Current Trends in Biotechnology and Pharmacy
Vol. 20(2) 3130-3137 July 2026, ISSN 0973-8916 (Print), 2230-7303 (Online)
DOI: 10.5530/ctbp.2026.3.34

The Effect of Microplastics and Its Impact on Human Health: Mapping India's Research Footprint

Anu[1,2] and NK Prasanna[1,2]

[1]CSIR-National Institute of Science Communication and Policy Research, New Delhi-110012, India
[2]Academy of Scientific and Innovative Research, Ghaziabad- 201002, India
***Corresponding author**: anu.niscpr21j@acsir.res.in

Abstract

Microplastics (MPs) are plastic particles smaller than 5 mm in size and have been identified as a major global concern because of their persistence and potential risks for human health. This study aimed to conduct a scientometric analysis of the global research on MPs with special referenceto India. Results indicated that most of the significant funding support was providedby the Department of Science and Technology (DST), University Grants Commission (UGC), and the Council of Scientific and Industrial Research (CSIR).The keywords mostlyused in the research studies were *microplastics*, *human health*, *toxicity* and *heavy metals*. However, the emerging themes were *artificial intelligence*, *pharmacokinetics*, and *biomedical applications*. The collaboration mapping of Institutions revealed IITs, CSIR labs, Banaras Hindu University and Cochin University of Science and Technology as the leading contributors in this research domain. The journals most opted by the authors for their publications were Science of the Total Environment, Environmental Science and Pollution Research, and Environmental Research. The findings reveal that Indian research on MPs is multidisciplinary and increasingly integrated with global efforts.

Keywords: Human Health, Ocean Pollution, SDG, Water Pollution, Marine Life

Introduction

Microplastics are classified into primary (e.g., cosmetic microbeads and plastic nurdles) and secondary microplastics (e.g., plastic bottle debris, bags, fishing nets, etc.), which are created from the breakdown of larger plastic debris (1). The presence of microplastics is now indisputable; they have been identified in the deepest trenches of the ocean (2), within the most remote alpine glaciers (3), in the atmosphere (4), and ultimately throughout the present global food chain. Microplastics and their associated-conjoined pollutants have been reported in a variety of marine species that enter the food system for human consumption, including mussels, oysters, shrimp, and fish (5,6). The ocean acts as the final destination for an entire suite of terrestrial pollution, including persistent organic pollutants (POPs), often from industrial sources, like polychlorinated biphenyls (PCBs), pesticides (e.g., DDT), heavy metals such as mercury and lead, and hydrocarbons derived from oil (7). Public health advisories have issued reports for decades warning about the dangers of consuming mercury and other toxic contaminants present in large predatory fish (e.g., tuna and swordfish). Mercury has been identified as a cause of neurodevelopmental deficits in children and cardiovascular issues in adults (8). Seafood-borne PCBs have been identified as caus-

Vol. 20(2) 3130-3137 July 2026, ISSN 0973-8916 (Print), 2230-7303 (Online)
DOI: 10.5530/ctbp.2026.3.34

ing carcinogenic, immunological, and reproductive effects (9).Plastic is not stable chemically. They are made with many types of chemicals, like plasticizers, flame retardants, stabilizers, and colorants. These chemicals are not tightly attached to the plastic, so they can come out. Many of these chemicals can cause hormone problems, cancer, or problems in having babies. The combination of chemicals in plastic and pollutants in the ocean can cause more bad health effects, especially for people who are weak, like pregnant women and children.

