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Editorial: *The sustainability series:* the plastics problem - pathways towards sustainable solutions against plastic pollution

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Editorial on the Research Topic
The sustainability series: the plastics problem - pathways towards sustainable solutions against plastic pollution

Plastic is acknowledged as a topic of growing international concern with impacts on people, communities, livelihoods and ecosystems (Worm et al., 2017). This has sparked a global response that has resulted in the creation of numerous national and international laws. An important step was reached when the United Nations Environment Programme (UNEP) agreed to be given the responsibility of negotiating a legally binding international convention to address the comprehensive effects of plastics (Treaty to End Plastic Pollution by 2024) (Mofokeng et al., 2023).

Over the past decade, most of the attention on the plastic problem has been centered around the issue of plastic pollution in the environment. However, this represents only a fraction of the overall impact of plastic. Plastic manufacturing, trading, and consumption heavily rely on fossil fuels, resulting in adverse consequences for people, communities, and the environment and contributing to climate change (Ford et al., 2022). Many initiatives to combat plastic pollution have focused on improving waste management (see OECD, 2018), cleaning existing pollution (e.g., https://theoceancleanup.com/), and redesigning eco-friendly products (e.g., https://zerowasteeurope.eu/). Some have also concentrated on implementing bans and encouraging reductions in plastic consumption. However, none of these measures can succeed in isolation. It is crucial to prioritize reevaluating the materials entering the supply chain and enhancing our ability to recycle and reuse plastic. We can fundamentally transform the situation by treating plastic as a valuable resource rather than mere waste.

In this Research Topic, we present new research, in the form of 12 articles, that addresses multiple areas to consider to reduce the challenges posed by this problem. Geographically, contributions span from the Galapagos and Brazil to South Africa and the Seychelles, Europe, Australia and New Zealand. Topics range from measurement and mapping of plastic losses in the environment, alternative materials to fossil-based plastic, management solutions and

the associated challenges, to policies that are likely to be effective in mitigating plastic losses to the environment and actions that can help improve plastics circularity (Figure 1).

Muñoz-Pérez et al. quantified and mapped plastic pollution's magnitude and biological effects in the Galapagos islands (Pacific Ocean), and they found that no sampled coast was plastic debris-free. By working closely with citizen scientists, the authors documented 52 species exposed to plastic pollution through entanglement and ingestion, including the iconic marine iguana (*Amblyrhynchus cristatus*) and four Critically Endangered species. Ballerini et al. also applied a citizen-science approach to quantify macrolitter along the Durance riverbank and Lake Serre-Ponçon's beach (France), finding that 82% of mismanaged waste was plastic. The information shared from both of these studies can be used to support the development of targeted policies in litter prevention, mitigation, and reduction of most abundant litter items, as well as to test whether implemented measures to reduce plastic pollution are effective.

Data availability is crucial to decision and policy-makers and to encourage a more sustainable science regarding financial and natural resource use. de Ramos et al. analyzed open data repositories to identify the presence of datasets related to marine litter in Brazil, and they concluded that more data still needs to be published. This work highlights the utility of data sharing, which supports resource optimization, complementarity, and data-driven management decision-making.

Plastic has impacts that go unnoticed, which are related to the whole life-cycle, from the extraction of the raw materials to the creation of the pellets until the end of life of plastic products. Thus, a life cycle management (LCM) approach for plastic products is needed, as declared in the Medellin Declaration on Marine Litter in Life Cycle Assessment and Management (Sonnemann and Valdivia, 2017). Chitaka et al. explored how enhanced knowledge of plastic leakage has influenced approaches to plastic product LCM in South Africa. The authors found that the drivers for developing strategies to address plastic pollution mirror those for adopting LCM-based concepts, including maintaining a competitive advantage, compliance with regulations and legislation, and meeting investor and consumer expectations.

