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PLASTIC POLLUTION IN LAGOS STATE, NIGERIA: CHALLENGES AND SUSTAINABLE SOLUTIONS.

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ABSTRACT

Plastic pollution poses a significant threat to environmental sustainability, with Nigeria, particularly Lagos State, facing substantial challenges in managing plastic waste. By evaluating the impact of plastic trash on the environment and human well-being and examining prior study findings, this review article critically investigates Lagos, Nigeria's current plastic pollution situation. The study explores existing waste management practices, including illegal disposal methods and infection of water bodies, highlighting the urgent need for sustainable solutions. By synthesizing insights from studies on waste-to-energy technologies and innovative approaches to plastic waste management, this review identifies key research gaps and proposes policy recommendations to deal with the intricate trouble of plastic pollution in Lagos State. The study emphasizes the significance of raising public awareness, putting into practice efficient waste management plans, and creating strong legislative frameworks to mitigate the negative effects that plastic pollution has on the environment and the health of the general people. This review advances knowledge on plastic pollution in Lagos State and offers useful data to policymakers, scholars, and interested parties working to make the state's environment cleaner and healthier for its residents.

Keywords: *Environment, Lagos, Nigeria, Plastic pollution, Public health, Waste management.*

INTRODUCTION

Plastic pollution is one of the most serious environmental issues that the world is currently facing. The continuous usage of plastic items combined with inadequate waste management and recycling procedures has created a global crisis that has an impact on human health, wildlife, and ecosystems. Plastic production has increased exponentially worldwide, with over 400 million metric tons of produced plastic in 2022 (Plastics Europe, 2023). This surge in plastic manufacture has resulted in a significant volume of plastic waste. Out of the 8.3 billion metric tons of plastic manufactured since the 1950s, the environment or landfills have disposed of about 60% of it (Geyer *et al.*, 2017). Approximately 8 million metric tons of plastic waste are dumped into the ocean annually, with the majority of it, remaining near shore (Jambeck *et al.*, 2015; Ritchie, 2023). In 2010, Nigeria was in ninth place out of 20 coastal countries with 0.13 – 0.34 million metric tons of plastic marine pollutants per year (Jambeck *et al.*, 2015). Inadequate garbage disposal and management is a significant environmental hazard since only 20 – 30% of Nigeria's 29 million metric tons of annual waste are collected (Bakare, 2021).

Lagos, a state in the southwestern part of Nigeria, is one of the most populous and rapidly developing regions in Africa. Lagos, being the country's major commercial center with about 22 million residents, generates an average of 870 thousand metric tons of plastic waste every year with a significant percentage of this waste ending up in road gutters, canals, waterways, lagoons, and eventually the ocean (Dania, 2022; Chukwuone *et al.*, 2022). The city's extensive coastline and waterways are particularly vulnerable to plastic pollution, which complicates existing environmental problems. Inadequate waste management infrastructure in Lagos, along with the high population density, contributes to the region's plastic pollution problem. This pollution poses significant threats to local ecosystems, public health, and the economy. The municipal solid waste characterization done by the Lagos Waste Management Authority (LAWMA) in 2016, shows that plastic waste accounted for nearly a quarter of the total waste collected and was the predominant type of inorganic waste. This trend has persisted consistently from 2016 to the present (Figure 1).
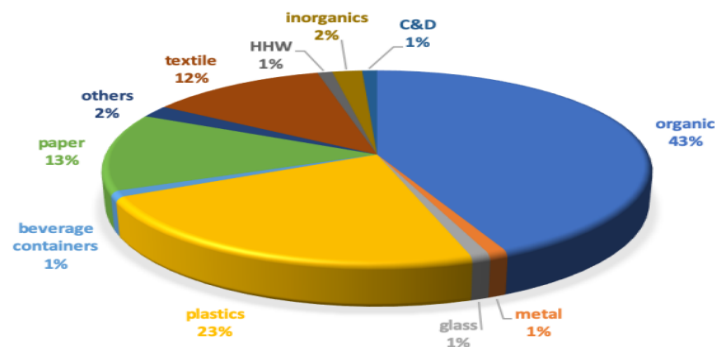

Figure 1: Municipal Waste in Lagos State, LAWMA 2016.

Source: Holland Circular Hotspot, 2020

This review aims to provide a thorough analysis of plastic pollution in Lagos State, Nigeria, by analyzing prior research, assessing the current state of plastic waste generation, evaluating the effects on the environment and human health, evaluating current waste management practices, and identifying obstacles to efficient plastic waste management. Also, the review will explore sustainable solutions and innovations, propose policy recommendations, and identify future research needs. By focusing on these areas, this review hopes to advance knowledge of plastic pollution in Lagos and provide guidance for countermeasures against its harmful impacts.

