Impact of Solid Waste Disposal in Calabar Metropolis of Cross River State

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Abstract

Solid waste disposal remains a critical environmental challenge in many urban centres of Nigeria, including Calabar Metropolis in Cross River State. This study investigates the environmental, health, and socio-economic impacts of improper solid waste disposal in the metropolis. Using a mixed-methods approach involving field surveys, interviews, and analysis of secondary data, the research reveals that indiscriminate dumping, inadequate waste collection infrastructure, and weak enforcement of environmental regulations contribute significantly to environmental degradation, blocked drainage systems, and increased incidence of vector-borne diseases. The findings also highlight the adverse effects on local livelihoods, property values, and overall urban aesthetics. The study recommends the implementation of an integrated solid waste management system, increased public awareness, and stronger institutional frameworks to promote sustainable waste practices. Addressing these challenges is vital for improving public health, environmental quality, and the liveability of Calabar Metropolis.

Key words: Solid waste disposal, Environmental impact, Public health, Calabar metropolis, Waste management, socioeconomic effects and Environmental regulation.

1.0 Introduction

Solid waste disposal has emerged as one of the most pressing urban environmental challenges confronting developing countries today. In Nigeria, the problem is particularly acute in rapidly urbanizing cities such as Calabar, the capital of Cross River State. The increase in population, urban migration, and economic activities has led to a significant rise in the volume and complexity of waste generated daily (World Bank, 2020). Solid waste includes domestic refuse, commercial and industrial waste, construction debris, and hazardous materials, all of which require appropriate management systems to prevent environmental and health hazards (UNEP, 2019).

The Calabar Metropolis, which comprises Calabar Municipal and Calabar South Local Government Areas, has experienced considerable urban expansion over the past two decades. This growth has not been matched by a proportional development of urban infrastructure, particularly in the area of waste management (Okon & Effiong, 2020). The inadequacy of waste collection services, poor disposal practices, and weak enforcement of environmental regulations have led to indiscriminate dumping of waste on streets, in drains, open spaces, and waterways. These practices result in blocked drainage systems, flooding during the rainy season, and the proliferation of disease vectors such as flies and mosquitoes (Afon, 2019).

Environmental degradation caused by improper solid waste disposal poses serious threats to urban sustainability. When waste is not adequately managed, it contaminates soil and groundwater, clogs urban drainage networks, and contributes to visual blight and odour pollution. Furthermore, the open burning of waste in residential areas contributes to air pollution and climate change due to the emission of greenhouse gases and particulate matter (Agunwamba, 2018; UNEP, 2019). These environmental consequences reduce the quality of life for urban dwellers and compromise the livability of cities like Calabar. The health implications of poor waste disposal are equally alarming. Residents exposed to unhygienic environments face increased risks of waterborne and vector-borne diseases such as cholera, dysentery, malaria, and typhoid (Ogwueleka, 2020). Children and informal waste pickers are particularly vulnerable due to their frequent contact with contaminated materials. Studies have shown a strong correlation between waste mismanagement and outbreaks of diseases in low-income urban settlements (Eze & Umeh, 2019). Despite this, public awareness of proper waste handling remains low, and community participation in sanitation initiatives is limited.

Economically, improper solid waste disposal adversely affects property values, business operations, and tourism — a key sector in Cross River State. Calabar, often referred to as Nigeria's tourism capital due to events like the Calabar Carnival, risks losing its appeal if waste-related issues are not urgently addressed (Adedibu, 2020). Overflowing dumpsites, littered streets, and polluted waterways send negative signals to investors and visitors, reducing economic opportunities and the city's aesthetic and functional appeal. While various waste management initiatives have been introduced in Calabar over the years, including the establishment of the Calabar Urban Development Authority (CUDA) and partnerships with private waste contractors, these efforts have largely been unsustainable. Challenges such as lack of funding, political interference, poor monitoring, and inadequate logistics continue to hinder effective service delivery (Federal Ministry of Environment, 2021). Moreover, the absence of a well-coordinated, integrated waste management framework has limited the success of existing programs.

