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Research Article

IMPACT OF PLASTIC WASTE ON ARCHITECTURAL COMPOSITION IN URBAN SLUM SETTLEMENTS OF JOS METROPOLIS

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Abstract
The uncontrolled use and disposal of plastic materials present significant environmental challenges in urban areas, particularly in slum settlements. This study examines the impact of plastic waste on the architectural composition of urban slums in Jos Metropolis, Plateau State, Nigeria, with the aim of improving the quality of the built environment. The research focused on Anguwan Rogo, a community within Jos Metropolis, and utilized physical observation, digital photography, case studies, and a review of related literature. The findings highlight the negative consequences of plastic waste, such as environmental pollution, foul odors, large-scale flooding, and the aesthetic degradation of the built environment. Additionally, the accumulation of plastic waste has led to increased health risks and disruptions to the functionality of urban infrastructure. The study emphasizes the need for increased awareness programs on the dangers of plastic waste, as well as the improvement of plastic waste collection, treatment, and disposal methods. It also advocates for the adoption of sustainable practices in managing plastic waste to safeguard the built environment and enhance the overall quality of urban life. This research provides valuable insights into the interplay between waste management and architectural composition in urban slums, offering recommendations for mitigating the adverse effects of plastic waste in these areas.
Keywords: longitudinal pier height difference; Bridges; Seismic response; influence

Introduction

Plastics are ubiquitous in modern society, playing an integral role in almost every aspect of daily life. From water bottles and food packaging to medical supplies, electronic goods, and construction materials, plastics have become indispensable due to their unique properties. They are lightweight, durable, versatile, resistant to moisture, chemicals, and decay, and can be molded into any desired shape, making them suitable for a wide range of applications (Pavani & Rajeswari, 2014; Zarma, 2018). The advent of plastics has revolutionized industries, providing solutions to numerous human needs. In the medical field, plastics are crucial in the production of disposable syringes, intravenous bags, joint replacements, and other medical supplies. In everyday life, they are used in telephones, clothing, and packaging, to name just a few examples (Onwuka & Ajator, 2018; Danladi, 2019).

However, despite their advantages, the pervasive use of plastics has led to significant environmental challenges. The mass production and disposal of plastic materials have resulted in serious pollution problems worldwide. While plastics are celebrated for their utility, they are also among the most problematic waste materials, particularly because they are not biodegradable and can persist in the environment for hundreds of

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years. The continued use and disposal of plastics, particularly in urban settings, are causing severe environmental damage, leading to clogged drains, flooded streets, contamination of waterways, and the degradation of wildlife habitats.

One of the most concerning aspects of plastic waste is its contribution to the growing waste crisis, particularly in urban areas. As cities expand and populations increase, the amount of plastic waste generated has reached unsustainable levels. According to the United Nations Environment Programme (UNEP), plastics are the third most common component of the solid waste stream, following food and paper waste (UNEP, 2009). The improper disposal of plastics, often through littering or inefficient waste management systems, has become a common sight in cities, leading to environmental degradation and public health risks.

In many parts of the world, particularly in rapidly urbanizing areas, plastic waste is not properly managed. This has resulted in plastic litter being found everywhere—from urban streets and slums to rivers and oceans. The disposal of plastic waste in landfills or by burning it introduces harmful substances into the atmosphere, contributing to air pollution. Moreover, plastics that enter the environment pose significant threats to marine life, wildlife, and human health. Animals, particularly marine species, often ingest plastic debris, mistaking it for food. This can lead to injury, malnutrition, or even death. Additionally, the harmful chemicals released during the decomposition or burning of plastics, such as dioxins and furans, have been linked to serious health conditions, including cancer, reproductive disorders, and immune system damage (Alabi et al., 2019). The long-term environmental and health effects of plastic waste are profound, necessitating urgent action to address the issue.