LITERATURE REVIEW

Previous studies have determined the causes, and consequences of plastic pollution and the challenges that come with plastic waste management both locally and globally. Chukwone *et al*. (2022) examined Lagos State waste disposal methods, and resident's commitment to take part in periodical cleanup. The study revealed that a substantial proportion of households in Lagos take part in illegal waste disposal, with 67.42% of households reported to dispose of waste improperly. Despite this high rate of illegal disposal, there is a significant willingness among the population to participate in cleanup programs. Notably, 75.50% of households expressed willingness to clean up road gutters and drainage channels. The research utilized regression analysis to investigate the causal factors of waste disposal behaviors and the readiness to participate in cleanup activities and also the Eurobarometer survey to collect relevant data for the analysis. The findings indicate that women are particularly more inclined to engage in cleanup activities. Factors such as education level and access to waste management awareness significantly influence this willingness.

Olarinmoye *et al*. (2020) emphasized the concerning amount of microplastics found in Lagos Lagoon's sediment and water. Microplastic abundance in sediment ranged from 310 to 2319 particles per kilogram and from 139 to 303 particles per liter in the water. These microplastics were predominantly identified as polypropylene and polyethylene, common types of plastics used in many products. The methodology employed in this study included digital microscopy for counting plastic particles, and Fourier Transform-Infrared Spectroscopy (FT-IR) along with Gas Chromatography-Mass Spectrometry (GC-MS) for identifying the types of microplastics. These advanced analytical techniques provided precise and reliable identification of microplastic particles. The results revealed significant variability in microplastic abundance based on sediment characteristics and location within the lagoon. Areas with finer sediment composition tended to have higher microplastic concentrations. The advanced analytical techniques used provided precise and reliable identification of microplastic particles. This variation demonstrates the complex dynamics of microplastic distribution in aquatic environments influenced by urban activities. The results of this investigation add to the increasing amount of data demonstrating how widespread microplastic pollution is in aquatic ecosystems, particularly in urbanized regions like Lagos. The study's conclusion emphasizes the necessity for effective waste and pollution control measures to address the issue of microplastics in Lagos. Mitigating microplastic pollution requires putting mechanisms in place to decrease the generation of plastic waste, improve waste assortment and recycling, and keep plastic debris out of waterways.

Igbo *et al*. (2018) investigated the contamination levels of Polychlorinated Biphenyls (PCBs), a class of toxic chemical compounds associated with plastic waste, in various environmental media around electronic waste (e-waste) dumpsites. The study reveals alarmingly high levels of PCBs in water, sediments, and biota near e-waste dumpsites

in Lagos, indicating significant plastic pollution and posing health and ecological risks. The methodology involved comprehensive sampling of water, leachate, sediments, and aquatic fauna such as *Tilapia guineensis*, *Callinectes amnicola*, and *Cardiosoma armatum* from the study areas. The analysis was conducted using Gas Chromatography Electron Capture Detector (GC ECD) Agilent 7820A, a technique well-suited for detecting and quantifying PCBs in environmental samples. Results showed high PCBs' concentrations in all analyzed media. Specifically, the levels of PCBs in water, sediments, and biota exceeded acceptable limits, highlighting the severe contamination around e-waste dumpsites. The findings of this study demonstrate the high environmental risk and contamination by PCBs in South-West Nigeria, particularly in regions close to e-waste dumpsites. The research points to an urgent need for authorities to address the health risks associated with e-waste management. Effective strategies include proper regulation of e-waste disposal, implementation of safe recycling practices, and public awareness campaigns about the risks of PCB contamination.

Olugbenga *et al*. (2021) explored the potential of converting waste plastics into valuable fuels through the process of pyrolysis. The study investigated the pyrolysis of waste polyethylene terephthalate (PET) using a fixed-bed reactor. The process was conducted under two conditions: catalytic pyrolysis at a maximum temperature of 600°C and thermal pyrolysis at 350°C. The use of a fixed bed reactor allowed for controlled pyrolysis reactions, producing different products, including liquid fuel, char, and gaseous fuels. The study sought to assess the effectiveness of these processes and the grade of the produced fuels. Results indicated that the pyrolysis of waste plastics effectively produced liquid fuel, char, and gaseous fuels. When compared to thermal pyrolysis, the liquid oil produced by catalytic pyrolysis had a noticeably superior quality. Also, the quality of the produced liquid oil and the gas yield were significantly influenced by the catalyst ratio. The findings demonstrate the potential of pyrolysis as a viable method for managing plastic waste and generating alternative energy sources. By converting waste plastics into fuels, this process not only reduces plastic pollution but also provides a sustainable energy solution. The liquid fuels produced through pyrolysis can serve as alternatives to conventional kerosene and petroleum fuel fractions, therefore lowering dependency on fossil fuels and enhancing energy security.

