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Editorial: Recent research advances on heavy metals, microplastics, persistent organic pollutants, and solid waste in aquatic and terrestrial ecosystems

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Editorial on the Research Topic

Recent research advances on heavy metals, microplastics, persistent organic pollutants, and solid waste in aquatic and terrestrial ecosystems

Introduction

The global surge in industrialization and urbanization has resulted in the unregulated release of anthropogenic pollutants into both aquatic and terrestrial ecosystems. This aforementioned trend has given rise to a plethora of environmental challenges, including contamination by heavy metal (HMs), the pervasive pollution caused by microplastics, the intricate management required for persistent organic pollutants (POPs), and the urgent concern surrounding solid waste disposal (Quina et al., 2008; Nadal et al., 2015; Zhao et al., 2015; Rillig et al., 2021; Senathirajah et al., 2021; Xue and Liu, 2021; Zhang et al., 2022; Zhang and Zhang, 2022; Zhao and You, 2022). To address these intricate challenges, *Frontiers in Environmental Science* presents a research theme, “Recent Research Advances in Heavy Metals, Microplastics, Persistent Organic Pollutants, and Solid Waste in Aquatic and Terrestrial Ecosystems”. Scholars from prestigious affiliations contribute their expertise and advancements in this field. This research theme has yielded ten publications, comprising seven research articles and three reviews, each offering unique perspectives on contemporary environmental challenges related to HMs, microplastics, POPs, and solid waste.

Key elements in this Research Topic

The research findings have unveiled the adverse impacts of heavy metals such as arsenic, lead, and bismuth on both plant and animal life, emphasizing the pressing need to mitigate their presence within ecosystems. Sun et al. conducted a study on the spatial distribution and associated health risks of HMs in the soils of the Yangtze River Basin, revealing significant variability in metal

concentrations and their corresponding health hazards, particularly in regions with advanced economic development. [Pietrini et al.](#) investigated bismuth's effects on garden cress, revealing its detrimental impact on growth, chlorophyll, carotenoid levels, as well as photosynthesis. The findings suggest plants may activate a defense mechanism in response to mitigate the damage caused to photosynthesis, which is indicated by an increase in anthocyanin and flavonol levels. [Kadirvel et al.](#) explored the toxic effects of arsenic, lead, and fluoride on boar spermatozoa, uncovering reductions in sperm motility, viability, and mitochondrial membrane potential (MMP) in a dose- and time-dependent manner, both individually and in combination. This study highlights the significant impact of HMs on reproductive health.

Three studies addressed the prevalence of microplastic pollution in marine and terrestrial ecosystems and explored various aspects of this challenge, including management strategies, impacts, and potential solutions. [Lou et al.](#) conducted a bibliometric study on global research pertaining to controlling marine microplastic pollution from 2013 to 2022. This study presented a theoretical framework for managing marine microplastic pollution, with a focus on quantification, traceability, and Research Topic. Additionally, it emphasized the crucial need for greater attention to policy implications and technological advancements within the field of marine microplastic pollution control. [Ng et al.](#) examined plastic waste in Southeast Asia, highlighting its detrimental effects on marine ecosystems resulting from inadequate waste management practices. This study evaluated the roles played by governments, businesses, and communities in addressing plastic pollution while analyzing the impact of global plastic trade specifically regarding waste transfer from developed to developing countries. It proposed solutions such as bio-based plastics, waste-to-wealth programs, and a circular plastics economy to tackle these challenges effectively. Of these, the production and application of bio-based degradable plastics may play an especially critical role in resolving the global plastic pollution problem at hand. [Barbir et al.](#), through their assessment of ecotoxicity associated with polylactic acid-based mulch film usage, found low plant toxicity but observed some adverse effects on earthworm reproduction as well as varying impacts on aquatic life; thus emphasizing that bio-based plastics have complex environmental consequences.

POPs are recognized for their persistence and long-range transmission, exacerbating ecological imbalances as they enter the food chain. [Debela et al.](#) conducted an analysis of POPs in Ethiopia, addressing their management, regulations, and environmental impacts. The study underscored the prevalence of POPs, identified regulatory gaps, and emphasized the necessity for enhanced oversight and legislation to mitigate their effects. [Saibu et al.](#) investigated the geochemistry and metagenomics of bacteria in Lagos' dumpsites to examine their response to pollution from POPs and HMs. The research revealed a diverse range of bacterial communities that correlated with pollution levels, while also identifying key bacteria involved in pollutant breakdown—suggesting potential bioremediation approaches.

