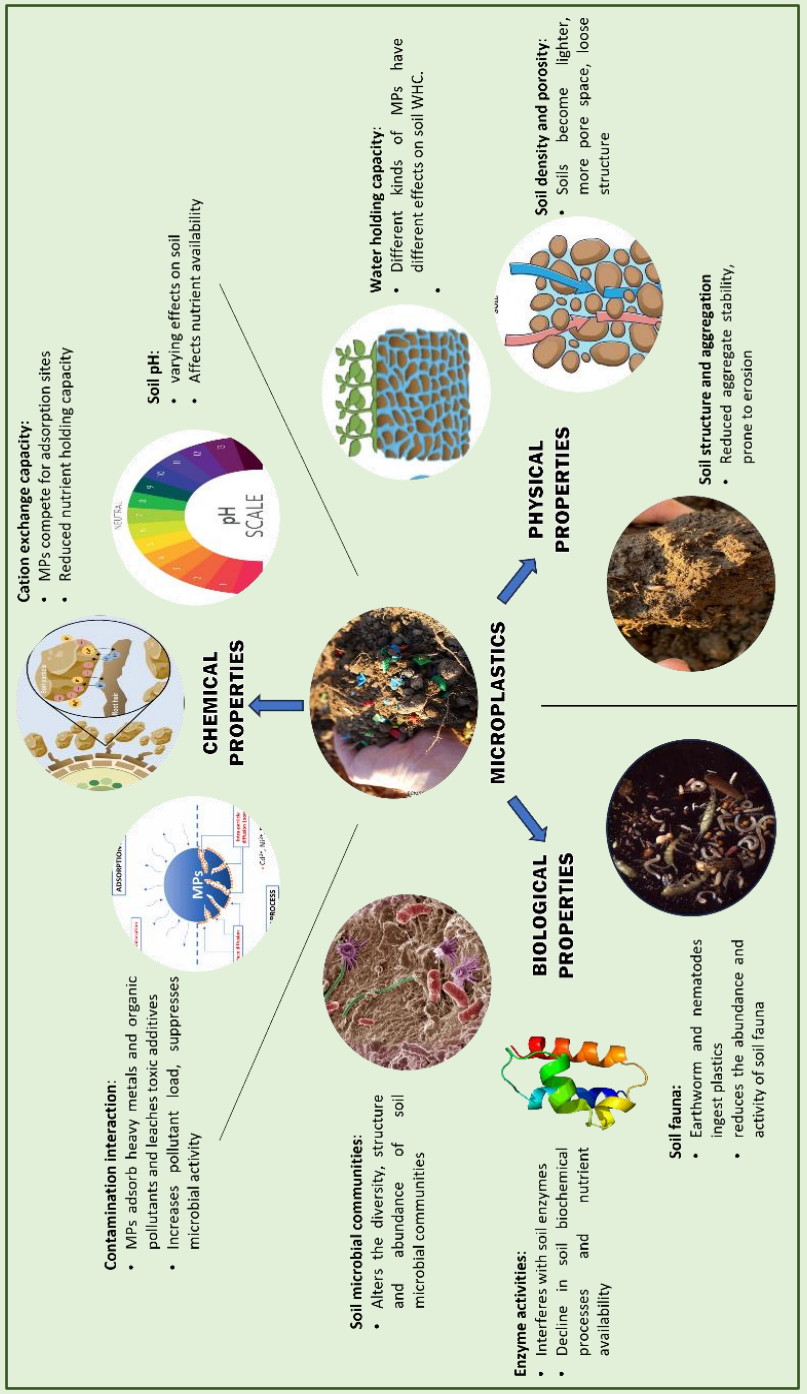

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NMHS

Microplastic pollution in Agricultural Soils

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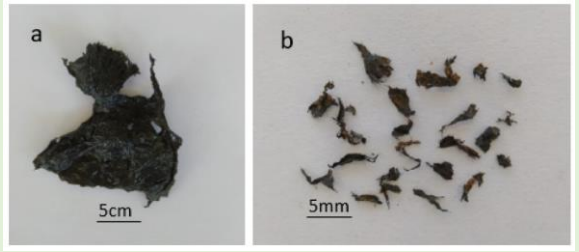
INTRODUCTION:

Microplastics (MPs) are tiny plastic particles that are less than 5 mm long and are a byproduct of plastic contamination in the environment. A "fully emerged threat" as opposed to an "emerging contaminant," they are now acknowledged for their extensive presence in terrestrial, aquatic, and atmospheric habitats.

