



# American Journal of Interdisciplinary Research and Innovation (AJIRI)

ISSN: 2833-2237 (ONLINE)

VOLUME 4 ISSUE 4 (2025)

PUBLISHED BY  
E-PALLI PUBLISHERS, DELAWARE, USA

## Survey on Waste Management Challenges: A Case Study

Ali Isa<sup>1\*</sup>, Saidu Baba<sup>2</sup>, Mallam Musa Aji<sup>2</sup>, Mohammed Bashir Ibrahim<sup>2</sup>, Abubakar Lawan Gajerima<sup>1</sup>

### Article Information

**Received:** April 22, 2025

**Accepted:** May 27, 2025

**Published:** December 10, 2025

### Keywords

*Maiduguri, Sanitation, WASH, Waste*

### ABSTRACT

Waste management is fundamental services that is crucial for the protection of human health and the larger environment before all organs of government and relevant stakeholders. Waste management challenges had been a subject of discussion by intellectuals for years, so as to achieve a healthy working environment globally. This study explores on waste management challenges bedevilling Maiduguri metropolis and environs. The study employed a survey research design. The study targeted population were individuals situated within Maiduguri metropolis in 21 wards. 397 representing (71%) of the total population 56159 was used as sample size. The structured questionnaire was coded and randomly administered to respondents in the language they understood, and the outcomes were analysed using online (Kobo Toolbox). The results were presented in tables using frequency count and percentage. The outcome of the survey reveals (79%) predominantly male while (21%) were female. The study further depicted a significant proportion of civil servant making the largest group of respondents (54). The findings show (60%) infrastructure challenges, (72%) poor drainages constructions, and (75%) understaffing. The findings also revealed socio-economic and governance factor in waste management where (62%) of respondents identified poverty as a major factor, while (75%) agreed that poor leadership is a significant challenge. The study identified (55%) as lack of education and poor coordination (73%) as contributing factors. The study suggests multifaced approach to address waste management challenges by incorporating capacity building, infrastructure development and community participation. The study recommends capacity building training for waste management staff, structured waste collection points, community participation in decision making, focusing on modern sanitation infrastructure, and ensuring realistic funding. The study findings offer treasured insights for waste management practitioners, community leaders and government at all level seeking for better and improve waste management in Maiduguri and similar contexts.

### INTRODUCTION

Waste management is fundamental services that is crucial for the protection of human health and the larger environment. Waste management challenges have been a subject of deliberations by researchers for a sustainable health promotion and healthy working communities globally. Proper waste management is an intervention that lessens or protects humans from exposure to various types of diseases, ensuring a clean environment and a clear measure that will interrupt disease transformation (Ambrus, 2016). Generation of waste has drastically increased around the world, having less than 20% of waste recycled every year. Advocates around the globe via the Sustainable Development Goal 12 encouraging for changing how we consume, produce, and dispose waste, the significant of driving a sustainable future is on how we dispose of our waste (Raphela *et al.*, 2024). Proper waste management activities begin with waste generation, categorization, safe collection, treatment, transportation, disposal and recycle (Jimme *et al.*, 2019). Waste management also includes partnership to innovate new ideas and facilities for a better human and environmental

health. This is stalwartly related to the World Health Organizations concept of health programmes which tries to provide individuals with proper health benefit and help improve the larger public health (WHO, 2020).

The capital city of Borno State, Maiduguri, has experienced fast urbanization due to displacement instigated by the Boko Haram insurgency (Nkwocha *et al.*, 2020). This has put immense pressure on the city's limited infrastructure, which including waste management services. The ensuing waste management challenges in Maiduguri metropolis can be attributed to several factors (Buba *et al.*, 2024). The available waste management infrastructure in Maiduguri is inadequate to address the growing population (Buba, *et al.*, 2024). These challenges resulted to the accumulation of waste in unauthorized areas, leading to environmental pollution and possible health hazards. Majority of Maiduguri dwellers are less informed of the importance of proper waste disposal and the consequences of poor waste management in the municipal (Mohammed *et al.*, 2022).

Waste generated by households, industrial premises, schools, hospitals, care homes, prisons, streets, markets,

<sup>1</sup> Department of Water Sanitation and Hygiene, Faculty of Physical Sciences, University of Maiduguri, P.M.B 1069 Maiduguri, Borno State, Nigeria

<sup>2</sup> Department of Geology, Faculty of Physical Sciences, University of Maiduguri, P.M.B 1069 Maiduguri, Borno State, Nigeria

\* Corresponding author's e-mail: [isaali38@unimaid.edu.ng](mailto:isaali38@unimaid.edu.ng)

abattoirs, public toilets, bus stops, parks, and gardens, known as Municipal Solid Waste, is in a very difficult situation in developing countries (NPOSWM, 2020). Gloomily, this peril (waste management challenges) is increasing day by day, solid waste clog in gutters, streets, high-ways, markets, rivers and public buildings, leading to undiscerning open burning among the communities resulting to poor condition of environment. Ezeudu (2020) pointed out that waste generated by 106 million people currently living in Nigeria's cities is about 67,000 tons per day (TPD), and this value is anticipated to surpass 125,000 TPD by 2040. Lagos generates 119,320 tons per day, 7,051,800 tons per year, Abuja the capital city generates 235 tons per day, 644,018 tons per year, and Sokoto generates 383 tons per day, 139, 950 per year as of 2022.

