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ASSESSMENT OF EFFECTIVENESS OF MUNICIPAL SOLID WASTE COLLECTION AND TRANSPORTATION IN KARU LGA, NASARAWA STATE, NIGERIA

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ABSTRACT

Purpose: *the study assessed the effectiveness of municipal solid waste collection and transportation in Karu with a view to examining the processes of waste collection and transportation infrastructure as it affects the health and environment of residents.*
Research Methodology*: To achieve this aim mixed method approach of quantitative data from questionnaires provided statistical evidence about waste generation rates, collection and service satisfaction while qualitative information gathered through field observations, and conversations revealed the human dimensions the health concerns about nearby dumps.*
Finding*: The result showed that a significant number of residents enjoyed waste collection from their point of disposal. In addition, vehicles meant to manage the waste shows that tipper trucks made up the bulk of the fleet, while modern compactor vehicles far more efficient and hygienic collection services are not available.*
Research Implications and Limitations*: The limitations include the use of mostly open tipper trucks to transfer wastes to dumpsites. The contribution to knowledge is that this study established the need for more collection points and access roads especially in the interior areas were vehicles find it difficult to move.*
Practical Implications: *The study offered a practical insight into waste collection and management through urban collection and transportation and provided the need for improvement on the services for better service delivery.*
Originality: *the study demonstrated how adequate funding of the waste management activities could cater for waste management in the fringes by the local government of which the failure would result in continuous dumping of waste in open lands.*

Keywords: Municipal solid waste, waste collection, transportation challenges, Karu LGA, periurban areas, environmental management.

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1.0 INTRODUCTION

Karu Local Government Area, a rapidly expanding peri-urban settlement within Abuja's metropolitan region, faces a mounting waste crisis. Like many Nigerian semi-urban areas, Karu is experiencing rapid urban growth and shifting consumption patterns, but its waste management infrastructure simply cannot keep pace. The situation mirrors a global trend: as cities grow, so does their waste particularly organic waste yet formal collection systems and proper disposal facilities struggle to meet demand (Hoornweg & Bhada-Tata, 2012).

Open dumps have proliferated near homes and drainage channels, while waste collection remains sporadic and unevenly distributed, focusing mainly on market areas and major roads. This imbalance stems from chronic underfunding and weak institutional capacity Ogah et al. (2020). Residents live with the consequences daily, drains clogged with refuse, contaminated water sources, foul odors, disease carrying pests, toxic smoke from burning waste, and valuable recyclable materials lost to uncontrolled dumping.

Existing studies on Karu's waste situation tend to provide snapshots mapping where dumps exist without connecting this spatial data to how much waste households actually generate or how collection routes currently operate. Without this integrated understanding, planners cannot develop realistic models to determine optimal collection frequencies or design efficient routes for Karu's diverse neighborhoods (Haruna et al., 2016).

This research tackles a fundamental gap in Karu needing a comprehensive, understanding of both waste accumulation and how collection systems should be designed to reduce illegal dumping and protect the environment. Therefore, this research aim is to assess the impact of municipal solid waste collection and transportation challenges in Karu LGA of Nasarawa State**.** The objectives identified includes to; examine the waste collection pattern in Karu; access the efficiency in transportation system for the collection of the solid wastes in the study area; and identify ways to manage municipal solid waste in the study area.

2.0 REVIEWED LITERATURE

Understanding the scale of Nigeria's waste challenge begins with knowing how much garbage people produce. Recent research paints a revealing picture of the country's urban waste landscape. In a study by Ogunjuyigbe et al. (2023), they studied six major Nigerian cities Lagos, Kano, Ibadan, Port Harcourt, Benin, and Maiduguri they found striking differences in how much waste residents generated daily. Lagosians produced the most at 0.79 kg per person each day, while Maiduguri residents generated considerably less at 0.44 kg per person daily. Across all six cities, the average stood at 0.58 kg per person per day, confirming earlier predictions by Hoornweg and Bhada-Tata (2012) while showing an upward trend driven by rapid urbanization and changing lifestyles.

A study conducted by Ayeleru et al. (2021) uncovered a crucial insight of how our places of residents significantly affects what and how much you throw away. High-income neighborhoods generated 0.89 kg per person daily nearly double the 0.52 kg produced in low-income areas. But the differences went beyond quantity. Wealthier households discarded proportionally more packaging waste (35% versus 18%), while poorer households produced more organic waste like food scraps (68% versus 47%). This disparity suggests that one size fits all waste management won't work different neighborhoods need different approaches.