In Nigeria, the challenge of plastic waste management is particularly acute. As urban centers continue to grow and industrialization accelerates, waste management authorities face increasing pressure to address the rising tide of plastic waste. The Nigerian government has acknowledged the critical threat posed by plastic waste, with the Federal Minister of Environment in 2013 noting that the unchecked use and indiscriminate disposal of plastic materials were causing significant environmental harm. This has resulted in large-scale flooding in major Nigerian cities and villages, as plastic waste clogs drains and waterways (Ishaku, 2013). Despite the acknowledgment of these issues, effective measures to manage plastic waste have been slow to materialize. As Ajoku et al. (2020) have pointed out, both the government and individuals have yet to adopt sustainable approaches to plastic waste management.

One of the most significant consequences of plastic pollution in urban areas is the aesthetic degradation of the environment. The accumulation of plastic waste not only lowers the visual appeal of neighborhoods but also creates health hazards by providing breeding grounds for mosquitoes and other disease vectors. When plastics are burned, they release toxic chemicals into the air, exacerbating air pollution and contributing to respiratory illnesses among the population (Onwuka et al., 2018). Additionally, plastic waste in urban slum areas can negatively impact soil quality, affecting agricultural activities and reducing the productivity of farmlands (Alabi et al., 2019). These environmental problems are compounded by the fact that plastic waste often ends up in informal settlements, which lack the necessary infrastructure to manage waste effectively.

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The challenge of plastic waste is also closely linked to the pursuit of Sustainable Development Goal (SDG) 11, which aims to make cities and human settlements inclusive, safe, resilient, and sustainable. Achieving this goal requires addressing environmental challenges such as plastic waste and ensuring that urban areas are designed to be livable, clean, and healthy (United Nations [UN], 2019). In this context, it is essential to develop policies and strategies that promote sustainable waste management practices, reduce plastic consumption, and encourage recycling and reuse. The creation of cleaner, more sustainable urban environments can only be achieved through a concerted effort from all sectors of society, including government, industry, and individual citizens.

In the realm of architecture and urban planning, addressing the issue of plastic waste involves rethinking the design and construction of buildings and infrastructure. As Sati (2015) notes, the architectural composition of urban areas is a product of human labor that combines physical elements and energy to create spaces for living, working, and recreation. One approach to mitigating the impact of plastic waste in the built environment is through the concept of Eco architecture. This involves using waste materials, including plastics, as construction materials or as finishing elements in building projects. By incorporating plastic waste into construction, it is possible to reduce the amount of waste generated while simultaneously providing sustainable and cost-effective building solutions. Additionally, the use of plastic waste in construction could serve as a means of reducing the environmental footprint of the construction industry, which is a major contributor to waste generation and environmental degradation (Sani et al., 2016).

While numerous studies have addressed the environmental and public health impacts of plastic waste (Ali et al., 2016; Ilyas et al., 2018; Danladi, 2019), few have focused specifically on the relationship between plastic waste and the architectural composition of urban slums, particularly in cities like Jos, Nigeria. Urban slums are often characterized by inadequate waste management systems, poor infrastructure, and overcrowding, which exacerbate the problem of plastic waste. In Jos Metropolis, plastic waste is commonly found littering the streets, blocking drainage systems, and creating unsanitary conditions in slum settlements. These areas, which are already grappling with poverty, lack of basic services, and environmental degradation, are particularly vulnerable to the negative impacts of plastic pollution.

The current study seeks to fill this gap in the literature by examining the impact of plastic waste on the architectural composition of urban slum settlements in Jos Metropolis. This research aims to understand how plastic waste affects the built environment and to identify strategies for mitigating its impact. By exploring how plastic waste is managed (or mismanaged) in these slums, the study will contribute valuable insights into the challenges of waste management in informal urban settlements. The findings will be of great importance to urban planners, architects, environmental policymakers, and the general public, offering practical solutions to improve the quality of life in these communities while advancing sustainable waste management practices.