Maiduguri metropolis and environs daily solids waste generation rose from 390 to 570 tons per day (UNDP, 2016). According to National Bureau of Statistics 2021 report the population of Maiduguri has dramatically increased from 660,302 in 2006 to 1,493,273 in 2021 (NBS, 2021). The unexpected increase in population of internally displace persons to the capital city and environs is increasing the volume of waste generation and aggravating the smooth addressing of the waste management challenges. The un-evacuated waste is endangering the population and affecting the aesthetic view of Maiduguri and environs mainly as a result of the accretion of fabulous volume of waste joined with the amassed pollutants. Rainfall and moisture usually aid in the replication of pathogens, contamination of water bodies through leaching and possible outbreak of diseases. These challenges are rendering the populace of Maiduguri metropolis to discomfort and fear of possible outbreak.

The highlighted waste management challenges have made some part of the municipal look infuriating and clumsy especially the areas with population density. Notwithstanding investigation by researchers in the last five years on waste management issues, the waste challenges still continue posturing potential risks to the general public and environmental safety. In view of the above background this study was conducted to address the lingering waste management challenges bedeviling Maiduguri metropolis of Borno State. The study underscored an in-depth understanding of the challenges of waste management practices. The study further edifies the general public on the ideals of proper waste management. The findings may also serve as a database for researchers in carrying out further investigation.

## LITERATURE REVIEW

### Brief Concept of Waste Management Challenges

Nigeria is amongst the African countries with higher population increases in sub-Saharan and is currently rassing with enormous socio-economic issues such as unemployment, water supply, sanitation, high poverty rate, electricity short supply, economic recession and

underperforming agricultural activities. Judging by the measure of economic and political importance, urban sanitation system ranks low among the government's priorities. This has to do with the substantial increase in volume of waste generation in the sixteenth century when people began to move from rural areas to urban as a result of corruption, unemployment, industrial revolution, poverty, displacement and for a greener posture. The migration of people to cities usually lead to high population increase which directly lead to a surge in the volume of waste generation. The proportion of population in cities and communities increases the indiscriminate littering in open spaces, roads sides and public buildings. These dumps sites in turn become breeding ground for rodents and other vermin, posing significant risks to public health (Williams, 2005).

The human waste disposal has been one of the most essential parts of civilization activity for years, which is expected to be managed and maintain properly (WHO, 2020). The history behind human faeces management began right from the use of clay sewage pipes in 4000 before the common era (BCE) to indoor plumbing systems and to flush toilets in the modern world. This revolution has been vital in human, environmental health development and economic prosperity (UNICEF & WHO, 2020). Notwithstanding the efforts being implemented on the challenges of waste management, billions of people's right to enjoy safe sanitation are hindered (WHO, 2020). World Health Organization reported more than half of the world's population are into sanitations services that mostly leave human waste untreated especially in developing countries. These acts are threatening both human and environmental health safety. On general notes, the effects of poor sanitation and hygiene practices are upsetting the developing countries and public health at large. Nevertheless, many developing countries have made positive progress in tackling waste management challenges which help in transforming lives, the environment and the economic development. Reports by WHO shows countries such as India, Ethiopia and Nepal have drastically reduced open defecation which contributed in the progress towards accessing universal basic sanitation and hygiene (WHO, 2020).

The reports of World Health Organisation in 2020 highlighted that achieving universal access to safe sanitation will be expensive, and inaction brings even greater costs (WHO, 2020). Neglect to poor waste management will result to recurrent and unbearable increase of healthcare costs, income and waste of educational opportunities, loss of productivity, and increase of environmental pollution (WHO, 2020). Research and innovations in water sanitation and hygiene particularly safe management of sanitation services will avert the costs and generate positive outwardness across communities (UNICEF, 2022). The socio-economic benefits of waste management have been estimated at about five times the cost of lack of it (UNICEF, 2020). In other to hasten progress, sanitation is defined

as an essential public matter that needs all hands-on deck (UNICEF and WHO, 2020). Government and relevant stakeholders at all level most take this view and accelerate investment in research and innovation on waste management services, to ensure society reaps the benefits rather than just privileged (WHO, 2020).