This study, therefore, seeks to examine the impact of solid waste disposal in Calabar Metropolis, focusing on environmental, health, and socio-economic dimensions. It aims to identify the major sources of waste, the effectiveness of current disposal practices, and the challenges facing relevant stakeholders. Through empirical data, the research hopes to propose sustainable strategies that align with global best practices and are adaptable to the local context of Calabar. Addressing solid waste issues is vital not only for environmental protection but also for safeguarding public health and promoting inclusive urban development.

1.2 Statement of the Problem

Solid waste disposal remains a persistent environmental and public health problem in Calabar Metropolis, despite efforts by governmental and private agencies to manage it. The rapid urbanization, coupled with population growth, has led to a significant increase in the volume of waste generated daily. However, waste management infrastructure and services have not kept pace with this growth. As a result, waste is frequently disposed of in unauthorized areas such as road medians, drainage channels, and vacant plots, leading to environmental degradation and posing serious health risks to residents (Ogwueleka, 2009; Udofia et al., 2020). In many parts of Calabar South and Calabar Municipality, residents often experience blocked drainages, flooding during rainfall, foul odour, and the presence of disease-carrying pests such as rodents and flies. These conditions contribute to the spread of communicable diseases, including malaria, cholera, and typhoid fever (Imoh & Okoro, 2019). Furthermore, the aesthetic appeal of Calabar—a city known for tourism and cultural heritage—is being diminished by the unsightly presence of waste on streets and public spaces. Although the Cross River State Government has partnered with private contractors and environmental agencies to improve

waste collection and disposal, challenges persist. These include inadequate funding, lack of public awareness and participation, poor enforcement of environmental regulations, and absence of proper waste segregation at source (Ajani & Iyanda, 2015).

Given the importance of environmental health and sustainable urban development, there is a pressing need to critically examine the existing solid waste disposal practices in Calabar, assess their impacts on the environment and human health, and propose practical and sustainable solutions. This study aims to fill that gap by providing evidence-based insights into the current situation and offering recommendations for improvement.

1.3 Objectives of the Study

The main objectives of this study are to:

1. Examine the current practices and challenges of solid waste disposal in Calabar Metropolis.

2. Assess the environmental and public health impacts associated with improper solid waste management in the study area.

3. Investigate the roles of government agencies, private sectors, and community members in waste management within the metropolis.

4. Propose sustainable and integrated strategies for effective solid waste management in Calabar Metropolis.

1.4 Research Questions

1. What are the current practices and major challenges of solid waste disposal in Calabar Metropolis?

2. How does improper solid waste management affect the environment and public health in the study area?

3. What roles do government agencies, private sectors, and community members play in managing solid waste in Calabar?

4. What sustainable strategies can be implemented to improve solid waste management in Calabar Metropolis?

2.1 Solid Waste Management in Developing Countries

Solid waste management (SWM) remains a persistent and growing challenge in many developing countries due to rapid urbanization, population growth, and industrial expansion. Unlike developed nations that have established systems and infrastructure for handling waste, many cities in Africa, Asia, and Latin America struggle with inefficient waste collection, limited disposal facilities, and unregulated dumpsites (World Bank, 2020). The increase in urban population places a high demand on municipal authorities, who often lack the financial and technical capacity to manage solid waste effectively (UNEP, 2019). Consequently, large quantities of waste remain uncollected, leading to environmental degradation and public health risks.

In most developing countries, solid waste is often dumped in open spaces, water bodies, and along roadsides without prior treatment. This unsustainable practice leads to serious environmental problems, including air and water pollution, blockage of drainage systems, and land degradation (Abila & Kantola, 2020). Furthermore, open burning of waste contributes significantly to air pollution and greenhouse gas emissions. Inadequate waste disposal has also been linked to the spread of infectious diseases such as cholera, typhoid, and malaria in densely populated urban slums (Hoornweg & Bhada-Tata, 2018). The informal sector, including waste pickers, often operates under unsafe and unhygienic conditions, further exacerbating the health risks.

