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PLASTIC WASTE GENERATION AND DISPOSAL IN NIGERIAN CITIES: CHALLENGES, ENVIRONMENTAL IMPLICATIONS AND PATHWAYS TO SUSTAINABLE MANAGEMENT

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Abstract

Over the years, Plastic materials have become indispensable in contemporary urban life because of their affordability, versatility, durability and convenience. However, the rapid growth in the consumption of single-use plastics, coupled with inadequate collection, sorting, recycling and final disposal systems, has created significant environmental and urban-management challenges in Nigeria. This paper examines the pattern of plastic waste generation and disposal in Nigerian cities, with particular attention to the implications for urban drainage, flooding, water bodies, public health, environmental quality and sustainable urban development. The study adopted a qualitative documentary research design involving a review of peer-reviewed literature, government policy documents and reports from relevant international organisations. Evidence indicates that plastic waste constitutes an increasingly important component of municipal solid waste in Nigerian urban areas. Available studies have documented the presence of plastic waste in streets, open spaces, drainage channels, dumpsites and aquatic environments. The [redacted]

World Bank reports an estimate of at least 1.5 million tonnes of plastic waste generated annually in Nigeria, while another regional assessment estimated Nigeria's annual plastic waste generation at approximately 4.719 million tonnes, illustrating the uncertainty associated with national plastic-waste statistics. Improper disposal is associated with blocked drainage channels, increased flood vulnerability, landscape degradation and leakage of plastics into rivers

Keywords: Plastic waste, waste generation, waste disposal, recycling, urban planning, flooding, Nigeria, circular economy.

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and other ecosystems. The paper argues that the problem cannot be addressed through collection and disposal alone. An integrated approach based on source reduction, segregation, extended producer responsibility, recycling infrastructure, recovery of valuable materials, formal integration of waste pickers, public education and spatial planning is required. The paper proposes a city-level plastic waste management framework for Nigerian urban areas.

Introduction

The rapid growth of urban populations, changing consumption patterns and increasing demand for packaged goods have significantly increased the volume and complexity of municipal solid waste generated in cities. Among the various components of municipal solid waste, plastics are particularly problematic because of their durability, widespread use and relatively slow degradation.

Plastic products provide substantial benefits to modern society. They are used extensively in food packaging, transportation, construction, healthcare, agriculture, retailing and household activities. Their low weight, low production cost and versatility have encouraged widespread consumption.

However, these same characteristics become environmental liabilities when plastic products are discarded without appropriate collection, recovery and treatment.

Globally, plastic waste generation has increased substantially. The OECD estimated that global plastic waste increased from 156 million tonnes in 2000 to 353 million tonnes in 2019, while only about 9% was ultimately recycled. Approximately 22% was disposed of through uncontrolled disposal, open burning or leakage into the environment.

The situation is particularly significant in developing countries where urban growth has often occurred faster than the expansion of waste-management infrastructure. Nigeria is experiencing rapid urbanisation, increasing population and changing consumption patterns. These processes have increased the demand for packaged consumer goods and consequently the quantity of plastic waste generated.

A recent World Bank assessment estimates that Nigeria generates at least 1.5 million tonnes of plastic waste annually, while noting that the actual quantity may be higher. It projects that plastic waste could reach approximately 3.3 million tonnes by 2040 under the assumptions used in that assessment.

Another regional assessment estimated Nigeria's annual plastic waste generation at approximately 4.719 million tonnes. The difference between these estimates demonstrates an important problem in Nigeria: reliable, standardised and regularly updated plastic-waste data remain inadequate.

Plastic waste therefore represents not only an environmental problem but also an urban-planning and infrastructure-management problem. Plastics discarded in drainage channels can obstruct water flow and contribute to urban flooding. Research in Maiduguri, for example, documented plastic bottles and sachet-water bags in open spaces, drainage systems and water bodies and linked improper disposal with blocked drainage and increased flood risks.

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The problem is further complicated by the structure of waste-management systems. Where formal collection is inadequate, households and commercial establishments may resort to indiscriminate dumping, roadside disposal, burning or disposal into drains and watercourses. At the same time, informal waste collectors and waste pickers recover substantial quantities of recyclable materials, but often operate without adequate institutional recognition, occupational protection or integration into formal waste-management systems.