The speedy generation of municipal solid waste is leading to environmental pollution, health risks, and economic losses (Wunubo *et al.*, 2017). The Federal Government of Nigeria has established the National Environmental Waste Management Regulations, 2009, to provide a framework for the management of solid waste (Federal Government of Nigeria, 2009). However, the implementation of these regulations has been challenging due to issues associated with institutional capacity, corruption, inadequate funding, and poor public awareness (Dauda & Osita, 2003). Therefore, there is a need for a comprehensive modern waste management approach to address these challenges sustainably.

### Waste Management Challenges

Investigations in the field of waste management challenges had shown significant presence of lack of institutional arrangement, insufficient financial resources, absence of bylaws and standards, insufficient information on waste quantity and composition and in appropriate technology as the main challenges in developing countries (Ferdoush *et al.*, 2024). Waste management challenges often to be serious in developing countries with poor sanitation practices and poor policies implementation (Akpabio *et al.*, 2021). This situation may as well result to desertification, shrinking of water sources, poor water supply which is growing the challenges of providing adequate sanitation and hygiene practices by governments and other relevant sanitation service providers in the region (Ohwo & Agusomu, 2018). A significant disparity exists in the efficiency of municipal solid waste collection between developing and developed countries. Research by Yadav and Samadder (2018) revealed that the efficiency of municipal solid waste collection in developing countries stands at 40%, which is substantially lower than the 90% efficiency rate observed in developed countries. Furthermore, a notable difference in priorities exists between developed and developing countries regarding waste management practices.

The United Nations strongly emphasise on sustainable practices, power generation, and safe disposal of municipal solid wastes. Majority of developing countries primarily focus on safe disposal, with less attention to sustainability and power generation (Marešová *et al.*, 2023). In developing countries, substantial disproportions in solid waste management exist, often impaired by wealth gaps. A study in South Africa revealed, the affluent population indicates greater proficiency in waste disposal against the impoverished, who face the effects of inadequate or poor waste management and government inaction (Kalina *et al.*, 2023). In essence, the concerns of developed countries and the United Nations for sustainable use, power

generation, and safe disposal of municipal solid wastes is to ensure and improve human and environment health so as to avert outbreak (Marešová *et al.*, 2023). Furthermore, in developing countries, there exists a notable disparity, exemplified by extreme cases of wealth gaps compared to developed nations.

Asian countries have been more practical in propagating waste management policies to compared to most African countries. Particularly, Middle East and West Africa countries having significant inadequacies in waste management models. An instance in Guinea shows, the poor widespread practice of open incineration in landfills or communities poses a serious threat to environment of local populations and to the entire living (Onyeabor *et al.*, 2024). This poor sanitation practices highlights gaps in effective local regulatory systems and inadequate waste management infrastructure. Generally, numerous factors contribute to the poor implementation of waste management policies. Kumar *et al.* (2024) in a study conducted on challenges of environmental health in wastes management for peri-urban areas revealed improper wastes management poses serious risk to the human and environmental health. Kumar further pointed out that less awareness among the general public on proper wastes management practices is exacerbating the problem and suggested citizen education on appropriate wastes disposal habits, efficient Municipal Wastes Management Planning, funding, sustained street sweeping and cleaning as a possible and sustainable solution.

Friedrich and Trois (2011) conducted a study in Morocco, which depicted, despite the establishment of 25 solid waste disposal and recycling centres, lack of adequate funds and environmentally friendly treatment options has resulted in poorly waste disposal, which is posing a potential threat to groundwater and the environment. This finding indicated a gap on policy implementation especially when it deals with large population.

Amos *et al.* (2024) conducted a study which depicted Osun state wastes management agency is not performing enough to its responsibility which is leading to delay in collection of wastes. The waste services of the municipal and social control towards it, is majorly executed by micro and macro scale enterprises with limited contribution of the agency that is saddled with such responsibilities. Oluwaseun and Olayemi, (2023) revealed in a study that the private wastes enterprises was primarily responsible for solid wastes collection using door-to door methods in providing its service. However, Jazat *et al.* (2023) reported that a greater government at all level and stakeholders' involvement in solid wastes collection in Ibadan North, Ibadan Northwest and Ibadan Northeast LGAs.

An assessment conducted by (Mukhtar & Akan, 2018) in Maiduguri metropolis reveals that many people do not observe the mandatory Monthly Sanitation Day slated for the last Saturday of every month as expected which is specifically meant to neat their areas. An attitude observed by earlier studies shows that average Nigerian views sanitation and management as the duty of either Local,

State or Federal Government and not the communities that generate them. This and other possible factors are affecting the Borno State Environmental Protection Agency BOSEPA which has resulted to poor evacuation of wastes generated in Maiduguri metropolis on daily basis. These gaps indicate the reasons behind huge backlogs of refuse piled up in most neighbourhoods (Chiroma *et al.*, 2016).