The objectives of this study 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. By addressing the issues of plastic waste in urban slums, this research will

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contribute to the broader goal of creating cleaner, safer, and more sustainable urban environments, ultimately improving the quality of life for residents in these communities. Through this study, it is hoped that new insights and approaches to plastic waste management can be developed, fostering a cleaner and more sustainable future for Jos Metropolis and other urban slum areas in Nigeria and beyond

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 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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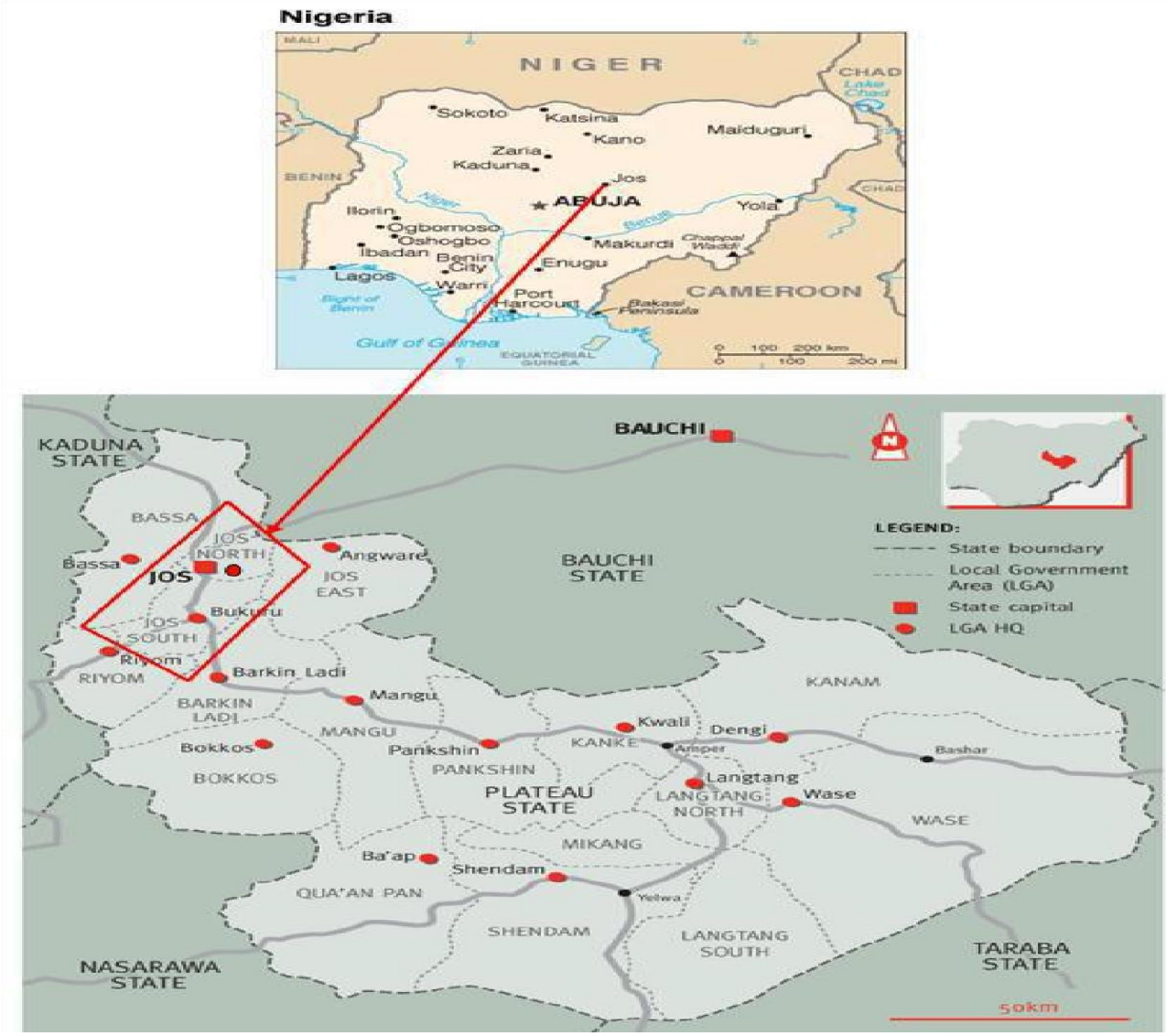

Figure 1: Location of Jos Metropolis in Plateau State and Local Government Areas Source: Department of Urban and Regional Planning, University of Jos, 2021.

