

Plastic Pollution and Nigeria's Waste Management Regime: An Environmental Security Analysis

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I. Introduction

In recent years, the emphasis of waste management regimes across the globe has digressed from the routine control of waste disposal activities, to include goals for waste prevention and recovery. This demanding reality specifically anchors on the need to reconcile economic and environmental objectives in waste management. The economic and environmental gains of waste management have been sufficiently documented, and these include job creation, reduced dependence on finite natural resources alongside the huge costs associated with extraction and processing, conserving natural resources, preventing environmental pollution, and a host of other tangible benefits (Zaman, 2016; De Feo et al, 2019).

Plastics accounts significantly for larger proportion of human wastes across the globe despite the deliberate policies enacted to curb its rise as part of SDG Goal 3, 6, 7 and 13 which emphasizes health, clean water, sanitation, clean energy and climate action (Shen et al, 2020). Recent estimates suggest that as much as 300 million tonnes of plastic wastes are produced annually on a global scale, while approximately 90 percent of such wastes are neither recycled nor incinerated, but majorly disposed as single use (Sofi et al, 2020). In perspective, this equals 6,000 ship load of waste ending its journey in our seas and ecosystem. In this light, it has been suggested that millions of years to come, plastic wastes may serve as the geological indicator of the current Anthropocene era (Bigalke & Filella, 2019). In Nigeria, clear statistical data on plastic waste generation is missing (Abubakar et al, 2019). However, recent assessments of solid wastes in Nigeria suggest that polyethylene accounts for as much as 19 percent of Nigeria's solid waste while other plastic types account for about 15 percent (Oyelola et al, 2017; Orhorho & Oghoghorie, 2019). This means that plastics alone may account for as much as 34% of Nigeria's total solid waste.

Plastic pollution is associated with a wide range of undesirable consequences. Notably, it is implicated for the death of over 1.1 million seabirds and animals annually (Xanthos & Walker, 2017), poses threat to the marine ecosystem (Dumbili & Henderson, 2020), threatens global food security (Zhang et al, 2020), and is associated with a number of health challenges in humans. Recent studies by (Barbosa et al, 2020; Zhu et al, 2020) have found the presence of microplastics in the human diet. However, while there is no consensus among scientists on the actual scope of effects associated with human exposure to microplastics (Prata et al, 2020), available evidence suggests that the ingestion or inhalation of microplastics could lead to inflammation and immune system response (Hwang et al, 2019), reproductive health challenges (Rist et al, 2018) as well as cancer (Prata et al, 2020).

Plastics are essentially made up of synthetic organic polymers. They are commonly used in food and water packaging, clothing, construction, electronic goods, and for a wide range of other purposes. They were once considered harmless and inert until the several years of plastic disposal began to reveal the negative consequences of its continued use (Worm et al, 2017). This research paper, therefore, undertakes to carry out an environmental security analysis exploring the burden of plastic wastes vis-à-vis the challenges and opportunities associated with plastic waste management in Nigeria. The paper will be divided into three main sections. In the first section, the notion of environmental security will be discussed as the conceptual framework guiding this paper, while the next section will explore current realities in relation to the burden of plastic wastes in Nigeria. In the last section, the challenges and opportunities inherent in Nigeria's plastic waste management efforts will be highlighted.

Plastic Pollution and Nigeria's Waste Management Regime: An Environmental Security Analysis **Conceptualizing Environmental Security**

Establishing a link between environment and security is a recent academic endeavor that draws from the realities of contemporary human and political relations. Traditionally, issues of security were primarily concerned with the use of force by state and non-state political actors in order to achieve a political objective. However, as highlighted by Utulu et al (2017), environmental security emerged in the 1980s as a concept

concerned with how environmental concerns pose non-military threats to people and the society at large. Environmental security is conceptualized along two main lines: positive and negative conceptualizations. Positive conceptualization of environmental security is concerned with efforts aimed at strengthening the environmental foundations of a state and its people, while negative conceptualization focuses on environmental threats such as pollution and natural disasters.