Among the various tools in LCM is life cycle assessment (LCA), which is a method for identifying and evaluating the environmental impacts of a product over its entire life cycle. LCA can broaden our understanding of the ecological impacts of a product beyond what is the most visible. In this Research Topic, Miller provided an overview of the LCA process and described the benefits and limitations of LCA methods as they pertain to plastic waste. The paper summarized major trends observed in prior LCA studies and discussed how LCA could best help resolve the plastics problem

FIGURE 1
Word cloud generated from keywords from the papers included in this Research Topic (generated through WordArt.com).

without causing other unintended issues. The author concluded that reduced consumption of the underlying need for plastic is the only way to ensure reduced environmental impacts.

Alternatives to fossil-based plastics exist, including compostable and biodegradable plastic. However, the damage caused by incorrect waste management may offset them, and currently, different products are confusing to consumers, as we still lack a consistent labeling system. Mismanagement of compostable plastic may derive from contamination in recycling, the inability of waste streams to separate compostable from traditional plastic due to a lack of technologies that automatically detect and divide it, or both. Allison et al. developed a program to improve compostable plastic disposal in the United Kingdom focused on improving citizens' behavior. The resulting intervention was a disposal instruction label for compostable packaging comprising instructions and a logo. However, the authors pointed out that introducing a disposal instruction label is unlikely sufficient as an intervention strategy until products that are not compostable—but claim to be—are banned from the market. Taneepanichskul et al. developed classification models for automatically identifying and classifying compostable plastics using a hyperspectral imaging camera and chemometric techniques. Indeed, the advantages of compostable packaging are realized when they do not enter the environment or pollute other waste streams or the soil. The system can accurately sort and differentiate compostable plastics from identical-looking conventional plastic items.

Recycling may be essential to reducing waste and developing a plastics circular economy. Circularity also includes the application of smart logistics to maximize the potential discarded plastic and the development of new business models. The European Commission has taken a circular economy-focused approach to the problem of End-Of-Life (EOL) fishing gear and abandoned, lost, or otherwise discarded fishing gear (ALDFG), encouraging their separate collection, transit, and circular treatment (Basurko et al., 2023). Andrés et al. propose a new circular business model for tuna purse seine nets. Tropical tuna purse seiners are one of the world's most significant contributors to EOL fishing gears, and these fishing nets can become a promising secondary raw material. Innovation and logistics play a fundamental role in making the business sustainable.

However, recycling is not the best option for all kinds of products. Whilst an increasing share of post-consumer plastic waste in OECD countries is collected for recycling (Bishop et al., 2020), globally, only 9% of plastic waste is recycled, while 22% is mismanaged (OECD, 2022). Plastic waste export has been a common waste management practice, and importing countries increasingly receive unrecyclable plastic waste designated as "recyclable". Unfortunately, nearly all nations that receive significant amounts of plastic waste also have some of the world's highest rates of waste mismanagement (Jambeck et al., 2015). In response, the Basel Convention, an international treaty designed to reduce the movements of hazardous wastes, adopted the Plastic Waste Amendments clarifying which types of plastic waste are subject to the control procedure for exports, transit and imports. Nevertheless, severe weaknesses still exist regarding the actual implementation of the convention, as reported by Farrelly and Chitaka by drawing on a plastic waste material flow analysis conducted in Palmerston North (New Zealand). According to the authors, weaknesses could be resolved with clarity and harmonization of key definitions, improved data collection, and greater transparency in the monitoring and reporting of plastic waste flows.

An important strategy to address plastic pollution is creating and supporting the model of replacing disposable items with reusable products and preventing waste generation in the first place. Moss et al. described the Global Landscape of Reusable Solutions,[1] a regularly updated, open and free-to-everyone dataset created to understand the evolution, current state, and potential environmental benefits of reuse and refill solutions. Reusable item material and assortment problems, expanding and integrating reuse infrastructure, businesses' willingness to adopt reuse solutions, customers' acceptance, and, in some places, policies that restrict reusing and refilling containers are some of the barriers to growth for reuse solutions identified by the authors. The acceptance and scalability of reuse solutions can be improved through behavioral campaigns, better and more easily accessible data, sharing examples of successful systems, and growing knowledge and understanding of reuse system design.

