https://dx.doi.org/10.4314/dujopas.v9i3b.6
ISSN (Print): 2476-8316
ISSN (Online): 2635-3490
Dutse Journal of Pure and Applied Sciences (DUJOPAS), *Vol. 9 No. 3b September 2023*

An Assessment of Solid Waste Management in State-Owned Tertiary Institutions, Kano State, Nigeria

[1]Saidu Adamu Haruna, [1]Ahmed Fate Ali and [2]Auwal Haruna Ismail,
[1]Department of Environmental Management,
Bayero University, Kano,
Nigeria

[2]Department of Geography,
Aminu Kano College of Islamic and Legal Studies,
Kano, Nigeria

Email: ahmadpate@yahoo.co.uk

Abstract
The research is aimed at assessing Solid Waste Management in Kano State Owned Tertiary Institutions. Both primary and secondary sources of data were used. Key informant interview was conducted with the head of cleaners using purposive sampling technique. The data collected was analyzed and presented using tables. The research revealed that the type of waste that is most generated in the schools are polythene, papers and dead leaves. The research also discovered that the numbers of cleaners are not enough in the study area when compared to the large portion they are assigned to work on. Also the research discovered that the schools have one main waste collection point with only the School of Management Studies which has two collection points. However, to make waste disposal simpler, tiny drums are positioned throughout the schools in various locations. Some of the major challenges faced in Waste Management in the Schools are lack of cleaning equipment, lack of cooperation from students and problem of managing the workers as most of them are uneducated and are not permanent workers. It was recommended that more cleaners should be employed and the school management should provide more working equipment like brooms, rake, dustbins, cutlass etc. Also the welfare and working condition of the workers should be improved.

Keywords: Solid Waste, Solid Waste Management, Cleaners, Tertiary Institutions, Kano

INTRODUCTION
By 2050, there will be 3.40 billion tons of waste generated worldwide, up from 2.01 billion tons in 2016, according to the World Bank (2019). The generation of solid waste is growing, making management increasingly difficult. Solid waste management refers to the regulation of solid waste generation, storage, collection, transfer, and disposal in accordance with the best practices of public health, economics, engineering, conservation, aesthetics, and other environmental problems. Due to changes in consumption patterns and the quick development of technology, solid waste has altered in both quantity and content. The transportation, storage, and disposal of solid waste become more problematic as their volume rises, making it more difficult to manage solid waste effectively (Mahmud, 2021). Poor solid waste management may put communities at risk of health problems, as well as environmental

**Author for Correspondence*

problems such as air pollution, flooding, water and soil contamination (Abu Qdais, 2007; Molina & Catan, 2021; Sharholy et al., 2008).

In Africa, thousands of tons of solid trash are produced each day. Most of it ends up in open landfills and marshes, where it contaminates surface and ground water and endangers people's health. Only a few cities and regions have generation rates accessible, although they are typically about 0.5 kilos per person per day, sometimes even as high as 0.8 kilograms. The majority of waste in Africa is not collected by municipal collection systems because of poor management, financial irresponsibility or malfeasance, equipment failure, or insufficient waste management budgets, even though this may seem like a small amount in comparison to the 1-2 kg per person per day generated in developed countries (Mahmud, 2021: Ali et al., 2022). Africa produces about 0.5 kg of solid waste per person every day, according to a 2009 assessment by the United States Agency for International Development (USAID). These solid wastes are only partially appropriately disposed of in authorized landfills. The leftovers are either openly dumped without using treatment techniques or are abandoned in public dumpsters since no one is around to properly dispose of them (Pradhan, 2009).

Uncontrolled disposal of solid waste clogs drains and canals and pollutes water sources. Only 20 to 30 percent of the solid waste that Nigeria produces each year is collected (Adeniran et al., 2017). Effective waste management initiatives are generally missing in Nigeria. Less success has been noted despite the fact that laws and regulatory bodies have been developed at the three levels of government (local, state, and federal) to drive the program (Nathaniel et al., 2012).