Many scientists and public health workers have become concerned about the health impact of ocean pollution as more and more environmental pollutants have been discovered in the marine environment. How does this complex, and ubiquitous exposure impact human health is a fundamental and urgent question. The pathway of human exposure is already clear. Microplastics and ocean pollution may be introduced into the human body through a number of avenues, most notably by ingestion and inhalation. Ingestion may result not only from eating seafood contaminated by pollution, but from a variety of other sources including sea salt (10), bottled water, tap water (11,12) and various beverages routinely consumed in daily life. Inhalation is another possible pathway through which microplastics may be introduced into the human body as synthetic fibers in our clothing and break down particles from urban dust may be reignited into the air we breathe in (13,14). With their broad sources and the possible inhalation/ingestion introduction into the human body, plastic particles and the chemicals they carry are available for biological interaction at various levels in a variety of systems, with their associated potential human health risk is currently largely unknown.Studies have shown that exposure to polystyrene microplastics can induce inflammation and oxidative stress in human lung epithelial cells (15) and in the liver and gut of mice (16,17). There is a well-established body of research focused on particle toxicity in other fields, especially involving asbestos fibers and particulate matter air pollutants (PM2.5 and PM10), which have been shown to induce pulmonary fibrosis, cardiovascular disease, and lung cancer when chronically inhaled (18,19). Thus, the fibrous and fragmented nature of many microplastics is a cause for concern relative to similar pathological findings.The precautionary principle states that, “Absence of evidence is not evidence of absence” (20); this means that even though there is no conclusive evidence, there should be no presumption that this continual increase in plastics in the environment is not associated with adverse human health effects. As plastic production and waste continues to rise, it is reasonable to conclude that environmental concentrations of microplastics and concomitant exposure of humans to microplastics will certainly rise in the coming decades. Given plastic has been found in various environments, e.g., freshwater, marine, soil, and even food systems, the widespread attendance of microplastics is troubling, both for ecotoxicological reasons and as a possible human health concern, that warrants prompt research investigation (21).

In India, the interest of scientists and researchers in MPs from freshwater environments has recently begun to build momentum. Nonetheless, the status of MPs is still unclear due to the inconsistency arising within studies and studies done in a few sites. While the research area is advancing very quickly, there remain considerable gaps in knowledge. So, for example, research addressing toxicological endpoints show that developing risks (e.g., oxidative stress and inflammation) is still lacking standard detection or risk assessment methods (22). Another challenge to this review is regarding nanoplastics, which are so small that they can cross biological barriers -although the evaluation methods for the nanoparticles themselves are still very much in the early stages of development. These challenges justify the need for standardized methods, multi-disciplinary research, and regulatory action aimed at preventing or minimizing microplastic pollution to mitigate harm to community/public health.

Vol. 20(2) 3130-3137 July 2026, ISSN 0973-8916 (Print), 2230-7303 (Online)
DOI: 10.5530/ctbp.2026.3.34

Publications and citations had a remarkable increase and showed a strong global effort around the year 2015 as per the literature on Scientometric studies (23,24). In majority of the studies, China has been come up as the most prolific country in the aspect of publication volume, demonstrating significant government support and rapidly surpassing the UK and the USA, although the European countries often have a higher citation impact (25,26,23). The large amount of published research, usually in the top Journal Science of the Total Environment (27), has been accompanied by a clear shift in the thematic area: the earlier studies dealt with marine and coastal pollution, whereas the recent congested areas are strongly around terrestrial ecosystems (like sources of plastic mulch and sewage sludge), the critical danger of airborne MPs, and the ubiquitous threat of "microplastics in food" as a route of human health impact (28,29,25). Besides, the research trends show that the application of solutions is gaining momentum, and adsorption has been highlighted as a consistently hot keyword for MP removal technologies (24). Apart from a huge volume of publication in the field of microplastics on global front, there is still bunch of studies are available which highlights the emerging themes and hotspots of microplastics research in Indian context.This article provides a comprehensive bibliometric study on area of microplastics and its association with human health, emphasising the participation of India in the world's scientific output in this research area. This research aims to analyze the publication output, top authors, and leading institutions in this domain and also to analyse the emerging areas of research. This research aimed to monitor India's contributions to a broader picture of research on microplastics and human health, mapping out the strengths, weaknesses, and opportunities to push the research further.

Materials and Methods

Methodology

A scientometric method was used to assess the scholarly research productivity in the field of microplastics and human health. The data was extracted from the Web of Science Core Collection (WoSCC), the largest and most comprehensive citation database. The keywords "microplastic," "human health*," "ocean pollutants*," and "effect of microplastic" were used under the Title search category. Initially a total of 51,459 documents were found.

The data was geographically restricted to include only documents published from India, which resulted in a compressed total of 2,532 documents and limiting the publication range from 2004 - 2024 to include the last two decades of publications. This search totaled up to 2,122 documents. The search was limited only to document types to Articles, Review Articles, Proceedings Papers, Editorial Material, and Meeting Abstracts. A total 2,094 documents were analysed in this study.

