

Evolving Research Perspectives on Microplastic Pollution: A Focus on Sri Lanka in Comparison to the South and Southeast Asian Region

Trends in Global Microplastic Research

Microplastics have been recognized as an emerging contaminant in terrestrial and aquatic environments due to their ubiquitous existence. Global study on microplastics has increased in recent years, indicating a growing concern of these tiny pollutants. Studies have investigated a variety of topics, including their prevalence in marine and freshwater ecosystems, aquatic organism ingestion, potential health consequences, and mitigation and management techniques. More than 17,000 journal publications were reported in Scopus from 2010 to 2024, led by China (>5900), and followed by USA (>1800), Germany (>1200), UK (>1100), Italy (>1000) and India (>1000). Researchers from various disciplines, including environmental science, chemistry, agriculture, medicine etc., have contributed to this multidimensional subject. Despite a global attention on assessing microplastic pollution in different environments, there is a lack of knowledge about this field in the South and Southeast Asia including Sri Lanka.

Microplastic Research in South and Southeast Asia

To figure out the status of studies on microplastic pollution in South and Southeast Asia, the studies on microplastic pollution affiliated with different countries in South and South-east Asia, available in Scopus were collected as per the following Boolean syntax; as an example: [AFFILCOUNTRY (“Thailand”) AND TITLE-ABS-KEY (microplastic AND microplastics)]. These include research articles, review papers, books, book chapters, conference proceedings, etc. and there were 1,650 studies for South Asian countries, of which 1,133 publications were from South-east Asian countries up to date. Studies clearly

indicate a predominant emphasis on marine and coastal environments as well as seafood, while scant attention is directed towards atmospheric and terrestrial environments.

As per the 56 publications in Sri Lanka, a considerable range of local and global collaborators were noted. Of 14 countries collaborated with Sri Lanka, the total link strength was higher with Australia, India, China and United States than the rest (Figure 1). Nevertheless, 33 articles and conference proceedings out of 56 articles dedicated to microplastic-related studies suggesting a growing interest of Sri Lankan researchers in this field.

The very first two studies in Sri Lanka were conducted in 2018, another two in 2020. There is one publication for the year 2021, the majority of studies (11) have been conducted in the year 2022. For the year 2023, there were only 8 journal articles which are on microplastic pollution in Sri Lanka. Early studies on microplastic pollution were mainly based on coastal areas viz., the study conducted on microplastic pollution in Southern coastline. With the X-Press Pearl shipwreck incident, which caused colossal plastic pollution in the Western coastline of Sri Lanka, the concern of both the public and researchers about microplastic pollution drastically increased (De Vos et al., 2022; Sewwandi et al., 2022). Studies on microplastics in marine-dried fish products from Asian countries and commercial salt products have opened new viewpoints for discussion (Piyawardhana et al., 2022; Kapukotuwa et al., 2022).

Further, studies have also been conducted to measure the microplastic pollution in the atmosphere, coral reef ecosystems, fish and pharmaceuticals and personal care

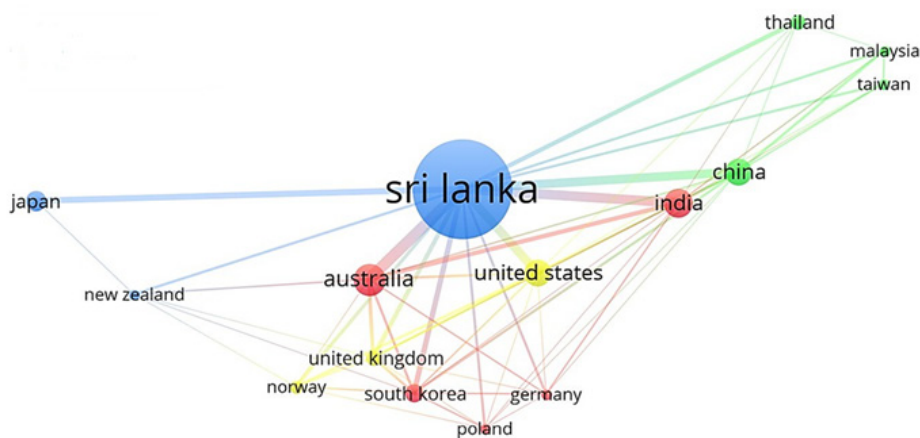


Figure 1: Co-authorship distribution map for countries that have performed microplastics-related studies affiliated with Sri Lankan institutes where their document type is a conference paper or a journal article

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products (Hansani et al., 2023; Kandeyaya et al., 2023), suggesting the diverse research perspectives in 2022 and 2023. In addition, microplastic pollution in urban surface waters and gastrointestinal tracts and gills of two shrimp species in the Negambo Lagoon was also undertaken (Lawan et al., 2024).

