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Research Article

EXAMINING THE IMPACT OF PLASTIC WASTE ON THE BUILT ENVIRONMENT IN URBAN SLUM SETTLEMENTS OF JOS METROPOLIS

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Abstract
The uncontrolled use and disposal of plastic materials have become a significant environmental concern, especially in urban slum settlements. This study investigates the impact of plastic waste on the architectural composition of such settlements in Jos Metropolis, Plateau State, Nigeria, focusing on Anguwan Rogo. The primary objective is to explore how plastic waste contributes to environmental degradation and to identify strategies to address this issue, enhancing the quality of the built environment. Using physical observation, digital photography, case studies, and literature review, the research reveals that plastic waste generation negatively affects the environment, causing pollution, foul odors, large-scale flooding, and aesthetic damage to urban areas. The study further highlights that plastic waste clogs drainage systems, contributes to air pollution when burned, and poses risks to public health and wildlife. The research emphasizes the need for greater awareness regarding the dangers of plastic waste and recommends improvements in waste management practices, including better collection, treatment, and disposal strategies. Additionally, it stresses the importance of sustainable urban planning and the integration of eco-friendly materials in the architectural composition of slum settlements to address these environmental challenges. This study provides valuable insights for policymakers, urban planners, and construction professionals in improving the urban environment in Jos Metropolis.

Keywords: Plastic Waste, Urban Slums, Environmental Pollution, Waste Management, Architectural Composition

Introduction

Plastics have become an indispensable part of modern life, offering a wide array of applications across multiple sectors. Their versatility, durability, and ability to be molded into various shapes have made plastics an essential material in daily life. They are used in the production of numerous products such as water bottles, food packaging, clothing, electronic goods, medical supplies, construction materials, and much more (Pavani & Rajeswari, 2014;

Danladi, 2019). In the medical sector, plastics are used in the creation of disposable syringes, intravenous bags, joint replacements, and other vital healthcare products. The durability and light weight of plastics also make them an ideal choice for manufacturing everything from telephones to optical instruments. However, despite the many advantages of plastic materials, their extensive use has resulted in a significant environmental burden.

The environmental challenges associated with plastic waste are becoming increasingly apparent, especially as urban populations grow and the volume of waste generated rises exponentially. As cities expand, the disposal of plastics and the management of waste have become pressing concerns. According to the United Nations Environment Programme (UNEP, 2009), plastics are the third-largest component of solid waste streams, following food and paper waste. Although plastics are highly useful, their persistence in the environment, combined with their non-biodegradable nature, presents serious problems. The improper disposal of plastic waste—especially in rapidly growing urban areas—has led to clogged drainage systems, unsightly litter in public spaces, and other environmental consequences. These issues pose a significant challenge for municipal waste management authorities in Nigerian urban centers, where the growth of cities and waste production are outpacing the ability to manage them effectively (Ali et al., 2016).

Plastics are synthetic or semisynthetic materials that can be molded into various forms and retain their plastic properties (Pavani et al., 2014). They are light, durable, resistant to moisture and chemicals, and capable of maintaining their structure over long periods. While these properties make plastics highly useful for a range of products, they also create significant challenges for waste management systems. The accumulation of plastic waste in urban areas exacerbates the already challenging issue of waste disposal. The mismanagement of plastic waste not only creates visual pollution but also contributes to environmental hazards such as flooding and air pollution. The Federal Minister of Environment in Nigeria, during a 2013 workshop in Abuja, emphasized the growing threat posed by the uncontrolled use and improper disposal of plastic materials. He noted that this issue had resulted in widespread flooding in Nigerian cities and villages, particularly during the 2012 rainy season, due to plastic waste blocking drainage systems and sewers (Ishaku, 2013).

These concerns have been echoed by several scholars and environmental experts. Ajoku et al. (2020) have argued that despite the recognition of the dangers posed by plastic waste, neither the government nor individuals have taken sufficient action to adopt sustainable waste management practices. Plastic waste continues to find its way into the environment, clogging drains and sewers, contributing to the spread of diseases, and affecting the aesthetic quality of urban spaces. When plastics are improperly burned, they release harmful chemicals such as dioxins and furans, which have been linked to serious health issues, including cancer (Alabi et al., 2019). Additionally, the improper disposal of plastic waste has adverse effects on agricultural land, as it contaminates

the soil and creates breeding grounds for mosquitoes and other disease vectors, further exacerbating public health concerns (Kehinde et al., 2020).

