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Assessment of Solid Waste Management in Yola North, Adamawa Nigeria

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Abstract

Solid waste is unwanted and occasionally harmful items with a low liquid content that come from municipalities, businesses, industries, agriculture, and other associated sectors. Household and agriculture are the primary contributors to solid waste in many developing nations. The study assesses solid waste management in Yola North LGA of Adamawa State. Specifically, the study seeks to; identify the characteristics of solid wastes and identify the solid waste management systems in Yola North LGA of Adamawa State. 381 copies of the questionnaires were administered to the residents and the Statistical Package for Social Sciences (SPSS) version 26.0 was used to analyse the data collected for this study. When answering the research questions, the mean (X) statistic and standard deviation were used to determine whether an item was considered Agreed (A) if its mean was 3.50 or higher, and Disagreed (D) if its mean was 3.49 or lower. Leather had the greatest mean score (4.1207) for the features of solid wastes in the study area, while spoilt toys had the lowest mean score (2.2913). There were 34 distinct solid waste management systems in the research locations,. Ploughing into the fields has the lowest mean score (2.0210), whereas open burning has the greatest mean score (4.1601). Residents of the study area frequently dump their trash by the side of the road, next to bushes or empty plots, in an open dumpsite which not only defaces the environment but also pollutes the air, which is dangerous and attracts mosquitoes and other harmful insects or flies. Additionally, accumulated waste produces soot and smog in the atmosphere, which leads to poor air quality, reduced oxygen levels for plants and vegetation and increased rates of respiratory diseases.

Keywords: Assessment, Solid Waste Management, Yola North, leather.,

INTRODUCTION

Public Health (2023) defines solid waste as any discarded material that is abandoned by being disposed of, burned, incinerated, recycled, or considered waste-like. Solid waste is defined as unwanted and occasionally hazardous materials with low liquid content generated from municipalities, industry, and commerce as well as agriculture and other related sectors. However, household and agriculture are the main sources of solid waste in many unindustrialised countries (Teshome, 2021). Solid waste can physically be a solid, liquid, semi-solid, or container of gaseous material.

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According to Shiksha (2013a), solid waste is any solid material in the material flow pattern that society rejects. Solid waste is produced by all human endeavours, including residential, commercial, industrial, medical, and agricultural. The amount and type of trash differ depending on the activity and a nation's degree of technical advancement. All wastes from human and animal activity that are typically solid and are thrown away as unnecessary or undesired are considered solid wastes.

Waste, construction debris, commercial rubbish, sludge from the water supply or waste treatment plants, air pollution control facilities, and other abandoned materials are all considered solid waste (Public Health, 2023). Solid waste can originate from domestic and community activities as well as from commercial, industrial, mining, or agricultural operations. Public Health (2023) went on to explain that solid waste excludes wastes source, special nuclear, by-products, and solid or dissolved contaminants in household sewage. Source reduction, recycling, storage, collection, transportation, processing, and disposal are some methods of managing solid waste. Landfills, composting sites, transfer stations, incinerators, and processing facilities are a few types of solid waste facilities. These establishments could be privately or publicly held.

According to Nathanson (2023), residential, commercial, institutional, and industrial activities are among the sources of solid waste. The article Hazardous Waste Management discusses the categories of garbage that are deemed hazardous because they provide an immediate risk to exposed people or surroundings. Refuse, also known as municipal solid waste (MSW), is any non-hazardous solid waste from a community that needs to be collected and transported to a processing or disposal location. Garbage and waste are included in refuse. Trash is primarily dry materials like glass, paper, cloth, or wood; garbage is primarily food waste that can be broken down. Unlike trash, garbage is highly putrescible or decomposable. Bulky objects like couches, big tree stumps, and outdated refrigerators are considered trash. Trash needs to be collected and handled carefully. Nwankwo (2021) stresses that the waste disposal habit of the people, and ignorance coupled with poverty may be adduced to the habit of most people in Nigeria especially in the densely populated states. Moreover, such issues are associated with various factors including lack of adequate infrastructures, lack of legal enforcement on environmental issues, irregular and unplanned dumping of solid wastes, population increase, urbanization due to rural-urban migration, insufficient capital to run SWM process and absence of new technology for waste disposal.(Lema *et al.,* 2019).

The poorest populations mostly resort to sporadic and indiscriminate dumping of their waste into available plots of land, sidewalks, roadways, streams, channels and drainage areas. More than 70 percent of the refuse generated in the city is disposed of in this way. These refuse are good contaminants of streams, ground water especially shallow wells and the entire environment. Therefore, this study aimed at assessing characteristics of solid wastes and to identify the solid waste management systems in Yola North LGA of Adamawa State and make necessary recommendations on waste disposal and management practices to prevent further deterioration of the environment in Adamawa, Yola North Local Government Area.

