World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(REVIEW ARTICLE)

PLASTIC POLLUTION: A NIGERIAN CASE STUDY

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World Journal of Advanced Research and Reviews, 2026, 31(02), 1576–1580

Publication history: Received on 18 July 2026; revised on 25 August 2026; accepted on 27 August 2026

Article DOI: https://doi.org/10.30574/wjarr.2026.31.2.2100

ABSTRACT

Nigeria, a country in West Africa, is grappling with the detrimental effects of plastic waste on its ecosystems and communities. Plastic wastes have two major categories of macro- and microplastics according to respective sizes. The urgent need for concerted efforts to determine the extent and characteristics of plastics waste, especially microplastics pollution in Nigerian water resources is emphasized. Land and marine-based plastic wastes have negative effects on human, aquatics systems and wild-life. Societal challenges contributing to plastic pollution in Nigeria include poor waste management practices, insufficient capacity and investment in waste collection infrastructure and prevalence of single-use plastic bags. The study also highlights that the few successes recorded in the fight against plastic pollution by virtue of Nigeria's recent collaboration with the World Economic Forum's Global Plastic Action Partnership (GPAP). This study recommends improved waste management practices, regulatory measures, increased research efforts and implementation of novel removal strategies (activated carbon adsorption), as feasible strategies for mitigating plastic pollution in Nigeria.

Keywords: Environment, Solid-waste management, Extant environmental regulations, Micro-plastics pollution, Sustainable development.

1 INTRODUCTION

Plastic waste pollution is accumulation of plastic objects (i.e. plastic bottles, plastic bag, pure water satchets e.t.c) discharged into the environment without any scientific process. Plastic pollution results from the build-up of plastic waste in the land and marine ecosystem, constituting harm to the environment and public health (Ameachi et al. 2022). Disposed plastics emit harmful chemicals into the environment that adversely affects humans and the ecosystem. In Nigeria, an estimated 2.5 million tonnes of plastic waste is generated annually, specifically Lagos, a Megacity with nearly 16 million people generates approximately 7,740 tonnes of plastic waste per day and majority of this waste finds its way into different water sources (Dembili and Henderson., 2020; Sogbanmu., 2022). This staggering amount highlights the magnitude of plastic pollution problem in the country. Nigeria is ranked number 6 amongst top plastic waste generating countries in terms of projected waste production and plastic waste produced as at year 2010 with figures of one million and 2.6 million tonnes respectively (See Figure 1)(Heinrich-Böll-Stiftung., 2020).

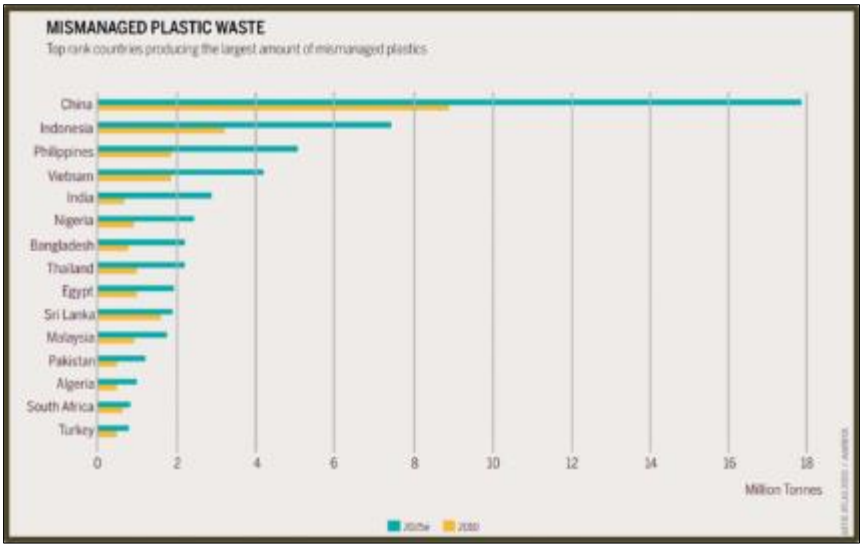

Figure 1: Plastic Wastes Production Ranking by Country (Adapted from Heinrich-Böll-Stiftung., 2020)