In the modern world, tertiary institutions can be compared to "mini cities" because of their extensive geographic coverage and variety of human activities, all of which have an impact on the environment to varied degrees (Alshuwaikhat & Abubakar, 2008; Adeniran et al., 2017). The majority of tertiary institutions in Kano state, like most developing cities, fail to collect several tons of municipal solid waste, which clogs sewers, serves as a breeding ground for bugs that spread disease, and leads to a variety of other infrastructure and health problems (Ismail, 2019). This widespread practice is unsustainable and has a substantial negative impact on a number of health and environmental problems. The production and disposal of waste remain a persistent issue that the academic institution still needs to properly address and resolve, despite the institutions' extensive efforts to raise awareness of, educate about, and involve staff and students in initiatives related to solid waste management.

In some cities in Nigeria in general and Kano state in particular, research has been done on the collection and characterization of solid wastes (Nabegu, 2010; Uwadiegwu & Chukwu, 2013; Nwachukwu, 2010; Olukanni & Ugwu, 2013; Longe & Ukpebor, 2008). However, there is little to no information on the generation, management, and difficulties of solid waste generated in the majority of tertiary institutions. In order to fill the gap left by previous researchers, it has become important for this research to examine the solid waste generation and management at a few chosen State-owned tertiary institutions in Kano State.

METHODOLOGY

The Study Area

The pre-colonial walled city established more than 1000 years ago was formerly known as Kano (WUPCBA, nd). The State, which is located in the north-west of Nigeria, has a total land area of 20,131 km2 (7,773 sq mi), or around 3.13% of the nation's 923,000 km^2 of land. Kano state extends from latitude 10^0 30'N to 12^0 30'N and longitude 7^0 30'E to 9^0 25'E (Figure 1).

Jigawa State borders the state to the north and east, Katsina State to the west, Kaduna State to the southwest, and Bauchi State to the southeast (Incekara and Abubakar, 2014). The Metropolis has been one of the nation's most significant business and industrial hubs for many years, drawing millions of visitors from all across the nation and abroad. The population is expected to continue to rise in the upcoming years due to immigration, which has a natural growth rate of 3%, and rising economic activity (Nabegu, 2010).

However, the research is only limited to some selected state-owned tertiary institutions which include Aminu Kano College of Islamic and legal studies with a population of 12,523, Saadatu Rimi College of Education with a population of 20,456, School of Technology with a population of 13,423, School of hygiene with a population of 3105 and School of management studies with a population of 15,432. These schools were selected because they are among the most populous in terms of students and staff in the state