Waste generation also fluctuates throughout the year. Nzeadibe and Iwuoha (2022) discovered that southeastern Nigerian cities experience dramatic spikes during festive periods, particularly December-January and April-May, when waste volumes jump 18-25%. Food waste accounted for 72% of this seasonal increase, creating significant headaches for waste management authorities whose trucks and facilities were designed for average, not peak, conditions.

Even when authorities know how much waste is being generated, collecting it is another matter entirely. The picture across Nigerian cities is sobering. When Ogunmakinde (2019) surveyed 1,200 households in Osogbo, Osun State, he found that only about one-third received regular weekly collection service. The situation was far worse in peri-urban areas, where coverage plummeted to just 12%. Too few trucks (one for every 45,000 residents instead of the recommended one per 20,000), inadequate collection points, and poor road access that made many neighborhoods essentially unreachable.

Dauda et al. (2020) used mapping technology to analyze collection patterns in Kaduna and found stark spatial inequalities. Downtown commercial areas enjoyed daily pickup, while people living on the outskirts might wait two weeks between collections, if they received service at all. Two factors strongly predicted whether your neighborhood would get regular service: how far you lived from local government headquarters and the quality of your roads. The closer and more accessible your area, the better your chances of regular collection.

The bias becomes even clearer when examining Port Harcourt. Abah and Ohimain (2021) documented those commercial districts and wealthy neighborhoods though housing less than half the urban population accounted for 68% of collected waste. Meanwhile, low-income communities containing 54% of residents contributed only 23% of collected volumes. This wasn't because poor neighborhoods produced less waste; it reflected deliberate choices about where to allocate limited trucks and personnel, systematically excluding marginalized populations from basic services.

Cities have tried different collection approaches with mixed results. Okot-Okumu and Nyenje (2023) examined three main models used across Nigeria: communal containers (used in 52% of cities), kerbside collection (31%), and door-to-door services (17%). While communal containers seemed cost-effective at ₦3,200 per ton, this apparent savings was illusory. Overflowing bins and illegal dumping around container sites generated cleanup costs exceeding ₦8,500 per ton nearly triple the original collection expense. The cheapest option upfront proved most expensive overall. For waste that does get collected, the destination is typically grim. Odukoya et al. (2018) surveyed 67 active dumpsites across six Nigerian states and found that 91% were simply unlined open dumps where garbage was piled without any environmental controls. Only 6% had even minimal management, and a mere 3% came close to meeting sanitary landfill standards. Not a single site

had leachate collection systems to prevent toxic liquids from seeping into groundwater, methane capture infrastructure to handle explosive gases, or the environmental monitoring programs required by Nigerian law.

The placement of these dumps compounds the problem. When Fagbohun et al. (2021) analyzed dumpsite locations in Lagos State, they discovered that 73% sat within 500 meters of rivers, streams, or lakes violating minimum setback requirements designed to protect water sources. Another 42% were within one kilometer of homes, subjecting residents to constant odors, diseasecarrying insects and rodents, and safety hazards. These poor locations weren't accidental; they reflected land scarcity, political pressure to put dumps somewhere quickly, and weak enforcement of environmental regulations.

The consequences of uncontrolled dumping extend far beyond unpleasant smells. Njoku et al. (2019) conducted detailed water testing around the Aba dumpsite in Abia State and found alarming contamination in wells near the site. Lead levels reached 340% above safe drinking water standards, cadmium was 870% too high, and chromium exceeded limits by 1,120%. Computer modeling showed this toxic plume spreading 800-1,200 meters from the dumpsite, potentially affecting water supplies for approximately 12,000 people living nearby.

Okunola et al. (2021) compared health outcomes between 847 people living within 500 meters of dumpsites in Ibadan and 923 people living more than two kilometers away. The differences were stark and statistically significant even after accounting for income, water sources, and sanitation access. Residents near dumps were 2.34 times more likely to suffer respiratory illnesses, 1.89 times more likely to experience diarrheal diseases, and had elevated rates of malaria and dengue fever. Living near an uncontrolled dumpsite wasn't just unpleasant it was genuinely dangerous to health. These empirical findings collectively reveal a waste management system under severe strain, characterized by inadequate collection coverage, systematic exclusion of vulnerable populations, environmentally hazardous disposal practices, and measurable public health consequences. The evidence makes clear that addressing Nigeria's urban waste crisis requires more than incremental improvements it demands fundamental transformation of how cities plan, resource, and implement waste management services.