Plastic waste can be classified as primary plastics such as bottle caps or cigarette butts, and secondary plastics, which are essentially small pieces of plastics derived from the breakdown of larger plastic debris both on land and the aquatic ecosystem (Dembili and Henderson., 2020). Plastic wastes are also classified according to their sizes namely: microplastics, which are small particles of plastics discarded in the land and marine environment with sizes less than 5 mm and larger particles of plastics with sizes greater than 5 mm (Macroplastics). Microplastics are further classified according to source type including primary microplastics normally utilized as starting raw materials for production of household and personal-care products such as microfibers, plastic pellets and micro-beads. About 3.2 million tonnes of primary microplastics are released into surface water-bodies and the remains can be found in wastewater sludge and the soil (Dembili and Heenderson., 2020). Further, secondary microplastics, result from breakdown of macro (larger) particles by subjection to weathering (physical) processes and external (ultra-violet light) conditions (Abulwatfa., 2021). In Nigeria, the major sources of secondary microplastics are pure water satchets, and single-use plastic bags (Ameachi et al., 2022). Microplastics emanate from anthropogenic (human) sources in households, industries, and wastewater treatment plants (Abulwatfa., 2021). Land-based and marine microplastics are toxic, persistent in nature, non-biodegradable and contaminate soils, clog drainage channels causing indiscriminate discharge of sewage water (Akindele., 2022). As of May 2021, studies on the topic of plastic pollution have been scant, only twenty six (26) academic studies have been conducted till date, despite growing awareness of this environmental problem (Sogbanmu., 2022). There is dearth of research pertaining to microplastic pollution in Nigeria. Hence, need for qualitative and quantitative research by Nigerian academics and researchers focusing on ascertaining the extent and characteristics of microplastics present in Nigerian aquatic (marine) systems. This paper examines the current state of plastic pollution in Nigeria, highlighting the challenges faced and potential solutions to address this pressing environmental problem. In addition to, plausible measures undertaken to combat plastic pollution in Nigeria.

2 IMPACT OF PLASTIC POLLUTION

Microplastics have harmful effects on human health, wild-life and the marine environment due to their persistent nature, high surface area to volume ratio, tendency to sorb and transport microorganisms, pathogens, and toxins as well as slow bio-degradation kinetics (See Figure 2) (Yalwaji et al., 2022).

Microplastics pollution degrades the aesthetic value of Nigerian landscapes, and aquatic systems, and compromise foreign exchange generation initiatives such as Ecotourism. In addition, human consumption of marine species containing toxins and chemicals released by plastic wastes leads to various health issues including cancer, immune disorders, and birth defects. Likewise, terrestrial and aquatic animals alike suffer kidney damage, malnutrition, and death from ingestion of microplastics present in soil and water sources (Abulwatfa et al., 2021).

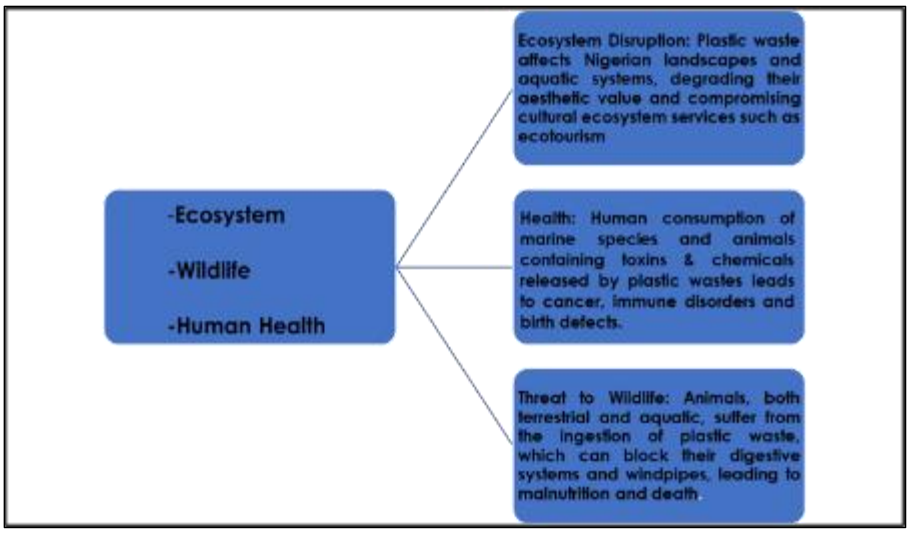

Figure 2: Environmental consequences of microplastics pollution.