Direct disposal of solid waste in landfills or incinerators not only results in resource wastage but also leads to the generation of secondary pollutants that are detrimental to ecosystem health. The formulation of specific management strategies and the adoption of advanced safe waste treatment technologies can significantly mitigate health risks, while also aiming for economic utilization of waste as a higher objective. [Haque et al.](#) investigated the complexities associated with managing medical waste in Rohingya refugee camps, highlighting the absence of tailored guidelines and the prevalent hazardous disposal methods. This study

emphasized the need for detailed management strategies to ensure secure waste processing and reduce health hazards. [Fianko et al.](#) explored creating phosphorus-rich biochar-compost from maize stover and groundnut husk in Ghana's Guinea Savanna to boost soil fertility. The study assessed biochar's impact on compost quality, especially phosphorus content, highlighting its agricultural and environmental benefits through waste recycling.

Conclusion

This research theme encompasses a compilation of original studies that investigate the impacts of HMs, microplastics, POPs, and solid waste on both aquatic and terrestrial ecosystems. It offers valuable insights into the environmental dynamics of these pollutants and their implications for ecosystems and human health. Encompassing fundamental as well as applied research, these articles enhance our comprehension of such environmental Research Topic while advocating for remedial strategies. The body of work sheds light on the distribution and toxicity of these pollutants, suggesting future research directions such as establishing exposure thresholds, evaluating bioaccumulation processes, and devising mitigation tactics to counteract their adverse effects. These findings are crucial in formulating effective environmental protection policies and contribute significantly to the advancement of environmental science.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

- Nadal, M., Marquès, M., Mari, M., and Domingo, J. L. (2015). Climate change and environmental concentrations of POPs: a review. *Environ. Res.* 143, 177–185. doi:10.1016/j.envres.2015.10.012
- Quina, M. J., Bordado, J. C., and Quinta-Ferreira, R. M. (2008). Treatment and use of air pollution control residues from MSW incineration: an overview. *Waste Manage.* 28 (11), 2097–2121. doi:10.1016/j.wasman.2007.08.030
- Rillig, M. C., Kim, S. W., Kim, T.-Y., and Waldman, W. R. (2021). The global plastic toxicity debt. *Environ. Sci. Technol.* 55 (5), 2717–2719. doi:10.1021/acs.est.0c07781
- Senathirajah, K., Attwood, S., Bhagwat, G., Carbery, M., Wilson, S., and Palanisami, T. (2021). Estimation of the mass of microplastics ingested – a pivotal first step towards human health risk assessment. *J. Hazard. Mater.* 404, 124004. doi:10.1016/j.jhazmat.2020.124004
- Xue, Y., and Liu, X. (2021). Detoxification, solidification and recycling of municipal solid waste incineration fly ash: a review. *Chem. Eng. J.* 420, 130349. doi:10.1016/j.cej.2021.130349
- Zhang, Y., and Zhang, H. (2022). Shade and Cd conditions strongly impact the physiological responses of purple perilla. *Front. Environ. Sci.* 10, 896963. doi:10.3389/fenvs.2022.896963
- Zhang, Z., Li, Z., Lin, H., Zeng, Z., Huang, J., and Li, D. (2022). Lead exposure was associated with liver fibrosis in subjects without known chronic liver disease: an analysis of NHANES 2017–2020. *Front. Environ. Sci.* 10, 995795. doi:10.3389/fenvs.2022.995795
- Zhao, F.-J., Ma, Y., Zhu, Y.-G., Tang, Z., and McGrath, S. P. (2015). Soil contamination in China: current status and mitigation strategies. *Environ. Sci. Technol.* 49 (2), 750–759. doi:10.1021/es5047099
- Zhao, X., and You, F. (2022). Life cycle assessment of microplastics reveals their greater environmental hazards than mismanaged polymer waste losses. *Environ. Sci. Technol.* 56 (16), 11780–11797. doi:10.1021/acs.est.2c01549