Eco-Environment & Health 2 (2023) 41–42

Contents lists available at ScienceDirect

Eco-Environment & Health

journal homepage: www.journals.elsevier.com/eco-environment-and-health

Commentary

Microplastics pollution: Economic loss and actions needed

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Microplastics originate from plastic bottles of water and soft drink, plastic bags, tire wear, plastic agricultural mulches and 3D printing [1,2]. These small fragments of wastes being 1 μm to 5 mm pollute the environment and threaten human health and ecosystem services including crops and others, leading to economic losses [1–3]. It is predicted that by 2030, plastic productions will be leading environmental pollution in terms of carbon footprint and toxic chemicals [4], making U.S. the world's largest plastic waste generator [5]. Based on reports from the United Nations Environment Assembly (UNEA) and the United Nations Environmental Program (UNEP), plastics in the environment annually burden the global economy by $19 billion, causing concerns for long-term ecological sustainability and the Global Goals [6]. It is reported that about 8.3 billion tons of plastic waste have been created, leading to 4.9 billion tons discarded through landfilling globally [7], causing a yearly financial loss of more than $13 billion [8].

The most significant portion is found in marine pollution compared with relatively low plastic pollution on land [9]. It is estimated that marine plastics cause significant economic losses, assessing a natural capital loss ranging from $3,300 to $33,000 per ton of plastic waste each year [9]. The reported loss in value included only marine natural capital impacts, and therefore the full economic cost could be much larger. According to UNEP, plastic pollution could be tripled by the year 2040 [6]. The approval of UNEP's End Plastic Pollution would accelerate plastic recycling and thereby help to achieve economic growth and ecosystem health [10]. It is the right time for every government to pay attention and subsequently act on this convention. Further research is needed on the heterogeneity and timescale of developing policies and regulations for the implementations of End Plastic Pollution. A necessary action is to eliminate plastic waste to meet the 26th UN Climate Change Conference of the Parties (COP26) agreement on net zero by 2060 [11]. As a response to microplastics threats, the UNEA approved the motion of End Plastic Pollution on March 2, 2022, aiming at promoting the global strategy against plastic pollution and poses new challenges to the study of environmental and human health risks [10].

The management of microplastic wastes is much more challenging compared to macroplastics due to their tiny size and less noticeable. Demanding actions for managing microplastics are suggested as follows.

(a) Increase public awareness of microplastics through education in schools, public organizations, and news media, e.g., UNEP has developed management guidelines for microplastics in response to environmental pollution concerns [11], which call for reducing the transmission of microplastics into oceans, leading to adverse chemical and physical effects.

(b) Improvement of the life cycle of microplastics in plastic products' design and manufacturing, consumption, and disposal, suggesting using an Integrated Waste Management System and Life Cycle Assessment (LCA) [12].

(c) National policies can assist to achieve the reduction of aquatic microplastic pollution [13], e.g., the national waste strategies, utilization of mechanical litter traps, addressing of marine debris as hot spots, adoption of manufacturer responsibility schemes, utilization of economic instruments to promote recycling, application of LCA in production/disposal of microplastics, and use of biodegradable plastics.

(d) To minimize microplastic pollution, biodegradation could be a viable technique. With the help of bacteria, biodegradation is an efficient technique for decomposing microplastics using them as a source of

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https://doi.org/10.1016/j.eehl.2023.04.001
Received 6 December 2022; Received in revised form 7 April 2023; Accepted 11 April 2023
Available online 26 April 2023

carbon and energy [14]. For example, *Staphylococcus* and *Pseudomonas* spp. efficiently break down soil-isolated polyethylene microplastics [15].

(e) Research on the interactions of microplastics with other pollutants is still very limited, and it is expected to explore broader ranges of microplastics and chemical contaminants in animals as well as to understand the environmental implications of microplastics and their threats to human health. The ecological and toxic effects of microplastics need to be evaluated under more realistic environmental conditions. Lastly, microplastics' destiny and effects after ingestion by humans and marine species are still debated and unclear [12].

(f) Research regarding human health risks considering pollution of multidimensional microplastics is limited and the effect of microplastics on human cells and tissues remains unclear [16]. The existing research gaps between microplastics in the environment and potential adverse human and environmental health effects make it difficult to estimate the loss of ecosystem services and the economy [7]. To alleviate the impact of microplastics, it is desired to reveal the risk extent of the microplastics to environments and human health, as well as the effective approaches to address these issues [17,18]. Compared with other environmental particles, the unique characteristics of microplastics need to be explored and quantified [10]. Since the risks of plastic pollution are still not fully understood, a growing number of research projects have focused on environmental and human health threats [19].

Declaration of competing interest

The authors declare no conflicts of interest.

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