational and municipal actors who are best positioned to act and understand the needs of their regions, as stated in Article 14 of the draft GPT (UNEP, 2024). Governance assessment tools, such as evaluating whether existing objectives and targets are SMART (specific, measurable, achievable, relevant, time-bound), can be used to understand implementation gaps, overlaps and regulatory blind spots. Moreover, institutional interplay will need to be managed to ensure that global measures complement and do not conflict with regional and national priorities. Particular attention should be paid to states that are strongly dependent on oil and plastic production and which need to transition to a more diversified economy. Together, this approach provides a pragmatic path forward for the GPT that strengthens existing institutions and promotes distributed but coordinated governance, as explored in recent studies on institutional design and treaty integration in fragmented global regimes (Tiller et al., 2022).

Implementing an interdisciplinary source-to-sea approach within the GPT provides an enormous opportunity to establish an integrated and adaptive framework to tackle plastic pollution across its entire life cycle. At the core of this approach is the need for globally binding and time-bound targets to reduce plastic production, use, waste and associated pollution, including chemical pollution, supported by binding commitments that signal a shared global determination to act. Such targets must be complemented by a framework that guides the mandatory implementation of source-to-sea strategies, enabling states and regions to develop context-specific targets and measures based on a comprehensive interdisciplinary analysis of their environmental, socio-political and economic realities.

By embedding guidelines and best practices into the GPT architecture, regions with advanced capacities and governance systems can take a leading role in applying the source-to-sea approach, serving as testbeds for implementation and generation of transferable knowledge and scalable solutions. The source-to-sea approach is particularly valuable because it accommodates varying levels of knowledge, resources and institutional maturity across states. It allows for flexibility in setting and achieving targets while fostering the development of regionally relevant solutions that respond to local challenges and priorities. This approach is also useful for assessing the effectiveness of policies proposed within the draft GPT (UNEP, 2024) in terms of eco-design (Article 5), production (Article 6), use and waste management (Article 8) and circular economy principles (life cycle stages) (Article 1), as well as other existing environmental policies and legal instruments related to land and water bodies.

Following the example of the Biodiversity Beyond National Jurisdiction Agreement, the GPT should include a duty for states to cooperate in implementing a source-to-sea approach. Existing governance institutions, such as river basin commissions and regional seas conventions (coordinated by UNEP Regional Seas Programme), are well placed to coordinate and operationalise this approach. Their established structures and mandates can help bridge sectoral divides, enhance policy coherence and facilitate multi-stakeholder cooperation across freshwater, coastal and marine systems. In operational terms, the GPT should also promote mechanisms that link different stages of the plastic life cycle. For example, extended producer responsibility (EPR) schemes, as part of Article 8 of the draft GPT (UNEP, 2024), can be designed to connect product design with downstream waste management and wastewater treatment. Similarly, eco-design principles should be aligned with recycling and disposal systems to ensure that products are developed with their end-of-life processing in mind. Such mechanisms can drive systemic change, reducing overall plastic demand and subsequently lowering production volumes, thereby addressing pollution at its root. Finally, the GPT should establish a dedicated forum for exchange and learning among states that are implementing the source-to-sea pollution approach, including river basin and regional sea (inter)governmental institutions and partnerships. This forum would serve to harmonise approaches, facilitate collaboration around joint development and sharing of knowledge and best practices, and ensure that lessons learned in one region can inform action in others, particularly for regions with low institutional maturity and capacity. By fostering such collaboration at both regional and global levels, the GPT can catalyse a cohesive, interdisciplinary and source-to-sea-driven response to plastic pollution, one that is inclusive, science-based and aligned with broader sustainability objectives.

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[3]The objective of this Convention is to protect human health and the environment from plastic pollution, including in the marine environment [based on a comprehensive approach that address the full life cycle of plastics]. - Chair's Text from December 01, 2024.

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