South Asian Journal of Marketing & Management Research (SAJMMR)
ISSN: 2249-877X Vol. 11, Issue 11, November 2021 SJIF 2021= 7.642
A peer reviewed journal

CURRENT RESEARCH TRENDS ON PLASTIC POLLUTION AND ECOLOGICAL IMPACTS ON THE SOIL ECOSYSTEM: A REVIEW

Dr. Manjula Jain*

* Sr. Professor,
Department of Finance & Marketing,
Teerthanker Mahaveer Institute of Management and Technology,
Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, INDIA
Email id: jainmanjula76@gmail.com

DOI: 10.5958/2249-877X.2021.00106.5

ABSTRACT

The issue of plastic contamination in the environment is now gaining international attention. The improper disposal of unused or abandoned plastic trash pollutes the environment. The disposal of municipal wastewater effluent, sewage sludge landfills, and plastic mulch generated by agricultural operations, in particular, is a significant problem and a major source of soil contamination. In contrast to plastic contamination in the marine and freshwater environments, soil pollution has received less attention. We addressed plastic pollution in the soil ecosystem and looked at studies on the impacts of plastic wastes, particularly microplastics, on the soil ecosystem in this study. We discovered that earthworms are often employed as test organisms in studies of the impact of soil plastic contamination on organisms. To fully comprehend the impacts of plastic pollution on the entire soil ecosystem, further study into the effects of plastic on other species models is needed. Furthermore, we provide additional insights for future studies on plastic pollution and soil ecotoxicity of plastic wastes, as well as a study path.

KEYWORDS: *Ecological, Ecosystem, Plastic, Pollution, Soil.*

1. INTRODUCTION

1.1 Concerns about plastic contamination in the soil environment are growing:

Because many species, including people, rely on the soil for life, soil contamination is a major concern, even affecting human food safety. Concerns about plastic pollution have grown as industrial growth has advanced and the production and disposal of plastics has risen. People were recently inspired to concentrate on the problem of microplastic (MP) contamination in soil and terrestrial ecosystems. Figure 1 shows the Schematic of the flow of plastic wastes in the soil environment and their distributions and fate in soil.

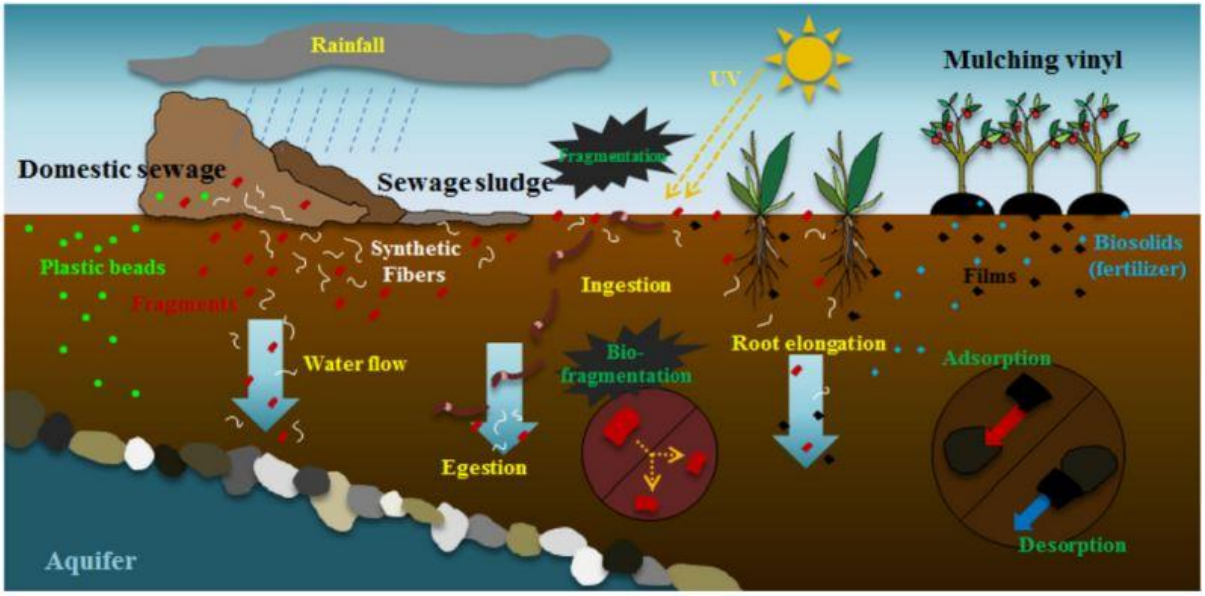

Figure 1: The above figure shows the Schematic of the flow of plastic wastes in the soil environment and their distributions and fate in soil.