3.0 METHODOLOGY

This study focused on Karu Local Government Area, home to approximately 333,800 residents according to Nigeria's National Bureau of Statistics 2022 projections.

Working with the total population of 333,800 and setting the confidence level at 95 it was determined that 400 completed questionnaires would provide statistically sound results. The targeted population are responsible adults living or working in Karu across seven key neighborhoods: Mararaba, Masaka, Kuchikau, Auta Balefi, Auta Gurki, Kugbaru, and Tudun Wada. These areas represent the diverse character of Karu from bustling commercial centers to quieter residential suburbs ensuring findings captured experiences across the Local Government Area.

A mixed-methods approach of quantitative data from questionnaires provided statistical evidence about waste generation rates, collection frequency, and service satisfaction. Qualitative information gathered through field observations, and conversations revealed the human

dimensions the frustration of missed collections, the health concerns about nearby dumps, the creative but inadequate coping strategies residents developed.

4.0 PRESENTATION AND DISCUSSION OF RESULTS 4.1 Examine the waste collection pattern in Karu

From the analysis on fiqure 4.1, it is observed that 20.8% of the respondents agreed that wastes are collected from house to house. 50.3% however, stated that waste collection is at the communal facility while 27.7% of the respondents stated that wastes are disposed at open dumps.

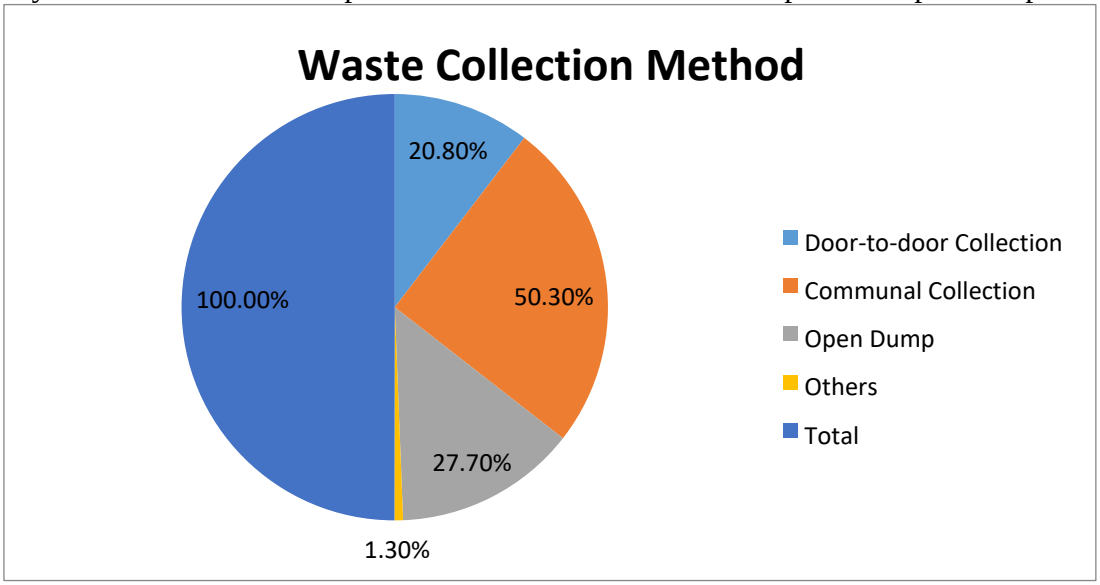


Figure 1: Waste Collection Methods Used by Respondents Source: field work, 2025

The high proportion of respondents using open dumping is of concern, as it can lead to environmental and health problems. The lack of access to proper waste disposal facilities and services may contribute to this practice. Therefore, it is essential to improve waste management infrastructure and services, including increasing access to door-to-door collection and proper disposal facilities.

Table 1: Reasons for Dissatisfaction with Collection Quality

The quality of waste collection services in Karu is a unique. While a significant proportion of residents (55.8%) are of the opinion there is delay in rate the of waste collection, a substantial number (29.7%) complain of pungent smell. Similarly, (3.6%) of the respondents complain of vehicular breakdown.

There is need for better improvement in services provided by NASWAMSA based on varied opinion from respondents as there are services are not meeting the expectation of the residents.