Majority of people in developing countries sometimes don't show sense of concern when it comes to an issue that is of public in nature. Many are tied to every public challenge is purely government responsibility and this is happening because the policy makers are not adequately allowing community participation in all angles of a project and in decision making. Several literatures revealed proper leadership is a key in attaining every meaningful project where lack of it is next to failure. Similarly, corruption signifies the most substantial resistance to policy improvement for less developed countries to which Nigeria is inclusive. In Nigeria, poor leadership and corruption is affecting many developmental projects, for instance, the organic content of solid wastes in Nigeria is around 63.6%, which can be exploited not only to power generation but to provide jobs (Temidayo, 2024).

Notwithstanding the existence of good policies, corruption and misappropriation of fund and resources have significantly hindered the effective implementation of waste management projects sustainably. For instance, Nigeria's 1999 solid waste management policy remains unimplemented due to these challenges (Ayodele *et al.*, 2024). In many developing countries lacking a working waste management system, alternative approaches have been employed. In Malaysia, an educational approach to foster awareness and understanding of waste classification and management among local communities has been implemented and is yielding good results (Moh, 2017). This strategy appreciates the impact of community participation and education in implementation of policies and promoting effective waste management practices. Community engagement and accountability may also help in tackling corruption at all levels and in addressing majority of the issues clogging the addressing of wastes management sustainably.

Thus, a comprehensive investigation of waste management challenges is crucial for shaping the future of global health and advancing effective waste management practices. Despite efforts, the collection, transport, storage, treatment, and disposal of waste within Maiduguri Metropolis and environs are still facing premature operations.

## MATERIALS AND METHODS

This study utilised a survey research design. The research design was is considered suitable because it enables recent data collection in surveys. The study area is Maiduguri metropolis and environs. Maiduguri is situated between latitudes 11°44'42"N and 11°56'6"N and Longitudes 13°2'24"E and 13°19'30"E. The population of the study

are individuals randomly selected from a total population of 56159 in 21 wards in Maiduguri Metropolis and environs, Borno State, Nigeria.

The sample size of this study was statistically determined where a sample size of 397 out of 56159 households in Maiduguri and environs was used, by substitution using Araoye (2004) finite formular. The sample size represents 71% of the population and was considered satisfactory for the study.

$$nf = \frac{400}{1 + \frac{400}{56159}} = \frac{400}{1 + 0.0071} = 397.2 \approx 397$$

The study used both primary and secondary data. This was to ensure recent information are observed, recorded and obtained. The questionnaire and interview were administered to general public within the 21 wards using online (Kobo Toolbox). The questionnaire was read out in the major public language and was randomly administered to the respondents.

The study in adherence to ethical standards obtained at a sport verbal consent and uphold confidentiality. The data collected were analysed with online kobotool box by adopting simple descriptive statistics using means of frequency counts, tables and percentage.

## RESULTS AND DISCUSSION

**Table 1:** LGA Distribution

Local Government Area	Frequency	Percentage (%)
Maiduguri Metropolitan Council	205	52
Jere Local Government Area	128	32
Mafa Local Government Area	39	10
Konduga Local Government Area	25	6
Total	397	100

Table 1 represent the local government areas of the study where Maiduguri Metropolis was having 52% respondents, Jere with 32%, Mafa having 10% and Konduga with the least 6% respondents recorded.

**Table 2:** Distribution of wards

Wards	Frequency	Percentage (%)
Maisandari Ward	41	10
Bolori II Ward	41	10
Old Maiduguri Ward	35	9
Gwange II Ward	33	8
Mafoni Ward	22	6
Ngomari Costain/ kaleri Ward	23	6
Hausari Ward	25	6

Gamboru Ward	20	5
Shehuri North Ward	21	5
Gwange I Ward	21	5
Gwange III Ward	21	5
Shehuri South Ward	16	4
Limanti Ward	16	4
Bulabulin Ward	11	3
Bulumkuttu Ward	6	2
Ngomari Airport Ward	8	2
Bolori I Ward	8	2
Lamisula Jabamari Ward	8	2
Bale Galtimari Ward	8	2
Mairi Ward	8	2
Mashamari	5	1
Total	397	100

Table 2 highlighted ward distribution of the study where majority were from Bolori II with 10% and 10% respondents in Maisandari respectively, Old Maiduguri and Gwange II with 9% and 8%, Mafoni having 6%, Ngomari Custain/Kaleri with 6%, Hausari 6%, Gamboru 5%, Shehuri North, Gwange I and Gwange with 5% each, Shehuri South and Limanti 4% each, Bulabulin 3%, Bulumkutu 2%, Ngomari Airport, Bolori I, LamisulaJabamari, Bale Galtimari and Mairi are having 2% and Mashamari 1% respondents identified.

