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Correspondence

Editor,
African - Diaspora Discourse, A-DD,
Institute of African and Diaspora Studies,
JP Clark Building,
University of Lagos.
08126519419.
oesuola@unilag.edu.ng,

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SEVEN

Adoption of Sustainable Solid Waste Collection and Disposal Practices in Urban Settlements in Lagos, Nigeria

Elizabeth Murey
Moi University

Abstract

It is estimated that almost half of the global population lacks access to regular waste collection, while over 3 billion people do not have access to designated waste disposal facilities. In developing countries, statistics shows that about thirty to sixty percent of waste is uncollected from urban areas due to massive increase in the volumes of waste generated. Nigeria generates more than 32 million tons of solid waste annually, out of which only 20– 30% is collected. The uncollected waste depicts an ineffective system and portends a serious environmental hazard. This study examines sustainable waste practices adopted in collection and disposal of waste in Lagos State, Nigeria. It assesses how sustainable waste practices have been adopted through waste collection, transportation and disposal. The research adopted a sequential explanatory mixed method design. The findings show that for many urban dwellers, it takes an average of 7 days to dispose their waste at collection points and that the final disposal place of the waste is the dumpsite. Waste is transported using enclosed trucks. The study found out that sustainable waste practices have been employed to some extent at different levels. A multidimensional approach to waste management is proposed with a keen bias towards enacting and integrating relevant policies on waste collection and infrastructural development.

Key Words: Sustainable Waste practices, Urban Communities, Waste Collection and Transport, Waste Disposal

Adoption de pratiques durables de collecte et d'élimination des déchets solides dans les zones urbaines de Lagos, au Nigeria

Résumé

On estime que près de la moitié de la population mondiale n'a pas accès à une collecte régulière des déchets, tandis que plus de 3 milliards de personnes n'ont pas accès à des installations d'élimination des déchets désignées. Dans les pays en développement, les statistiques montrent qu'environ 30 à 60 % des déchets ne sont pas collectés dans les zones urbaines en raison de l'augmentation massive des volumes de déchets produits. Le Nigeria produit plus de 32 millions de tonnes de déchets solides par an, dont seulement 20 à 30 % sont collectés. Les déchets non collectés témoignent de l'inefficacité du système et laissent présager un grave danger pour l'environnement. Cette étude examine les pratiques durables adoptées pour la collecte et l'élimination des déchets dans l'état de Lagos, au Nigeria. Elle évalue comment des pratiques durables ont été adoptées pour la collecte, le transport et l'élimination des déchets. La recherche a adopté une méthode mixte explicative séquentielle. Les résultats montrent que pour de nombreux citoyens, il faut en moyenne 7 jours pour éliminer leurs déchets aux points de collecte et que le lieu d'élimination finale des déchets est la décharge. Les déchets sont transportés dans des camions fermés. L'étude a révélé que des pratiques durables en matière de déchets ont été employées dans une certaine mesure à différents niveaux. Une approche multidimensionnelle de la gestion des déchets est proposée, avec une préférence marquée pour l'adoption et l'intégration de politiques pertinentes en matière de collecte des déchets et d'infrastructures.

Mots clés : Pratiques durables en matière de déchets, communautés urbaines, collecte et transport des déchets, élimination des déchets

1.0 INTRODUCTION

Globally, the effective management of solid waste is one of the greatest challenges for cities especially for cities in developing countries (Abdel-Shafy & Mansour, 2018). According to the UN (2019), 55% of the total global population resides in urban areas and this percentage is expected to grow to 68% by 2050. Rapid urban population, improved technology, industrialization and change in the living standards lead to high consumption of resources (UN, 2022). It is estimated that almost half of the world's population lack access to regular waste collection, while over 3 billion people do not have access to designated waste disposal facilities (Wilson, et al., 2015). In developing countries, statistics shows that between 30% to 60% of waste is uncollected from urban areas due to the massive increase in volumes of waste generated by many countries.

In Africa, only 25% to 70% of the generated waste is collected and about 57% is collected in Sub-Saharan Africa (Muheirwe, Kombe, & Kihila, 2022). According to Statista (2019), an estimated 468, 289 and 231 million metric tons of waste are generated annually from East Asia and the Pacific, Latin America and the Caribbean and Sub-Saharan Africa respectively. Wilson & Velis, 201 & World Bank, 2018 project that by 2050, waste generation will double globally particularly in Africa and Asia. While waste generation is high and is projected to continue increasing, approximately 50% of urban waste from developing countries remains uncollected (World Bank, 2018). The uncollected waste is noted as one of the indicators of urban planning challenges which reflects weak

institutional, legislative and participative strategies Loukil & Rouached, 2020; Hettiarachchi et al. 2018.