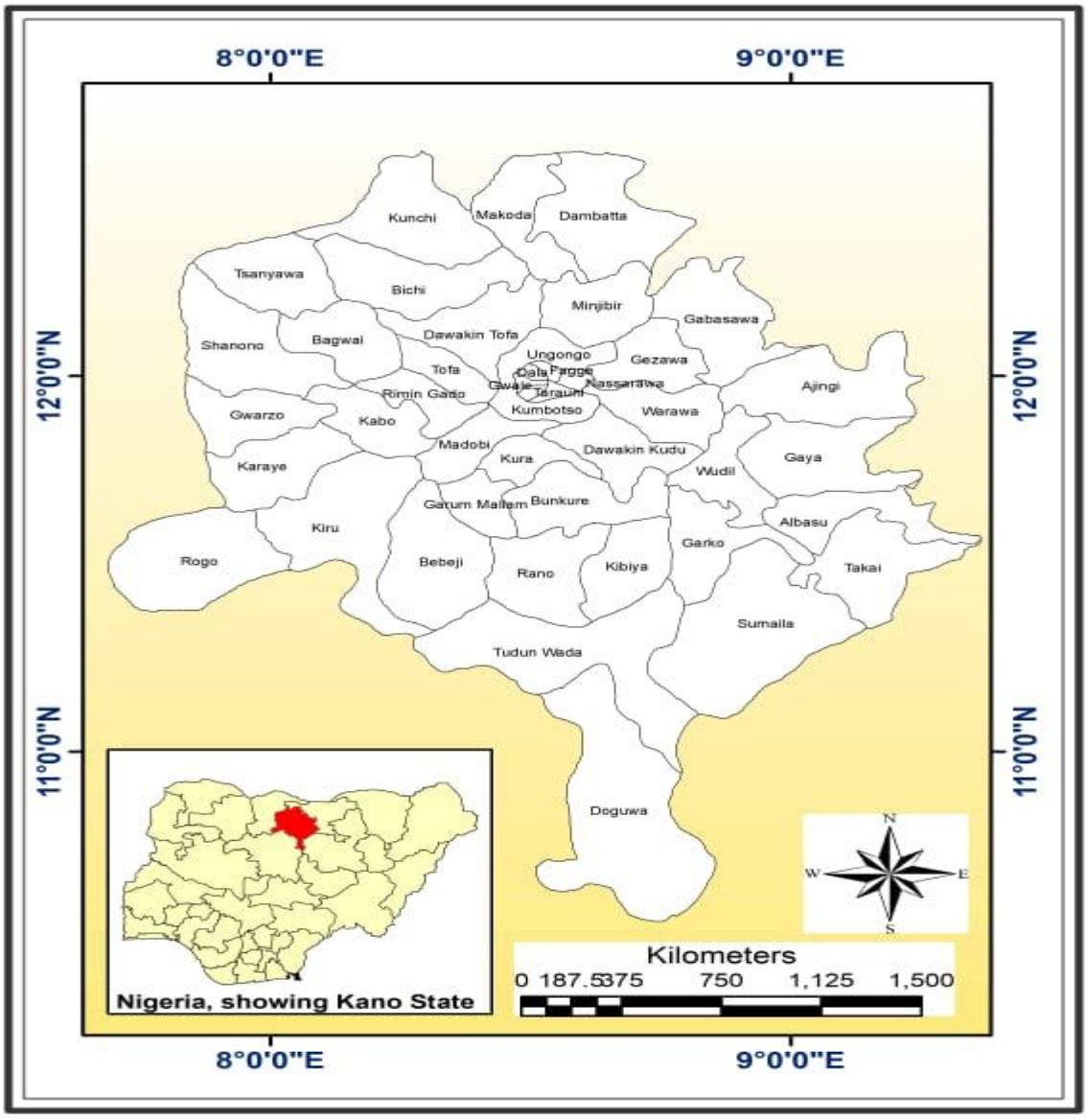

Figure 1: Kano State: The study area
Source: Ismail (2019)

Types of Data
For the purpose of fulfilling the research's objectives, both primary and secondary sources were gathered together with both qualitative and quantitative data. The head of cleaners of the selected tertiary institutions provided the primary data, which was used to learn about the production, difficulties, and management of solid waste in the study area. The secondary data came from books, publications, and earlier research. This makes it easier to comprehend how waste is managed in tertiary institutions.

Data Collection Technique
The researcher used Key informant interview to collect data for this study. The interview was conducted to the various heads of cleaners that engage in solid waste management in the study area. This helps to know the type of waste most generated, their method of solid waste management, challenges and ways to improve waste management in the selected schools.

Sampling
Due to the fact that the study area is geographically large for the research to cover every Kano state owned tertiary Schools, some sampling procedures were adopted which enabled the researcher to get reliable results.

Sampling Frame: The sampling frame consist of the purposely selected five Kano state owned tertiary institutions. The schools include Aminu Kano College of Islamic and Legal Studies, Saadatu Rimi College of Education, School of Technology, School of hygiene and School of management studies. These schools were selected because they have more infrastructure and students which means they produce more waste.

Sampling techniques: For this research, purposive sampling was used in selecting the Kano state owned tertiary institutions and also the heads of cleaners in the selected schools.

Data Analysis and Presentation
The data collected was gathered and analyzed in descriptive format which was presented in a tabular form. This makes it more clear and presentable.

