Chapter 5
Mitigating the Negative Effects of Plastic Pollution for Sustainable Economic Growth in Nigeria

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Abstract Plastic pollution is a leading global environmental challenge negatively affecting Nigeria's economic growth and sustainable development. The high population density, consumption pattern and technological developments are among the significant factors contributing to Nigeria's increasing quantity of plastic waste generated annually. This chapter examined current progress with "Mitigating the negative effects of plastic pollution for sustainable economic growth in Nigeria" through existing literature review and data collection from relevant agencies. This chapter identified technological innovation, policy formulation, advocacy and sensitization, bioremediation as some of the approaches currently used to mitigate plastic pollution in Nigeria. This chapter also highlighted the need to encourage, enhance, and disseminate scientific research on mitigating the harmful effects of plastic pollution in Nigeria. It concluded with a clarion call for people at all levels to play their part in correctly disposing of plastic waste, which will go a long way to reducing the menace of plastic pollution in Nigeria.

Keywords Bio-remediation · Climate Change · Economic Growth · Mitigation · Plastic Pollution

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1 Introduction

Plastic is a generic term for polymeric materials that may contain other substances (additives) to improve efficiency, reduce cost and produce desired colour (Hahladakis et al., 2018). Plastic has become one of the most widespread and globally used materials, and thus gives rise to 9% in increased global production per year since 1950, attaining 367 million tonnes per annum in 2020 (Plastics Europe, 2021). Plastics are organic polymers (synthetic or semi-synthetic) that are lightweight, robust, durable and low cost (Van Eygen et al., 2017). Due to their unique key characteristics, plastics have become integral to everyday human life. Derived from a wide range of synthetic polymeric materials from fossil hydrocarbons, such as PET or PETE (polyethene terephthalate), HDPE (high-density polyethene), PVC (polyvinyl chloride), LDPE (low-density polyethene), PP (polypropylene) or PS (polystyrene), plastics are designed to meet varying needs of thousands of end products (Leal et al., 2021). Kings and Queens, Servants and Masters, Peasants and Paupers, Young and Old will find something useful to do with plastics in our twenty-first century. According to Bourguignon (2017), plastic materials are primarily classified into three groups based on their physical attributes, which include: i) thermosets (hard plastics that cannot be re-melted and reshaped), ii) thermoplastics (plastics that can be re-melted back into a liquid and reshaped or recycled repeatedly), and iii) elastomers (soft elastic plastic). The practice of accumulating plastic objects and particles in the Earth's environment that adversely affects aquatic life, wildlife, wildlife habitat, animals and humans is called plastic pollution (Britannica, 2013; Laura, 2018). Plastic pollution can also be defined as the indiscriminate disposal of plastic waste, which constitutes a nuisance to the environment, thereby inhibiting sustainable development. Plastic pollution has become such a severe problem in Nigeria that it has practically become a sign of human activity. Many people who visit beaches, riverbanks, parks, and waterfalls frequently dump their plastic bottles carelessly, despite the dangers that such plastics pose to the environment (Chironda, 2022; Okolo et al., 2022). At other times, many passengers dispose of their plastics carelessly on the road while in their vehicles, especially when travelling, without considering the negative effects of their ill-informed actions leading to pollution in Nigeria. Plastic pollution has profound negative impacts on Nigeria's health, socio-economic and agricultural sectors, but this menace can be curbed via plastic waste recycling (Anabaraonye et al., 2022). Traditional methods like burning in the open field, mostly adopted to dispose of post-consumer plastics, especially in developing countries like Nigeria, are of global environmental concern. The release of harmful substances from smoke containing mercury, polychlorinated biphenyls, dioxins, and furans, which are injurious to health and the environment, into the atmosphere during the open burning of plastics leads to air pollution which consequently contributes to climate change and global warming (Webb et al., 2013). Plastic pollution negatively affects the atmosphere and environment, leading to global warming and climate change. Apart from direct landscape problems, plastic pollution in soil, marine and freshwater ecosystems causes severe problems to both macro and