Several research have calculated the concentrations of MPs in dry sludge deposited in landfills following wastewater treatment. In comparison to techniques for extracting and analyzing small plastics such as MPs from other media such as seawater and beach sand, the development of techniques for extracting and analyzing small plastics such as MPs from soil media has only recently begun. Previously, density differences of these media were achieved by separating them with solutions ranging from pure water (1.0 g cm3) to NaCl, CaCl2, or NaI (1.2e1.6 g cm3)[1]–[3].

KOH, NaOH, or H2O2 have all been extensively employed in the digestion or extraction process. Several studies employed acids (H2SO4, HNO3, or HCl), however these acids have the drawback of degrading a variety of polymers. Various filters with pore dimensions ranging from 0.45 to 300 mm were also utilized. Finally, Fourier Transformed Infrared Spectrometry (FTIR) and Spectroscopy depending on the locations.

1.2 Pollution of the soil environment with microplastics:

Various sources of plastics that pollute the environment have been. Domestic sewage, which contains fibers from clothing and microplastic beads from personal care products, fertilizers, landfills from urban. These polymers infiltrate the soil environment, settle on the surface, and penetrate deep into the subsoil. Several researchers have begun to concentrate on these anthropogenic elements that reach the soil ecosystem via a variety of pathways. Habib et al. focused on fibers from municipal wastewater in 1998; they discovered synthetic fibers generated from washing machines in effluent water and sewage sludges, and utilized polarized light microscopy to examine the fibers. They also discovered that effluents from wastewater facilities with final microfiltration stages contain less synthetic fibers than effluents from plants without. Various test settings, counted the quantity of fibers, and proposed composite pictures of synthetic fibers recovered from sludge products. They conducted a simple experiment to recover fibers from the sludges[4]–[6].

Both of these investigations found that synthetic fibers may be transmitted to the soil and that effluent applied to land can contaminate soil ecosystems. Even after these investigations, there has been renewed interest in plastic contamination of the soil environment by tiny plastics. Rillig (2012) reignited interest in microplastic pollution in the soil ecosystem after a three-year hiatus, and many studies have since proceeded to investigate and highlight microplastics in the soil environment. The presence of chronic plastic pollution in the soil environment has been indicated in recent research. UV light and high temperature may cause plastic fragmentation in the surface soil. These fragmented plastics may be tiny MPs (less than 5 mm). Earthworm burrowing operations, according to Rillig (2012), may absorb plastics on the soil surface into the deep soil. The actions of soil organisms such as collembolans, insects, and plants may transfer the mixed fragmented plastics and MPs in surface soils to deeper layers of the soil. Furthermore, despite the fact that no study has shown that microplastics are transferred or exist in groundwater, many researchers have warned of the possible dispersion and transportation of MPs into groundwater and the hypothetic zone based on prior studies on MP transportation. Microplastics may move through the soil profile and reach groundwater[7]–[9]. Nano plastics or colloids may penetrate through macrospores and coarse soil. Microplastics are more likely to be transmitted to groundwater in regions with a high groundwater table and coarse soils. Despite this, the process is mainly unclear due to the fact that there have been few research on plastic contamination in the soil environment.

1.3 Microplastics' effects on soil organisms:

Many academics are now focused on the effects of MPs in the environment, and their toxicities and consequences have been widely researched. Most research; however, concentrate on MPs in the aquatic environment since water contamination by MPs has been identified as one of the most significant worldwide problems. Only a few research have focused on plastic pollution originating from landfill sludge and agricultural plastic mulch in soil ecosystems. MPs in soils may be swallowed and transmitted to soil organisms.The effect and impact of microplastics on soil organisms[10].