A typical United Nations' definition of environmental security combines the positive and negative conceptualizations of environmental security to mean "the relative public safety from environmental dangers caused by natural or human processes due to ignorance, accident, mismanagement or design and originating within or across national borders." While this definition has not been accepted by all scholars and analysts as the gold standard for making sense of the notion of environmental security, it helps to provide a wide dimension for understanding the concept and is particularly relevant to this present paper.

Another perspective through which the notion of environmental security has been understood over the years is the issue of resource availability and scarcity. This notion of environmental security focuses on the role of resource scarcity in sparking military and non-military disturbances peculiarly within Africa. Klare (2001) is a leading proponent of this conceptualization of environmental security, as he argues that in the absence of the ideological and superpower rivalries that occupied the global space at the end of the Second World War,

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conflicts as a result of scarce resources have become the new nature of world politics. Suffice to note that the notion of environmental security became a principal focus for scholars, analysts, and policymakers in the period following the end of the Cold War. This was after the disintegration of the Union of Soviet Socialist Republics (USSR) in 1991 and the turns that succeeded this event triggering a scramble for certain types of resources. However, one striking criticism against the scarcity-related conceptualization of environmental security is that it is mostly related to the traditional notion of security which is primarily concerned with the use of force or threat of its use (Mahlakeng, 2019). In this regard, the expanded understanding of security to include issues relating to health and wellbeing, freedom from hunger, want, and scarcity, as well as the absence of peace, is ignored (Etim, 2017; Gierszewski, 2017; Spring, 2020). Moreover, the scarcity-related conceptualization of environmental security holds little or no relevance to the subject of this study, as issues of plastic waste pollution are unrelated to the question of resource scarcity.

Nigeria's Plastic Waste Burden

Plastics are fundamentally products or materials made from polymers extracted from natural occurring hydrocarbons such as crude oil or natural gas. In recent years, plastics have replaced the use of metals, glass, wood, and ceramics in a wide range of everyday consumer products, and this expansion is supported by the technological simplicity involved. However, at its end of life, plastics become non-biodegradable wastes that pose huge threats to environmental security when poorly managed. This is especially true in societies with suboptimal waste management regimes where solid wastes are neither recycled nor incinerated. In this regard, African countries rank high in terms of the inability to recycle solid waste despite their high waste generation occasioned by high population densities across choked cities.

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In Nigeria, the widespread use of plastics dates to the second half of the 20th Century, when the use of plastics for packaging was introduced. At the time, there were only about 50 registered companies engaged in the production of plastics countrywide. However, as its popularity grew, people began to embrace the use of plastics, and plastic production multiplied such that, at the dawn of the 21st Century, over 3,000 registered plastic production companies had been registered in Nigeria. Presently, Nigeria is ranked as the highest importer of plastics and plastic raw materials in Africa. This stands apart from the large number of Nigeria's plastic producing companies who rely on locally sourced raw material for plastic production. Against this backdrop, recent estimates by Hanafi (2018) suggest that as much as 100,000 tons of plastic are produced annually in Nigeria.

Therefore, with an average useful lifecycle of three years, the most conservative estimates suggest that over 30,000 tons of plastic wastes are generated annually across Nigeria. However, considering that a preponderant percentage of plastics used in Nigeria is for short term purposes (SUPs) like food packaging, some analysts suggest that the actual amount of plastic wastes generated annually in Nigeria could be as much as the quantity of plastic produced in the country. Also, relying on available data for plastic production to estimate Nigeria's plastic waste is problematic. This is especially because, despite the growing business of plastic production in Nigeria, a very significant proportion of plastics used in Nigeria are from direct importation of finished goods. On this note, Obiezu (2019) suggests that the total amount of plastic waste generated annually in Nigeria could be as high as 2.5 million tonnes.

Evidently, it is difficult to ascertain the actual amount of plastic wastes generated annually in Nigeria. This is for two main reasons. First is the absence of official statistical data in relation to waste generation, disposal, and management in Nigeria. Next, is the culture of illicit disposal of solid waste in Nigeria which makes data collection a very challenging process (Okafor, 2020). Nevertheless, there is no doubt that Nigeria generates some of the highest amounts of plastic wastes in Africa, most of which often end up in

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marine environments, landfills, or indiscriminate waste burning (Dumbili & Henderson, 2020; Ikpe et al, 2020). Sadly, in all three methods of plastic waste disposal, there are adverse consequences for the environment.