According to Nwosu and Chukwueloka (2020), only 40 per cent of the 10,000 tonnes of daily waste produced in Lagos is collected and dumped in landfill sites such as Olusosun. These statistics indicate that due to the massive increase in volumes of waste generated, many countries are struggling to cope with the challenges involved in the collection, transportation, and disposal of solid waste. Without adequate waste collection services, waste generators may resort to illegal waste disposal, which will eventually pollute the environment.

Improper waste collection, transportation and disposal practices are some of the greatest contributors to environmental and health challenges (Sarkodie & Owusu, 2021; Abdel-Shafy & Mansour, 2018; Khandelwal, Dhar, Thalla, & Kumar, 2019; da-Silva, et al., 2021). Additionally, the lack of infrastructure for collection, transportation, treatment and final disposal, management planning, financial resources, technological know-how and passive public attitude reduces the chances of improvement in waste management in urban communities (Khandelwal, *et al.*, (2019). If not addressed, it will continue to create humongous pressure on already stressed waste management system of the local authorities and national governments as urban populations continue to rise and consumption patterns change over time (Marshall & Farahbakhsh(2013).

According to Kamaruddin *et al.*, (2017), solid-waste management addresses the process of how to control waste generation, storage, collection, transportation, processing, and disposal in

compliance with the best available practices regarding human health, economic contribution, engineering consideration, aesthetic values, and other environmental inputs and in attainment of Sustainable Development Goals. Mandal (2019), adds that establishing more sustainable waste management practices is currently seen as one of the most urgent global challenges.

A study Godfrey, et al (2017) on Solid Waste Management in Africa: Governance Failure or Development Opportunity found out that Africa faces many challenges with respect to solid waste management. Which include lack of awareness; weak environmental legislation and enforcement; and limited resources, including financial resources, this result in inefficient waste management. It can therefore be argued that the current poor state of solid waste management is largely due to failures in governance and organizational weaknesses resulting in poor service delivery.

Aliu, Adeyemi & Adebayo (2014) conducted a study on the performance of public private partnership in household solid waste collection in Lagos, Nigeria. Their findings showed that the public private partnership performance is significantly influenced by economic status, affordability, flexibility, consistency, cleanliness, coverage and accessibility, as well as number of waste collection vehicles, vehicle maintenance, capacity, trip rate, frequency, number of personnel and quality of personnel.

Adeniran, Nubi & Adelopo (2017) conducted a study on solid waste generation and characterization in the University of Lagos for a sustainable waste management. The study found out that the estimated daily waste generation of University of Lagos Akoka

campus is about 32.2 tons with polythene product representing the largest portion of waste at 34%. Another study by Chidiebere, Abubakar & Shabako (2018) in Lagos state showed that that the rate of municipal solid waste generation out weights the present management strategies and the number of recycling firms in Lagos State.

The study focussed on two formal settlements (Lekki phase 1 and UNILAG) and two informal settlements (Makoko and Bariga). The study considered this approach as essential for a comprehensive and effective waste collection and management strategy. These two aspects provide unique insights and challenges that, when considered together, can lead to more sustainable and equitable solutions for urban environments. This approach promotes sustainability by reducing waste generation, minimizing environmental impact, and fostering social equity by ensuring that all residents have access to clean and healthy living conditions. In essence, studying both formal and informal areas of a city in solid waste collection is essential for creating resilient, inclusive, and environmentally responsible urban environments. This study therefore, examines sustainable waste practices adopted in collection and disposal of waste in Lagos State, Nigeria.

2.0 LITERATURE REVIEW

2.1 Solid Waste Collection

Waste collection practices constitute the most important and major part in the waste management chain. Mandal, (2019), posits that the amount of money spent on the collection system is estimated to constitute 60 – 70% of the total fund spent in the entire waste management from production to disposal, yet the

quantity of waste collected is usually less than half of the total waste generated. Historically, the burden of solid waste collection was the sole responsibility of the governments in developing countries (Yukalang, Clarke, & Ross, 2017; Katusiimeh, 2017). This service has an important impact on both public health and aesthetics within urban areas. Due to the massive increase of waste generation, diverse actors are a necessary pillar to supplement governments in providing waste collection services (Katusiimeh, Mol, & Burger, 2012; Tukahirwa, Mol, & Oosterveer, 2013).