Ethical Considerations
The researcher formally conveys the goals and objectives of the study to the respondents and the management of the schools, highlighting the expected outcomes of the research. All parties involved in the collection of data or any other form of help to the completion of this study, whether directly or indirectly, received introduction letters from the Department of Environmental Management. Before any data was gathered for this study, the respondents' permission was formally obtained. All information gathered for this study was accepted and handled with utmost confidentiality.

RESULTS AND DISCUSSIONS
This section analyses the data collected from the field as described in the methodology. To evaluate the solid waste generation, management, and challenges among the chosen Kano state-owned tertiary institutions in Kano state, data were gathered through interviews and field surveys.

Table 1: Type of Waste Most Generated in the Study Area

Name of School	Type of Waste
Aminu Kano College of Islamic and Legal Studies	Polythene
School of Hygiene	Paper
School of Management Studies	Dead leaves
Saadatu Rimi College of Education	Polythene
School of Technology	Paper

Source: Fieldwork, 2022

Table one shows the type of waste most generated in the study area as revealed by head of cleaners of the selected schools during the key informant interview. Based on the result, the data point that, polythene is the type of waste that is most generated in Aminu Kano College of Islamic and Legal Studies, paper is the type of waste that is most generated in School of Hygiene, dead leaves are most generated in School of Management Studies, polythene is most generated in Saadatu Rimi College of Education while paper is most generated in School of Technology. This indicates that solid waste is most generated in the schools when compared with liquid and gaseous waste. This validates the findings of Al-Khitab et al (2010) that most schools generate solid waste like polythene, paper, plastics etc.

Table 2: Number of Cleaners in the Study Area

Name of School	Number of Cleaners
Aminu Kano College of Islamic and Legal Studies	45
School of Hygiene	20
School of Management Studies	16
Saadatu Rimi College of Education	60
School of Technology	6

Source: Fieldwork, 2022

Table 2 shows the number cleaners in the selected schools. The data indicates that, Aminu Kano College of Islamic Studies have 45 cleaners, School of Hygiene have 20 cleaners, School of Management Studies have 16 cleaners, Saadatu Rimi has 60 cleaners while School of Technology have 6 cleaners. The research further discovered that these cleaners are not enough when compared to the large portion they have to cover every day as revealed by the head of cleaners. In school of management studies for example, 9 cleaners are assigned to offices and the remaining 7 are assigned to classes and the school compound which is clearly not enough. Also each cleaner in the remaining schools is given a large portion which makes their work very difficult. This coincides with the findings of Adeniran et al (2017) that most tertiary institutions are suffering from lack of enough cleaners which resulted to poor sanitation in the schools.

Table 3: Use of Protective Equipment in the Study Area

Name of School	Response
Aminu Kano College of Islamic and Legal Studies	Yes
School of Hygiene	No
School of Management Studies	Yes
Saadatu Rimi College of Education	Yes
School of Technology	Yes

Source: Fieldwork, 2022

Table 3 shows how the cleaners in the schools employ safety gear such as facemasks, boots, and caps. According to the data, cleaners in Saadatu Rimi College of Education, Aminu Kano College of Islamic and Legal Studies, School of Management Studies, and Schools of Technology wear protective gear whereas those in the school of Hygiene don't. The research further discovered that most cleaners supply their safety gear rather than receiving it from the

school administration. Because they cannot afford to purchase all three pieces of equipment, they are forced to use just one piece of protective gear. This affects the health of the cleaners as well as the waste management in the selected schools.

Table 4: Number of Collection Points in the Study Area

Name of School	Number of Collection Points
Aminu Kano College of Islamic and Legal Studies	1
School of Hygiene	1
School of Management Studies	2
Saadatu Rimi College of Education	1
School of Technology	1

Source: Fieldwork, 2022

The number of waste collection points in the schools is shown in Table 4. Saadatu Rimi College of Education, Aminu Kano College of Islamic and Legal Studies, School of Hygiene, and Schools of Technology, per the data, have one main collection site each, whilst the School of Management Studies has two. To make waste disposal simpler, tiny drums are positioned throughout the schools in various locations. According to the research, Aminu Kano College of Islamic and Legal Studies has roughly 40 drums, the School of Technology has 16, the School of Management Studies has 11, the School of Hygiene has 70, and Saadatu Rimi College of Education has 65 drums. These drums are sufficient enough to make it easier for the staff and students to dispose their waste.