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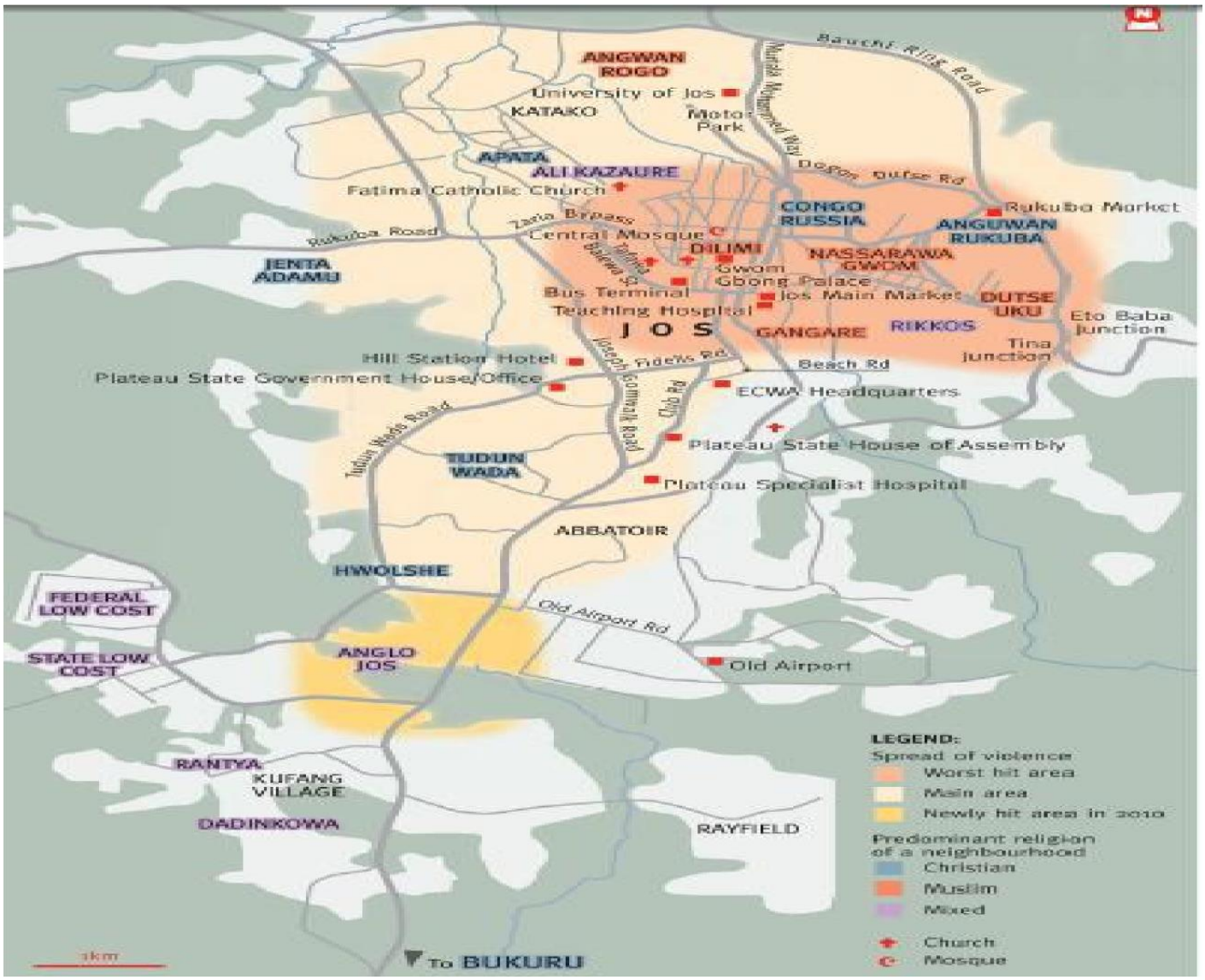

Figure 2: Location of Angwan Rogo within Jos Metropolis in Plateau State
Source: Department of Urban and Regional Planning, University of Jos, 2021

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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 has 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 **Plate iii:** Water supply from a water vendor Source: Field photographs, 2023.

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 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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