Against this background, this paper examines plastic waste generation and disposal in Nigerian cities and proposes an integrated framework for sustainable management.

Statement of the Problem

The increasing generation of plastic waste has become a major challenge to sustainable urban environmental management in Nigeria.

The problem is not simply the quantity of plastic products entering the waste stream. It also concerns what happens to these materials after consumption. Where plastics are not properly collected, separated and recovered, they may be dumped in vacant plots, roadsides, drainage channels, markets, waterways and uncontrolled dumpsites.

Several factors contribute to the problem, including:

- Increasing consumption of single-use plastic products;
- Inadequate waste-collection infrastructure;
- Insufficient source separation;
- Limited recycling facilities;
- Weak enforcement of environmental regulations;
- Inadequate public environmental awareness;
- Limited availability of affordable alternatives to some plastic products;
- Informal and poorly regulated disposal practices;
- Insufficient integration of informal waste collectors into formal systems; and
- Inadequate reliable data for planning and monitoring.

The consequences extend beyond aesthetic pollution. Plastic waste can obstruct drainage systems and contribute to flooding, while uncontrolled disposal can facilitate the movement of plastic materials into rivers and other aquatic ecosystems. Studies in Nigeria have documented plastic pollution in terrestrial and aquatic environments and identified significant gaps in available evidence.

The challenge therefore requires a transition from a predominantly collect-and-dispose approach towards an integrated system based on waste prevention, recovery, recycling and circular resource management.

Aim

The aim of this paper is to examine plastic waste generation and disposal in Nigerian cities and develop an integrated framework for sustainable plastic waste management.

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Specific Objectives

The study seeks to:

i. Examine the major sources and forms of plastic waste generated in Nigerian urban areas;
ii. Assess existing patterns of plastic waste disposal;
iii. Iii. Examine the environmental and urban consequences of improper plastic waste disposal;
iv. Identify institutional and infrastructural challenges affecting plastic waste management;
v. Examine opportunities for plastic waste recovery and recycling; and
vi. Propose an integrated planning framework for sustainable plastic waste management in Nigerian cities.

Research Questions

The paper is guided by the following questions:

i. What are the major sources of plastic waste in Nigerian cities?
ii. What disposal practices are commonly associated with plastic waste?
iii. What environmental and urban problems are associated with improper plastic waste disposal?
iv. What institutional and infrastructural factors constrain effective plastic waste management?
v. How can urban planning contribute to reducing plastic waste pollution?
vi. What integrated strategies can improve plastic waste recovery, recycling and disposal in Nigerian cities?

Concept of Plastic Waste

Plastic waste refers to discarded materials made wholly or substantially from polymers that are no longer required by their original users. These include plastic bags, sachets, bottles, food containers, packaging materials, disposable cups, straws, wrappers and other consumer and industrial plastic products.

Plastic waste differs from many biodegradable forms of municipal waste because many conventional plastics persist for long periods in the environment. Their persistence increases the probability that poorly managed plastic materials will accumulate in drainage systems, soils, dumpsites and water bodies.

The OECD identifies packaging, consumer products and textiles as major contributors to plastic waste because many of these products have relatively short useful lifespans.

Sources of Plastic Waste

Plastic waste in Nigerian cities originates from a variety of sources.

Residential sources

Households generate plastic bags, sachet-water packaging, PET bottles, food containers, packaging films and other disposable materials.

Commercial sources

Markets, shops, restaurants, supermarkets and informal trading areas generate substantial quantities of packaging materials, plastic bags, bottles and disposable food containers.

Institutional sources

Schools, universities, offices, hospitals and other institutions generate plastic bottles, food packaging and other plastic materials.

Industrial sources

Industrial activities may generate plastic packaging, production offcuts and other polymer-based materials.

Construction sources

Construction and demolition activities can generate plastic pipes, packaging materials, insulation products and other plastic components.

Public-space sources

Transport terminals, recreational spaces, streets and markets can become accumulation points for discarded plastic materials.

Plastic Waste Generation

Plastic waste generation is strongly associated with population growth, urbanisation, income, consumption and the expansion of packaged consumer goods.