micro-organisms and may endanger human health (Filho et al., 2019). Living organisms, mainly marine animals, can be harmed by exposure to chemicals within plastics that interfere with their physiology, mechanical effects such as entanglement in plastic objects, and problems related to the ingestion of plastic waste. The harmful impact of plastic waste can come through the disruption of various hormonal mechanisms, indirect consumption (by eating animals) and direct consumption (i.e. in tap water) (Babayemi & Dauda, 2018; Economist, 2018; Eslamian & Eslamian, 2022). This chapter examined current progress with "Mitigating the detrimental impact of plastic pollution for sustainable economic growth in Nigeria" through existing literature review and data collection from relevant agencies. The primary purpose of this research work was to survey theoretical backgrounds and previous studies on the above subject matter and the current progress in implementing these mitigation strategies towards ensuring sustainable economic growth and development in Nigeria.

2 Results and Discussion

2.1 Trends of Plastic Usage in Nigeria

More than 23,400,000 tonnes of plastics were imported into Nigeria's technological sector between 1996 and 2014, yet less than 12% of the ensuing garbage was recycled. There is a need for sustainable management of this significant waste and resource category, given the threats this volume poses to local and global habitats and human health (Ugochukwu et al., 2018). Furthermore, the amount of plastic produced worldwide increased from 1.5 million tonnes (Mt) in 1950 to 245 million tonnes (Mt) in 2008, and a threefold increase could be seen by 2050. In the last fifty (50) years, the use of plastics has multiplied 20-fold, and in the following twenty (20) years, it is predicted to double once again as metals, glass, ceramics, and wood are progressively in a steady manner replaced by plastic in various items (Geyer et al., 2017). The food, beverage, and other fast-moving consumer products industries now use plastic packaging materials (*see* Fig. 5.1).

Plastic recovery and recycling rates are poor in African nations, which could be attributed to improper solid waste management, a significant issue that contributes significantly to plastic pollution (Babayemi & Dauda, 2018). Leal et al. (2021) identified the need for further investigation to comprehend people's motivation to purchase biodegradable plastic products. In many developing nations in Africa, improper solid waste management is a significant issue that contributes significantly to plastic pollution (Babayemi et al., 2019; Babayemi & Dauda, 2018). Babayemi and Dauda (2018) emphasized that plastic waste and other polymers wind up at dumpsites with other discarded waste in more significant quantities because there is no source separation of solid waste. Another critical factor is the gap in technology and inefficient waste-collecting methods that have exposed the region to difficulties.

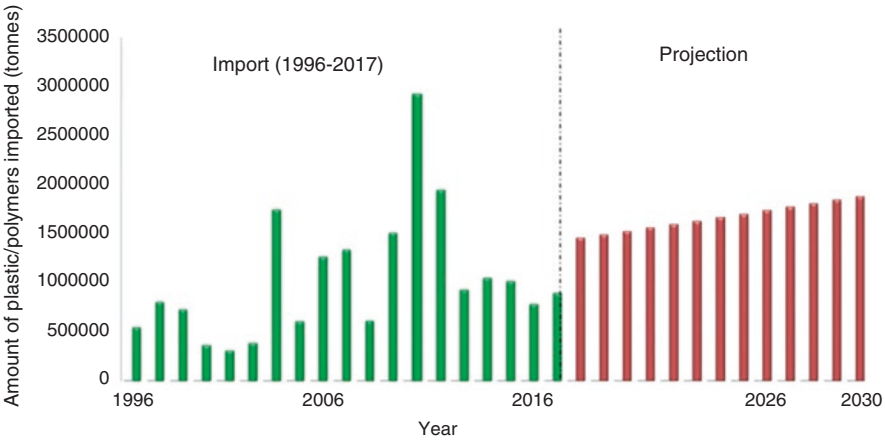

Fig. 5.1 Plastic importation into Nigeria. (Source: Babayemi et al. (2019))

Thus, there is a great need for technological advancement to increase the capacity and efficiency of plastic waste management infrastructures in Nigeria.