Analysis and Interpretation

Publication Type

The analysis of document types shows that there is a strong majority of published research articles including 1,421 publications, suggesting that most articles on microplastics and human health are original research articles. This is followed by review articles (509), that allow others to synthesize the available literature, discuss gaps in knowledge, and provide future research directions. The remaining document types collectively represent a smaller share of the publication distribution: proceeding papers (74), editorial materials (55), and meeting abstracts (35) (Figure 1).

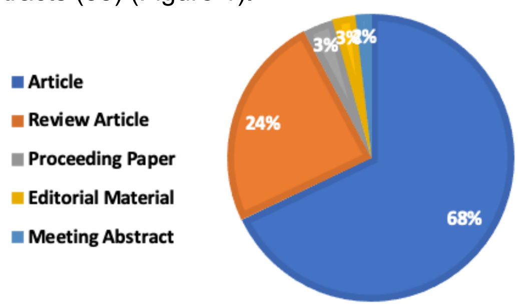


Fig 1: Distribution of various document types retrieved for the study

Current Trends in Biotechnology and Pharmacy
Vol. 20(2) 3130-3137 July 2026, ISSN 0973-8916 (Print), 2230-7303 (Online)
DOI: 10.5530/ctbp.2026.3.34

Funding Agency

The analysis had identified the role of specific institutions in the contributions. The Department of Science and Technology (DST), India has the most significant contributions of 145 documents, which signifies its primary role in the research on microplastics and human health, followed by the University Grants Commission (UGC), India, is second with 117 contributions. The Council of Scientific and Industrial Research (CSIR), India, has contributed 55 contributions (figure 2).

At the international level, King Saud University (42 contributions) and the National Research Foundation of Korea (22 contributions) both relate to greater engagement to issues of microplastics. In addition, there is a further engagement multi-sectoral engagement follows with the Indian institutes of the Indian Council of Medical Research (34 contributions) and Science and Engineering Research Board (33 contributions). Other contributors with significance, but smaller volumes, include the UK Research Innovation, the National Natural Science Foundation of China, and generally King Khalid University. These contributions are beginning to demonstrate the increased collaboration with contributions, also contextualized as global sharing.

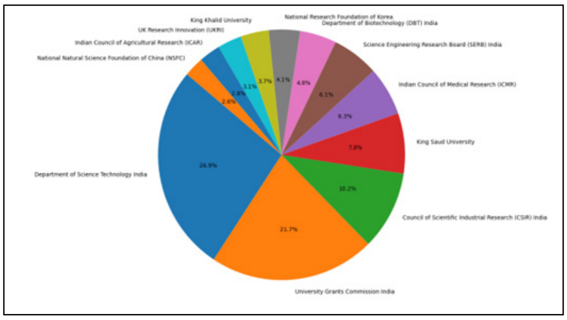


Fig 2: The leading financial bodies that supported the research on microplastics and human health

Most productive organizations

The institutional co-authorship mapping revealed that microplastics research is most commonly produced from India's prominent institutions such as the Indian Institutes of Technology (IITs), the Council of Scientific and Industrial Research (CSIR), Banaras Hindu University (BHU), the Cochin University of Science and Technology and the Vellore Institute of Technology (Figure 3). Institutions in India have begun to form strong co-authorship collaboration networks nationally and internationally, with academic links to universities including King Khalid University, which suggests the internationalization of research is increasing.

Keyword co-occurrence mapping

The keyword co-occurrence mapping illustrated the most frequently used keywords by authors in the field of microplastics research. Figure 4 shows that the keyword most commonly used is *microplastics*, which is a key component of the research landscape. Closely associated keywords include *human health, toxicity, heavy metals, nanoplastics*, and *biodegradation*, all of which are prevalent in the research interests of authors in this field. Other common keywords are *sediments*, *groundwater, water quality, risk assessment*, and *pollution*, showing the environmental component of the field. In addition, keywords that have recently emerged in the research include *artificial intelligence, machine learning, pharmacokinetics*, and *biomedical implications*.