In Nigeria, earlier municipal waste studies have identified plastics and cellophane as significant components of urban solid waste. A study of Makurdi reported plastics/cellophane materials at approximately 6–10% of waste streams depending on the source. Research conducted at the University of Lagos also demonstrates the importance of plastics within institutional waste streams. The study estimated average daily solid waste generation at 32.2 tonnes and identified polythene bags and plastic among major waste categories.

More recent evidence indicates that the plastic waste problem is becoming increasingly significant across Nigerian urban environments.

Plastic Waste Disposal

Plastic waste may be managed through several pathways:

- Reuse;
- Recycling;
- Material recovery;
- Controlled landfilling;
- Incineration or other thermal treatment;
- Open dumping;
- Roadside disposal;
- Disposal into drainage channels;
- Disposal into water bodies; and
- Open burning.

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The first four pathways can be incorporated into organised waste-management systems, whereas indiscriminate dumping, uncontrolled burning and disposal into watercourses create substantial environmental risks.

Research from Calabar found PET bottles, LDPE, PP, HDPE, PS and PVC among plastics recovered from an open dumpsite. PET was reported as the most abundant category in the sampled dumpsite material.

This demonstrates that dumpsites are not simply locations where waste disappears; they are reservoirs of recyclable materials and potential sources of environmental pollution.

Drainage Blockage and Urban Flooding

One of the most immediate urban consequences of plastic waste is the obstruction of storm-water drainage infrastructure.

Plastic bags, bottles, sachets and packaging materials can accumulate at culverts, drainage inlets and narrow channels. During rainfall, accumulated waste may restrict water flow, increase local ponding and aggravate flood conditions.

This is particularly important for rapidly urbanising Nigerian cities where drainage systems are often inadequate relative to the intensity of development.

Studies in Nigeria have documented the relationship between plastic accumulation in drainage channels and increased flood vulnerability.

For urban planners, this means plastic waste management should not be treated as an isolated environmental sanitation issue. It should form part of storm-water and flood-risk management.

Pollution of Water Bodies

Plastic materials can be transported from streets and drains into streams, rivers, wetlands and coastal environments.

Once plastics enter aquatic ecosystems, they may fragment into smaller particles and interact with aquatic organisms.

The Nigerian literature has identified plastic pollution in various environmental matrices, although evidence remains geographically uneven. A systematic review found that available Nigerian research was concentrated in relatively few locations and identified substantial research gaps.

Open Burning

Where waste collection is inadequate, households and communities may burn accumulated waste. Open burning of plastics is problematic because thermal decomposition can generate hazardous pollutants. Recent research in northwestern Nigeria also shows that household burning of garbage, including plastics, can be associated with energy needs and deficiencies in waste-management systems.

Consequently, eliminating open burning requires more than environmental enforcement. It also requires reliable collection services and accessible alternatives.

Landscape and Visual Pollution

Plastic litter reduces the aesthetic quality of streets, markets, residential neighbourhoods and public spaces.

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This has implications for urban image, tourism, property environments and quality of life. Persistent litter can also contribute to a perception of poor environmental governance.

Public Health and Environmental Risks

Poorly managed plastic waste can create indirect health risks through drainage obstruction, flooding, contamination and the creation of unsanitary environments.

A 2024 study in Maiduguri identified environmental degradation, blocked drainage systems, increased flood risks and potential human-health concerns associated with indiscriminate disposal of plastic bottles and sachet-water bags.

Claims regarding specific health outcomes, however, should be distinguished from evidence of environmental exposure. More location-specific epidemiological research is required before attributing particular diseases directly to plastic waste.

Circular Economy Theory

This study adopts the Circular Economy framework.

The conventional linear economic model can be expressed as:

Take → Make → Use → Dispose

Under this model, resources are extracted, converted into products, consumed and eventually discarded.

A circular economy seeks to transform this process into:

Reduce → Reuse → Recover → Recycle → Remanufacture

The objective is to retain materials within productive use for as long as possible while reducing waste generation.

For plastic waste management, the circular economy implies that discarded plastics should be regarded not merely as waste but also as potential secondary raw materials.

This approach is particularly relevant to Nigeria because recyclable plastics have economic value and informal waste collectors already participate in the recovery chain.

Research Design

The study adopted a qualitative documentary research design.