A key constraint in waste management in developing countries is the lack of institutional coordination and policy enforcement. Municipalities often operate without updated waste

management plans or reliable data on waste generation and composition. In many cases, waste collection services are limited to wealthier neighbourhoods, leaving low-income communities underserved (Kaza et al., 2018). Moreover, public awareness and participation in waste segregation and recycling are generally low. This is compounded by insufficient funding, lack of equipment, and poor maintenance of available infrastructure, which result in ineffective service delivery and low waste recovery rates.

Despite these challenges, some developing countries have made progress through publicprivate partnerships, community-based waste initiatives, and the promotion of circular economy principles. In Rwanda, for instance, a nationwide ban on plastic bags and strong environmental enforcement have improved urban cleanliness. In Ghana and Kenya, decentralized composting and waste-to-energy technologies are being piloted to improve resource recovery (UN-Habitat, 2021). Such interventions show that with political will, adequate funding, and public participation, waste management systems in developing countries can be reformed for sustainability.

The role of international agencies and donor organizations has also been crucial in supporting solid waste management reforms in the Global South. Programs by the World Bank, UNEP, and UN-Habitat have provided technical assistance, funding, and policy frameworks to improve municipal solid waste systems (World Bank, 2020; UNEP, 2019). However, sustainable progress depends on local government commitment, institutional reform, and grassroots involvement. Developing countries must prioritize integrated solid waste management strategies that include waste reduction, reuse, recycling, and safe disposal. This holistic approach is necessary for achieving environmental sustainability and public health goals in line with the United Nations Sustainable Development Goals (SDGs).

2.2 Environmental Health Impacts of Proper Waste Disposal

Proper waste disposal plays a critical role in maintaining environmental integrity and safeguarding public health, especially in urban areas. When solid waste is adequately collected, treated, and disposed of, it prevents the proliferation of disease vectors, reduces pollution, and ensures a cleaner and healthier environment for human habitation (World Health Organization [WHO], 2021). Proper waste management reduces human exposure to harmful substances, such as leachates, pathogens, and toxic fumes, which are often associated with open dumping and burning of waste materials. Cities that have effective waste systems experience lower incidences of diseases like cholera, malaria, typhoid, and respiratory infections. One of the most significant environmental benefits of proper waste disposal is the protection of water resources. Unregulated dumping of waste into rivers, streams, and open drains often leads to contamination of surface and groundwater, affecting both aquatic life and human populations relying on these sources for drinking and domestic use (Ogbonna et al., 2019). Conversely, when waste is managed through secure landfills, composting, and recycling programs, the risk of water pollution is minimized. This in turn contributes to better public health outcomes by reducing waterborne diseases and chemical contamination of food chains.

Proper waste disposal also improves air quality by minimizing the emission of pollutants from burning garbage and decomposing organic waste. In poorly managed settings, open burning is a common method for waste reduction, which releases carbon monoxide, sulfur dioxide, and other hazardous air pollutants that contribute to respiratory illnesses and climate change (Adelekan & Jerome, 2020). Waste-to-energy initiatives and the controlled incineration of hazardous materials in developing countries are emerging solutions that, when implemented correctly, can reduce air pollution and convert waste into useful energy. From a public health perspective, organized waste management significantly lowers exposure to vectors such as rats, flies, and mosquitoes that thrive in uncollected garbage piles and contribute to the transmission of diseases. Children and informal waste pickers are particularly vulnerable to these health risks due to frequent contact with untreated waste (Okechukwu & Olufunke, 2020). By implementing structured waste collection and sanitation services, communities experience fewer outbreaks of diseases and benefit from a cleaner, more dignified living environment. Moreover, environmental education and community involvement in waste disposal practices enhance awareness of the link between sanitation and health. Proper waste management programs that include public education campaigns, recycling incentives, and neighbourhood clean-up activities have shown positive results in cities like Kigali, Rwanda and Curitiba, Brazil (UN-Habitat, 2022). These interventions not only improve health outcomes but also foster a culture of environmental responsibility and civic participation.

2.3 Stakeholders' Role in Waste Management

Effective waste management in urban areas requires the active involvement of multiple stakeholders, including government agencies, private sector actors, non-governmental organizations (NGOs), and the general public. Each stakeholder plays a crucial role in ensuring that waste is collected, treated, and disposed of in an environmentally sound manner. According to the United Nations Human Settlements Programme (UN-Habitat, 2022), multi-stakeholder collaboration is one of the foundational pillars for achieving sustainable urban waste management. Government institutions, especially local municipal councils, are typically responsible for creating regulatory frameworks, funding infrastructure, and enforcing environmental standards.