One of the most pressing environmental challenges is the growing volume of plastic waste in urban slums, particularly in cities like Jos, Nigeria. Urban slums are often characterized by overcrowding, lack of proper sanitation infrastructure, and limited waste management services. As a result, plastic waste in these areas is often indiscriminately dumped on the streets, in drainage systems, and in open spaces. The accumulation of plastic waste in urban slums not only worsens the quality of the environment but also poses significant risks to public health. Preliminary studies in Jos Metropolis indicate that plastics are commonly found littering the streets in the form of plastic bottles, take-away plates, spoons, and nylon bags, all of which contribute to the environmental degradation of the city's slum settlements. These unsightly plastic piles not only compromise the aesthetic value of the urban landscape but also hinder the efforts of local authorities to maintain a clean and safe environment.

The Sustainable Development Goal (SDG) 11, which aims to make cities and human settlements inclusive, safe, resilient, and sustainable, highlights the importance of addressing environmental issues such as plastic waste. Achieving this goal requires the implementation of policies that prioritize sustainable waste management, social inclusion, and the protection of urban spaces (United Nations [UN], 2019). Wash et al. (2022) have emphasized the need for a healthy and adequately protected environment to foster prosperity and improve quality of life. However, in order to effectively address the problem of plastic waste, it is essential to examine the architectural composition of urban slums, as these areas often lack the infrastructure and resources necessary to manage waste effectively.

Architectural composition refers to the human-made environments in which people live, work, and recreate. It encompasses buildings, green spaces, infrastructure, and public spaces that are essential to daily life (Sati, 2015). In many cases, urban slums lack the necessary infrastructure to properly manage waste, resulting in the accumulation of plastic waste and other forms of pollution. Sati (2015) further explains that architecture is not just about the construction of buildings but involves the creation of spaces that support human activities and contribute to the well-being of the population. In the context of urban slums, architects and urban planners face the challenge of designing spaces that are functional, safe, and environmentally sustainable. This includes the need to address waste management, particularly the disposal and recycling of plastics, in order to create cleaner and healthier urban environments.

The concept of eco-architecture presents a potential solution to the problem of plastic waste in urban slums. Eco-architecture involves the use of sustainable building materials and waste products, such as plastics, to create environmentally friendly structures (Sani et al., 2016). By incorporating waste materials into construction

projects, it is possible to reduce the environmental impact of building processes while also addressing the issue of plastic waste. Moreover, the use of recycled plastics as a building material or decorative element can help reduce the volume of plastic waste in urban areas while contributing to the creation of more sustainable and affordable housing solutions.

While numerous studies have been conducted on the environmental and health impacts of plastic waste (Ali et al., 2016; Ilyas et al., 2018; Danladi, 2019), few have explored the intersection of plastic waste management and architectural composition, particularly in urban slum settlements. This gap in the literature is particularly significant in the context of Jos Metropolis, where plastic waste continues to pose a major challenge in the city's slums. By examining how plastic waste affects the built environment in these areas, this study aims to contribute to a deeper understanding of the environmental and architectural issues associated with plastic waste in urban slums.

The objectives of this research are twofold: first, to examine the characteristics of slum settlements in Jos Metropolis, and second, to identify strategies for addressing plastic waste in the context of architectural composition in these settlements. Through this study, we hope to contribute to the body of knowledge on the impact of plastic waste in urban slums and provide practical recommendations for improving waste management practices and the quality of the built environment. This research is intended to be of value to academic researchers, urban planners, architects, and policymakers working toward the goal of creating more sustainable, resilient, and livable urban spaces.

By addressing the environmental deterioration caused by plastic waste in Jos Metropolis' urban slums, this study seeks to offer solutions that will not only improve the quality of the environment but also contribute to the broader goal of creating more sustainable and inclusive cities. In doing so, it aims to promote cleaner, safer, and more resilient urban environments that are capable of meeting the needs of a growing population while minimizing the environmental impact of plastic waste.