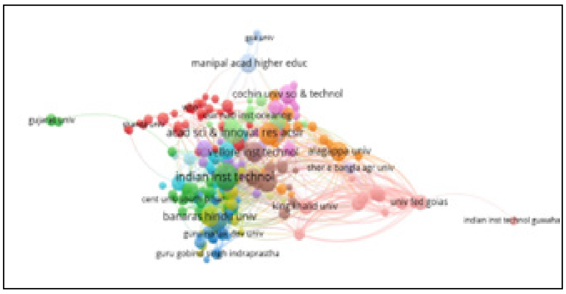
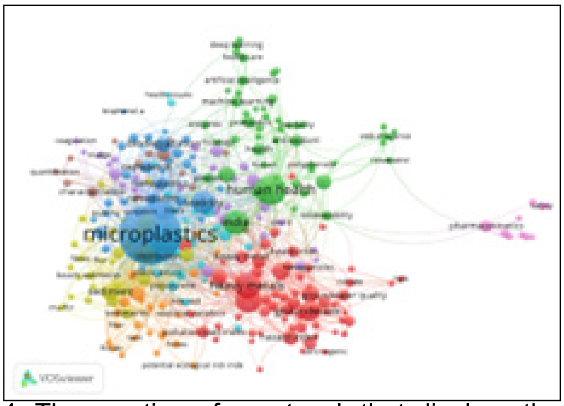


Fig 3: The most active Indian institutions that were involved in this area of research\

Most opted journals

The mapping of co-citation of journals implies a preference among scholars for publication in the prestigious journals including- *Science of the Total Environment*, *Environ Fig*

Vol. 20(2) 3130-3137 July 2026, ISSN 0973-8916 (Print), 2230-7303 (Online)
DOI: 10.5530/ctbp.2026.3.34



4: The creation of a network that displays the keyword co-occurrence patterns in the dataset

mental Science and Pollution Research, and *Environmental Research* as core publication outlets with a degree of subject diversity represented by outlets like *Frontiers in Microbiology*, *Current Science*, and the *International Journal of Environmental Research* and *Public Health*. *The Journal of Food Science*, *Journal of Food Composition and Analysis*, and *International Journal of Pharmaceutics* suggest a growing convergence of microplastics with issues related to food safety, health, and biomedical focus (Figure 5).

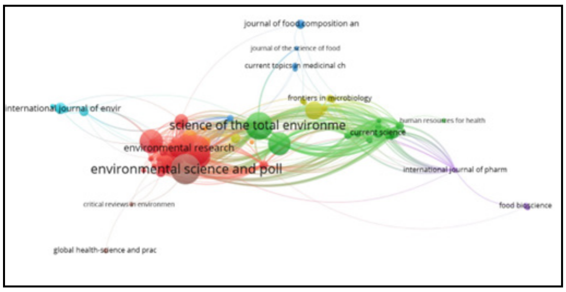


Fig 5: The most important scientific journals leading this area or research

Discussion

This scientometric analysis has shown that research in microplastics and human health has increased sharply in recent years, with engagement and investments from institutions and funding bodies in India. The large number of research articles implies focus on original research, while the proportion of review articles means that there is an evidence synthesis that serves to direct further research. The funding landscape illustrated significant funding from India in the form of national funding bodies including the DST, UGC, and CSIR, as well as discipline-based funding (i.e., ICMR, DBT), as demonstrated with the interdisciplinary encouragement of funding body engagement at the national and international level. The institutional mapping shows that IITs, CSIR, Banaras Hindu University, and Cochin University of Science and Technology are the most productive Institutions. An increased overall level of international collaborations is also indicative that there could still be an opportunity for undertaking research in this area, as it highlighted as an international issue. Co-occurrence of keywords identified Microplastics as the central node in the literature and is linked to aspects of health and human health, toxicity, and environmental transport. The journal analysis indicated a clear trend of growth from traditional environmental science disciplines through to food safety and into biomedical journals, despite its origins in environmental science research which involved clear shift and demonstrate a shift toward interdisciplinary engagement in this research area.

Conclusion

The findings indicated that microplastics have shifted from an environmental problem to a serious public health concern, with India emerging in the global research landscape. The analysis has shown strong clusters of research on environmental fate, toxicity, and human health, while highlighting gaps from standardization to long-term human epidemiological research. Future studiesmay utilise the artificial intelligence, pharmacokinetics, and medical implications of microplastics in biomedical applications to combat this global pandemic of coming times.