**Table 3: Gender Distribution**

Gender	Frequency	Percentage (%)
Male	315	79
Female	82	21
Total	397	100

Table 3 outcome on the gender distribution of the study, depicting a significant majority of males as 79% and a minority of females as 21% responses.

**Table 4: Age Status Distribution**

Age	Frequency	Percentage (%)
26-40	263	66
41-55	83	21
18-25	38	10
56- above	13	3
Total	397	100

Table 4 finding is on the age distribution of study, revealing a significant majority of respondents with 66% within the 26-40 years age bracket, followed by 21% between 41-55 years with 10% between 18-25 years, and 3% aged 56 years and above responses.

**Table 5: Educational Status Distribution**

Education	Frequency	Percentage (%)
Students	125	31
Secondary Education	113	28
NCE/Diploma Education	81	20
Degree/HND Education	65	16
Master and above	13	3
Total	397	100

Table 5 results on the educational categorization of the study shows students undergoing studies having 31%, Secondary certificate holders having 28%, N.C.E/ Diploma holders with 20%, Degree/HND with 16% and Masters and above recorded 3% responses.

**Table 6: Employment Status Distribution**

Employment	Frequency	Percentage (%)
Civil Servant	216	54
Business	142	36
Others	39	10
Total	100	3

Table 6 is on the employment status of the respondents depicting 54% identified as civil servant, 36% as business and 10% representing other occupations. This shows majority of the respondents where civil servants representing 54%.

**Table 7: Responses on Waste Management Challenges**

Challenges	Frequency	Percentage (%)
Drainages Open waste dumping and in public buildings, uncompleted buildings, road side etc.	293	74
Uncontrol population growth	140	35
Inadequate waste collection points	293	74
Inadequate staff and engagement of feeble individual	296	75
Inadequate of modern waste infrastructures	241	61
Poor education system	219	55
Poor Coordination with stakeholders	289	73
Poor Economic policies	247	62
Lack of proper leadership at all level	296	75
Poor drainage structures	287	72

Table 7 results are on a question “What are the challenges of waste management within your area?” the findings highlighted open waste dumping in drainages, public buildings, uncompleted buildings, road side etc recorded 74% responses. Rapid population growth recorded 35% responses. Lack of specified waste collection points and containers the respondents view recorded 74%. Understaff and engagement of weak hands also recorded 75% responses. The result further shows 61% responses on the lack of modern sanitation infrastructure. The outcome further reveals on lack of education recorded 55% and on lack of proper coordination the findings show 73%. Poverty is also considered as a major factor 62%. The findings on poor leadership 75% responses and poor drainages construction recorded 72% responses.

### Discussion

The study in its quest to address waste management challenges in Maiduguri metropolis conversed the findings on demographic which revealed a diverse range of characteristics amongst the respondents. Geographical distribution shows, majority of the respondents (52%) were from Maiduguri Metropolis, with wards spread across various areas, such as Bolori II and Maisandari (10% each). The study further shows reasonable disparity in gender distribution, where males having 79% of respondents and females with 21%. The age distribution shows 66% mostly adult population respondents between 26-40 years old.

The outcome on educational and employment highlight mixt status of the respondents. The majority (31%) were students undergoing studies and (28%) held secondary certificates, while civil servants having (54%) comprised the largest group of respondents. This has the support of a study conducted by Oluwaseun and Olayemi (2023) on solid wastes management practices in Ibadan indicated majority of the respondents had formal education (61.5%), which means that the respondents are in position to make reasonable contributions that help in conducting this study. Similarly, Amos *et al.*, (2024) in a study conducted on assessment of municipal solid wastes management system in Oshogbo, reveals a larger proportion of respondents (27.3 %) attained an educational level of undergraduate program. Additionally, a study conducted by Umadhay (2025) revealed Academic attainment covers exceptional performance across various field within and beyond the classroom. This study demographic characteristics provide an insight into the waste management challenges and may as well have implications for the findings and generalizability. The study outcome simply depicted knowledgeable people usually have good understanding while dealing with investigations. This has significantly facilitated the study where the majority of the people had at least primary school education.

The collective demographic findings have painted a picture of a diverse sample with different characteristics.

The dominance of males (79%) over female with 21%, adults (66%), and civil servants (54%) may reflect the study’s focus or societal factors. This finding opened a unique insight into waste management challenges investigations, particularly from a male perspective, while also highlighting the need for female stakeholders’ engagement in decision making processes. Literatures have shown that women are often at the forefront bearing the primary responsibility for household waste management, yet, are underrepresented in decision making especially that of waste management processes (UNEP, 2019). This discrepancy can lead to an ineffective wastes management services, because of the disregarding the needs and perspectives of women and other marginalised group. The spread of wards across different local government areas provides a broad geographical representation, while the diverse educational fulfilment highlights the complexity of the sample. These discoveries can be a guide to future studies and policy interventions aimed at addressing the needs and concerns of the population. Engagement of varied community-based initiatives will foster a better outcome in waste management decision-making processes, a sense of responsibility and promoting environmental awareness.