MATERIALS AND METHODS

Study Area

The study was conducted in Yola North Local Government Area of Adamawa State. Adamawa State has twenty-one Local Government Areas, including Yola North. According to Sahabo and Mohammed (2016), Yola North is roughly located between latitudes 09^0 13'N

and 09⁰ 20'N and longitudes 12⁰ 20'E and 12⁰ 30'E. Alkalawa, Ajiya, Doubeli, Gwadabawa, Jambutu, Karewa, Limawa, Luggere, Nassarawo, Rumde, and Yelwa Wards are the 11 Wards that make up Yola North LGA (Sahabo and Mohammed, 2016; Olaitan, 2022) (Figure 1). About 500 miles (800 km) above the Benue River's junction with the Niger, the port of Jimeta (5.5 miles [9 km] north-northwest) and an airfield serve Yola North LGA.

Yola also has road connections with Numan, Jalingo, Ganye, Mubi and Yola town (McKenna, 2019). Yola North has an area of 714.8 km², a population density of 393.7/km², and an estimated population of 281,435 (European Commission's Joint Research Centre, 2019).

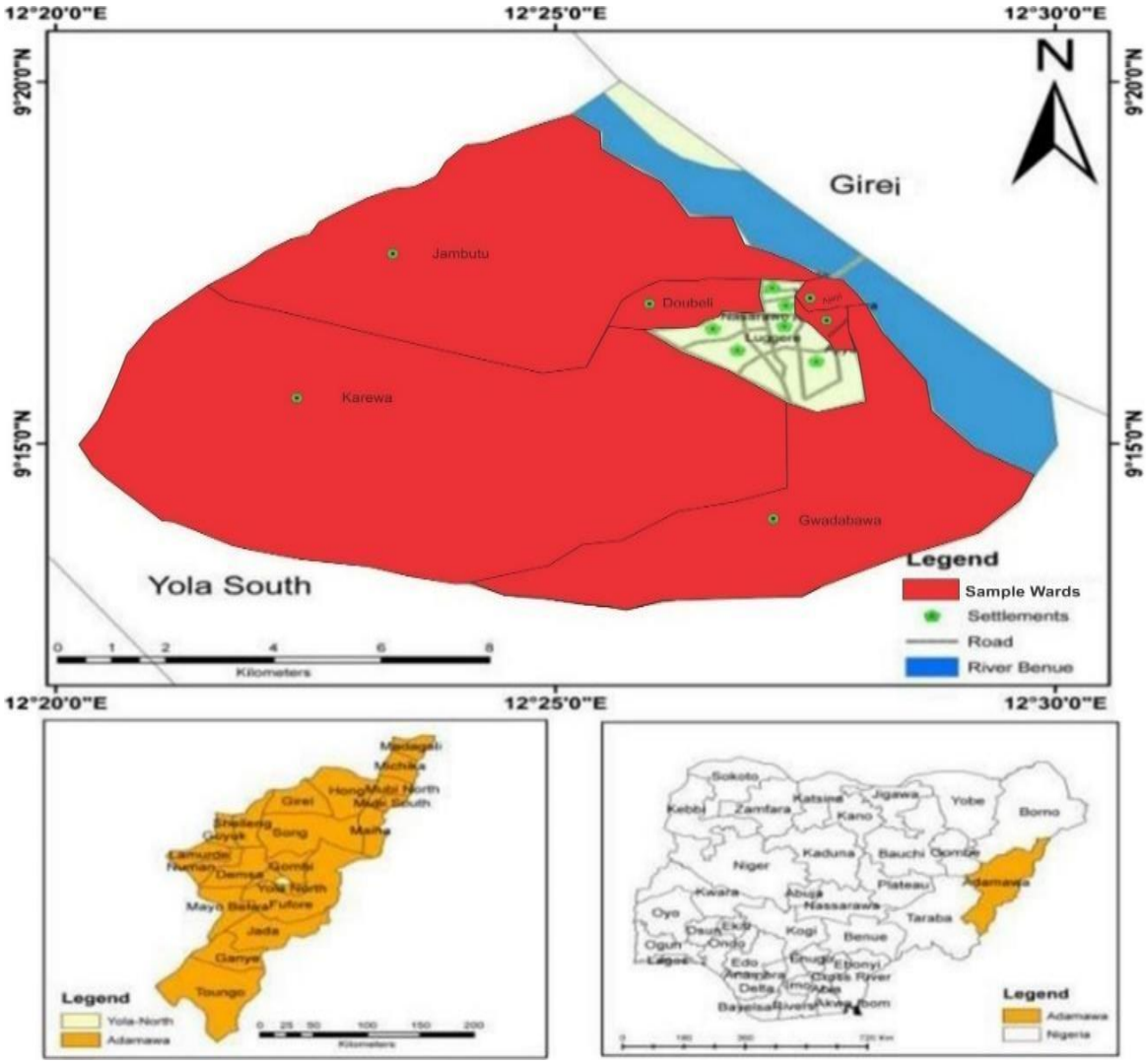

Figure 1: Map of Yola North LGA showing various wards Source: Sahabo and Mohammed, (2016).