Table 5: Government Role in Waste Management in the Study Area

Name of School	Response
Aminu Kano College of Islamic and Legal Studies	No
School of Hygiene	No
School of Management Studies	No
Saadatu Rimi College of Education	No
Kano State Technology	No

Source: Fieldwork, 2022

The table above shows the government's role in waste management in the study area. The research revealed that Kano State government is not playing any role in waste management in the selected schools. The school management is responsible for all matters that involve waste management in the respective schools. This ranges from employing the cleaners, providing the cleaning materials, protective materials etc.

Table 6: Method of Waste Disposal in the Study Area

Name of School	Method
Aminu Kano College of Islamic and Legal Studies	Burning
School of Hygiene	Cape Gate Investment
School of Management Studies	Burning
Saadatu Rimi College of Education	Burning
School of Technology	Burning

Source: Fieldwork, 2022

The method of waste disposal in the study area which was asked during the interview is shown in Table 6 above. According to the data, the method used at Aminu Kano College of Islamic and Legal Studies, School of Management Studies, Saadatu Rimi College of Education, and School of Technology is waste burning. In the School of Hygiene, waste is disposed of by contacting Cape Gate Investment, the government agency in charge of waste management in Kano State. This contradicts with the findings of Amori et al (2013) that most tertiary institution in urban centers has a sustainable way of waste disposal.

Table 7: Effect of Improper Waste Management in the Study Area

Name of School	Effects
Aminu Kano College of Islamic and Legal Studies	Diseases
School of Hygiene	Poor Sanitation
School of Management Studies	Environmental pollution
Saadatu Rimi College of Education	Diseases
Kano State Technology	Poor Sanitation

Source: Fieldwork, 2022

Table 7 depicts the effect of improper waste management in the study area. The data point out that diseases, poor sanitation and environmental pollution are some of the problems that can arise as a result of poor waste management. This is in line with the findings of Mahmud (2021) that improper waste management can leads to various health and environmental issues.

Table 8: Challenges in Waste Management in the Study Area

Name of School	Challenges
Aminu Kano College of Islamic and Legal Studies	1. Lack of cleaning equipments 2. Lack of cooperation from students
School of Hygiene	1. The problem of managing the workers as most of them are uneducated 2. Lack of cooperation from the students 3. Most of the cleaners are casual workers not permanent
School of Management Studies	1. Lack of enough cleaners 2. The workers are always late 3. Lack of cooperation from students
Saadatu Rimi College of Education	1. Lack of enough cleaners 2. Lack of cleaning equipments
School of Technology	1. Lack of enough cleaners 2. Lack of cleaning equipments

Source: Fieldwork, 2022

Table 8 depicts the difficulties encountered by waste management workers in the study area. According to the data, Aminu College of Islamic and Legal Studies is facing challenges such as a lack of cleaning equipment and a lack of student cooperation. The School of Hygiene is confronted with the challenges of managing workers because the majority of them are uneducated, a lack of cooperation from students, and the majority of cleaners are casual workers rather than permanent, causing them to take their work lightly. In addition, the School of Management Studies is dealing with issues such as a lack of cleaners, workers who are constantly late, and a lack of cooperation from students. Similarly, Saadatu Rimi College of Education is facing the challenges of lack of enough cleaners and lack of cleaning equipments. Lastly, School of Technology is facing the challenge of lack of enough cleaners and lack of cleaning equipments. This means that, all the tertiary institutions under study are facing similar challenges in waste management. This corroborates the research findings of Alshuwikat and Abubakar (2008) that poor working condition and lack of cleaning equipments are among the challenges facing waste management in Nigerian tertiary institutions