Local governments are the primary drivers of waste management at the municipal level. Their duties include waste collection, transportation, disposal, and monitoring of landfill operations. However, in many developing countries, municipal agencies often suffer from underfunding, poor logistics, and inadequate manpower (Abila & Kantola, 2020). As a result, service delivery is inconsistent, and many urban communities are underserved. To address these deficiencies, some cities have begun to decentralize waste management responsibilities and partner with private companies or community-based organizations, a model that has shown success in cities like Lagos, Accra, and Addis Ababa.

The private sector plays a vital role in complementing public services, particularly through waste collection, recycling, and waste-to-energy initiatives. Private waste contractors often have more flexible structures and better equipment than public entities, allowing for greater efficiency in service delivery (Kaza et al., 2018). Additionally, informal waste collectors and recyclers contribute significantly to waste recovery by collecting and sorting recyclable materials. However, this sector is largely unregulated and lacks occupational safety standards, which exposes workers to numerous health risks. Formalizing the informal sector, through training and registration, can improve their working conditions and enhance the overall effectiveness of waste management.

Civil society organizations and NGOs also serve as critical stakeholders by raising awareness about the environmental and health impacts of poor waste management. They engage in advocacy, capacity building, and community mobilization, often filling gaps left by the public and private sectors. For instance, organizations like WECF International and Let's Do It World have led community clean-up campaigns and environmental education programs in several African cities (WECF, 2021). By fostering grassroots participation and environmental literacy, these organizations promote behavioural change and enhance public cooperation in waste segregation and recycling efforts.

Lastly, citizens themselves are fundamental actors in the waste management value chain. Household-level waste generation accounts for a significant portion of municipal solid waste, and individuals' practices—such as littering, improper sorting, or refusal to pay waste levies can hinder system effectiveness (UNEP, 2021). Public participation through source segregation, compliance with disposal schedules, and willingness to engage in recycling initiatives is essential. Sustainable waste management requires a change in public attitude and a collective sense of responsibility, driven by inclusive policy-making and effective communication among all stakeholders.

2.4 Sustainable Strategies for Waste Management

Sustainable waste management strategies are essential for minimizing environmental degradation, promoting resource efficiency, and enhancing public health. One of the most recommended approaches is the Integrated Solid Waste Management (ISWM) system, which emphasizes a hierarchy of waste reduction, reuse, recycling, energy recovery, and environmentally safe disposal (Kaza et al., 2018). This model allows municipalities to manage waste more effectively by reducing dependency on landfills and encouraging resource recovery. ISWM has been successfully implemented in several cities across the Global South, leading to improved waste collection rates and reduced pollution.

Waste segregation at source is another critical strategy that enhances the efficiency of downstream recycling and treatment processes. When households and institutions separate waste into biodegradable, recyclable, and hazardous categories, it reduces the burden on landfills and increases the quality and quantity of recyclable materials (UNEP, 2021). Public education campaigns and enforcement of mandatory separation policies, as seen in countries like India and Brazil, have led to increased compliance and better outcomes. In Nigeria, pilot projects in Abuja and Lagos have demonstrated the viability of community-based waste segregation initiatives (Ogbonna & Ekere, 2020).

Composting and biological treatment of organic waste offer sustainable solutions for managing biodegradable materials, which often constitute over 50% of total municipal solid waste in many developing countries. Composting not only reduces landfill loads but also produces organic fertilizer for agriculture, enhancing soil fertility and supporting climate-smart farming practices (Adelekan & Jerome, 2020). Community composting initiatives have been effective in cities like Kampala and Dhaka, where local governments provide training and equipment to residents for household or neighbourhood-level composting.