Reasons for Dissatisfaction with	Frequency	Percent (%)

Collection Quality		
Delay in Packing Waste	220	55.8%
Pungent Odour	117	29.7%
Vehicle Breakdown Always	14	3.6%
Others	43	10.9%
Total	394	100.0%

Source: field work, 2025

The tables show the respondents' satisfaction rating with the quality of waste collection services in Karu. The results indicate that only 24.1% of respondents are satisfied with the quality of waste collection services, while 75.9% are not satisfied. The reasons for dissatisfaction with collection quality are varied, but the most common reason is delay in packing waste (55.8%), pungent odour (29.7%) and vehicle breakdown (3.6%). These are indicative of inadequate waste management infrastructure and services. These issues can lead to environmental pollution, health problems, and decreased quality of life for residents.

There is the need for improvements in waste collection services, including increasing the frequency of waste collection, providing adequate waste management infrastructure, and ensuring that waste collection vehicles are well-maintained.

4.2 Access the efficiency in transportation system for the collection of the solid wastes in the study area.

Table 2: Types of Vehicles Used for Waste Collection

The table 2 shows the distribution of vehicles used for waste collection in Karu. The results indicate that the most commonly used vehicle for waste collection is the Tipper (36.8%), followed by the Roll-on-truck (24.9%) and the Skip Truck (20.8%).

Vehicle Type	Frequency	Percent (%)
Automatic Compactor	66	16.8%
Tipper	145	36.8%
Skip Truck	82	20.8%
Roll-on-Roll-off Truck	98	24.9%
Others	3	0.8%
Total	394	100.0%

Source: Field work, 2025

The Automatic Compactor is used as indicated by 16.8% of respondents, while only 0.8% said other vehicles such as pickups are used by residents to move wastes from interior to the designated collection points.

The findings on the vehicle used for waste collection provide insights into the capacity and efficiency of waste collection services in Karu. The dominance of Tippers and Roll-on trucks suggests that waste collection services in Karu may prioritize bulk waste collection over more specialized or compact waste collection methods.

The relatively low proportion of Automatic Compactors used for waste collection may indicate a need for more efficient and compact waste collection technologies in Karu. Additionally, the use of Skip Trucks and Roll-on-trucks may suggest that waste collection services in Karu are adapted to handle a variety of waste types and volumes.

Table 3: Which Service Will Be Effective In Karu For Waste Collection

The results of the survey indicate that respondents in Karu have varying opinions on who is best to manage the waste problem. The majority of respondents (57.9%) believe that a public-private partnership is the most effective way to manage waste, while 25.9% believe that government agencies should take the lead.

Entity	Frequency	Percent
Government Agencies	102	25.9%
Private Organizations	59	15.0%
Public-Private Partnership	228	57.9%
Individuals	5	1.3%
Total	394	100.0%