Table 9: Possible Ways of Solving Problems of Waste Management in the Study Area

Name of School	Solutions
Aminu Kano College of Islamic and Legal Studies	1. Employ more cleaners 2. Provision of more working equipments like brooms, rake, dustbins, cutlass etc
School of Hygiene	1. Increase welfare and working condition 2. Employ more cleaners 3. Cooperation from other workers
School of Management Studies	1. Provision of protective equipments 2. Employ more cleaners
Saadatu Rimi College of Education	1. Increase welfare and working condition 2. Employ more cleaners
School of Technology	1. Cooperation from school management 2. Employ more cleaners

Source: Fieldwork, 2022

Table 9 displays potential approaches for resolving waste management problems in the selected schools. The head of cleaners at Aminu Kano College of Islamic and Legal Studies suggests that hiring more cleaners and providing equipments like brooms, rakes, dustbins, and cutlasses can help with waste management. The head of cleaners at the School of Hygiene suggests that improving welfare and working conditions, hiring more cleaners, and enlisting the assistance of other employees will all significantly improve waste management in the school. The supply of safety equipment and the hiring of more cleaners were both recommended in the School Management Studies. In Saadatu Rimi it was suggested that improving welfare and working condition as well as employing more cleaners will also improve waste management in the school. Finally in School of Technology, the head of cleaners suggested that cooperation from school management and employing more cleaners will improve waste management in the school.

CONCLUSION

Waste management is a significant problem at the state-owned tertiary institution in Kano, as this study has shown. It is obvious that there are not enough cleaners in the schools, which makes managing waste quite challenging. Various tertiary institutions' solid waste management policies and sanitation legislation enforcement, as well as various environmental groups and societies, should be invigorated to work harder until Nigeria's desired clean environment becomes a reality.

It was therefore recommended that the school management should provide more working equipment like brooms, rakes, dustbins, cutlasses etc. There is also a need to employ more cleaners in the schools and the welfare and working condition of the workers should be improved.

REFERENCES

Abu Qdais, H. (2007). Techno-economic assessment of municipal solid waste management in Jordan. Waste Management, 27(11), 1666-1672. https://doi.org/10.1016/j.wasman.2006.08.004

Adeniran, A.E, Nubi A.T and Adelopo, A.O. (2017). Solid waste generation and characterization in the University of Lagos for a sustainable waste management. Elsevier. http://dx.doi.org/10.1016/j.wasman.2017.05.002

Adedibu. A.A (1993). Development control and environmental protection: A case study of Ilorin. A paper presented at the 20th Annual conference of the NITP Kano, Nigeria, 25th-27th October 1993.

Ahmed, K. (2010) 'The Kano Physical Environment'. Chapter 1 in Perspectives on Kano, Produced By Inuwar Jama'ar Kano. Published by Tellettes Consulting Coy Ltd. Nigeria.

Ali, A.F, Tanko, A.I, Kovo, A.S, (2017). Solid Waste Management Practice in a Less Developed Urban Setting: A Case Study. J Environ Stud. 2017;3(1): 4.

Ali, A.F, Abdullahi, H, Tanko, A.I & llah, S.K.(2018). Water Supply and Sanitation Challenges in Dala Local Government Area of Kano State, Nigeria. Dutse Journal of Pure and Applied Sciences (DUJOPAS), Vol. 4 No. 2 December 2018

Al-Khatib, I. A., Monou, M., Abu Zahra, A. S., Shaheen, H. Q., & Kassinos, D. (2010). Solid Waste Characterization, Quantification and Management Practices in Developing Countries. A Case Study: Nablus District – Palestine. Journal of Environmental Management, 91(5), 1131-1138. https://doi.org/10.1016/j.jenvman.2010.01.003

Amori, A.A., Fatile, B.O., Ihuoma, S.O., Omoregbee, H.O., (2013). Waste Generation and Management Practices in Residential Areas of Nigerian Tertiary Institutions. Journal of Education and Social Research 3 (4), 45–51.

Alshuwaikhat, H.M., Abubakar, I.. (2008). An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices. Journal of Cleaner Production 16, 1777–1785.