The study’s results on waste management challenges shows a multitude of issues where one of the most significant challenges is open waste dumping having 74% responses, and Lack of well level designated waste collection points and containers with 74% meaning waste is often dumped in drainages, public buildings, uncompleted buildings, and roadside due to poor specification of wastes collection centers which is hindering effective waste management. These poor practices do not only contribute to environmental degradation but also poses potential risks to human and community health.

Similarly, the study also highlights the role of systemic and infrastructural challenges, 75% responses show the significant challenges of understaffing and the engagement of weak personnel as major challenges, while 61% identified the lack of modern sanitation infrastructure. Additionally, poor drainage construction was identified with 72% responses that this challenge also contributes to waste management difficulties. Addressing waste management challenges will require a multifaceted approach that includes infrastructure development and capacity building to staff and contributions of all relevant stakeholders.

The findings further point to the role of socio-economic and governance factors where 62% responses show poverty as a major factor, while 75% indicated poor leadership as a significant challenge. Lack of education 55% and poor coordination 73% were also identified as contributing factors. These findings underscored the need for a comprehensive approach to addressing waste management challenges, one that takes into account the complex interplay of factors contributing to the identified challenges. Asia and Africa has presented rapid growth of solid waste generation which happens to be serious

challenges to the existing waste treatment infrastructure over the past decade (Adam *et al.*, 2021). The needs for a proper implementation of wastes management policies are now not tomorrow and must be adhered properly to ensure a safer and healthy environment by all.

Waste management requires effective awareness measures, well-informed and educated mindset contributions, as lack of awareness can exacerbate problems and lead to widespread issues. Appropriate coordination involving relevant stakeholders including community participation are essential components of successful waste management projects and will directly impact the general public. Furthermore, capacity building to waste management staff through training and retraining is crucial for efficient and effective service delivery, so as to enable updated skills and work within targeted periods.

Inadequate funding is unequivocally accepted as a threat to any progressive projects. Therefore, injecting adequate funding for research and capacity buildings are crucial for the success of any project, including waste management initiatives. Unsatisfactory funding can hinder effective waste management achievement, particularly in developing countries with a rapidly population growth having high waste generation increases. Moreover, inadequate funding and failing to hold offenders accountable for improper waste disposal can lead to understaffing, placing undue stress on existing personnel, perpetuate a culture of non-compliance, encouraging others to engage in similar behavior and ultimately affecting productivity.

In essence, the waste management system in Maiduguri and its surrounding areas is characterized by unprofessional practices, relying heavily on vulnerable hands to collect and dispose of waste. This approach poses serious environmental and health risks highlighting the need for a more structured and sustainable waste management system.

## CONCLUSION

In conclusion, this study provides valuable insights into the demographic characteristics and waste management challenges in Maiduguri and its environs. The findings reveal a diverse sample with varying characteristics, including a predominantly male population, adults, and civil servants. The study reveals that effective waste management is hindered by multiple challenges, including open waste dumping, lack of designated collection points, understaffing, poor sanitation infrastructure, and poor leadership. The current unprofessional practices of waste management services, which rely on vulnerable individuals, pose significant environmental and health risks, underscoring the need for a more structured and sustainable waste management system. Addressing these challenges requires multifaceted approach, incorporating infrastructure development, capacity building, and community participation. Furthermore, adequate funding for research and capacity building is crucial. Engagement of the community members in decision making processes can foster a sense of responsibility and promote

environmental awareness, ultimately contributing to more effective waste management practices.

## Acknowledgements

We thank all individuals that contributed in achieving this success. We also acknowledged the contributions of Prof. Saidu Baba and the entire staff of National Water Resources Capacity Building Centre University of Maiduguri. Thank you all for the great effort.

## Recommendation

In view of the findings of this assessment, the undermentioned measures are tremendously critical in addressing Maiduguri and environs waste management challenges:

1. Designate specific waste collection points and provide adequate containers to reduce open waste dumping and promote proper waste disposal practices.
2. Provide regular training and retraining programs for waste management personnel to enhance their skills and efficiency in managing waste effectively.
3. Community Engagement and Education: Implement community-based initiatives to educate the public on proper waste management practices, foster a sense of responsibility, and promote environmental awareness.
4. Invest in modern sanitation infrastructure, including proper drainage systems and waste treatment facilities, to address the challenges of poor infrastructure and promote effective waste management.
5. Ensure timely and sufficient fund allocation for waste management activities, and engage in research and development to identify innovative solutions and improve waste management practices.