Used different exposure scenarios (bio solid or PBDE-containing polyurethane foam micro particles) to mimic the exposure of polybrominated diphenyl ether (PBDE) to the earthworm. The author discovered that PBDEs leached from polyurethane foam (75 mm) accumulated in earthworm bodies. This is a significant discovery, indicating that MP-derived chemicals may penetrate the soil ecosystem and accumulate in soil invertebrate species. Additives or dangerous compounds in MPs, such as PBDEs, may be transmitted to other environments and species, not only in the marine ecosystem but also in the soil ecosystem. After 14 and 60 days of exposure to low density polyethylene (LDPE) MPs (150 mm), mortality, growth, tunnel development, location in the microcosm, and MP intake in earthworm Lubricousterrestrosin. After 4 days of exposure, the mortality, growth rate, intake rate, and accumulation were all examined.

1.4 The authors speculated on various possibilities based on their findings:

- When earthworms were exposed to high concentrations of MPs (28, 45, and 60% w/w microplastics in litter), their health was affected.
- MPs have the potential to be preferentially retained in earthworms and transferred to other organisms in the soil ecosystem through the food chain.
- MPs concentrated by earthworms could be transported to deeper layers of the soil ecosystem through the food chain.

1.5 Prospects for further research:

Plastic contamination in the soil ecosystem has gotten a lot of attention lately, and active research on the subject have just recently begun. Investigating the contamination and negative impacts of plastic wastes on soil ecosystems is challenging due to the specific features of soil media. Two tasks are required to enhance research on plastic contamination in the soil ecosystem. First, improved methods and approaches for sampling, extraction, and detection of plastic wastes in soil medium must be developed.

Several recent research have established techniques for extracting and sorting plastic wastes from soil medium. Several limitations remain, however: size detection, difficulties in analyzing small plastics with high density or disintegration during the oxidation of organic matter lack of standard protocol, and high cost.

Furthermore, no sampling method can accurately reflect the average amounts of microplastic in soils vs water samples. The second objective is to determine the current status of plastic contamination in soils. Several studies have measured microplastic concentrations in soils from an Australian industrial site and Swiss floodplain soils. However, only a small amount of data has been gathered thus far. Understanding the present status of plastic pollution in the soil environment is now the most essential job for suggesting effective ways to solve existing issues connected to plastic pollution.

We propose a number of future missions, with a focus on soil ecotoxicity caused by plastic waste. Future research must address the following issues in order to study and understand the effect of plastic pollution on organisms in the soil environment.

Too far, earthworms have been the most often employed test species. Earthworms are model organisms in soil ecosystems, and there are several advantages to using them as test species: they are large enough to be easily identified, convenient for conducting experiments, provide enough endpoints to assess the effects of test materials, and there are established guidelines for using them as test species (Ma and Bodt, 1993; Paoletti, 1999). They also consume plastic trash directly in the soil medium, and the negative consequences of this ingestion may be readily evaluated. The soil ecosystem, on the other hand, is a complex ecosystem with many physical, chemical, and biological variables and a diverse range of species (Oades, 1988; Phillips, 1998; Arias-Estevez et al., 2008). As a result, additional species, such as plants, invertebrates, insects, and microbes, must be investigated in order to determine the effect of plastic pollution on the soil ecosystem. This will help researchers better understand the processes (ingestion and egestion, ecological impact, transmission, and so on) by which plastic wastes affect each soil organism, as well as the overall impact of plastic pollution on the soil ecosystem.

The author have concentrated on PE fragments and spheres, although effluents from wastewater treatment facilities include a variety of polyester and polyacrylic fibers. These different polymers have the potential to be transferred into the soil environment during the sludge dumping process. Furthermore, agricultural plastic mulch does not come in the shape of spheres, but rather uneven fragments or films. While utilizing spherical microplastics in studies is easy and offers a rudimentary knowledge of plastic toxicity in the soil environment, doing so in a laboratory setting is not relevant to real-world situations. Plastics of different sizes, forms, compositions, and origins are required to mimic actual and realistic circumstances.

Future study should take into account a variety of real-world situations, such as trophic transmission and generational effects. In actual settings, interactions between organisms may

occur via the food chain, and long-term exposure to plastic wastes can damage the reproductive system. Food chains and trophic transfers are significant in the environment and ecosystem because they may influence community structure, population dynamics, and individual performance at higher trophic levels Plastic additives (plasticizers, retardants, antioxidants, and

The growing quantity of plastic trash in the environment, as well as the danger it poses to ecosystems and human health, can no longer be ignored. As a result, it is past time to take plastic contamination in the soil environment seriously. Previous studies on plastic contamination in marine and freshwater ecosystems may be used to future study for this aim.