For the marine environment, the presence of plastic wastes is associated with the suffocation and entanglement of marine animals. The African Development Bank suggests that every year, an estimated

100,000 marine species such as seabirds, turtles, fishes, mussels, crustaceans, and marine mammals are killed in Africa as a result of plastic pollution of the marine environment (Stock et al, 2020). In landfills, the presence of plastic wastes alters the quality and structure of the soil thereby inhibiting agricultural practices, contaminates groundwater, and makes its way into the human food chain. In addition, the burning of plastic wastes is associated with poor air quality. Soot and solid residue ash caused by the burning of plastics cause greenhouse effects and deplete the ozone layer. Also, the burning of plastic wastes is associated with the release of hazardous pollutants such as polychlorinated biphenyls which endangers humans and wildlife. Finally, plastic wastes contribute significantly to the menace of flooding which is a significant challenge facing Nigeria. This is as plastic wastes often block drainages and natural water channels, thereby causing the overflow of water to submerge dry and arable land expressed as flooding .

Opportunities and Challenges

As discussed in the previous section, plastic waste constitutes an enormous environmental security threat for Nigeria. However, there are several latent opportunities associated with the availability of plastic wastes in the environment. Notable in this regard is the opportunity to convert plastic waste into sources of energy, and this is particularly achievable through pyrolysis. Pyrolysis refers to the thermal decomposition of materials at elevated temperatures in an inert atmosphere (Yatim et al, 2020). It

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involves a change in chemical composition and is irreversible. It is done largely in an environment absent of oxygen and is a proven method of chemical recycling for plastic wastes.

The chemical recycling of plastic wastes is considered as an evidence-best strategy to address the threats to environmental security posed by the use of plastics and the generation of plastic wastes. In the case of plastic pyrolysis, plastic wastes are fed into a cylindrical chamber where they are evenly heated to a narrow temperature range. Thereafter, oxygen is purged from the chamber while the carbonaceous char by-product is managed to avoid lowering heat transfer to the plastic. This is followed by a careful

condensation and fractionation of the pyrolysis vapours to produce good quality and consistent distillate (Bridgwater, 2018) which is an astounding fuel oil.

There are essentially two types of plastic pyrolysis, and these include thermal and catalytic pyrolysis (Constantinou, 2017). Thermal pyrolysis requires high temperature, and this is primarily as a result of the low thermal conductivity of polymers. On the other hand, catalytic pyrolysis involves the use of catalysts to aid decomposition reactions in lower temperatures. In most cases, and particularly in Nigeria where power availability is dwarfed, the catalytic pyrolysis is preferred since it requires lower energy consumption. It is imperative to note that as much as 900°C could be required for decomposition reactions using thermal pyrolysis, while catalytic pyrolysis requires less than 300°C to achieve decomposition reaction.

Multiple studies have ascertained the usefulness of plastic pyrolysis for generating alternative sources of fuel. As such, pyrolysis plants have been set up across different countries to serve as a tool for achieving economic and environmental objectives. For instance, in the United States, it was estimated that the rapid deployment of plastic pyrolysis in 2014 had the capacity of contributing as much as \$9 billion to the country's economy, with a potential of reducing the nation's unemployment rates with over 40,000 jobs

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(Al Qattan et al, 2018; Wienchol et al, 2020). Similarly, the United Kingdom hosts **CYNAR PLC**, one of the most successful pyrolysis companies in the world, and national policies and guidelines have been enacted to encourage plastic pyrolysis (Abad et al, 2015). This is in acknowledgment of the benefits of plastic pyrolysis for the British economy. Similar efforts are on-going in Ghana and several other African countries mainstreaming and commercializing the process in a push for a more secured environment.