MATERIALS AND METHOD

The Study Area

Jos, the capital of Plateau State is situated approximately on latitude 9.6° North and Latitude 8.5° East. The city lies close to the geographical center of Nigeria (Figure 1). Jos metropolitan area is made up of two main local government areas, Jos North and Jos South. However, with recent expansion of the city it has extended into Bassa and Jos East Local Government Areas. During British colonial rule (1900 to 1960) it was an important Centre for tin mining. With an altitude of 4,062 feet (1,217 m) above sea level, it enjoys a more temperate climate than much of the rest of Nigeria (average monthly temperatures range from 70° to 77°F or 21° to 25°C). The weather has

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played an important role in attracting population into the city, coupled with its unique terrain and topography (National Population Commission [NPC], 2019).

Geographically, Angwan Rogo is a community, in Naraguta 'B' electoral ward of Jos North L.G.A. of Plateau State. It lies on latitude 9° 56' 47 N and longitude 8° 53' 12 E with an altitude of 1276m (Figure 2). According to Musa & Dung-Gwom (2018), it is a high-density residential area dominated by Muslim and foreigners, with a total of 3,980 units as at 2014. It is accessed through the Bauchi Road and the Bauchi Ring Road with poor setbacks and airspaces which would have helped in curbing the effect of fire outbreaks. Their main occupation is trading in the formal and informal sectors.

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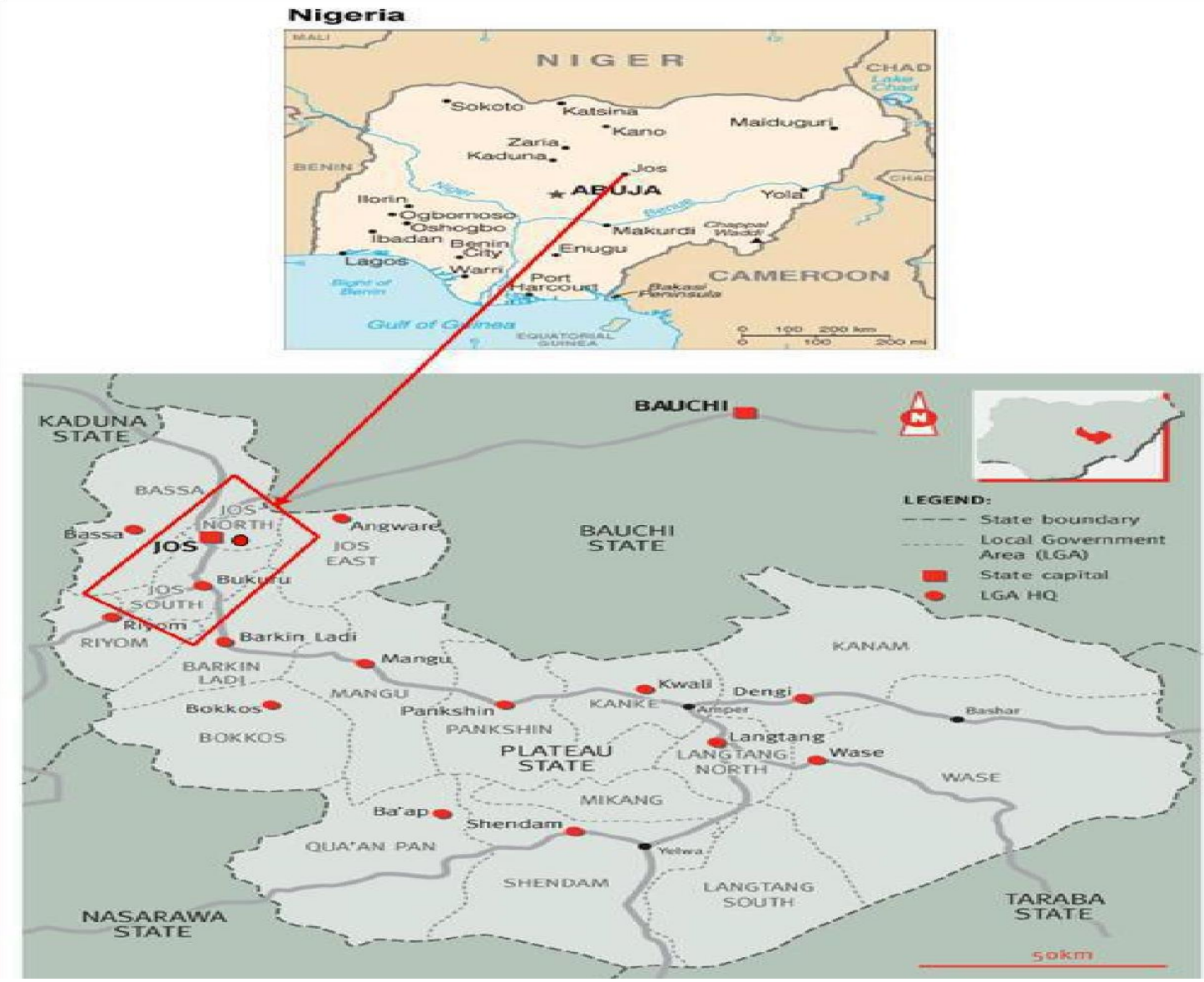

Figure 1: Location of Jos Metropolis in Plateau State and Local Government Areas Source: Department of Urban and Regional Planning, University of Jos, 2021.