Gilardino *et al.*, (2017) conducted a study to optimize Municipal Solid Waste (MSW) collection in Lima district of Peru using LCA and operational research. The location of collection sites and the number of containers required were optimized using the heuristic approach based on operational research and subsequently, the results of optimization were analysed using LCA. The results showed that replacing the present door-to-door collection system with the container collection system would reduce the GHG emissions by 14%. Collection route and time optimization have been achieved through a routing problem approach with heuristic solutions (Bartolozzi, Baldereschi, Daddi, & Iraldo, 2018). Similar methods for waste collection optimization have been achieved by advanced modelling framework using GIS technology (Rossi, Papetti, & Germani, 2022; Bartolozzi, Baldereschi, Daddi, & Iraldo, 2018; Ferronato, Alarcón, Lizarazu, & Torretta, 2021). Odonkor, Frimpong & Kurantin (2020) conducted a study on an assessment of household solid waste management in a large Ghanaian district. The study found that communal waste collection bins were far from households and that the number of waste collection point in the community were few.

Douti, Abanyie & Ampofo (2017) study in Ghana found out that factors that adversely affected waste collection and transportation systems were; inadequate supply of waste collection containers, existence of a weak waste transportation system and a low patronage of the door-to-door collection method. The study showed that the municipal landfill did not meet the required standard.

The frequency of how waste is collected in terms of the number of times in a week or a month is a fundamental parameter of any waste collection system, (Bisinella, Conradsen, Christensen, & Astrup, 2016). Other scholars argue that frequency of collection is mainly based on income level of community, the higher the income of the community the higher the frequency of waste collection and transportation and vice versa (Okot-Okumu & Nyenje, 2012; Sandhu, Burton, & Dedekorkut-Howes, 2017). On the other hand, collection points are not emptied regularly due to an infrequent collection of containers and lack of planned transportation routes and schedules, insufficient number of vehicles and the frequent breakdown of vehicles (Das & Bhattacharyya, 2015; Yadav & Karmakar, 2020; Cirrincione, La Gennusa, Peri, Rizzo, & Scaccianoce, 2022; Feng, Xu, Xu, & Cheng, 2022). Delay in collection of waste from the residences have now forced the residents to seek alternative means of disposing their waste either by engaging the services of cart pushers at an extra cost, dumping the waste indiscriminately on the road or also burning the waste. Kanuku, Nzyengy'a, Vundi & Nzeve (2020) posit that overflowing, accumulated and stinking uncollected waste bins created negative perception on waste collection practices.

2.2 Solid Waste Transportation

Smart collection and sorting are the keyways of improving waste transportation since a large quantity (organic) can be composted at source of generation (Boubaris, et al., 2022 June; Jorge, Antunes, Ramos, & Barbosa-Póvoa, 2022). The first step to sustainable solid waste management is generation control. After generation, waste must be collected and sorted. Yet, almost all collected solid wastes in developing and underdeveloped countries are poorly sorted despite the fact that the quantity of waste collected is usually less than half of the total waste generated. These wastes are finally transported to landfills, dumpsites or composting sites while another proportion is burnt or thrown to the streets/water bodies. (Sahib & Hadi, 2023; Liang, Minanda, & Gunawan, 2023). Among all these solid waste management systems, only landfilling and composting can be considered as sustainable for careful sorting (Kushwah, Gokarn, Ahmad, & Pant, 2023; Di Foggia & Beccarello, 2023).

Ike, Ezeibe, Anijiofor & Daud (2018) in their study on Solid waste management in Nigeria found out that waste management in Nigerian cities is largely monopolized by the agencies of state governments (sub-national governments) which have limited capacity to tackle the problems of solid waste management in their cities.