The policy environment is critical in reducing plastic pollution (Vince and Hardesty, 2017). National and international policy changes tend to redefine how plastics are designed, produced and used to lay the foundations for a new circular plastic economy. Hardesty et al. focused on Australia's National Plastics Plan as a case study of a national approach to addressing this transboundary issue. The Plan was considered in regard to supply chains, best practices and standards, and guidelines for a successful circular plastic economy. Recognizing that plastic leakage into the environment is a social equality issue, the authors encourage place-based solutions that are culturally relevant, commercially viable, and environmentally appropriate.

Plastic pollution is a problem that begins long before it reaches the environment, and so it must be the solution. García-Hermosa and Woodall suggested a multidisciplinary approach to effectively address the marine plastic litter problem, minimizing plastic production and consumption and reducing waste leakage through better waste management. The authors also encouraged the creation of a shared user-friendly tool designed to facilitate transparency and democratization of methodologies by gathering pertinent information from diverse sources. This tool would present the current problem and a list of possible interventions, serving as a valuable mechanism to help choose, prioritize and optimize interventions.

Overall, the papers included here highlight important areas of consideration and opportunities to reduce waste losses to the environment. These span improved data collection and management, methods harmonization and data sharing, to increased circularity via design and better waste management practices. While plastic production continues to grow, we are seeing an increase in more holistic understanding and integrated approaches to change

1 www.reuselandscape.org/database

our relationship with plastic at all steps along the plastics life cycle.

Author contributions

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Conflict of interest

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References

Basurko, O. C., Markalain, G., Mateo, M., Peña, C., Mondragon, G., Larruskain, A., et al. (2023). End-of-life fishing gears in Spain: quantity and recyclability. *Environ. Pollut.* 316, 120545. doi: 10.1016/j.envpol.2022.120545

Bishop, G., Styles, D., and Lens, P. N. L. (2020). Recycling of European plastic is a pathway for plastic debris in the ocean. *Environ. Int.* 142, 105893. doi: 10.1016/j.envint.2020.105893

Ford, H. V., Jones, N. H., Davies, A. J., Godley, B. J., Jambeck, J. R., Napper, I. E., et al. (2022). The fundamental links between climate change and marine plastic pollution. *Sci. Total Environ.* 806, 150392. doi: 10.1016/j.scitotenv.2021.150392

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., et al. (2015). Plastic waste inputs from land into the ocean. *Science* 347, 768–771. doi: 10.1126/science.1260352

Mofokeng, R. P., Faltynkova, A., Alfonso, M. B., Boujmil, I., Carvalho, I. R. B., Lunzalu, K., et al. (2023). The future of ocean plastics: designing diverse collaboration frameworks. *ICES J. Mar. Sci.* 2030, 1–12. doi: 10.1093/icesjms/fsad055

OECD (2018). *Improving Plastics Management: Trends, Policy Responses, and the Role of International Co-operation and Trade OECD Environment Policy Papers, No. 12*. Paris: OECD Publishing.

OECD (2022). *Global Plastics Outlook: Economic Drivers, Environmental Impacts and Policy Options*. Paris: OECD Publishing.

Sonnemann, G., and Valdivia, S. (2017). Medellin declaration on marine litter in life cycle assessment and management. *Int. J. Life Cycle Assess.* 22, 1637–1639. doi: 10.1007/s11367-017-1382-z

Vince, J., and Hardesty, B. D. (2017). Plastic pollution challenges in marine and coastal environments: from local to global governance. *Restor. Ecol.* 25, 123–128. doi: 10.1111/rec.12388

Worm, B., Lotze, H. K., Jubinville, I., Wilcox, C., and Jambeck, J. (2017). Plastic as a persistent marine pollutant. *Annu. Rev. Environ. Resour.* 42, 1–26. doi: 10.1146/annurev-environ-102016-060700