Also, due to the extensive use of plastics in the production of bottles, polythene bags, disposable items, waste containers, margarine tubs, milk jugs, and water pipes, polythene makes up 64% of all synthetic plastic (Lee et al., 1991). However, it has been discovered that ethylene polymers play a significant role in many daily activities. They are used for various purposes across several industries, including packaging, consumer goods, and food wrapping. The demand for these synthetic polymers has reportedly increased from 500 billion to 1 trillion tonnes, representing what is used globally (Anani & Adetunji, 2021). Additionally, it has been stated that during the past five decades, the amount of plastics polluting marine ecology has significantly increased. The rise in human requirements linked to population growth and the technological revolution has resulted in a commercial upsurge in the manufacture of plastics at an accelerated rate (Anani & Adetunji, 2021). Globally, 6300 million tonnes (Mt) of virgin plastics were manufactured between 1950 and 2015, resulting in around 8300 Mt. of plastic garbage, of which about 9% have been recycled, 12% have been burned, and 79% have accumulated in landfills (Geyer et al., 2017). Around 300 Mt./year of plastics is being manufactured globally, with 57 Mt./year coming from the European Union (Ratnasari et al., 2016). Worldwide, the average annual plastic usage per person is 43 kg (WEF, 2019). To combat the global challenge of plastic pollution, developed and developing nations have taken a variety of measures, ranging from banning plastic bags (such Kenya and Rwanda) to passing legislation in the European Parliament that will outlaw the top ten single-use plastics found in European beaches as well as fishing gear (E.U., 2019). Despite being one of the top six importers and consumers of plastic, calls for a reduction in the amount of plastic generated remain divisive, and Nigeria has not yet adopted regulations on single-use plastic items like other African nations have (Babayemi et al., 2019).

2.2 *Factors Contributing to Increasing Quantity of Plastic Waste in Nigeria*

The ease of processing for a variety of products used for carrying food items, packing textiles, producing scientific instruments, and creating automotive components from plastics in various forms, such as polythene, finds a wide range of applications in people's daily lives in Nigeria (Akinola et al., 2014; Anabaraonye et al., 2019). Due to the growing number of applications that rely on plastics' beneficial properties, including their light weight, strength, durability, affordability, resistance to corrosion, and low production costs, plastic production and consumption have expanded in recent decades (Li et al., 2016). Over the years, many plastics have entered Nigeria, but there are a lot of information gaps in Nigeria regarding plastics and the waste that goes with them (Jambeck et al., 2015). More plastics and plastic items are being produced now than what has been produced in history. Between 2015 and 2016, its production rose by 13 million tonnes in just one year (Kehinde et al., 2018). Since they are single-use plastic items and packaging materials, 50% of the plastic products fall under the category of disposable items. Similarly, disposable packaging is the leading market segment for plastic resins and production; consumption of single-use plastics is rising in Nigeria (Emeka & Lesley, 2020). There are many factors contributing to the increasing quantity of plastic waste generation and accumulation in Nigeria which include:

2.2.1 Improper Disposal of Plastic Wastes

It is common to observe in many states in Nigeria that many plastic waste products are not collected in trash cans for further processing, recovery, and standard disposal via landfills, incinerators, or recycling facilities but rather are carelessly scattered or thrown into areas that are inaccessible for waste collection, ending any chance of recovery or recycling (Anabaraonye et al., 2019). Plastic bottles and containers are frequently tossed on the ground, thrown out of cars, hipped around tight spaces, or blown away by the wind, which litters the area and ultimately pollutes the nearby ecosystem. Thus, the ecosystem in Nigeria is now seriously threatened by the ongoing accumulation of plastic waste products, a severe global environmental concern.

2.2.2 Consumption Pattern

The Nigerian populace depends heavily on plastic materials because of their affordability, flexibility and versatility as packaging materials. Studies revealed single-use plastic as the principal constituent of plastic products used in Nigeria (Kehinde et al., 2018). A study by Nnaji et al. (2013) in Nsukka, a city in Enugu State, Nigeria, shows that single-use plastics contribute 23% of packaging potable water in the

suburban metropolis, which could be higher in an urban metropolis like Lagos, Abuja, Port Harcourt, Calabar, Onitsha, Kano, and Aba. In Nigeria, water sachets/bottles and shopping bags are the major constituents of plastic waste (Dumbili & Henderson, 2020). Single-use plastic is mainly used for packaging food items and drinks, shopping, and other items such as drinking straws, textile materials, and footwear. According to Kehinde et al. (2018), single-use plastics constitute fifty per cent of plastic products used in Nigeria. These forms of plastic, known as polyethylene terephthalates (PET), are very common plastic wastes found in the streets of Nigeria. These plastics are usually burned in the open air or dumped on the roadsides, constituting potential environmental health hazards.