References:

1. Andrady AL (2011) Microplastics in the marine environment. Marine Pollution Bulletin 62(8):1596-1605. https://doi.org/10.1016/j.

marpolbul.2011.05.030

2. Peng G, Zhu B, Yang D, Su L, Shi H, Li D (2017) Microplastics in sediments of the ChangjiangEstuary, China. Environmental Pollution 225:283-290. https://doi.org/10.1016/j.envpol.2016.12.064

3. Ambrosini R, Azzoni RS, Pittino F, Diolaiuti G, Franzetti A, Parolini M (2019) First evidence of microplastic contamination in the supraglacial debris of an alpine glacier. Environmental Pollution253:297–301. https://doi.org/10.1016/j.envpol.2019.07.005

4. Brahney J, Hallerud M, Heim E, Hahnenberger M, Sukumaran S (2020) Plastic rain in protected areasof the United States. Science 368(6496):1257–1260. https://doi.org/10.1126/science.aaz5819

5. Rochman CM, Tahir A, Williams SL, Baxa DV, Lam R, Miller JT, Teh FC, Werorilangi S, Teh SJ (2015) Anthropogenic debris in seafood: Plastic debris and fibers from textiles in fish and bivalves sold for human consumption. Scientific Reports 5(1):14340. https://doi.org/10.1038/srep14340

6. Van Cauwenberghe L, Janssen CR (2014) Microplastics in bivalves cultured for human consumption.Environmental Pollution 193:65–70. https://doi.org/10.1016/j.envpol.2014.06.010

7. Landrigan PJ, Stegeman JJ, Fleming LE, Allemand D, Anderson DM, Backer LC, Brucker-Davis F, Chevalier N, Corra L, Czerucka D, Bottein MY, Demeneix BA, Depledge MH, Dony RM, Fenical S, Flahault A, Franco G, Gerwick WH, Goh HC, Rampal P (2020) Human health and ocean pollution.Annals of Global Health 86(1):151. https://doi.org/10.5334/aogh.2831

8. Karimi R, Fitzgerald TP, Fisher NS (2012) A quantitative synthesis of mercury in commercial seafood and implications for exposure in the United States. Environmental Health Perspectives 120(11):15121519. https://doi.org/10.1289/ehp.1205122

9. Porta M, Gasull M, Pumarega J, Kiviranta H, Rantakokko P, Raaschou-Nielsen O, Bergdahl IA, Sandanger TM, Agudo A, Rylander C, Nøst TH, Donat-Vargas C, Aune D, Heath AK, Cirera L, Goñi-Irigoyen F, Alguacil J, Giménez-Robert À, Tjønneland A, Sund M, Overvad K, Mancini FR, Rebours V, Boutron-Ruault MC, Kaaks R, Schulze MB, Trichopoulou A, Palli D, Grioni S, Tumino R, Naccarati A, Panico S, Vermeulen R, Quirós JR, Rodríguez-Barranco M, Colorado-Yohar SM, Chirlaque MD, Ardanaz E, Wareham N, Key T, Johansson M, Murphy N, Ferrari P, Huybrechts I, Chajes V, Gonzalez CA, Bueno-de-Mesquita B, Gunter M, Weiderpass E, Riboli E, Duell EJ, Katzke V, Vineis P (2022) Plasma concentrations of persistent organic pollutants and pancreatic cancer risk. Int J Epidemiol,51(2):479-490. https://doi.org/10.1093/ije/dyab115

10. Karami A, Golieskardi A, Choo CK, Larat V, Galloway TS, Salamatinia B (2017) The presence of microplastics in commercial salts from different countries. Scientific Reports 7(1):46173. https://doi.org/10.1038/srep46173

11. Kosuth M, Mason SA, Wattenberg EV (2018) Anthropogenic contamination of tap water, beer, and sea salt. PLOS ONE 13(4):e0194970. https://doi.org/10.1371/journal.pone.0194970

12. Schymanski D, Goldbeck C, Humpf HU, Fürst P (2018) Analysis of microplastics in water by micro-Raman spectroscopy: Release of plastic particles from packaging into mineral water. Water Research 129:154–162. https://doi.org/10.1016/j.watres.2017.11.011

13. Gasperi J, Wright SL, Dris R, Collard

F, Mandin C, Guerrouache M, Langlois V, Kelly FJ, Tassin B (2018) Microplastics in air: Are we breathing it in? Current Opinion in Environmental Science & Health 1:1–5. https://doi.org/10.1016/j.coesh.2017.10.002

14. Zhang Q, Zhao Y, Du F, Cai H, Wang G, Shi H (2020) Microplastic fallout in different indoor environments. Environmental Science & Technology 54(11):6530–6539. https://doi.org/10.1021/acs.est.0c00087