Adoption of waste-to-energy (WTE) technologies is gaining traction in developing nations as a dual solution to waste accumulation and energy shortages. By converting waste into electricity or biogas, WTE plants help reduce greenhouse gas emissions while supplying clean energy to urban centres. However, these technologies require significant investment, policy support, and technical expertise to be viable in low-income settings (UN-Habitat, 2022). In Nigeria, recent partnerships with private firms aim to establish WTE plants in Lagos and Port Harcourt, signalling a shift toward more sustainable waste practices.

Lastly, policy reforms and stakeholder engagement are foundational to sustaining waste management improvements. Governments must enact and enforce laws that support sustainable practices, such as extended producer responsibility (EPR), waste minimization policies, and incentives for recycling businesses. Collaboration among local authorities, private companies, NGOs, and citizens is essential to develop inclusive waste management systems that are economically feasible and socially acceptable (World Bank, 2020). Without such collaborative frameworks, technical solutions alone are insufficient to achieve long-term sustainability.

3.0 Materials and methods

The study adopted a descriptive survey design. This design was chosen because it allows the researcher to gather detailed information about the current practices, effects, and perceptions related to solid waste disposal in Calabar Metropolis. The descriptive survey method is suitable for studies that aim to observe, describe, and document aspects of a situation as it naturally occurs (Nworgu, 2015). The population of the study comprised all residents of Calabar

Metropolis, including environmental officials, waste management workers, business owners, and household heads. This diverse group ensures a broad understanding of how waste disposal practices impact different stakeholders in the metropolis.

A sample size of 200 respondents was selected using a stratified random sampling technique. The population was divided into strata based on residential areas (e.g., urban, peri-urban), and respondents were randomly selected from each stratum to ensure representation. This method was used to improve the accuracy and representativeness of the data collected. The main instrument for data collection was a structured questionnaire, divided into sections: demographic information, types of waste generated, disposal methods, environmental and health impacts, and stakeholders' roles. In addition to questionnaires, oral interviews were conducted with selected waste management officials to provide qualitative insights. he main instrument for data collection was a structured questionnaire, divided into sections: demographic information, types of waste generated, disposal methods, environmental and health impacts, and stakeholders' roles. In addition to questionnaire, divided into sections: demographic information, types of waste generated, disposal methods, environmental and health impacts, and stakeholders' roles. In addition to questionnaire, divided into sections: demographic information, types of waste generated, disposal methods, environmental and health impacts, and stakeholders' roles. In addition to questionnaire, divided into sections: demographic information, types of waste generated, disposal methods, environmental and health impacts, and stakeholders' roles. In addition to questionnaires, oral interviews were conducted with selected waste management officials to provide qualitative insights.

4.0 Data Analysis, Interpretation, and Discussion of Findings

This section presents the analysis of the data collected through questionnaires and interviews. A total of 200 questionnaires were distributed, and 180 were duly completed and returned, representing a 90% response rate.

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Variable	Frequency	Percentage %
Male	98	54.4%
Female	82	45.6%
Age group		
18¬30 years	62	34%
31¬45 years	75	41.7%
46 years and above	43	23.9%
Occupation		
Civil servants	48	26.7%
Traders	52	28.9%
Students	35	19.4
Others	45	25.0%

Table 1: Demographic Characteristics of Respondents

From table 1 above, majority of respondents were between 31 and 45 years, with a relatively balanced gender distribution. Traders and civil servants formed the largest occupational groups, indicating active engagement with urban waste practices.

Table 2: Common Solid Waste Disposal Practices

Disposal method	Frequency	Percentage %
Government waste bins	65	36.1
Open dumping	52	29.8
Roadside disposal	38	21.1
Waste burning	25	13.9

Table 2 shows a significant number of respondents still engage in open dumping and roadside disposal due to inadequate access to proper waste bins, confirming poor coverage of formal waste management systems.

Impact type	Frequency	Percentage %
Blocked drainage/flooding	72	40
Offensive odour	50	27.8
Breeding of diseases vectors	41	22.8
Land and water pollution	17	9.4

Table 3: Perceived Environmental and Health Impacts

Blocked drainage systems and flooding are the most common environmental impacts, followed by unpleasant odour and health concerns due to increased vector populations.