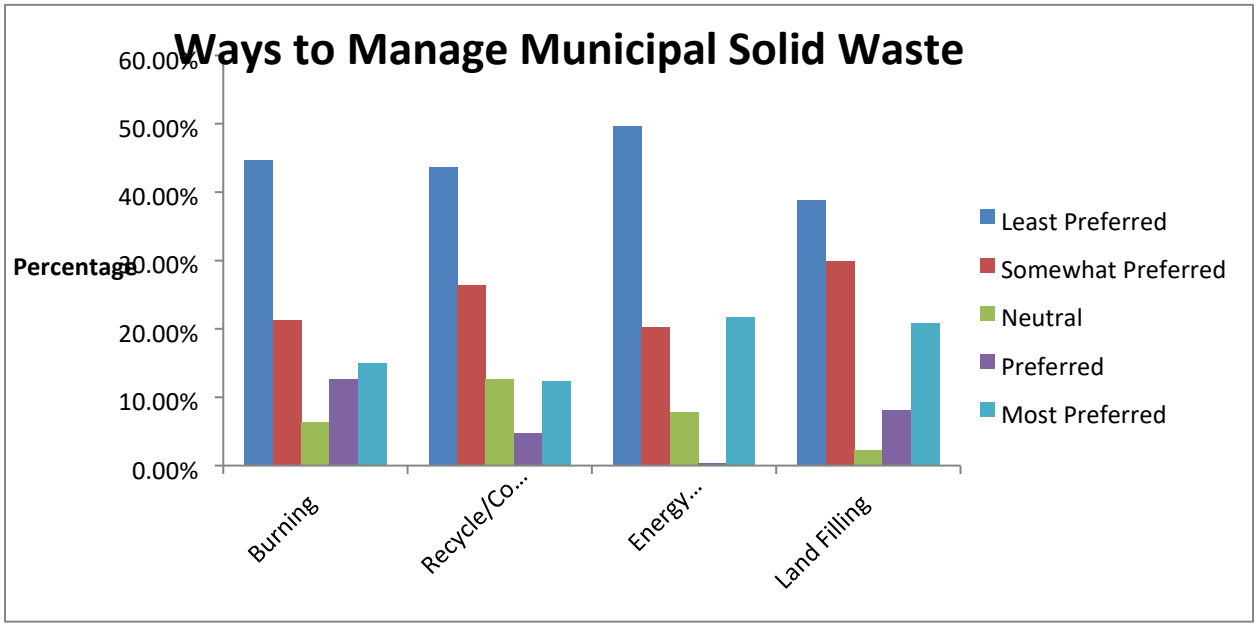
Source: field work, 2025

The private sector has not been engaged in municipal solid waste management in Karu though some areas have shown the presence of private sector participation. 14.2% of the respondents said the waste is collected through private companies to dumpsites. As highlighted municipal solid waste management is a challenging task for NASWAMSA due to insufficient waste collection equipment and personnel.

In a study by Babalola et al. (2010) revealed that inadequate infrastructure and funding are obstacles to a successful waste management system. Iriruaga (2012) stated that without monetary resources to buy waste trucks and waste bins, build and maintain waste sorting facilities, local government are completely incapable of operating successful waste management facilities.

4.3 Ways to Manage Municipal Solid Waste in Karu

The results of the survey indicate that respondents in Karu have varying opinions on environmentally friendly ways to manage municipal solid waste. The majority of respondents (44.7%) rated waste burning as their least preferred option, while 15.0% rated it as their most preferred option.



Fiqure 2: Ways to Manage Municipal Solid Waste in Karu Source: field work, 2025

Due to poor waste collection services, focus group discussions with respondents established that most residents of the study area burned (45.0%) and openly dumped (31.1%) their own waste corroborating the findings of Babayemi & Dauda (2009), Daffi & Kassam, (2013), found that Nigerians consider dumping and burning a cheap and cost-effective way of disposing of their waste.

5.0 CONCLUSION AND RECOMMENDATION

This research set out to assess the municipal solid waste collection and transportation challenges confronting Karu Local Government Area, a rapidly expanding peri-urban settlement within Nigeria's Abuja metropolitan region. The evidence gathered paints a sobering picture of a waste management system struggling under the weight of population growth, inadequate infrastructure, and institutional weaknesses that leave residents particularly those in low-income and peripheral neighborhoods without reliable access to basic sanitation services.

Just as studies in other Nigerian cities have shown, Karu's waste collection exhibits clear geographic bias, with commercial areas and main roads receiving preferential service while interior residential neighborhoods often home to the most economically vulnerable populations are systematically excluded. This isn't merely an inconvenience; it's a fundamental denial of environmental justice that exposes already marginalized communities to disproportionate health risks from blocked drains, contaminated water, disease vectors, and toxic smoke.

The vehicle fleet analysis reveals technological inadequacy that compounds these problems. The dominance of basic tipper trucks over more efficient automatic compactors, combined with frequent vehicle breakdowns and the reliance on only five collection points for the entire municipality, demonstrates infrastructure investment that falls short of what is required.
The environmental and public health consequences of continuing on the current trajectory are too severe to ignore. Contaminated groundwater, disease transmission through vectors breeding in uncollected waste, respiratory illnesses from burning garbage, and the loss of potentially recoverable materials represent both immediate human suffering and long-term economic costs that dwarf the investment required for proper waste management. Karu stands at a crossroads: it can continue managing waste through informal, environmentally destructive methods that condemn residents to preventable illness and environmental degradation, or it can embrace the comprehensive reforms this research identifies as necessary for sustainable, equitable service delivery.

Based on the empirical findings and analysis presented in this study, the following recommendations are proposed to address the critical waste collection and transportation challenges in Karu Local Government Area:
Ultimately, this study demonstrates that Karu's waste challenge is solvable but requires fundamental transformation rather than incremental adjustments. The components of an effective system are clear: adequate collection infrastructure distributed equitably across all neighborhoods, appropriate technology deployed where it can maximize efficiency, professional management insulated from political interference, sustainable financing through innovative public-private arrangements, and participatory governance that gives residents voice in service design. What's lacking is the political will to make these changes and the institutional capacity to implement them consistently.

The limitation for the research was the sampling of 400 respondents drawn across seven neighborhoods represents a reasonable cross-section of the study area, Karu LGA is large, diverse, and rapidly changing. Certain sub-communities, particularly the most remote or informal settlements, may remain underrepresented in the data. The findings therefore capture the dominant patterns across the study area but cannot claim to speak equally for every pocket of the local government.

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