3 SOCIETAL CHALLENGES

In Nigeria, over 60 million plastic sachet wastes are generated on a daily basis. More than 50% of plastic wastes are non-biodegradable and only a small percentage of plastics can be recycled (Dembili and Henderson., 2020). Certain societal practices contribute to plastic pollution including: Poor waste management practices prevalent amongst the general populace aggravates plastic pollution problem in Nigeria. Lack of sanitation/hygiene training and education as well as carefree attitude of the Nigerian youth have led to serious environmental issues like indiscriminate litter (solid waste) disposal, poor waste segregation at source and use of unapproved open dumpsites (Dembili and Henderson., 2020; Akindele., 2022). Insufficient capacity and investment in functional waste collection and recycling facilities worsen the problem. Poor waste collection infrastructure (i.e. litter bins), unreliable road network, few trained waste collection personnel, inadequate waste collection vehicles, lack of financial investment and recycling infrastructure for plastic waste exacerbate microplastic pollution in Nigeria. Garbage collection systems are often inefficient and non - existent. Waste receptacles differentiated by color to enable proper sorting of municipal wastes are not provided to enable proper disposal and recycling of plastics (WEF., 2021). Furthermore, the prevalence of free (single-carrier) plastic bags provided by retailers, shop owners, stores, supermarket and local vendors aggravates this issue. These bags are often discarded after a single use, adding to the plastic waste stream. Past studies have indicated that pure water sachets and shopping bags are the major constituents of plastic waste in Nigeria (Akindele., 2022).

4 SOLUTIONS AND MITIGATION STRATEGIES

There are a number of strategies essential to improve microplastics waste management in Nigeria. First, capacity building by way of investment in waste collection infrastructure (i.e. litter bins) and recycling facilities are necessary to enhance waste management facilities (Dembili and Henderson., 2020; WEF., 2021). Promoting sustainable waste management practices amongst businesses and consumers through creation of awareness campaigns, can help reduce plastic waste generation (Dembili and Henderson., 2020). Deployment of multi-media platforms by implementing interactive educational programs, television advertisements and radio jingles to enlighten the public on the dangers of microplastic pollution can also aid in reducing plastic waste generation. The introduction of charges and levies for disposable (single-carrier) plastic bags will encourage reuse and facilitate awareness creation of land-based and marine plastic pollution problems by retailers, shop owners, supermarkets and local market vendors (Dembili and Henderson., 2020; loko et al., 2022). As regards to the usage of plastic satchets and bags, introduction of legislation to prohibit single-use plastic bags, as promulgated in the Draft National Environmental Regulations (Plastic Waste control) 2023, would significantly reduce plastic waste (Nesrea., 2024).

Likewise, enforcement of extant environmental regulations i.e. Sanitation and Wastes control regulations 2009 and Domestic and Industrial Plastics, Foam and Rubber regulations, 2011 (Nesrea., 2024). The role of plastic product manufacturers is also significant in controlling microplastics pollution through implementation of Extended Producer's Responsibility (EPR) policies such as plastic satchet buyback from end-users can hold producers accountable for the life-cycle of their plastic products, encourage sustainable practices and recycling initiatives (Dembili and Henderson., 2020). The government should encourage academic studies and fund research on plastic pollution in Nigeria, to help identify specific challenges and effective solutions (Yalwaji et al., 2022). An excellent example of research innovation in this area is the development of new recyclable (biodegradable) plastics, using triketones, and amines for monomers by

researchers at Lawrence Berkeley Laboratory, USA (Christensen et al., 2019). **Figure 4** showcases the recycling process for recovery of monomer-triketone from waste plastics for reuse in the production of thermosetting plastics.