Aderoju *et al*. (2019) presented a compelling analysis of how plastic waste can be repurposed for energy generation, addressing significant environmental and energy challenges in Nigeria. The study focused on recovering energy through the burning of waste plastics. The plastic waste's Higher Heat Value (HHV) and Lower Heat Value (LHV) as well as its Power Generation Potential (PGP) were estimated using both proximate and ultimate studies. The methodology employed in this study includes an incentive-based approach and an Extended Producer Responsibility (EPR) approach to manage and collect plastic waste. The analyses revealed that the HHV of the plastic waste was 568.96 kcal/kg, and the LHV was 561.55 kcal/kg. Based on these values, the Power Generation Potential was estimated to be 0.6 MW per 100 tons of plastic waste and 29,000 MW for 4.83 million tons of plastic waste. The findings indicate that waste plastics significantly contribute to environmental degradation in Nigeria. However, the study also demonstrates that these waste plastics can be effectively used for electrical power generation. By converting plastic waste into energy, this strategy helps to solve Nigeria's energy shortage while also lessening the negative environmental effects of plastic waste.

The review of literature on plastic pollution in Lagos State, Nigeria, reveals a complex issue involving illegal waste disposal practices, significant contamination in water bodies, and innovative waste-to-energy solutions. Studies by Olarinmoye *et al*. (2020), Igbo *et al*. (2018), Olugbenga *et al*. (2021), and Aderoju *et al*. (2019) provided insights into the sources, impacts, and potential mitigations for plastic pollution, highlighting the presence of microplastics in Lagos Lagoon, severe PCB contamination near e-waste dumpsites, the potential of pyrolysis to turn plastic waste into fuels, and the feasibility of using plastic waste for electrical power generation. Despite these contributions, research gaps remain, including the need for a better understanding of economic factors influencing waste disposal, cultural influences on waste management practices, long-term environmental and health impacts of plastic pollution, technological feasibility and scalability of waste-to-energy solutions, and the development of robust policy and regulatory frameworks. Future research should focus on economic and behavioral studies, cultural dimensions of waste management, long-term impact assessments, practical implementation of pyrolysis and waste-to-energy technologies, and policy development to support sustainable practices, ultimately leading to a healthier environment and improved quality of life for residents of Lagos State.

CURRENT STATE OF PLASTIC POLLUTION IN LAGOS STATE, NIGERIA

The most common type of packaging material used in Nigeria for liquid products, such as bottled water and drinks, is polyethylene terephthalate (PET) bottles (Abdulkarim and Abiodun, 2012). The same is true of polyethylene wraps and bags (popularly referred to as polybags, nylon bags, or cellophane), which are primarily used for packing and shopping. One of the main products packaged in polyethylene bags is sachet water, often referred to as "Pure Water". In Nigeria, single-use plastic items such as straws, cups, spoons, takeout meal packs, and bottles are frequently used daily (Dumbili and Henderson, 2020). The nation's water scarcity has been lessened with the packaging of table water in polyethylene sachets since several administrations have failed to supply the public with clean drinking water, and using polyethylene shopping bags makes doing business easier (Edema *et al*., 2011; Okeke and Mudashir, 2018). But often, these single-use items are thrown away irresponsibly. As a result, they are contributing increasingly to Nigeria's plastic pollution problem and its associated hazards (Nnaji, 2014). Many Nigerian streets and communities, especially those in Lagos, regularly have large amounts of plastic waste lying around. Because plastic sachets are composed of materials that are not biodegradable, they do not decompose and have a variety of negative effects on the surrounding environment. (Adegboye, 2018; Dumbili and Lesley, 2020). Plastic waste breaks into smaller harmful components, as mentioned by Akinola *et al*. (2014), which eventually pollute soil and waterways, clog drains, cause water and sewage to overflow, and can serve as a breeding ground for germs and bacteria that spread disease.