2.3 Solid Waste Disposal

Nathanson, (2020) , reported that a technological approach to solid-waste management began to develop in the latter part of the 19th Century and by the beginning of the 20th century, 15 percent of major American cities were incinerating their solid waste. By mid-century, however, it had become evident that

open dumping and improper incineration of solid waste were causing problems of pollution and jeopardizing public health which as a result, sanitary landfills were developed to replace the practice of open dumping and to reduce the reliance on waste incineration. Modern solid-waste management plants in most developed countries now emphasize the practice of recycling and waste reduction at the source rather than incineration and land disposal (Silva, 2022)

However, in Africa, one of the main development challenges is waste management which is often characterized by uncontrolled dumping and open burning, with limited cases of disposal to sanitary engineered landfills, or diversion of waste away from landfill towards reuse, recycling and recovery (UNEP, 2018). If done responsibly and sustainably, it can minimize both the environmental and human health impacts associated with the current poor solid waste management practices seen across the African continent (Godfrey, Sithole, Jacob-John, Mturi, & Muniyasamy, 2022; Godfrey & Oelofse, 2017).

Even though the disposal of waste at the landfills is cost-effective, it however, builds various negative impacts on the environment such as toxic gas emissions, groundwater pollution, odour, and climate change (Hoang, Pham-Phu, Fujiwara, & Pham-Van, 2020; Parvin & Tareq, 2021; Khan & Nopiah, 2019). The proper and scientific collection, transportation and treatment or disposal of MSW could reduce the CO₂ emissions significantly and could play a key role in achieving the desired CO₂ reduced targets. These problems can be taken care of by adapting the principle of circular economy and life cycle thinking (Malav, et al., 2020).

The improper management of MSW is a significant contributor of anthropogenic greenhouse gases (GHG) such as methane (CH₄), biogenic carbon dioxide (CO₂) and non-methane volatile organic compounds (NMVOCs) etc. About 28.4 kg of methane is emitted into the atmosphere per tonne of landfill waste (Kumar & Samadder, 2022). Methane is the most serious pollutant as it contributes 25 times greater than that of carbon dioxide to the global warming. Globally, methane emitted from landfills accounted for 3–9% of the anthropogenic source (Ramachandra, Bharath, Kulkarni, & Han, 2018).

Incineration is an alternative waste disposal method that involves the combustion of solid waste, but it has its setback in the areas of efficiency in reducing waste volume, energy recovery, and emissions control, as well as the potential environmental and health risks associated with the release of pollutants. For instance, according to Khan et al (2022), if wastes have a high proportion of organic matter, the possibility of composting and biogas regeneration as means of handling wastes is a better mechanism than incineration, reuse, and recycling. Moreover, using incineration as a means of waste disposal has been mostly negative experience due to environmental pollution.

Recycling and resource recovery strategies play a crucial role in waste management by diverting valuable materials from disposal and reducing the demand for virgin resources. Literature on recycling practices has examined collection systems, sorting technologies, market incentives, and the economic and environmental benefits of recycling. Studies have also explored innovative approaches such as waste-to-energy technologies, anaerobic digestion, and composting for organic waste management.

Abdullah, Salleh & Ismail (2017) found out that the main problem expressed by respondents with respect to waste disposal is that collection schedules are not adhered to by the collectors. Disorderly disposal of rubbish is also perceived to be a problem, and a majority of the respondents believe that lack of awareness, knowledge and enforcement are the major causes of the problem.

Haywood, Kapwata, Oelofse, Breetzke & Wright (2021) in a study on waste disposal practices in low-income settlements of South Africa found interesting correlation between place and settlement, fuel use type and dumping behavior. Families living in a shack were more likely to dump waste in the street. Additionally, families that used non-electric sources of fuel for heating/cooking, those who lacked proper sanitation, and those who did not have access to piped water inside the dwelling were more likely to dispose of waste by dumping it in the street/in the yard or burying it. They concluded by saying that the social economic status determined the risk of solid waste exposure with poor families being adversely affected.

3.0 Research Methodology and Theoretical Framework

3.1 Theoretical Framework

This paper is grounded on the Triple Bottom Line Model (TBL) advocated by business consultant John Elkington in 1990 to describe economic, environmental, and social value of investment. The concept is sometimes referred to as the 3Ps (people, planet, profit). Waste management promotes the aspect of resource utilization through promotion of waste to wealth initiatives. Economic sustainability is achieved because the proper waste collection, transport and disposal practices play a

vital role in job creation. This contributes to income generation in high-unemployment areas.

Social sustainability can be achieved by clarifying four coherent and compatible interventions namely: social inclusion, participation, empowerment, and community mobilization. It can be argued that social inclusion entails the participation of the residents in the waste management practices which requires the empowerment of the local citizens. This leads to a sense of responsibility, improved waste management habits, and increased environmental consciousness (Ezechi, Nwabuko, Enyinnaya, & Babington, 2017).