## REFERENCES

- Ambrus, M. (2016). Access to water services: the World Bank and water rights. *In Socio-Economic Human Rights in Essential Public Services Provision* (pp. 77-94). Routledge. <https://doi.org/10.4324/9781315618081>
- Amos, O., Ademola, O. A., Abiodun, O. A., Olalekan, O. E., Opeodu, O. T., & Bode, A. M. (2024). An assessment of municipal solid waste management system in Oshogbo, Osun State Nigeria: Challenges and prospects. *International Journal of Multidisciplinary Research and Growth Evaluation*, 5(1), 687-696. <https://doi.org/10.54660/IJMRGE.2024.5.1.687-696>
- Araoye, M. O. (2004). Sample size determination. *Research methodology with statistics for health and social sciences*. Ilorin: *Nathadex Publishers*, 2004, 115-8. <https://www.sciepub.com/reference/202819>
- Ayodele, T. R., Ogunjuyigbe, A. S. O., & Alao, M. A. (2017). Life cycle assessment of waste-to-energy (WtE) technologies for electricity generation using municipal solid waste in Nigeria. *Applied energy*, 201, 200-218. <https://doi.org/10.1016/j.apenergy.2017.05.097>
- Buba, I., Monguno, A. K., Ayuba, H., Madueke, K. L., & Ajadi, S. B. (2024). ACRC Working Paper 14. Maiduguri: City report. Maiduguri: City report (May