15. Xu M, Halimu G, Zhang Q, Song Y, Fu X, Li Y, Li Y, Zhang H (2019) Internalization and toxicity: A preliminary study of nanoplastic effects on human lung epithelial cells. Science of the Total Environment 694:133794. https://doi.org/10.1016/j.scitotenv.2019.133794

16. Deng Y, Zhang Y, Lemos B, Ren H (2017) Tissue accumulation of microplastics in mice and biomarker responses suggest widespread health risks of exposure. Scientific Reports 7(1):46687. https://doi.org/10.1038/srep46687

17. Lu L, Wan Z, Luo T, Fu Z, Jin Y (2018) Polystyrene microplastics induce gut microbiota dysbiosis and hepatic lipid metabolism disorder in mice. Science of the Total Environment 631–632:449–458. https://doi.org/10.1016/j.scitotenv.2018.03.051

18. Brook RD, Rajagopalan S, Pope CA III, Brook JR, Bhatnagar A, Diez-Roux AV, Holguin F, Hong Y, Luepker RV, Mittleman MA, Peters A, Siscovick D, Smith SC Jr, Kaufman JD (2010) Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association. Circulation 121(21):2331–2378. https://doi.org/10.1161/cir.0b013e3181dbece1

19. Donaldson K, Borm PJ (1998) The quartz hazard: A variable entity. Annals of Occupational Hygiene 42(5):287–294. https://doi.org/10.1016/s0003-4878(98)00044-1

20. World Health Organization (2019) Microplastics in drinking-water. World Health Organization.

21. Neelavannan K, Sen I (2023) Microplastics in Freshwater Ecosystems of India: Current Trends and Future Perspectives. ACS Omega, 8(28):34235-34248. https://doi.org/10.1021/acsomega.3c01214

22. Zhang X, Yu C, wang P, Yang C (2025) Microplastics and human health: Unraveling the toxicological pathways and implications for public health. Front Public Health, 13:1567200. https://doi.org/10.3389/fpubh.2025.1567200

23. Davtalab M, Byčenkienė S, Uogintė I (2023) Global research hotspots and trends on microplastics: A bibliometric analysis. Environmental Science and Pollution Research 30(10):107403–107418. https://doi.org/10.1007/s11356-023-27647-1

24. Jiang L, Wang M, He S, Ren J, Zhang T, Cheng Z (2025) Bibliometrics and visualization analysis of microplastics research in water from 2011 to 2023. Journal of Water and Health 23(3):322–335. https://doi.org/10.2166/wh.2025.211

25. Puga AL, Pecoraro R, Portugal SGM, Castelo Branco CW (2025) Microplastics and human health: A scientometric analysis. Research, Society and Development 14(5):e4314548749. https://doi.org/10.33448/rsd-v14i5.48749

26. Sharma D, Jaiswal S, Kaur G (2022) Scientometric analysis and identification of research trends in microplastic research for 2011–2019. Environmental Science and Pollution Research 29(56):84312–84324. https://doi.org/10.1007/s11356-022-20872-0

27. Gao Y, Fan K, Lai Z, Wang C, Li H, Liu

Current Trends in Biotechnology and Pharmacy
Vol. 20(2) 3130-3137 July 2026, ISSN 0973-8916 (Print), 2230-7303 (Online)
DOI: 10.5530/ctbp.2026.3.34

Q (2022) A comprehensive review of the circulation of microplastics in aquatic ecosystem using scientometric method. Environmental Science and Pollution Research 29(29):30935–30953. https://doi.org/10.1007/s11356-022-18837-4

28. Tan H, Mong GR, Wong SL, Wong KY, Sheng DDCV, Nyakuma BB, Othman MHD, Kek HY, AbdullRazis AF, Abdul Wahab NH, Abdul Wahab R, Lee KQ, Chiong MC, Lee CH (2024) Airborne microplastic/nanoplastic research: A comprehensive Web of Science data-driven bibliometric analysis. Environmental Science and Pollution Research 31(1):109–126. https://doi.org/10.1007/s11356-023-31228-7

29. Lou X, Sui Y, Fang C, Tang Y, Huang D, Guo Y (2023) Bibliometric analysis for global marine microplastic pollution control from 2013 to 2022. Frontiers in Environmental Science 11. https://doi.org/10.3389/fenvs.2023.1215317