2.2.3 High Population Density

Nigeria, presently known as the giant of Africa, has a high population density. The high population density in Nigeria is one of the leading causes of the country's inadequate plastic waste management (Kehinde et al., 2018). Being the most populous African country, Nigeria is a major consumer of plastics and contributes mainly to global plastic pollution (Dumbili & Henderson, 2020). Nigeria generates around 2.5 million tonnes of plastic waste annually and ranks ninth among the highest plastic waste-generating countries (Dumbili & Henderson, 2020; Obiezu, 2019). As a local recycling company reported, Lagos, the most densely populated state in Nigeria, generates an estimated 870,000 tonnes of plastic waste annually (Dania, 2022). Plastic wastes generated in densely populated cities of Nigeria are higher compared to the rural, less densely populated regions because of the high demand for plastic products in the form of sachet water, food packs, clothing, shoes, and automobile tyres. High population density is a significant factor contributing to Nigeria's poor waste management. High population density results in high solid waste generation and hence creates difficulty in adequate waste management infrastructure by the relevant agencies, which presently need to be adequately equipped.

2.2.4 Consumer Ignorance

Ignorance is a deadly disease which usually wreaks havoc on communities and institutions in Nigeria and beyond. Many Nigerians are ignorant of the potential environmental and health hazards plastic waste poses, which results in the lackadaisical handling of plastic waste among Nigerian residents. It is commonly observed in several streets and markets that a significant amount of plastic waste is not disposed of in trash cans for proper disposal and recycling; instead is carelessly scattered or discarded on the roadsides, drainage or dump sites hindering effective waste handling by the waste management agencies.

2.2.5 Lack of Implementation of the National Plastic Waste Management Policy

After numerous advocacy at both international and national levels for sustainable plastic waste management in Nigeria, the national plastic waste management policy emerged under the supervision of the Federal Ministry of Environment in 2019 (Isaac, 2021). The Federal Executive Council 2020 approved the newly formulated policy, which is yet to be implemented (Isaac, 2021). They stated, "Whatever strategy the government employs will be ineffective unless the long-awaited 'plastic pollution bill' is passed by Nigerian legislators and swiftly signed into law". The plastic ban bill presented by the National House of Representatives in 2019 aimed at regulating the use of single-use plastics is yet to be assent into law, suggesting the Nigerian government's lack of passion and political will to solve the plastic waste pollution menace (Raji, 2021). Other frameworks of the national policy on plastic waste management, such as extended producer responsibility, are yet to be fully implemented.

2.2.6 Poor Waste Management Infrastructure

In Nigeria, there are insufficient functional waste collection and recycling facilities. The government agencies monopolize waste collection services in Nigeria with poorly trained personnel, outdated and inadequate facilities and are not sufficiently funded (Ike et al., 2018). Waste management involves diverse stages, which include "generation and storage, collection and transfer, sorting, treatment, material recovery and disposal" (Nnaji et al., 2013). According to UNIDO (2021), solid waste management (which includes plastic waste management) is one of the most daunting environmental sanitation challenges currently encountered in Nigeria. This could be attributed to the poor waste management infrastructure, lack of trained waste management personnel, and lack of willpower by Nigerians and the waste management agencies in effective waste management (Salami, 2018).