Microplastics are generally categorised as primary and secondary microplastics. MPs mainly comprises of the following seven types of plastic items: Polypropylene (PP), Polyamide (PA), Polyethylene (PE), Polystyrene (PS), Polyurethane (PUR), Polyethylene Terephthalate (PET) and Polyvinyl Chloride (PVC).

Soil is the loose upper layer of the Earth that facilitates plant growth, is essential for energy and environmental security, and safeguards biodiversity. Soil MPs contaminate the soil when macroplastics used in farming decompose, threatening both agriculture and human health. Demand for agricultural plastics to regulate field climate is estimated to increase by 50% by 2030. Frequent extreme weather and growing food demand have exacerbated reliance on plastics to increase crop yield. Plastics used in agriculture include greenhouses and plastic films for temperature control, irrigation pipes, and seed plastic coating to prevent pests and diseases.

The majority of microplastics are hard to biodegrade; they just fragment into smaller pieces and typically linger in the environment for years.



EFFECTS OF MICROPLASTICS ON AGRICULTURAL SOILS:

Microplastics enter the agricultural soil environment primarily through the usage of plastic mulch covers and the addition of organic wastes (such as composts and biosolids) that may be contaminated by air sedimentation. Microplastics can also change the physiochemical properties of soil, such as its structure, water-holding capacity, and density, which could restrict root growth, nutrient uptake, and yield of future crops. Dispersed throughout soils, microplastics can affect microbial communities, enzyme activities, plant growth, fauna, and soil physico-chemical characteristics

- **Effect of microplastics on soil physical properties:** Microplastics (MPs) alter soil physical properties by disrupting soil aggregation, reducing bulk density, and increasing porosity. Fibrous MPs entangle soil particles, weakening aggregate stability and increasing erosion risk. They variably affect water holding capacity and infiltration, with fibers enhancing retention while films may block pores. MPs also mislead soil texture assessments and reduce workability, ultimately compromising soil structure, stability, and agricultural productivity.
- **Effect of microplastics on soil chemical properties:** Microplastics (MPs) alter soil chemical properties by disrupting nutrient cycling, slowing decomposition, and reducing nitrogen, phosphorus, and carbon availability. They cause minor shifts in soil pH, affecting microbial activity and nutrient solubility. MPs weakly interact with ions, slightly lowering the soil's cation exchange capacity (CEC), especially in sandy soils. They also hinder organic matter decomposition, reducing humus formation. Additionally, MPs adsorb heavy metals and pesticides and release toxic additives, increasing soil contamination and posing risks to plant and microbial health.
- **Effect of microplastics on soil biological properties:** Microplastics adversely affect soil biological properties by disrupting microbial diversity, reducing beneficial microbes, and altering community composition. They suppress enzyme activities vital for decomposition and nutrient cycling, slowing key soil biochemical processes. Soil fauna like earthworms and nematodes ingest microplastics, leading to digestive blockages, reduced activity, and toxin accumulation. Additionally, microplastics release harmful additives and adsorb pollutants, causing oxidative stress and cellular damage in soil organisms, ultimately degrading soil health and ecosystem functions.

CONCLUSION:

Microplastics (MPs) pose a growing threat to terrestrial ecosystems, with soils serving as major sinks for this pollution. Soil alone may hold more MP debris than oceanic basins, and MPs pollution in terrestrial ecosystems may be 4–23 times greater than in the ocean. Though less studied than aquatic systems, soil microplastic contamination disrupts physical structure, nutrient cycling, and microbial health. MPs degrade soil stability, alter water dynamics, carry toxic substances, and harm both microbes and soil fauna, ultimately reducing soil fertility and ecosystem sustainability. As soils are vital for biodiversity and agriculture, the widespread presence of MPs signals an emerging soil health crisis, highlighting the urgent need for further research and mitigation efforts.