Figure 2: Current Situation of Plastic Pollution in Lagos State, Nigeria

Source: Ugbana, 2023

ENVIRONMENTAL AND PUBLIC HEALTH IMPLICATIONS OF PLASTIC POLLUTION

Plastic pollution affects ecosystems, biodiversity, and human health extensively, making it a serious environmental problem. In oceans and water bodies, large plastic items such as bags and fishing gear pose entanglement risks to marine life, while fragmented plastics become microplastics, which enter the food chain and cause bioaccumulation and biomagnification, threatening larger marine species. This pollution alters aquatic habitats, smothering coral reefs and affecting marine biodiversity, while leaching harmful chemicals like bisphenol A (BPA) and phthalates into the environment (Aare *et al*., 2023). On land, plastic waste infiltrates terrestrial ecosystems, affecting soil health and wildlife, and contributes to soil pollution and mosquito breeding in landfills (Geyer *et. al*., 2017). Also, plastic pollution degrades landscapes, diminishes recreational values, and clogs water drains (Deonath, 2019). Airborne microplastics, released through the degradation of plastic items, can be inhaled by humans and animals, raising health

concerns. Climate change is made worse by the manufacture and disposal of plastic, which increases greenhouse gas emissions. Plastics introduce health risks such as chemical exposure, respiratory problems, and endocrine disruption. Microplastics found in drinking water, the air, and even in bottled water pose potential risks upon ingestion and inhalation, with long-term health effects remaining a subject of ongoing research (Aare *et al*., 2023).

EXISTING WASTE MANAGEMENT PRACTICES

The Lagos State Waste Management Authority (LAWMA) was established in 1991 to gather, move, and get rid of industrial and municipal waste. Recently, the administration has upgraded open dumpsites and sent out street sweepers. It also brought in waste collection trucks and the Adopt-A-Bin program, which allows businesses and homes to purchase waste bins. It invested in equipment to control dumpsites and launched the Lagos Recycle project utilizing a collection and reporting software application. To encourage the practice of sorting waste at the site of generation, it introduced the Blue Box Initiative. However, this project has failed (Allen-Taylor, 2023).

Figure 3: Waste Collection Trucks

Figure 4: LAWMA Blue Box Initiative

Figure 5: LAWMA "Adopt-A-Bin" Waste Bins

According to Allen-Taylor (2022), the waste bins that the Lagos state government provided were limited. They are sold online at outrageous amounts, starting at 72,000 Naira with a delivery cost of 3000 Naira (buylawmabin.com,

2024), or the LAWMA office for similar rates. Because of this, several residents of Lagos have found substitutes for these waste bins for discarding their waste, like utilizing plastic bags and sacks. The problem worsened to the point where assigned collectors were loading waste collection trucks with different types of waste from waste bags, sacks, and plastic buckets without proper segregation (Allen-Taylor, 2022). The collected waste was not appropriately sorted before being delivered to dumpsites.

Valuable commodities, including aluminum, glass, metal scraps, reusable plastic containers, and paper, are recovered by scavengers at dump sites and sold to recycling companies. Since scavenger hunts have become a significant source of revenue for certain individuals, they are regarded as advantageous from both an environmental and financial standpoint. The remaining waste that is left over after scavengers have recovered valuable things is burned. To decrease the volume of waste, this kind of waste treatment is employed in the majority of Lagos State dumpsites. The direct treatment of waste used in Lagos State involves the open burning of waste materials on dumpsites, an unsustainable technique that damages the environment and jeopardizes the health of residents. Additionally, Lagos uses the combustion approach at its three major dumpsites in Oloshosun, Agege, and Iyana-Iba (Allen-Taylor, 2022). Despite these failed initiatives and poor waste management practices, Lagos continues to generate a large amount of waste, particularly plastics.

CHALLENGES TO THE EFFECTIVE MANAGEMENT OF PLASTIC WASTE

Inadequate Waste Management Facilities

One of the primary barriers to addressing the trouble of plastic pollution in Lagos is the lack of an effective waste management system (Dumbili and Henderson 2020). Poor recycling facilities, limited landfill capacity, and inadequate waste-collecting methods are the main causes of inappropriate disposal of plastic waste (Rajmohan *et al*. 2019). Without a well-organized waste management system, plastic waste cannot be effectively segregated, recycled, or disposed of, leading to its accumulation in landfills, waterways, and streets (Hossain *et al*., 2022; Nnebue and Abubakar, 2023).

Residents' Lack of Awareness of Plastic Pollution

One major barrier to tackling plastic pollution in Nigeria is the general public's ignorance of the issue (Solaja *et al*., 2020). Few people are aware of how damaging plastic waste is to the environment and their health (Kutralam-Muniasamy *et al*., 2022). This ignorance leads to a lack of concern and involvement in ethical waste control initiatives (Miner *et al*. 2020).