There is a high level of inconsistency in waste collection services due to poor funding in the major cities of Nigeria. Furthermore, organized waste management services are absent in many towns and cities; hence waste needs to be adequately handled. The uncollected wastes are discarded carelessly and constitute health and environmental hazards. Nnaji et al. (2013) noted that 80 per cent of people living in Nigeria do not receive the services of waste collectors. According to Kofoworola (2007), an increased percentage of waste in Lagos State, Nigeria, is left uncollected from the streets due to inadequacy and inefficiency of the waste management system. In Abuja, the Department for International Development (2004) estimated that the waste collection agency serves about 56% of individuals living in the Federal Capital Territory. Nigeria's tertiary institutions are among the country's highest consumers of plastic products, but waste management in these institutions is far from satisfactory. According to reports, less than 12% of plastic waste generated in

Nigeria is recycled (Sogbanmu, 2020), which is very poor for a country ranked ninth globally in plastic consumption.

2.2.7 Packaged Foods, Sachet and Bottled Water Preference

In Nigeria, the use of sachet water, bottled water, bottled drinks, takeaway food packs, straws, cups, and spoons, among others, in homes and occasions is alarming. These packages come in handy for most people and are widely accepted by many Nigerians because one doesn't need to remain at the point of purchase or service to consume them (Okolo et al., 2022). Plastic wastes are toxic. Most are non-biodegradable and consequently constitute a nuisance in the environment. The burning of these plastics is a common practice in Nigeria. Emeka and Lesley (2020) opined that the single daily use of plastic takeaway packs and shopping bags is enormous, while the consumption and disposal of sachet water bags have risen to over 60 million in Nigeria. Nigerians eat and drink from these different packages comfortably anywhere as the need arises, hence the increase in the rate of plastic waste generation (Okolo et al., 2022). Beyond the toxicity of plastic waste, they find their way to different environmental media. They pollute soils and clog drains and waterways, eventually causing water and sewage overflow. Subsequently, this becomes the breeding ground for disease-spreading germs and bacteria (Akinola et al., 2014).

2.3 Strategies for Mitigation of Plastic Pollution in Nigeria

In mitigating the adverse effects of plastic pollution in Nigeria, it is vital to understand the nature and characteristics of plastics. Plastics are inexpensive and durable, making them adaptable for different uses; as a result, humans produce a lot of plastics (Hester & Harrison, 2011). However, the chemical structure of plastics renders them resistant to many natural degradation processes and results in slow degradation (Le Guern, 2018). It is essential to know microplastic's prospective sources and sinks, the process by which its distribution is affected, and their uptake and exchange in ecosystems to understand the potential ecological harm microplastics do (Jang et al., 2015). It is assumed that there was a stock of over 86 million tonnes of plastic and marine debris in the ocean in 2013, with an assumption that 1.4 per cent of global plastics production from 1950 to 2013 entered the sea and has accumulated (Jang et al., 2015). In the UK, more than five million tonnes of plastic are used yearly, of which only an estimated 25 per cent is recycled, with the remainder ending up in landfills. In some regions, there have been substantial efforts to lessen plastic pollution by promoting plastic recycling and reducing the consumption of plastic(Walker & Xanthos, 2018). Many researchers suggest that by 2050 there may be more plastic waste than fish in the world's oceans by weight (Sutter, 2016).

The following are the innovative strategies for mitigating the negative effects of plastic pollution in Nigeria:

2.3.1 Bioremediation

Bioremediation is defined as engineered or enhanced bio-degradation. Some researchers view it as a sustainable and environment-friendly tool to clean up post-consumer plastic bottles that already accumulate on land, soil, and water bodies (Idowu et al., 2021). Bioremediation refers to cleaning up contaminated environments by exploiting and harnessing the metabolic abilities of micro-organisms to convert contaminants into harmless products by mineralization, generation of carbon (IV) oxide and water or by conversion into microbial biomass through living organisms or biological processes (Baggot, 1993; Boopathy, 2000; Sardrood et al., 2013). Bioremediation, as evolving environmental biotechnology, adopts micro-organisms in the degradation process and can be optimized to achieve a better result (Borasiya & Shah, 2007). Micro-organisms are primarily used in biodegradation investigations on polymers.

