Need of groundwater microplastics study: insights from India

Susanta Paikaray*

Department of Geology, Panjab University, Chandigarh 160 014, India

Dependence on groundwater as a freshwater resource is increasing worldwide, yet the study of microplastics (MPs) contamination in groundwater remains limited. Infiltration from landfills, urban runoff, seawater and river discharge through soil pores, fractures and joints in rocks, along with disintegration of the MPs in aquifers, significantly contributes to groundwater contamination by the MPs. The strong hydrophobicity of MPs combined with chemical additives can lead to trace metal enrichment, which may eventually enter groundwater systems. Despite groundwater being a major source of freshwater across the country, research on MPs in groundwater in India began in 2019 and to date, has been largely confined to the state of Tamil Nadu. Existing studies indicate the presence of small-sized MPs, primarily composed of polyethylene and polypropylene, with fibres and fragments being the dominant shapes. Current research is focused on coastal zones and landfill sites, where sampling has been carried out using pumping and filtration techniques. The characterization and quantification of MPs have primarily relied on optical microscopy, infrared spectroscopy, and electron microscopy. However, future research should focus on comprehensive monitoring efforts, identifying MP hotspots, understanding the subsurface migration mechanisms, and investigating behaviour and reactivity at the soil-groundwater interface.

Keywords: Groundwater contamination, landfill origin, microplastics, microplastic migration, soil microplastics.

unknowingly consumes between 39,000 and 252,000 MP fragments annually through various pathways[4].

Even though most MPs in the environment are linked to continental ecosystems through production, use, treatment and recycling[5], the concern surrounding MPs in freshwater ecosystems is still poorly studied[6]. Freshwater systems have been documented to contain abundant MPs, which can easily enter living organisms through direct consumption[6,7]. Consequently, MPs in freshwater are now considered a serious emerging threat globally[8]. Groundwater is regarded as one of the safest freshwater resources in the world with over 2 billion people relying on it for domestic, agricultural and industrial purposes[2,9,10]. In India, groundwater accounts for 85% of drinking water and 60% of irrigation water demand[11]. However, the study of MPs in groundwater ecosystems has been limited, probably due to lesser attention, poor diffusivity of MPs through soil pores and their effective retention within the soil.

Agricultural soils, however, are recognized for their ability to store MPs, and the high accumulation of MPs in these soils is a global concern. These MPs may get released into groundwater through chemical and microbial disintegration and vertical migration into the aquifer[2]. China suffers most from microplastic contamination, followed by the Republic of Korea. India stands fourth in groundwater MPs, based on the published articles up to June 2023 as reported by Lee *et al.*[7]. Recent studies have documented up to 6832 MPs/l in the groundwater of Jiaodong Province, China, highlighting the seriousness of the issue[12]. A similar high concentration of MPs in