İncekara, S. Abubakar, A.S. (2014). *A comparative analysis of students' attitude towards the environment: Case study from Turkey and Nigeria*. Deutschland: Lambert Academic Publishing

Kadafa, A.Y., Latifa, A. Abdullahi, H. S and W.A. Suleiman (2013), comparative assessment of the municipal solid waste management services. Life science journal ,Page 10-26

Liman M., Idris, H.A. and Mohammed, U. (2014). Weather and climate In Tanko, A.I. and Mommale, S.B. (edits) *Kano environment, society and development*. London: Adonis & Abbey Publishers Ltd.

Liman M., Idris, H.A. and Mohammed, U. (2014). Weather and climate In Tanko, A.I. and Mommale, S.B. (edits) *Kano environment, society and development*. London: Adonis & Abbey Publishers Ltd.

Ludwig C, Hellweg S, Stucki S (2003). Municipal Solid Waste Management: Strategies and Technologies for Sustainable Solutions. Berlin Heidelberg: Springer-Verlag.

Mahmud, N.G. (2021). Assesseement of solid waste generation and characterization in Kantin Kwari Market, Kano state. A Masters of Environmental Management thesis, submitted to the department of Environmental Management, Bayero University, Kano. April, 2021

MARDITECH (2011). Development of a GIDS-Based Soil Suitability Classification for Rice Production in Kano State, Nigeria, Unpublished Interim Report submitted to the Kano State Government, MARDITECH, Kualar Lumpur, Malaysia

Molina, R. A., & Catan, I. (2021). Solid Waste Management Awareness and Practices among Senior High School Students in a State College in Zamboanga City, Philippines. Aquademia, 5(1), ep21001. https://doi.org/10.21601/aquademia/9579

Nathaniel, U.E., Romanus, U.E., Gladys, A.C. (2012). Minimizing the negative externality from sachet water consumption in Nigeria. Euro. J. Bus. Manage. 4, 118–125.

Nwachukwu, M.U., 2010. Solid waste generation and disposal in a Nigeria City: an empirical analysis in onitsha metropolis. J. Environ. Manage. Saf. 1, 180–191.

Olofin, E.A. (1987): Some aspects of the Physical Geography of the Kano Region and Related Human Responses, BUK Press.

Olofin, E.A. (1989): "Human Responses to the Natural Environment in the Kano Environment in the Kano Region". Article in Kano and some of her Neighbours. Edited by Barkindo, B.M. Published for the Department of History, Bayero University by ABU Press Limited Zaria, Nigeria.

Olofin, E.A. and Tanko, A.I. (2002). *Laboratory of areal differentiation: Metropolitan Kano in geography perspective.* Department of Geography field studies series 1. Published by Bayero University Kano

Olukanni, D.O., Ugwu, N.C. (2019). Analysis of municipal solid waste management in Ota, Ogun State, Nigeria: potential for wealth generation. Int'l J. Water Res. Environ. Eng. IJWREE 5, 262–271.

Pradhan, U. M. (2009). Sustainable solid waste management in a mountain ecosystem. Darjeeling, West Bengal, India.

Sharholy, M., Ahmad, K., Mahmood, G. and Trivedi, R. (2008). Municipal Solid Waste Management in Indian Cities – A Review. Waste Management, 28(2), 459-467. https://doi.org/10.1016/j.wasman.2007.02.008.

Uwadiegwu, B.O., Chukwu, K.E. (2013). Strategies for effective urban solid waste management in Nigeria. Euro. Sci. J. (98), 296–308

Water Utility Partnership for Capacity Building in Africa (WUPCBA, nd). Strengthening the Capacity of Water Utilities to Deliver Water and Sanitation Services, Environmental Health and Hygiene to Low-Income Communities. Case Study for Kano (town), Nigeria Context and Practices. Water Utilities Project No. 5

World Bank, (2003). Thailand Environmental Monitor 2003. A joint publication of the Pollution Control Department, Royal Thai Government. The World Bank, US Asia Environmental Partnership.

World Bank. (2019). Solid Waste Management. Retrieved from https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management