Environmental sustainability is a multifaceted issue since it addresses creating a balance between varieties of matters. Immurana *et al.*, (2022), argue that waste disposal plays a crucial role in reducing environmental pollution and recovery of materials. In summary, the TBL model not only recognizes the need to practice waste management, but it also seeks to do so while maintaining, increasing or restoring environmental and social assets. TBL model is highly relevant to waste collection as it provides a framework for assessing and improving the overall impact of waste management practices on society, the environment, and the economy.

3.2 Methodology

The research adopted a mixed method approach and sequential explanatory design which involves the collection and analysis of quantitative data followed by the collection and analysis of qualitative data. The priority is given to the quantitative data, and the findings are integrated during the interpretation phase of the study (Creswell & Creswell, 2017). Data in the urban communities

in Lagos that include Makoko, Bariga, Lagos mainland, Lekki Phase 1 and UNILAG and its environs was collected using 200 closed ended questionnaires. Key informants interviewed included: 4 LAWMA waste collectors (contractors/drivers) per settlement, 2 Dumpsite managers/Dumpsite attendant and 4 private waste collectors/cart pushers. In-depth interviews involved 1 LAWMA manager, 1 ministry of environment official, 1 scholar of environmental/waste management and 2 recycling managers.

4.0 RESEARCH FINDINGS AND ANALYSIS

4.1 Waste Collection and Disposal

Households in the urban settlements dispose their households waste in numerous ways as indicated in Figure 3.1 below. Majority of the residents dispose their waste within the settlement (40%), while 21% through “doorstep collection” method. 19% of respondents dispose waste in garbage pits while 14 % dumped waste at the roadside. A small percentage (9%) burnt their waste.

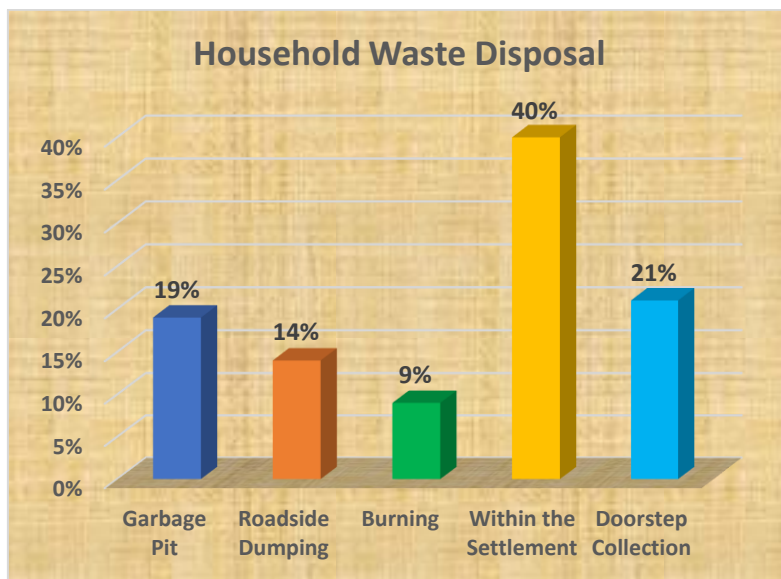


Figure 4.1: Disposal of Household Waste

Source: Researcher, 2023

Majority of the urban settlements dispose their waste in the collection points within the settlements. This implies that the collection points serve as centralized locations where waste can be conveniently deposited. This also helps streamline the collection process and ensures that waste is collected in a systematic manner. The research also found out that it is only UNILAG and some parts of Lekki Phase 1 that have separate containers in the collection points. This would facilitate waste segregation at the source. It was observed during field work that despite the availability of separate containers, waste is disposed in the wrong containers resulting to higher costs associated with waste segregation and management.

The average distance between the house and the collection point was 100 meters. Placing collection points strategically within the residential areas ensures easy access for individuals. This convenience encourages more people to use designated waste disposal containers instead of resorting to indiscriminate dumping. The findings disagree with those of Odonkor, Frimpong & Kurantin (2020) who found out that communal waste collection bins were far from households and that the number of waste collection point in the community were few.

4.2 Improper Dumping

The respondents highlighted reasons why they dump waste outside the collection bins. The results are illustrated in figure 3.2.