2. DISCUSSION

The author has discussed about the current research trends on plastic pollution and ecological impacts on the soil ecosystem, even after these studies, there has been continued interest in the issue of small plastics contaminating the soil environment. After a three-year break, Rillig (2012) revived interest in microplastic contamination in the soil ecosystem, and numerous research have followed to study and highlight residues in the soil environment. Recent study has shown the prevalence of chronic plastic contamination in the soil environment. UV radiation and high temperatures may cause plastic breakage in the soil layers. These broken plastics may be microscopic MPs (less than 5 mm). According to Rillig (2012), earthworm-burrowing activities may absorb plastics from the topsoil into the deep soil. Soil creatures like collembolans, insects, and plants may move mixed fragmented plastics and MPs from the surface to the deeper layers of the soil. Moreover, despite the fact that no study has proven that substances are transferred or exist in bedrock, several researchers have warned of the possibility of MP dispersion and transportation into aquifer and the hypothetic zone based on previous MP transportation studies. Microplastics have the potential to go through the soil profile and into groundwater.

3. CONCLUSION

The author has concluded about the current research trends on plastic pollution and ecological impacts on the soil ecosystem,In particular, the dumping of sludge treatment effluent, sewage sludge dumps, and plastic mulch produced by agricultural activities is a major cause of soil pollution. Environmental contamination has attracted less attention than plastic waste in the aquatic habitats ecosystems. In this research, we looked at studies on the effects of plastic wastes, especially microbeads, on the soil ecosystem and addressed environmental degradation in the soil ecosystem. Earthworms are often used as test organisms in investigations of the effects of soil plastic pollution on species, we found. More research on the effects of plastic on other species models is required to completely understand the impacts of plastic pollution overall soil ecosystem.

REFERENCES

1. T. Bourdrel, M. A. Bind, Y. Béjot, O. Morel, and J. F. Argacha, "Cardiovascular effects of air pollution," *Archives of Cardiovascular Diseases*. 2017, doi: 10.1016/j.acvd.2017.05.003.

2. J. Rembiesa, T. Ruzgas, J. Engblom, and A. Holefors, "The impact of pollution on skin and proper efficacy testing for anti-pollution claims," *Cosmetics*. 2018, doi: 10.3390/cosmetics5010004.

3. Y. Chae and Y. J. An, "Current research trends on plastic pollution and ecological impacts on the soil ecosystem: A review," *Environmental Pollution*. 2018, doi: 10.1016/j.envpol.2018.05.008.

4. K. K. Lee, M. R. Miller, and A. S. V. Shah, "Air pollution and stroke," *Journal of Stroke*. 2018, doi: 10.5853/jos.2017.02894.

5. K. Maduna and V. Tomašić, "Air pollution engineering," *Phys. Sci. Rev.*, 2017, doi: 10.1515/psr-2016-0122.

6. K. Aunan, M. H. Hansen, and S. Wang, "Introduction: Air Pollution in China," *China Quarterly*. 2018, doi: 10.1017/S0305741017001369.

7. F. Rajé, M. Tight, and F. D. Pope, "Traffic pollution: A search for solutions for a city like Nairobi," *Cities*, 2018, doi: 10.1016/j.cities.2018.05.008.

8. P. Villarrubia-Gómez, S. E. Cornell, and J. Fabres, "Marine plastic pollution as a planetary boundary threat – The drifting piece in the sustainability puzzle," *Mar. Policy*, 2018, doi: 10.1016/j.marpol.2017.11.035.

9. D. Ierodiakonou *et al.*, "Ambient air pollution," *J. Allergy Clin. Immunol.*, 2016, doi: 10.1016/j.jaci.2015.05.028.

10. T. M. Karlsson, L. Arneborg, G. Broström, B. C. Almroth, L. Gipperth, and M. Hassellöv, "The unaccountability case of plastic pellet pollution," *Mar. Pollut. Bull.*, 2018, doi: 10.1016/j.marpolbul.2018.01.041.