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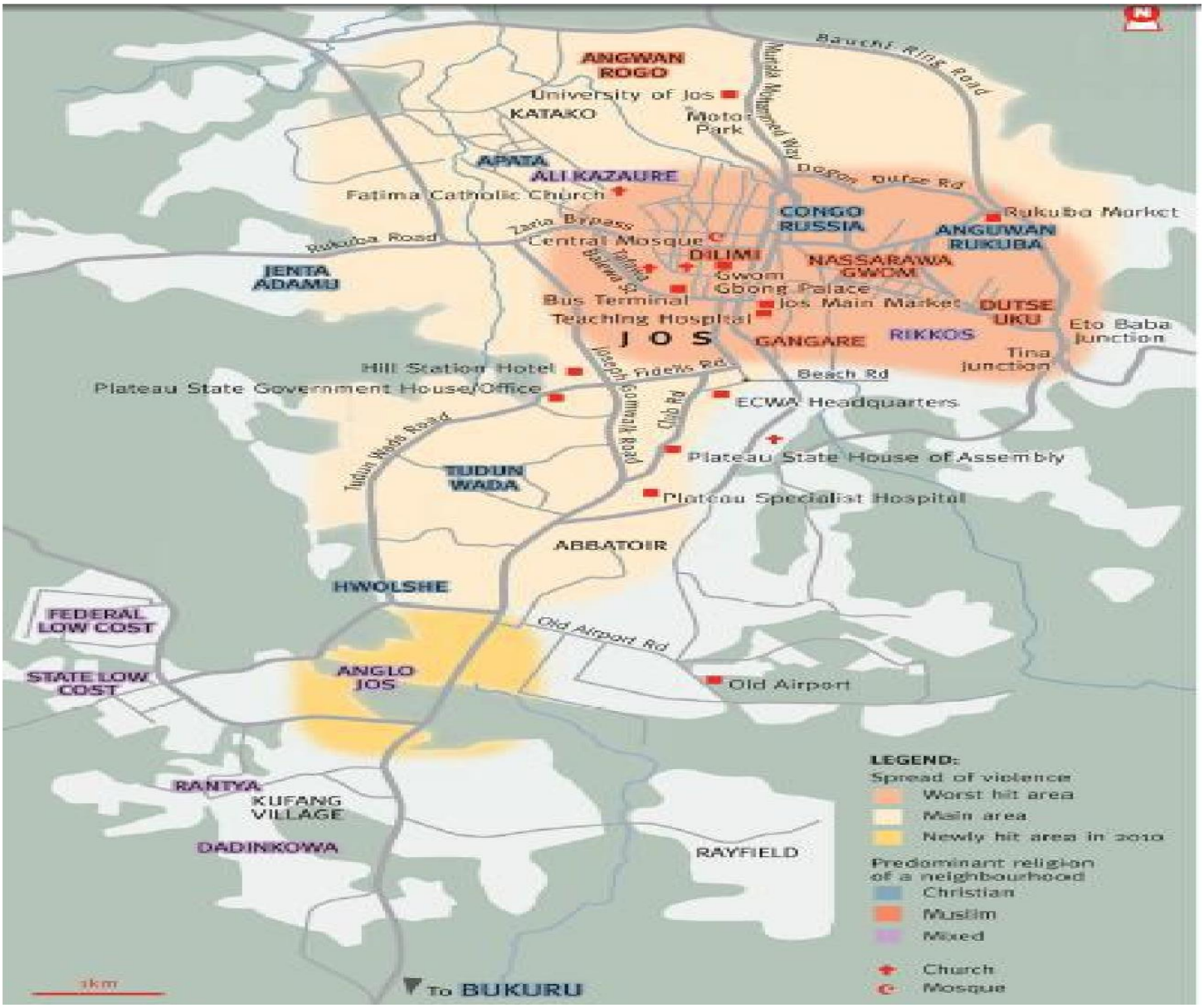

Figure 2: Location of Angwan Rogo within Jos Metropolis in Plateau State
Source: Department of Urban and Regional Planning, University of Jos, 2021

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Method of Data Collection

This study employed the use of data and information from both primary and secondary sources. Primary data were obtained by physical observation, digital photography and case study. The secondary data involves the use of information already in existence and this was sourced largely through literature review.