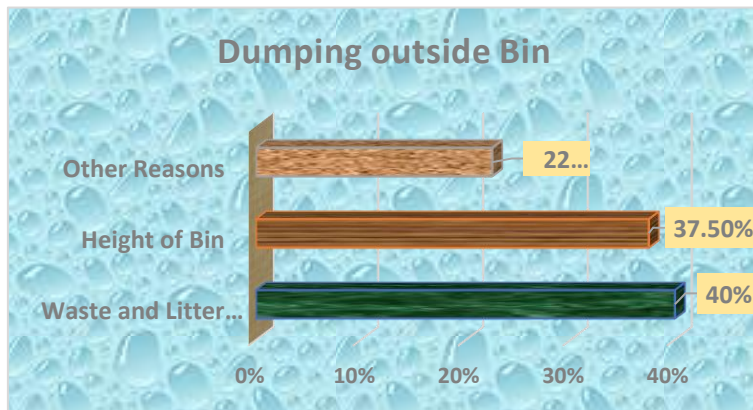


Figure 4.2: Reasons for Dumping Outside the Bin

Source: Researcher, 2023

There is a culture of dumping waste outside the collection bins instead of putting the waste inside the bins as indicated in the

findings. Most of the residents dispose waste outside the bins due to obstruction caused by waste and litter spread around the bin and the height of the collection bins. Some of the other reasons why residents dump waste outside the collection bins were inadequate or overflowing containers, and insufficient collection frequency. The study found that it is essential to ensure that collection points have appropriate infrastructure and are well designed to handle the volume and types of waste generated in the area. The findings concurs with those of Abdullah, Salleh & Ismail (2017) who found out that disorderly disposal of rubbish is also perceived to be a problem, and a majority of the respondents believe that lack of awareness, knowledge and enforcement are the major causes of the problem.

4.3 Frequency of Waste Collection

The average number of days on collection bins being emptied is seven days. Delayed waste collection results in odours, attract pests such as rodents and insects, and create breeding grounds for disease-causing bacteria. Increased waste buildup poses health and hygiene risks to individuals, potentially leading to the spread of infections and diseases. The interview with a recycling manager in waste management at UNILAG revealed that cost and budget constraints affect collection frequency due to the fact that establishing frequent collection and maintaining collection points require financial resources. Peri, Rizzo, & Scaccianoce, 2022; Feng, Xu, Xu, & Cheng, 2022 argues that collection points are not emptied regularly due to an infrequent collection of containers and lack of planned transportation routes and schedules, insufficient number of vehicles and the frequent breakdown of vehicles.

3.4 State of Collection Bins

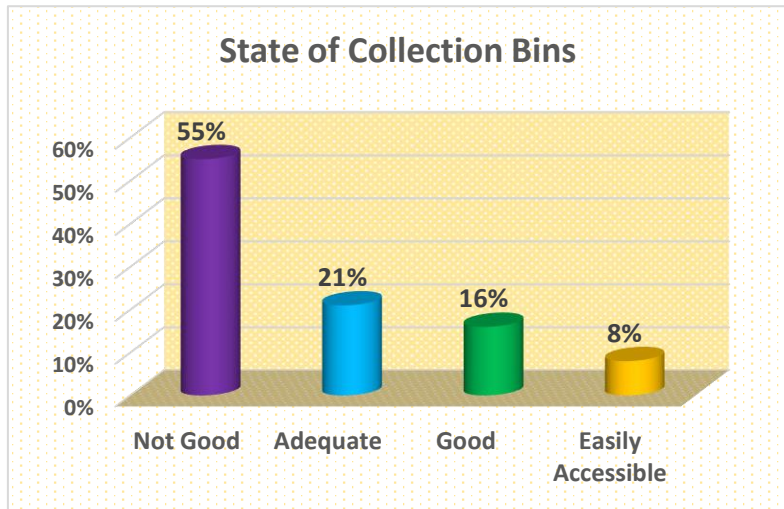


Figure 4.3: State of Collection Bins

Source: Researcher, 2023

The research found out also that the collection bins were not in a good shape. Collection points need regular maintenance and cleaning to ensure their functionality and hygiene. Neglected collection points can become unsightly, attract pests, and create a nuisance for the community. Adequate resources and dedicated staff are necessary to maintain the cleanliness and functionality of collection points effectively. The costs associated with infrastructure development, regular maintenance, waste transportation, and staff can strain the budgets of waste management authorities. Limited funding may result in inadequate infrastructure or compromised services at collection points. In agreement, Kanuku, Nzyengy'a, Vundi & Nzeve (2020) posit that overflowing, accumulated and stinking uncollected

waste bins created negative perception on waste collection practices.