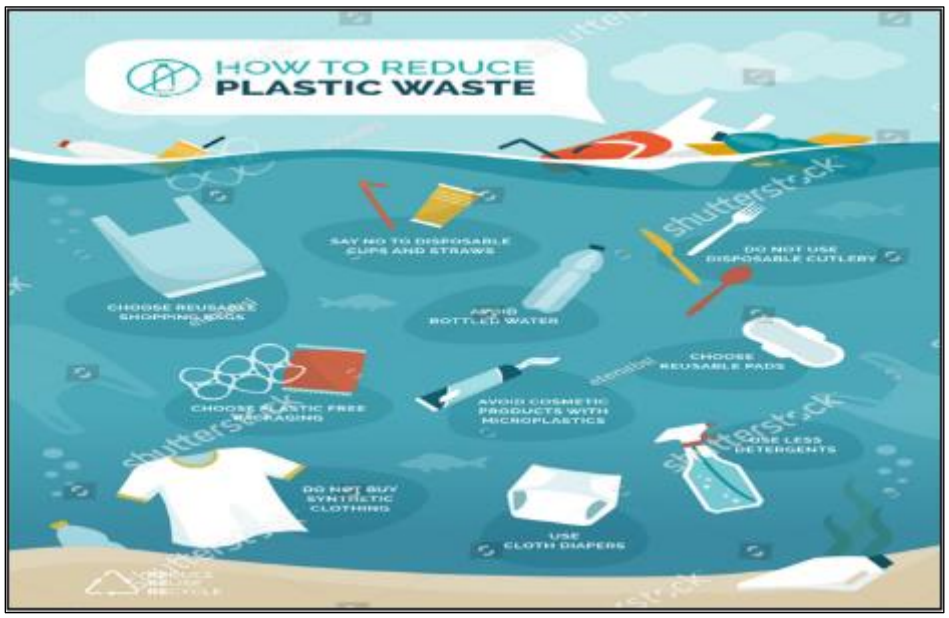

Figure 3: Strategies for improved plastic waste management.

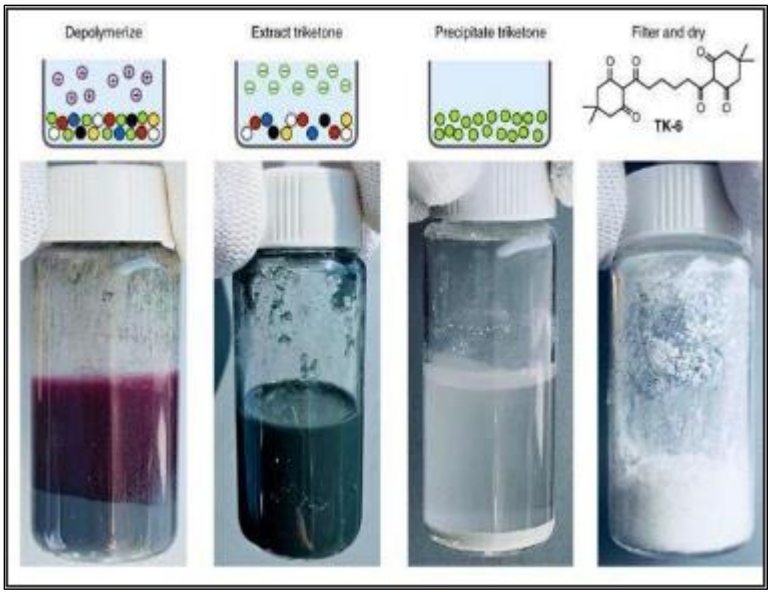

Figure 4: New Recyclable Plastics (Christensen et al., 2019).

Supporting innovative approaches such as reduce, reuse (refillable plastic sachets), recover, repair and recycle [5 R's] initiatives can contribute to the reduction of plastic waste (WEF., 2021). Additional measures aimed at encouraging artists, textile manufacturers, and product manufacturers to utilize waste plastics for the production of textile materials, clothing apparel, and other artistic works can contribute to the reduction of plastic waste (Dembili and Henderson., 2020; WEF., 2021). A recent advancement in mitigation of microplastic pollution is utilization of low-cost activated carbon (modified bio-char) as an efficient adsorbent for treatment of microplastic contaminated wastewater(s). Scant research has been conducted in the removal of microplastic waste from wastewater by activated carbon adsorption. Hence, more studies on this subject is required for design, implementation, and scaling-up of industrial-sized wastewater treatment plants (Abulwatfa., 2021). While, microplastic pollution is still receiving growing research attention, a few successes have been recorded in the area of public-private partnerships (PPP).

In January 2021, Nigeria joined the World economic forum's Global Plastic Action Partnership (GPAP). GPAP is a global public-private partnership platform for collaboration that works with government, businesses, and civil society to

translate plastic pollution commitments into concrete solutions (practical steps to adopt for mitigation of microplastic pollution) (Yalwaji et al., 2021).

5 CONCLUSION

In conclusion, this paper has pointed out that microplastic pollution poses a significant threat to the Nigerian environment, ecosystems and communities. The country faces a number of challenges such as poor waste management practices, inadequate research, and limited awareness of sustainable practices. However, through improved waste management, regulatory measures, increased research efforts and implementation of novel removal strategies (activated carbon adsorption), Nigeria can mitigate the detrimental effects of plastic pollution. It is essential for stakeholders, including government, businesses, and individuals to collaborate in finding sustainable solutions to address this pressing environmental problem.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

The author declares no conflicts of interest regarding this manuscript.

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