Enzymatic processes that result in a chain cleavage of the polymer into monomers cause the microbial breakdown of plastics. Plastics are partially degraded due to micro-organisms using waste polythene as their only carbon source. Numerous authors have described how different bacteria, including Aspergillus (Khan et al., 2000), Streptomyces sp. (Ibrahim et al., 2011), Pseudomonas, and Bacillus, have been involved in the microbial degradation of polyethene (Lee et al., 1991). Micro-organism application is a sustainable method of cleaning up a severely synthetic plastic-polluted environment. It was claimed that many micro-organisms could oxidize or hydrolysate various polymers through biodegradation (Idowu et al., 2021).

The regulation of plastic waste in Nigeria and elsewhere has been the subject of attempts in several parts of the world to preserve ecosystem components while avoiding ecological and health problems. The use of bacteria and fungi in plastic biodegradation has gained popularity. They foretell success due to their effectiveness, affordability, environmental friendliness, and sustainability (Anani & Adetunji, 2021). This process involves secreting metabolites that help break down polymers. When other management techniques are unsuccessful, it is necessary to use well-engineered native micro-organisms that actively participate in the cleanup of plastics (Anani & Adetunji, 2021). The biodegradation of plastics has been tried in many economies with encouraging results. This is relevant to Nigeria, where plastic pollution has continued to be a significant problem. In Nigeria, reducing plastic waste is a sustainability strategy. The effectiveness of the approach of biodegradation has been shown in numerous research. These distinctive techniques must be carefully considered and applied in Nigeria (Senthilkumar et al., 2016).

In a preliminary investigation, Odusanya et al. (2013) identified, characterized, and assessed the breakdown of plastic bottles by micro-organisms in Nigeria. The LLDPE (linear low-density polyethylene) potable plastic container was employed, and it was powdered and solubilized using a straightforward proprietary solvent procedure. Eight bacterial colonies that could convert LLDPE into a usable carbon source were identified using enrichment culture procedures. Serratia marcescens was the organism that was found to be most prolific. The isolated and characterized organisms were gram-rod bacteria, which could degrade plastic trash (Muthukumar & Veerappapillai, 2015; Odusanya et al., 2013). Senthilkumar et al. (2016) wrote a

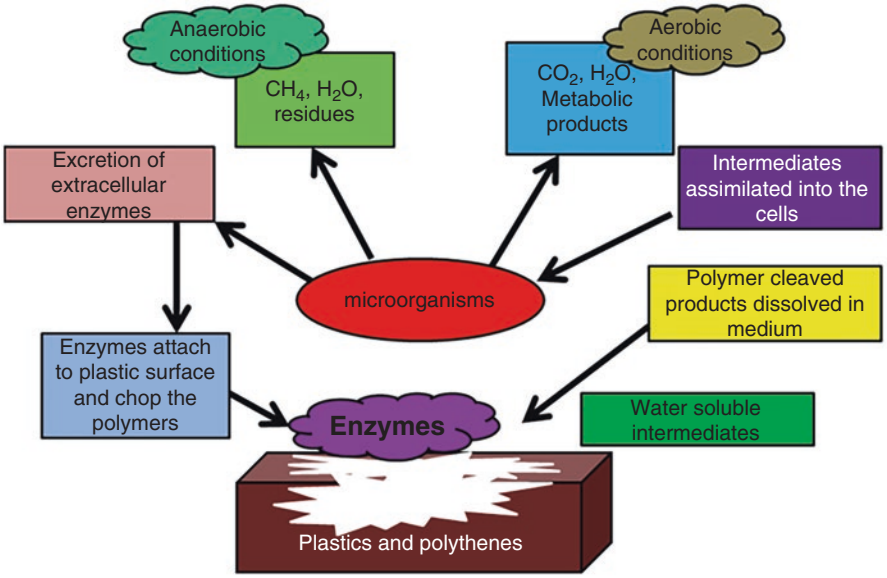

Fig. 5.2 Microbial approach to bioremediation of polyethylene and plastic. (Source: Sharma (2018))