4.5 Garbage Collectors

The study sought to identify the main collectors of waste in the settlements. The results revealed that the main collector of waste is LAWMA at 122 (81%) which is under the government and 28 (19%) are private collectors.



Figure 4.4: Garbage Collectors

Source: Researcher, 2023

The findings show that waste collection in Lagos is mainly done by private partners in waste collection. This explains why majority of the households indicate that LAWMA vehicles collect their waste. Through the interview, it was revealed that those who are termed as private collectors are the waste pickers and cart pushers who are involved in waste collection. It was observed through field work that waste is transported through enclosed

trucks. This is consistent with the findings of Ike, Ezeibe, Anijiofor & Daud (2018) who posit that waste management in Nigerian cities is largely monopolized by the agencies of state governments (sub-national governments) which have limited capacity to tackle the problems of solid waste management in their cities.

4.6 Cost of Waste Disposal

Households paying for waste disposal services were asked to indicate their perception on the amount they pay for waste collection services. The finding shows that the average number of respondents indicate that the payment on waste disposal was expensive, a small percentage stated that the services were cheap, and majority indicated that the amount they are paying per month was reasonable.

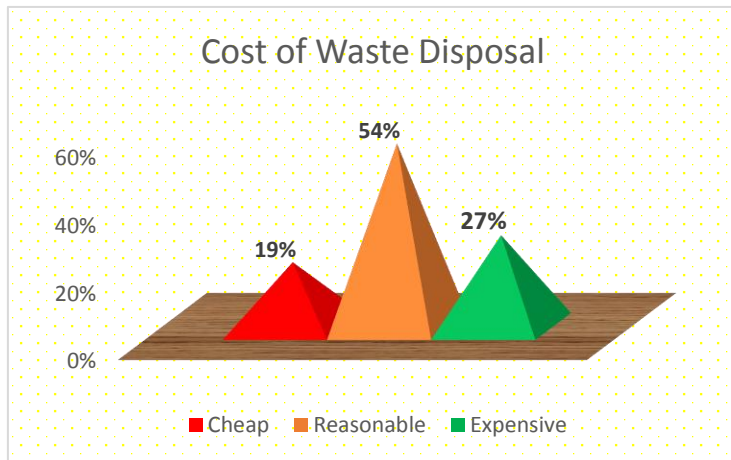


Figure 4.5: Cost of Waste Disposal

Source: Researcher, 2023

The perception among the urban residents that the money they are paying is reasonable is a good indicator that many are willing to pay for the services and this is important to the waste managers because the sustainability of funds to manage solid waste is contingent on the willingness of people to pay for improved solid waste disposal services.

4.7 Waste Disposal Practices

Landfill disposal is one of the most common methods used for the final disposal of solid waste in Lagos. Waste is dumped in Olusosun, Isashi, Solu dumpsites. Since UNILAG is a gated community, there is a dumpsite within the university. It was observed during field work that the dumpsite at Olusosun was not well secured and that there was no serious compacting of waste into layers even though compacting can enable the accommodation of large quantities of waste. The dumpsite at UNILAG provides a location for the disposal of waste generated within the campus. It serves as a central collection point where waste is dumped and stored before further processing or disposal. It also facilitates waste segregation activities and this contributes to resource recovery and recycling efforts by the local recycling companies, thereby generating revenue for the university while supporting local recycling industries. However, the dumpsite is not well fenced and secured. It lacks a well-planned space for organic waste to compose into nutrient-rich compost that can be used to support sustainable agriculture.

Conclusion

This study has examined sustainable waste practices adopted in collection and disposal of waste in Lagos State, Nigeria. Waste collection and disposal practices in Lagos formal and informal

settlements showcase distinct approaches influenced by their respective landscapes and infrastructural capabilities. Majority of residents in UNILAG, Lekki phase 1 and Bariga opt for utilizing designated collection points, while majority in Makoko dispose their waste in water. This variance underscores the importance of tailoring waste management strategies to local preferences and conditions. Lagos state have entrusted the responsibility of waste collection to private sector entities, operating under LAWMA. The majority of collection trucks are closed and designed to ensure proper transportation, ensuring reduced spillage and potential health hazards. The management of dumpsites should be enhanced in order to better public health and environmental sustainability.

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