- 01, 2024). <https://dx.doi.org/10.2139/ssrn.4869448>
- Chiroma, M. A., Shah, M. Z., Isa, A. H., Usman, A. S., Kagu, A., & Ijafiya, I. (2018). Impacts of infill development on land use in Ibrahim Taiwo Housing Estate, Maiduguri, Nigeria. *Advanced Science Letters*, 24(5), 3758-3764. <https://doi.org/10.1166/asl.2018.11479>
- Dauda M., O. O. (2003). *Solid waste management and re-use in Maiduguri, Nigeria*. 29th WEDC International Conference Abuja, Nigeria, 2003. Towards the Millennium Development Goals. [https://repository.lboro.ac.uk/articles/Solid\\_waste\\_management\\_and\\_re-use\\_in\\_Maiduguri\\_Nigeria/9596477/files/17236763.pdf](https://repository.lboro.ac.uk/articles/Solid_waste_management_and_re-use_in_Maiduguri_Nigeria/9596477/files/17236763.pdf)
- Ezeudu, O. B. (2020). Urban sanitation in Nigeria: the past, current and future status of access, policies and institutions. *Reviews on environmental health*, 35(2), 123-137. <https://doi.org/10.1515/andrevh-2019-0025>
- Ferdoush, M. R., Al Aziz, R., Karmaker, C. L., Debnath, B., Limon, M. H., & Bari, A. M. (2024). Unraveling the challenges of waste-to-energy transition in emerging economies: Implications for sustainability. *Innovation and Green Development*, 3(2), 100121. <https://doi.org/10.1016/j.igd.2023.100121>
- Friedrich, E., & Trois, C. (2011). Quantification of greenhouse gas emissions from waste management processes for municipalities—A comparative review focusing on Africa. *Waste management*, 31(7), 1585-1596. <https://doi.org/10.1016/j.wasman.2011.02.028>
- Jazat, J. P., Akande, J. A., & Ogunbode, T. O. (2023). State of solid waste disposal and suggested fixes for Iwo and Ibadan Metropolis, Nigeria. *Frontiers in Sustainability*, 3, 1022519. (<https://doi.org/10.3389/frsus.2022.1022519>)
- Jezza, M. L. (2025). Ethnic Identity, Academic Self-Concept, and Achievement of Blaam Learners Within the Municipality of Tampakan. *American Journal of Interdisciplinary Research and Innovation (AJIRI)*, 4(2). <https://doi.org/10.54536/ajiri.v4i2.4606>
- Jimme, M. A., Musa, A. A., & Sambo, G. H. (2019). Urbanization and its effects on the environment in Maiduguri Metropolis, Borno State, North East, Nigeria. *Jalingo Journal of Social and Management Sciences*, 1(3), 1-18. <https://oer.tsuniversity.edu.ng/index.php/jjsms/article/view/3>
- Kalina, M., Makwetu, N., & Tilley, E. (2024). “The rich will always be able to dispose of their waste”: a view from the frontlines of municipal failure in Makhanda, South Africa. *Environment, Development and Sustainability*, 26(7), 17759-17782. <https://doi.org/10.1007/s10668-023-03363-1>
- Kumar, G., Vyas, S., Sharma, S. N., & Dehalwar, K. (2024). Challenges of Environmental Health in Waste Management for Peri-urban Areas. In *Solid Waste Management: Advances and Trends to Tackle the SDGs* (pp. 149-168). Cham: Springer Nature Switzerland. [https://doi.org/10.1007/978-3-031-60684-7\\_9](https://doi.org/10.1007/978-3-031-60684-7_9)
- Marešová, D., Mareš, K., Alexiou-Ivanova, T., Satyakti, Y., & Pilařová, T. (2023). Evaluating the waste management situation and attitudes of residents in Bandung, Indonesia. *Integrated Environmental Assessment and Management*, 19(1), 114-125. <https://doi.org/10.1002/ieam.4630>
- Moh, Y. (2017). Solid waste management transformation and future challenges of source separation and recycling practice in Malaysia. *Resources, Conservation and Recycling*, 116, 1-14. <https://doi.org/10.1016/j.resconrec.2016.09.012>
- Mohammed, J. (2022). An assessment of the impact of state local government joint account on service delivery in Maiduguri Metropolitan Council, Borno state, Nigeria. *International Journal of Recession, Inflation and Good Governance Quagmire in Africa*, 7(1), 1-15. <https://arcnjournals.org/images/GARC-IJRIGQA-2022-7-1-1.pdf>
- Mukhtar, A., & Akan, J. C. (2018). Assessment of challenges facing solid waste management in Maisandari neighbourhood of Maiduguri Metropolis, Borno State, Nigeria. *Int. J. Res. Innov. Soc. Sci*, 2(7), 170-177. <https://www.researchgate.net/publication/326997567>
- National Bureau of Statistics (NBS, 2019). *National outcome routine mapping of water, sanitation and hygiene services levels in Nigeria: Summary of Survey Findings 2019*. <https://nigerianstat.gov.ng>
- National Policy on Solid Waste Management, (NPOSWM) (2020). *Federal Republic of Nigeria*. [https://nesgroup.org/download\\_policy\\_drafts](https://nesgroup.org/download_policy_drafts)
- Nkwocha, K. F., Iheukwumere, S. O., Shettima, M. K., & Audu, A. (2020). An autopsy of housing challenges in urban Maiduguri. *Open Access Journal of Waste Management and Xenobiotics*, 3(4). <https://doi.org/10.23880/oajwx-16000149>
- Ogunseye, N. O., & Lawal, A. O. (2023, December). Solid waste management practices in an indigenous Nigerian city: a case of Alesinloye in Ibadan. In *Forum Geografic* (Vol. 22, No. 2, p. 170). University of Craiova, Department of Geography. <https://doi.org/10.5775/fg.2023.2.3592>
- Ohwo, O., & Agusomu, T. D. (2018). Assessment of water, sanitation and hygiene services in sub-Saharan Africa. *European Scientific Journal*, 14(35), 308-326. <https://doi.org/10.19044/esj.2018.v14n35p308>
- Onyeabor, E. (2024). Waste Management Perspectives in Some Selected African Regions. In *Environmental Law: International and Regional African Perspectives on Law and Management* (pp. 1027-1056). Cham: Springer Nature Switzerland. [https://doi.org/10.1007/978-3-031-68956-7\\_17](https://doi.org/10.1007/978-3-031-68956-7_17)
- Raphela, T., Manqele, N., & Erasmus, M. (2024). The impact of improper waste disposal on human health and the environment: a case of Umgungundlovu District in KwaZulu Natal Province, South Africa. *Frontiers in Sustainability*, 5, 1386047. <https://doi.org/10.3389/frsus.2024.1386047>
- Temidayo, A. O. (2024). *Human Excreta Estimation for Biogas*

- Production in the University of Abuja, Nigeria* (Master's thesis, University of Abuja, Nigeria). [https://doi.org/10.1007/978-981-19-4921-0\\_2](https://doi.org/10.1007/978-981-19-4921-0_2)
- UNDP. (2016). *North-East Nigeria waste and debris Assessment*. Final report January 2016 (pp. 26-28).
- UNICEF. (2020). *State of the world's sanitation*.
- UNICEF. (2022). *Water, Sanitation and Hygiene Sector-Wide Sustainability Checks Report (2022)*.
- UNICEF and WHO. (2020). *Learning from History*.
- United Nations Environment Programme (UNEP). (2019). *Global Waste Management Outlook*.
- Williams, P. T. (2005). *Waste treatment and disposal*. John Wiley & Sons. <https://doi.org/10.1002and0470012668>
- Wunubo, B., Biame, C. C., & Bukar, M. A. (2017). An assessment of waste management activities of Borno State environmental protection agency (BOSEPA). *Journal of Environment and Waste Management*, 4(1), 173-180. <https://www.researchgate.net/publication/330777875>
- Yadav, P., & Samadder, S. R. (2018). Environmental impact assessment of municipal solid waste management options using life cycle assessment: a case study. *Environmental Science and Pollution Research*, 25, 838-854. <https://doi.org/10.1007/s11356-017-0439-7>