thorough review on isolating beneficial micro-organisms with the capacity to break down synthetic polymers from the soil. With the use of enzymes and the cloning of genes for biodegradation, these soil bacteria can break down these polymers. These enzymes naturally come in the form of lignin peroxidase and manganese peroxides. According to the authors, different soil micro-organisms with the potential to break down various plastics and polymers, particularly those from varied sources, must still be isolated using the technique of bio-stimulation (Senthilkumar et al., 2016). When exposed to multiple environments, the application of various bacteria for the bioremediation of plastic was reviewed by Muthukumar and Veerappapillai in 2015. According to the authors, bioremediation of plastic using unconventional methods could provide a future free of several risks caused by micro-plastics and plastics, particularly those used in packaging and commercial polymers, which are the most prevalent types of plastic wastes (Muthukumar & Veerappapillai, 2015) (*see* Fig. 5.2).

2.3.2 The Use of 3Rs of Plastic Waste Management

The three plastic waste management strategies are the 3Rs (Reduce, Reuse, and Recycling) (Mohamed, 2016; Yosi et al., 2019; Olowoyeye, 2021). Recycling plastic waste is the best solution to managing plastic waste from an environmental and socio-economic aspect (Woldemar, 2019). However, recycling is one of the most effective ways to collect plastic trash, landfilling, and incineration. Even though most plastic trash comes from underdeveloped nations, some come from Western countries, primarily because of the inadequate capacity of collection systems and

the low recycling rates. On the other hand, Horodytska et al. (2019) emphasized the need for recycling to reduce the quantity of waste that must be disposed of and prevent the trash from entering rivers, oceans, and other habitats.

Generally, there are two types of recycling: primary and secondary. However, alternative techniques such as pyrolysis/thermal degradation, catalytic degradation, and gasification were mentioned in 2019 (Bhongade, 2019). Plastic recycling is a technique that has drawn much interest from enthusiastic people and businesspeople. Environmentalists and experts in the attenuation of plastic waste, such as Anabaraonye et al. (2022), asserted that plastics recovered from solid waste become a source of valuable raw materials for industries, reducing the need for countries to import those materials from abroad while allowing for the export of excess production (Anabaraonye et al., 2022). According to the authors, recycling plastic would make cities more resilient to extreme weather events that disrupt communities and their way of life and cause pollution, flooding, and infrastructure damage. Recycling plastic can promote regional industrial competitiveness, fight poverty, create more jobs, and save municipal expenditure on various costs (Anabaraonye et al., 2022, 2019; Olowoyeye, 2021). One important step would be implementing a fully operational plastic waste management, recycling, and environmentally responsible disposal system to guarantee almost zero plastic waste discharge to the environment. Plastic waste recycling is one of those plastic pollution mitigation strategies involving reducing, reusing and recycling plastic waste materials to ensure that our environment is a cleaner, healthier and greener place to live in (Anabaraonye et al., 2019). Plastic waste recycling will also help provide employment for many unemployed or underemployed youths in Nigeria, thereby eradicating poverty and hunger to achieve sustainable economic growth. The demand for plastic products is on the rise, with increasing demand in different sectors of communities and institutions in Nigeria. This amounts to the generation of plastic waste nationally at an alarming rate. Mitigating the harmful effects of plastic pollution in Nigeria will undoubtedly enhance climate resilience in Nigeria.

2.3.3 Education, Advocacy and Community Engagement

Communities, businesses and other institutions in Nigeria can benefit economically from plastic waste management and recycling, achieving sustainable economic growth (Anabaraonye et al., 2019). The waste management systems can reduce significant amounts of plastic garbage with the help of campaigns to make plastic litter socially unacceptable and educate consumers along the supply chain about designing for recycling (Asase et al., 2009). Communities, businesses, and institutions can be engaged in plastic waste management efforts by putting marked containers out in the open for public use or giving bins to house and company owners for strategic garbage disposal and waste collection for recycling. It is encouraged to design interactive activities that can raise awareness of the issues of plastic pollution and our shared obligation to address them. Increased public and societal participation in plastic pollution and potential solutions would result from raising awareness.