Challenge	Frequency	Percentage %
Inadequate funding	58	32.2
Poor public awareness	45	25.0
Lack of waste bins/infrastructure	42	23.3
Weak law enforcement	35	19.4

Table 4: Challenges to Effective Waste Management

Inadequate funding and poor public awareness are the major challenges, underscoring the need for policy reform and public education.

Discussion of Findings

The findings of this study reveal that poor solid waste management remains a pressing environmental challenge in Calabar Metropolis. A majority of respondents reported irregular waste collection services, indiscriminate dumping, and minimal source separation, which corroborates the findings of Adejobi and Oloruntoba (2021) that urban areas in Nigeria suffer from inefficient municipal waste systems due to poor infrastructure and lack of enforcement. The limited participation in source segregation despite awareness suggests that knowledge alone is insufficient without enabling systems and incentives. This aligns with UN-Habitat (2022), which argues that sustainable waste management must combine awareness with accessible services and institutional support.

Environmental and health impacts such as blocked drainage, increased mosquito breeding, and a rise in malaria and typhoid cases were significantly reported. These observations reflect the conclusions of Ogbonna et al. (2020), who noted that unmanaged solid waste in tropical urban centres fosters the spread of vector-borne diseases and contributes to seasonal flooding. Blocked drainage systems not only degrade environmental aesthetics but also pose a serious threat to public infrastructure. The correlation between waste and disease prevalence in this study underscores the need for proactive health and sanitation policies that prioritize waste reduction as a preventive health strategy (Adelekan & Jerome, 2020). The findings also reveal that most residents perceive waste management to be the sole responsibility of government, while also expressing a strong willingness to be involved in the process. However, public sensitization and NGO participation were found to be grossly inadequate. This supports the work of Ajani and Medayese (2021), who emphasized the importance of multi-stakeholder participation and the integration of civil society in environmental governance. Without active community involvement and accountability from public agencies, sustainable urban waste management remains unattainable.

Lastly, the study affirms that despite the high volume of waste generated daily, there is limited implementation of sustainable strategies such as composting, recycling, or waste-to-energy initiatives. This aligns with Kaza et al. (2018), who reported that most sub-Saharan African cities continue to rely heavily on open dumping and landfilling due to policy gaps, weak institutional capacity, and inadequate funding. For Calabar Metropolis to transition toward sustainable waste management, it must adopt a holistic approach that incorporates technology, private sector participation, public education, and legal enforcement.

5.0 Summary

This study set out to examine the impact of solid waste disposal in Calabar Metropolis, Cross River State, with a focus on environmental, health, and socio-economic implications. Drawing on both quantitative and qualitative methods, the study engaged residents through structured questionnaires, interviews, and secondary data sources. The findings revealed that improper waste disposal practices such as open dumping, littering, and insufficient waste collection services continue to plague Calabar, consistent with the observations of Nwachukwu et al. (2022), who noted that poor municipal waste infrastructure remains a critical issue in many Nigerian cities.

Data analysis showed that while public awareness about proper waste management is relatively high, there is a significant gap in behavioural practices due to infrastructural and policy shortcomings. Most residents do not separate waste at the source, and only a small proportion benefit from regular collection services. This situation contributes to blocked drainages, flooding, air and water pollution, and health risks such as malaria and typhoid outbreaks. These findings mirror those of Adedayo and Ogunbiyi (2023), who emphasized the link between poor waste management and the rise of environmental health hazards in urban Nigeria.

The study also examined the role of various stakeholders, including government agencies, local communities, and non-governmental organizations, in managing solid waste. Results revealed that while government authorities are seen as the primary custodians of waste management, public involvement is weak, and non-state actors are largely absent. The findings support those of Ezeudu et al. (2021), who argued that sustainable waste management in developing countries requires a participatory approach, where all actors—public and private—collaborate effectively. Respondents strongly advocated for increased awareness campaigns and more inclusive platforms for public participation.

Furthermore, the study highlighted a significant lack of sustainable practices such as composting, recycling, and resource recovery in Calabar. This aligns with the conclusions of Akinbile and Alabi (2022), who pointed out that most Nigerian urban centres have yet to adopt integrated solid waste management frameworks due to weak institutional capacity and lack of funding. The absence of such strategies has led to environmental degradation, declining urban aesthetics, and deteriorating public health. Therefore, the study recommends a shift toward sustainable waste governance, increased investment in infrastructure, and stronger policy enforcement to mitigate the escalating impacts of solid waste in the metropolis.