RESULTS AND DISCUSSION

The Characteristics of Slums

A review of the definitions used by national and local governments, statistical offices, institutions involved in slum issues and public perceptions reveals the following attributes of slums.

i. Physical Environment and inadequate building structures:

Slum areas are associated with a high number of substandard housing structures, often built with non-permanent materials unsuitable for housing given local conditions of climate and location. The condition of housing in the study area is very poor due to the low quality of materials used for their construction, inadequate technology and poor planning standards of the building components This compares with the findings Bello, Ogunrayewa & Hassan, (2018) who posited that the living conditions of the slum dwellers is very poor. (Plate i). Factors contributing to a structure being considered substandard are, for example, earthen floors, mud-and-wattle walls or straw roofs. Various space and dwelling placement bylaws may also be extensively violated (The challenge of slums: global report on human settlements, 2003).

Plate i: Physical housing condition.

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Source: Field photographs, 2023.

ii. Lack of basic services

The findings from physical observation indicated the absence of pipe borne water supply leaving the inhabitants of the area with no option than to buy water for drinking and other domestic use from water vendors and from people who have sunk in boreholes for commercial purposes. (Plate ii & iii). Here 50 litres water-can (10 in number) sells for N500.00. This compares with the findings of Daniel, Wapwera, Akande, Musa & Aliyu, (2015) who discovered that slum residents in Jos, Port Harcourt, Abuja and Makoko area of Lagos State are deprived and excluded from getting access to safe drinking water. The slum resident have to travel some distance to get water or buy from *'mairuwa'* (water vendor) who sell water that is fetched from the commercial boreholes or from distant rivers and streams.

Plate ii: Flowing water with waste in it
Source: Field photographs, 2023.

Plate iii: Water supply from a water vendor

iii. Unhealthy living conditions and hazardous location

Unhealthy living conditions are the result of a lack of basic services, with visible, open sewers, lack of pathways, uncontrolled dumping of waste, polluted environments, etc. Houses may be built on hazardous locations or land unsuitable for settlement, such as floodplains, in proximity to industrial plants with toxic emissions or waste disposal sites, and on areas subject to landslip. The layout of the settlement may be hazardous because of a lack of access ways and high densities of dilapidated structures (Daniel *et al.*, 2015 and Bello *et al.*, 2018).

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iv. Insecure tenure; irregular or informal settlements

A number of definitions consider lack of security of tenure as a central characteristic of slums, and regard lack of any formal document entitling the occupant to occupy the land or structure as prima facie evidence of illegality and slum occupation. Informal or unplanned settlements are often regarded as synonymous with slums. Many definitions emphasize both informality of occupation and the non- compliance of settlements with land-use plans. The main factors contributing to non-compliance are settlements built on land reserved for non-residential purposes, or which are invasions of non-urban land (The challenge of slums: global report on human settlements, 2003).

v. Poverty and social exclusion

Income or capability poverty is considered, with some exceptions, as a central characteristic of slum areas. It is not seen as an inherent characteristic of slums, but as a cause (and, to a large extent, a consequence) of slum conditions. Slum conditions are physical and statutory manifestations that create barriers to human and social development. Furthermore, slums are areas of social exclusion that are often perceived to have high levels of crime and other measures of social dislocation. In some definitions, such areas are associated with certain vulnerable groups of population, such as recent immigrants, internally displaced persons or ethnic minorities (Daniel *et al.*, 2015 and Bello *et al.*, 2018).

vi. Minimum settlement size

Many slum definitions also require some minimum settlement size for an area to be considered a slum, so that the slum constitutes a distinct precinct and is not a single dwelling (The challenge of slums: global report on human settlements, 2003).