Making plastic waste recycling a cultural norm would lessen plastic pollution on land and the amount of plastic that enters the marine ecosystem (SAPEA, 2019a, b). This is demonstrated by a European study, where teachers and students were given the tools to work with plastic waste to address the issue through an online training course and instructional film competition on marine debris (Hartley et al., 2018). Another crucial step is designing specialized evidence-based education to raise awareness of the risks of plastic pollution and inspire change among Nigerians. This action has helped reduce environmental debris in other places (Creel, 2003).

3 Further Recommendations

(a) Plastic recycling businesses need to be well subsidized by the Nigerian government. The Nigerian government and other multilateral organizations must fund and construct infrastructure in Nigeria that will facilitate waste collection, plastic recycling, repurposing, and reuse (Okolo et al., 2022).
(b) Due to society's reliance on single-use plastics, an outright ban may not be possible. Nigeria would benefit significantly from a perfect reduction in plastic waste production and availability in society through policy and enforcement, as well as by adopting cleaner lifestyles, more ecologically responsible choices, and optimum plastic waste management.
(c) To respond to the great need for plastic waste reduction, recycling, and reuse in Nigeria today, environmentalists, engineers, scientists, and related environmental fields must band together (Anabaraonye et al., 2019) to achieve this common goal. This will significantly mitigate the harmful effects of plastic pollution in Nigeria.
(d) Using bio-plastics instead of fossil-based plastics will help improve the end-of-life management of plastic waste because most bio-plastic materials can degrade under controlled conditions (Filho et al., 2022).
(e) Nigerian artists could use plastic garbage in their creations. These actions could lessen the burden of uncollected plastic waste and the careless disposal of plastic sachet bags and items contributing to Nigeria's plastic pollution (Wagner-Lawlor, 2018).
(f) Efficient disposal methods should be implemented, such as the supply of waste bins that differentiate between biodegradable and non-biodegradable waste. When other methods fail, it is also necessary to use well-engineered native micro-organisms, actively participating in the micro-plastic cleanup.
(g) More efforts have to be put towards increasing people's awareness about bio-based and biodegradable products, their properties, their use, and the environmental and human health impacts (Filho et al., 2022).
(h) Promotion of specific monthly or annual leadership summits to attract individuals or groups to invest funds to mitigate plastic pollution in Nigeria.
(i) There should be a constitutional review to let Nigerians be aware of the impacts of plastic pollution in various socio-political and economic dimensions with new strategies to tackle them.

(j) Granting loans and incentives to individuals and organizations engaged in plastic recycling businesses by Nigeria is greatly encouraged.
(k) Carrying out intensive research to be aware of communities or cities that have suffered the harmful effects of plastic pollution in Nigeria. Knowing these communities or cities enables the government to better plan and invest in them.
(l) Attracting the increasing inflow of funds from International establishments such as the World Bank and United Nations Environment Programme (UNEP) by the Nigerian government to mitigate the adverse effects of plastic pollution is greatly encouraged.

4 Conclusions

There is a great need for communities and institutions to unite to devise the means of ensuring a cleaner and healthier environment through proper plastic waste management and recycling strategies, which will help guarantee sustainable economic growth and sustainable development in Nigeria (Anabaraonye et al., 2019). Proper plastic waste management has been identified as a viable strategy for mitigating the harmful effects of plastic pollution in Nigeria (Okolo et al., 2022). Recognizing and maximizing the green entrepreneurial opportunities in the plastic recycling industry is a mitigation strategy to eradicate plastic pollution and ensure sustainable economic growth in Nigeria (Anabaraonye et al., 2022). Through capacity building supported at all levels of government, it is vital to raise people's understanding of the hazards posed by plastic waste in the environment. We must manage our environment by using our plastics sustainably, properly disposing of plastic debris and thereby eradicating plastic pollution, attaining the United Nations Sustainable Development Goals (SDG 13) (Okolo et al., 2022). Policies should focus on reducing plastic waste and recycling while addressing the hierarchy. Potential mitigating tactics may include waste plastic reuse, bioremediation, recycling, waste conversion to energy, and proper malleable control policy frameworks (Olowoyeye, 2021). Additionally, people must contribute at all levels to the correct disposal of plastic waste, and ill-mannered disposal must be shelved, thereby achieving economic growth and sustainable development in Nigeria.

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