Aspects of Culture and Economy that Influence How Residents Use and Discard Plastic

Economic and cultural factors also pose a major obstacle to Nigeria's efforts to combat plastic pollution (Uba 2021). Plastic packaging is the preferred material for many consumers because it is often thought to be convenient and affordable (Rujnić-Sokele and Pilipović, 2017). Using single-use plastics for packaging food and beverages is another cultural practice that bolsters the generation of plastic waste (Hardesty *et al*., 2021).

Inadequate Legal Structure

Nigeria's inadequate waste management regulatory structure makes it difficult to put environmental rules and regulations into practice. Discharging trash on the streets and in sewer gutters is illegal in Nigeria. Not that there aren't penalties for this kind of action, but they're hardly ever applied (Braimah, 2023).

Lack of Collaboration

When it comes to waste management, there is an absence of cooperation between the public and private sectors, foreign investors, and civil society. This makes it hard to put into practice a thorough waste management strategy that takes care of the problems associated with trash development, collection, treatment, and disposal (Braimah, 2023).

SUSTAINABLE SOLUTIONS AND INNOVATIONS

Reduce

It is not necessary to use plastics all the time, especially when there are more suitable substitutes. The use of plastics needs to be balanced for a more environmentally friendly use of our space. Packaging materials made of PET and polyethylene should only be used in situations where there are no other options. This is to lessen the overuse of plastic in packaging and packing. Reducing the usage of plastics, particularly single-use ones, can help conserve resources including energy, water, and fabrication stocks (Elehinafe *et al*., 2021). To cut down on the usage of plastic bags, reusable jars, and bags should be utilized to package consumables and other goods.

Reuse

The term "reusability" describes the practice of using materials multiple times in their original state as opposed to discarding them after each usage. This minimizes waste while also ensuring that the material's life span is used to its fullest. The importance of reuse in tackling a variety of societal issues of poverty, health, and well-being is becoming more widely acknowledged (Obebe and Adamu, 2020). The general public should be informed that reuse is not inherently a waste problem. It gives products the chance to live twice as long. Nonetheless, it did help to reduce the quantity of non-decomposable plastic bags used to some extent (Njomo, 2019). Lagos State residents must consider the various uses of plastic. Retailers can repurpose PET bottles to sell different products in portions, and households can use them to store cooking oil. Reusable shopping bags should be encouraged as an alternative to single-use plastic bags.

Recycle

Plastic recycling is gathering waste plastic and turning it into new items in an attempt to lower the quantity of plastic entering the trash stream. Plastic does not decompose readily, so recycling plastic means it is still plastic but can be used for a completely different purpose. (Obebe and Adamu, 2020). Thus, recycling does not equate to a decrease in plastic exposure or usage. Plastic is a valuable commodity, but it must be properly recycled so that it doesn't end up in the environment. It is suggested that local government districts have recycling facilities established by the government. This will promote waste recycling and open up job opportunities for many young people without jobs. Since some people might not be able to buy the recycling equipment, it should also empower those who are interested in the recycling business (Nwabuisi and Ihenetu, 2022).

Educating the Public about Plastic Pollution

Raising public awareness about plastic pollution is crucial. It is the primary force behind the creation, application, and use of plastic. People need to be aware of the existing circumstances to confront the plastic crisis. Governments may help individuals alter their habits of using plastic, using sustainable materials, and disposing of them by putting awareness programs and campaigns into action and collaborating with international stakeholders (Pilapitiya and Ratnayake, 2024).

Policy Implementation

The Lagos State government has to be actively involved in handling plastic waste sustainably. To lessen the ecological and socioeconomic repercussions of plastic pollution, government and management organizations must the primary focus in regulating the quantity of plastic trash generated by society and the consequent release of litter into the ocean. Single-use plastics usage should be outlawed by government decree, or individuals who do so should be charged a fee or be subject to a tax, with the money raised going toward cleanup (Nwabuisi and Ihenetu, 2022).

CONCLUSION

The prevalent issue of plastic pollution in Lagos State, Nigeria, demands immediate attention and concerted efforts from various stakeholders to implement sustainable solutions. The findings from this review emphasize the urgent need for enhanced waste management infrastructure, public awareness programs, and legislative actions to tackle the growing concern of the accumulation of plastic waste. Addressing the barriers to effective plastic waste management, such as inadequate facilities, ignorance, and improper disposal practices, is crucial for safeguarding the environment, and promoting public health in Lagos. By leveraging innovative technologies and fostering community engagement, policymakers can work towards a cleaner and more sustainable future for Lagos, reducing the aftermath of plastic waste on ecosystems and public health. Moving forward, collaborative initiatives, research endeavors, and policy interventions are essential to drive positive change and create a more resilient and environmentally conscious society in Lagos State. Together, we can strive towards a greener and healthier environment for current and future generations.

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