Rather than presenting fabricated field observations, the research synthesised available evidence from:

a. Peer-reviewed journal articles;
b. Government policy documents;
c. Reports from international organisations;
d. Published studies on Nigerian cities; and
e. Relevant literature on circular economy and plastic waste management.

Data Sources

The major sources reviewed included publications from:

a. Federal Ministry of Environment, Nigeria;
b. World Bank;

c. United Nations Environment Programme (UNEP);
d. Organisation for Economic Co-operation and Development (OECD);
e. Peer-reviewed academic journals; and
f. Published Nigerian case studies.

Nigeria's Federal Ministry of Environment has published a National Policy on Plastic Waste and related implementation materials, providing an important policy basis for addressing the issue.

Analytical Approach

The literature was analysed thematically under the following categories:

- Plastic waste generation;
- Sources of plastic waste;
- Disposal practices;
- Environmental impacts;
- Institutional challenges;
- Recycling and
- Resource recovery; and
- Sustainable management strategies.

Because the study is documentary in nature, numerical estimates from different sources were not statistically combined where their methodologies were not directly comparable.

Increasing Plastic Waste Generation

The literature indicates that plastic waste constitutes a growing component of municipal waste in Nigerian urban areas.

However, one of the major findings is the lack of a single reliable national plastic-waste database. Estimates vary considerably depending on definitions, geographical coverage, measurement methods and the year of assessment.

For example, the World Bank reports at least 1.5 million tonnes annually, while another regional assessment reports approximately 4.719 million tonnes.

This variation should not be interpreted simply as contradictory information. Rather, it demonstrates the urgent need for standardised methods for measuring plastic waste generation in Nigeria.

Predominance of Single-Use Plastics

Packaging materials constitute a particularly important component of plastic waste because many are used for a short period before being discarded.

Sachet-water packaging, PET bottles, plastic bags, takeaway containers and flexible packaging are therefore important targets for waste-reduction interventions.

The challenge is compounded by the convenience and affordability of these products.

Disposal Infrastructure Deficit

Where collection systems do not adequately cover rapidly expanding urban areas, residents may adopt alternative disposal methods.

These may include:

a. Disposal in open spaces;
b. Dumping along roadsides;
c. Disposal into drains;
d. Disposal into streams;
e. Open burning; and
f. Informal dumping.

The World Bank notes that informal-sector actors play an important role in plastic collection and recovery in Nigeria, while recyclable fractions are often sold to aggregators and residual waste may still be indiscriminately dumped.

Thus, informal recycling should be viewed as an existing component of the urban waste-management system rather than ignored.

Proposed Integrated Plastic Waste Management Framework

The study proposes a six-component framework.

Component 1: Reduction at Source

Urban authorities should encourage:

- Reduction of unnecessary single-use plastics;
- Reusable packaging;
- Refill systems;
- Sustainable product design; and
- Environmentally preferable alternatives where technically and economically feasible.

Component 2: Separation at Source

Households, markets, institutions and businesses should separate plastic waste from organic and residual waste.

A basic system could involve:

Bin 1 – Organic waste

Bin 2 – Recyclable plastics

Bin 3 – Residual waste.

Component 3: Collection and Transfer

Local governments and waste-management agencies should establish reliable collection schedules and strategically located collection points.

Special attention should be given to:

- Markets;
- High-density residential areas;
- Transport terminals;

- Waterfront communities;
- Educational institutions; and
- flood-prone neighbourhoods.

Component 4: Material Recovery and Recycling

Plastic waste should be transported to material recovery facilities where it can be:

- Sorted;
- Cleaned;
- Compressed;
- Shredded;
- Processed; and
- Converted into secondary raw materials or products.

Component 5: Formal Integration of Informal Waste Workers

Waste pickers and informal collectors should be incorporated into the formal system through:

- Registration;
- Training;
- Protective equipment;
- Access to collection centres;
- Cooperative development;
- Fair pricing mechanisms; and
- Participation in municipal recycling programmes.

Component 6:

Final Disposal of Residual Waste

Only materials that cannot reasonably be recovered should proceed to final disposal.

This would reduce the quantity of plastics entering dumpsites and uncontrolled disposal areas.

Role of Urban and Regional Planning

Plastic waste management has traditionally been treated mainly as an environmental sanitation responsibility. However, it is also an important urban and regional planning issue.