Sources of Plastic Wastes in the Environment

Plastics have permeated every facet of human life and researchers such as Yakubu, 2017; Ilyas *et al.*, 2018; Alabi *et al.*, 2019; Danladi, 2019; Ajoku *et al.*, 2020; and Kehinde *et al.*, 2020 categorised the sources of solid waste (plastics) as residential (water bottles, plastic cutlery, plates, jerry cans, salad dressing, biscuit trays, straws and salad domes); industrial (Plastic films, shampoo, detergents bottles, big shopping bags, drums);commercial (plastic chairs, milk bottles, ice cream containers, juice bottles, chemical and detergent bottles, rigid agricultural pipe, crates, potato chip bags);Institutional (e-waste (e.g. computers, phones); medical (Intravenous bags, disposable syringes, joint replacements, medical supplies, gloves); agricultural (agricultural waste (e.g. rice husks, cotton stalks, coconut shells, coffee waste), hazardous wastes); construction and demolition (C&D).

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Table 1: Quantity (in kg) of plastics sold by 15 shops in Jos per day

S/No	Name of shop	Location	Types of goods sold	Qty/Day in kg
1	Tem Provision Store	Bukuru	Provisions	2.3
2	Hillary Eze & Sons	Dadin Kowa	Provisions	2.6
3	Lizzy Provisions	Kugya, Bukuru	Provisions	2.3
4	Peter Provisions	Rwang Pam Street	Provisions	1.8
5	Mandela shop	Rantya, State lowcost	Clothing	1.7
6	Elegant world	Ahmadu Bello way	Clothing	1.1
7	Jossey Electronics	Old Bukuru Park	Electronics	12.4
8	De-Roy Ventures	Laranto, Jos	Furniture	0.9
9	Ochy Brothers int.	Dilmi Street	Spare parts	5.4
10	Okoye & Sons Ltd	Rwang Pam St.	Building materials	7
11	Sule Store	AngwanRimi	Provisions	1.1
12	Chi-God Ent.	Rayfield	Building materials	5.6
13	Hademy	Old Bukuru Park	Drawing equipment	2.8
14	Dele Oluyomi	Etobaba	Provisions	1.4
15	Zira Provisions	Rayfield	Provisions	4.8
	Total			**53.2 kg**

Source: Field Survey, 2023 as documented by Agada, (2017).

Table 1, above reveals the situation of sales of plastics in Jos metropolis, Plateau State has over 22,000 shops, each of which sells an average of about 3.5kg of plastic materials per day. This result when multiplied by the number of shops in the state totals about 77,000kg/day (77tonnes/day). This figure is most likely to double by

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2040. This compares with the findings of Agada, (2017) and Yakubu, (2017) whose research revealed amount of plastic waste being generated in the metropolis.

Strategies for Solving Plastic Waste in the Context of Architectural Composition of Urban Slum Settlements.

The results of the studies carried out by Alabi *et al.*, (2019), Ali *et al.*, (2016), Onwuka *et al.*, (2018), and Danladi, (2019) in some residential, commercial and institutional areas of Nigeria have put forward some strategies for solving environmental deterioration from plastic wastes:

i. Since the major sources of plastic waste generation in the study area are residential and commercial there is need to educate grassroots residents on the impacts of plastic wastes and the need for a healthy lifestyle should be employed for effective transitioning.

ii. There is need for improvement in proper plastic waste collection, treatment and disposal. Inadequate management of landfills will make way for harmful chemicals in plastic wastes to leach into the environment, polluting the soil, air and underground water.

iii. There should be sufficient awareness of citizens on dangers of plastic in the environment through the mass media.

iv. Government can introduce the 'wealth to waste scheme' where plastic wastes can be recycled and generates income as well as employment for the unemployed youths in the society.

CONCLUSION

This research was able to reveal the extent to which plastic wastes generation has indeed presented negative impacts such as environmental pollution and foul smells, large scale flooding, aesthetic defacement of the built environment, etc. on the residents of Angwan Rogo slum community in Jos Metropolis of Plateau State. The secondary data reviewed related generally to the current state of solid waste management in Jos metropolis particularly the study site. There is the need to urgently address these challenges in order to lay a solid foundation for the Sustainable Development Goals (SDGs) for the environment. This can be achieved through participatory approach by all built environment professionals, increase financing and private sector involvement and planned maintenance of infrastructures. Also, the Jos Metropolitan Development Board (JMDB) of the State, should embark on more awareness of citizens on environmental sanitation in line with the mandatory month-end sanitation exercise and enforcement of penalties to defaulters.

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