Therefore, considering the huge amount of plastic wastes generated annually in Nigeria, plastic pyrolysis offers a useful and innovative strategy for turning plastic pollution, and all attendant threats that comes with it, into a source of economic growth and development. The adoption of plastic pyrolysis will help to reduce the problem of illicit disposal of plastic wastes, as these wastes would rather be used as feedstock for the plants.

This will also reduce the country's over-dependence on crude oil, which has proven to be a bane to her economic growth and development (Charles et al, 2018).

The end product of plastic pyrolysis is the pyrolysis oil or biofuel which is noted to be useful in the generation of industrial scale heat and power, and for use as automotive fuel, and biorefineries. Several studies have highlighted the usefulness of biofuel for industrial and domestic purposes (Balasubramanian & Steward, 2019; Philippidis et al, 2019; Perea-Moreno et al, 2020).

Therefore, considering Nigeria's energy shortage (Dioha& Kumar, 2020), plastic waste and plastic pyrolysis would contribute significantly to improving the country's energy situation.

However, in turning plastic wastes into a viable source of economic growth and development in Nigeria, certain challenges are expected and will need to be addressed. First, there will be a need to address Nigeria's problem of indiscriminate solid waste disposal. Illegal dumping of solid waste at undesignated

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areas is identified as a major challenge facing Nigeria's waste management regime (Alumona&Onwuanabile, 2019). Particularly, the indiscriminate dumping of solid wastes makes it difficult for recyclers to gain access to sufficient feedstock for their recycling plants. According to Adeleke (2018), the spate of indiscriminate waste disposal in south-Western Nigeria is so alarming that it already constitutes adverse public health consequences.

Similarly, Abubakar et al (2019) stress that in North Central Nigeria, the indiscriminate disposal of domestic and industrial waste is so rampant that even waste management companies have begun to indulge in such illicit activities. Therefore, the point to stress is that while indiscriminate dumping of wastes poses a series of adverse environmental and health consequences, it also makes it difficult for recyclers to collect the plastic wastes needed as raw materials for the production of bio-oil. As such, it is necessary for efforts aimed at addressing the problem of plastic pollution in Nigeria through pyrolysis, to begin with, mass sensitization on the need to avoid indiscriminate waste disposal. A strong senate backed policy/legal framework with very strong sanctions must be instituted to curb this waywardness. Widespread illiteracy and poor public awareness of the environmental impact of indiscriminate waste disposal is widely considered as one of the main challenges facing Nigeria's waste management regime, and this can be adequately addressed through mass sensitization, public education, and provision of collection units across cities.

Also, inadequate financing and endemic corruption are identified as some other challenges that may face intervention strategies aimed at converting plastic waste to wealth in Nigeria. Presently, Nigeria ranks high in the global corruption perception index as it is rated as the fourth most corrupt country in West Africa (Transparency International, 2019). In the waste management sector, corruption is evident in delays to the evacuation of household and industrial wastes, bribery among waste management operators, as well as the inability of responsible government agencies to prosecute defaulting individuals, organizations,

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as well as waste management operators (Oluwatayo&Ojo, 2018). Finally, the absence of robust governmental policies and regulatory instruments to guide waste disposal may pose a challenge to the effective implementation of plastic waste to wealth innovative projects. Therefore, there will be a need for concerted efforts aimed at introducing useful legislation to discourage indiscriminate waste disposal and stipulate measures to punish defaulters.

II. Conclusion

This paper has explored the problem of plastic pollution in Nigeria from an environmental security perspective. The paper stresses that in view of Nigeria's teeming population of over 200 million, and its suboptimal waste management regime, the country faces a huge burden of waste from plastics and other biodegradable and non-biodegradable wastes. The paper argues that plastic wastes stand out, and this is not just because of their ubiquity, but also as a result of the adverse consequences they portend for human health and the environment. Therefore, as a strategy for addressing Nigeria's challenge of plastic pollution, this paper suggests plastic pyrolysis as a proven strategy to reduce the menace of plastic wastes and convert such waste into a sustainable source of energy and economic development. The likely challenges and opportunities associated with plastic pyrolysis in Nigeria are discussed in this paper.

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