Though several studies covered many branches of microplastic pollution during the past 5 years in Sri Lanka, a majority is focused on monitoring microplastics pollution in marine and coastal waters. Since Sri Lanka is an island country, marine microplastic pollution would be a severe problem that affects the health and well-being of the entire marine/coastal ecosystem. Therefore, future studies should focus on evaluating microplastic contamination in edible fish and fish-related products such as Maldives fish, Salmon, etc.

Navigating Challenges and Future Research Horizons of Microplastic Research in Sri Lanka

Due to the ubiquitous nature of the microplastic pollution, a systematic assessment is imperative to understand the distribution and status of the pollution. Research efforts have been fragmented across various locations and levels, driven solely by the individual capacities of scientists, with minimum engagement from governing agencies responsible for science policy and research funding, such as the National Science and Technology Commission, National Science Foundation, and National Research Council. Furthermore, attention of the mass media is also limited, hindering the information flow and public awareness on health aspects of microplastic pollution. At this juncture, there should be a national task force to assess the public exposure to microplastics. More research on coastal microplastic pollution in the entire coastal belt is recommended. Focus on freshwater systems is also essential due to unsolicited discharge of domestic and industrial wastewater and lack of storm water management, thus leading to spilling loads of microplastics into drinking water sources.

Recently, the focus has been directed to animal and food samples. For instance, the most trending area is determining the microplastic pollution in human and animal body fluids. Nevertheless, less information exists in microplastics in food items in Sri Lanka. Atmospheric fall-out of microplastics are deposited on street foods and it must be focused due to direct ingestion. A proper assessment of the beverages stored in plastics need to be assessed for microplastics. Accordingly, the research gap in the Sri Lankan context should be fulfilled rapidly to stand up with the global level and prepare a baseline data system, which can empower future research.

Environmental science-related undergraduate research in both state and private universities primarily focuses on microplastics. Nevertheless, most research on microplastic pollution in Sri Lanka is not up to the global standards, thus limiting them either fulfilling the requirement of a degree or as a conference abstract. A few of those studies go for an indexed publication whereas many of them are end up in theses. The reasons behind this tragedy is the lack of experience of propagating their research up to a standard level or unavailability of funding/facilities.

After the X-Press Pearl shipwreck, Sri Lanka received advanced instrumentation support from overseas for microplastic-related research. While significant funds and equipment are allocated to government organizations aimed at empowering staff and increasing their focus on addressing microplastic pollution, some of these resources often remain underutilized, serving merely as displays on tables. This poses a significant challenge for research teams who struggle due to inadequate access to facilities and equipment. As a result, a notable disparity exists in the availability of facilities and support for researchers dedicated to enhancing awareness and collecting data, while policymakers often make arbitrary decisions, such as banning plastics, without conducting thorough baseline survey or need analyses. Consequently, the research interest in Sri Lankans towards microplastic pollution and associated environmental impacts needs to be strategically strengthened while developing or providing the essential laboratory infrastructure and instruments to the parties/ organizations currently involved with microplastic-related studies in the country, as per the globally accepted standard criteria. Thus, an expertise community for microplastic research is an essential component for mentoring and supervising young researchers and developing projects that have a diverse range of perspectives.

Efforts to address microplastic pollution must extend beyond research to encompass a shift in public attitudes toward a plastic-free lifestyle. Despite recent bans implemented by the Central Environmental Authority and the Ministry of Environment in Sri Lanka to reduce single-use plastics, the lack of viable alternatives has resulted in the proliferation of low-quality 'biodegradable' polymer products entering the country through illicit means. The authenticity of these products remains uncertain, raising concerns about their true biodegradability. Regrettably, regulatory authorities demonstrate a lack of interest or comprehension, thus blaming the lack of capacity and facilities as reasons for their shortcomings. To overcome the gaps and lack of interest in novel bioplastics and thereby reducing plastic pollution in the country, a strategic policy framework is necessary via private-public partnership discussions. To effectively mitigate plastic pollution in the country, it is imperative to establish and implement a comprehensive fine system. Otherwise, plastic polluters may exploit loopholes by increasing the production of single-use plastics, promoting their usage, and subsequently engaging in beach cleaning activities as part of corporate social responsibility efforts to garner publicity and obtain tax reductions. Moreover, introducing knowledge on microplastic pollution and health effects into education system is crucial considering the microplastic pollution in Sri Lanka and the best practices of plastic waste disposal among the young generation.

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