5.1 Conclusion

The findings of this study underscore that solid waste disposal in Calabar Metropolis remains a critical environmental and public health concern. The prevalence of indiscriminate dumping, limited access to waste bins, and irregular waste collection services have contributed significantly to environmental degradation and health challenges in the metropolis. These issues reflect the broader waste management challenges faced by many urban centres in developing countries, where infrastructural deficits and weak policy enforcement exacerbate urban sanitation problems. It is evident that unless proactive steps are taken, the city will continue to suffer from flooding, blocked drainage systems, and increasing rates of vector-borne diseases.

The data obtained through surveys and interviews also revealed that the local population is aware of the dangers posed by poor waste disposal but often lacks the means or incentives to practice proper waste management. This gap between awareness and action is a common feature in many Nigerian cities, where behavioural change is hindered by inadequate infrastructure and weak institutional support. Community members are often willing to participate in waste reduction and recycling practices, but such initiatives are rarely facilitated or promoted by government agencies or non-governmental stakeholders. This highlights the need for inclusive, community-based solutions backed by effective policy enforcement.

Furthermore, the absence of sustainable waste management strategies such as composting, recycling, and waste-to-energy systems indicates a missed opportunity for resource recovery and environmental conservation. The current reliance on open dumping and minimal segregation at source reflects a linear waste management approach that is no longer sustainable. Calabar, like other growing urban centers, must transition toward an integrated solid waste management system that considers environmental, social, and economic dimensions. This transition requires robust government leadership, private sector involvement, and continuous community engagement.

In conclusion, tackling the solid waste problem in Calabar Metropolis demands a multifaceted strategy that addresses policy, infrastructure, awareness, and accountability. Strengthening institutional capacity, improving public education, and investing in sustainable waste technologies are essential to curbing the negative impacts of poor waste disposal. As urbanization continues to accelerate in Cross River State and across Nigeria, prioritizing effective waste management is critical not only for environmental sustainability but also for the overall health, safety, and economic well-being of urban residents.

5.2 Recommendations

Based on the findings of this study, it is recommended that the Cross River State Government and Calabar Urban Development Authority implement an Integrated Solid Waste Management (ISWM) system that prioritizes waste reduction, reuse, recycling, and environmentally sound disposal. Such a system should include infrastructural upgrades such as the provision of standardized waste bins, door-to-door collection services, and properly engineered landfill sites. This aligns with the recommendations of Kaza et al. (2018), who emphasized that urban waste challenges in developing countries can be significantly reduced through integrated and context-specific waste strategies.

Secondly, public awareness and environmental education campaigns should be intensified at the grassroots level to bridge the gap between knowledge and sustainable waste practices. These campaigns should focus on waste segregation at source, the health risks of open dumping, and the benefits of recycling and composting. Schools, religious institutions, community associations, and media outlets should be mobilized as platforms for continuous sensitization. According to Ezeudu et al. (2021), sustained community education is a crucial factor in promoting responsible environmental behaviour in urban settings.

Thirdly, it is important to foster multi-stakeholder collaboration in waste management by involving community-based organizations, private waste contractors, and NGOs. The government should provide regulatory frameworks and incentives for private sector participation, such as tax rebates or access to loans for recycling businesses. This approach has been successfully implemented in cities like Kigali and Nairobi, where inclusive governance

models have led to improved sanitation outcomes (Akinbile & Alabi, 2022). Partnerships can also help close financial and technical gaps in the waste management system.

Lastly, there should be robust enforcement of existing environmental regulations and periodic review of waste management policies to reflect current realities. Environmental monitoring units should be equipped with the authority and resources to penalize non-compliance, while rewarding responsible behaviours through community-based incentives. Digital innovations such as mobile reporting apps and GIS-based monitoring tools can support real-time oversight. As noted by UNEP (2022), governance and accountability are indispensable pillars for sustainable urban environmental management.

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