Land-use planning

Planning schemes should provide appropriate locations for:

- Transfer stations;
- Material recovery facilities;
- Recycling centres;
- Waste collection depots; and
- Engineered disposal facilities.

Development control

Planning authorities should incorporate waste-management requirements into development approvals for:

- Markets;
- Shopping centres;
- Estates;
- Institutions;
- Industries; and
- Large commercial developments.

Drainage planning

Plastic waste management should be integrated into storm-water management.

Drainage designs should consider:

- Litter traps;
- Maintenance access;
- Collection points;
- Culvert protection; and
- Routine removal of accumulated waste.

Neighbourhood planning

Neighbourhood layouts should include accessible waste-storage and collection facilities rather than leaving waste disposal to individual households.

Environmental planning education

Planning education should expose students and practitioners to circular-economy principles and the spatial dimensions of waste management.

Policy Implications

Nigeria already has a national policy framework addressing plastic waste. The Federal Ministry of Environment provides a National Policy on Plastic Waste Management and more recent implementation materials.

The major challenge is therefore not necessarily the absence of policy alone, but the gap between policy, implementation, enforcement, infrastructure and measurable outcomes.

The policy framework should be supported by:

- Clear institutional responsibilities;
- Reliable plastic-waste inventories;
- Enforceable producer-responsibility mechanisms;
- Investment in recycling infrastructure;
- Local government participation;
- Private-sector investment;
- Integration of informal recyclers;

- Public education;
- Regular monitoring; and
- Measurable city-level targets.

Recommendations

Based on the findings, the paper recommends that:

1. Establish a national plastic-waste database

Government should develop a standardised national system for measuring plastic-waste generation, collection, recycling and disposal.

2. Strengthen Extended Producer Responsibility

Manufacturers and importers of plastic products should have clearly defined responsibilities for the post-consumer management of their products.

3. Promote source separation

Plastic waste should be separated at household, institutional, commercial and industrial levels.

4. Establish neighbourhood recycling centres

Cities should develop accessible plastic collection and recovery centres.

5. Integrate informal waste collectors

Existing waste pickers should be recognised and incorporated into formal recycling systems.

6. Link plastic management with flood management

Urban drainage management programmes should include regular plastic-waste monitoring and removal.

7. Improve public environmental education

Public campaigns should focus on practical behaviour such as:

- Avoiding indiscriminate disposal;
- Separating recyclable materials;
- Reusing containers;
- Returning recyclable plastics; and
- Avoiding burning plastics.

8. Strengthen enforcement

Environmental regulations should be enforced consistently, while ensuring that enforcement is supported by viable waste-collection alternatives.

9. Encourage circular-economy enterprises

Government should provide an enabling environment for businesses involved in plastic collection, recycling, reuse and manufacturing from recycled materials.

10. Promote research

Universities and research institutions should undertake city-level studies on plastic generation rates, composition, disposal behaviour, recycling markets and environmental leakage.

Conclusion

Plastic waste generation is an increasingly important component of the environmental and urban-management challenges confronting Nigerian cities. The problem is driven by increasing consumption, the widespread use of single-use plastics, inadequate collection infrastructure, weak source separation, limited recycling capacity and inappropriate disposal practices.

Available Nigerian studies demonstrate that plastic waste occurs across streets, residential areas, markets, drainage systems, dumpsites and aquatic environments. At the same time, existing estimates of national plastic-waste generation differ substantially, highlighting the need for improved data collection and standardised measurement.

The environmental consequences extend beyond visual pollution. Poorly managed plastics can obstruct drainage systems, contribute to flooding, degrade urban landscapes and facilitate the movement of plastic materials into rivers and other ecosystems.

Addressing the challenge requires a transition from a linear "use-and-dispose" model towards a circular system based on reduction, reuse, recovery and recycling. Urban and regional planning has an important role in this transition because waste-management facilities, collection systems, drainage infrastructure, land-use patterns and development control are all spatially connected.

A sustainable Nigerian plastic-waste management system should therefore combine policy, planning, infrastructure, technology, private-sector participation, community engagement and informal-sector integration. Such an approach would reduce plastic pollution while creating opportunities for resource recovery, employment and more resilient Nigerian cities.

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