Population of the study

49,579 homes in Adamawa State's Yola North Local Government Area, made up the study's target population. Alkalawa (5,761), Ajiya (3,590), Doubeli (7,769), Gwadabawa (5,302), Jambutu (4,495), Karewa (5,557), Limawa (3,623), Luggere (3,963), Nassarawo (3,973), Rumde (2,873), and Yelwa Wards (2,672) were the 11 wards of Yola North LGA from which this population was selected (Mohammed and Sahabo, 2015).

Sampling technique

In particular, the study's sample consists of 380 randomly selected households from Alkalawa, Ajiya, Doubeli, Gwadabawa, Jambutu, and Karewa Wards of Yola North LGA,

Adamawa State. The sample size was found using Krejcie and Morgan Table 1 (Krejcie and Morgan, 1970).

Table 1: Distribution of the population size, sample size and the percentages of the wards.

S/N	Ward(S)	Population size	Sample Size	Percentage (%)
1	Alkalawa	5761	67	11.74
2	Ajiya	3590	42	11.05
3	Doubeli	7769	91	23.92
4	Gwadabawa	5302	62	16.33
5	Jambutu	4495	53	13.85
6	Karewa	5557	65	17.11
Total		32474	380	100

Instrument for data collection

The Impact of Improper Solid Waste Management Questionnaire (IISWMQ), a tool created by the researcher, was utilised to gather data for this investigation. The questionnaire is divided into two sections: Section A contains the respondents' personal information, and Section B contains items organised into four subsections intended to elicit answers on the effects of inadequate solid waste management in Adamawa State's Yola North LGA. In particular.

The response options were based on a four-point scale and defined as follows:

Strongly Agree (SA) …… 5 points
Agree (A) ……4 points
Undecided (UD) …… 3 points
Disagree (D) ……2 points
Strongly Disagree (SD) ……1 points

Data collection

Before distributing the research instruments to the respondents (ward, families), approval was sought from the ward councillors of Alkalawa, Ajiya, Doubeli, Gwadabawa, Jambutu, and Karewa Wards. A total of 380 copies of the questionnaire were distributed to the households. The purpose of distributing the questionnaire over the course of a weekend was to provide the researcher access to all of the study participants in each of the 20 households. Copies of the completed questionnaires that were given to the respondents were immediately collected. Over the course of six weeks, the questionnaires were distributed. The six-week period was chosen to allow the researcher to sufficiently cover the study area. That is for each of the six wards, once a week.

Data analysis

The Statistical Package for Social Sciences (SPSS) Version 26.0 was used to examined the data gathered for this study. The standard deviation and mean (X) statistic were used to answer the research questions. According to the lower and upper limit of numbers, as indicated in Table 2, an item with a mean of 3.50 and above 2 was deemed to be Agreed (A) in responding to the study questions, while an item with a mean of less than 3.50 (3.49 and below) was deemed to be Disagreed (D):

	Point	Lower Limit	Upper Limit
Strongly Agree (SA)	5	4.50	5.00
Agree (A)	4	3.50	4.49
Undecided (UD)	3	2.50	3.49
Disagree (D)	2	1.50	2.49
Strongly Disagree (SD)	1	1.00	1.49

RESULTS AND DISCUSSION

Characteristics of Solid Waste in Yola North L.G.A of Adamawa State

The mean (X) distribution of the different categories of solid 26 wastes in the research region was shown by the analysis on Table 3. Papers have 3.9449, textiles 2.5906, metal scraps 3.3412, plastics 4.0026, glass 3.3780, food trash 3.9554, and polythene bags 4.0446. Spoilt toys had the lowest mean score (2.2913), whereas leather had the highest (4.1207). Table 3 shows the mean score for additional solid wastes found in the study locations.

Solid Waste Management Systems in Yola North LGA of Adamawa State

Various solid waste management strategies in the research areas are shown in Table 4. The mean score for sanitary landfills is 2.9606, for mechanical landfills it is 2.2415, for recycling it is 4.0420, for open burning it is 4.1601, for river dumping it is 3.7664, for incineration method it is 2.3097, and for vermicomposting it is 2.0472. Ploughing into the fields has the lowest mean score (2.0210), whereas open burning has the greatest mean score (4.1601).

Table 3: Characteristics of Solid Waste in Yola North LGA of Adamawa State

Variables	SA	A	ND	D	SD	Mean (X)	Remark
Food Waste	33	325	0	19	4	3.9554	Agreed
Wood	25	294	0	60	2	3.7349	Agreed
Glass	23	221	14	123	0	3.3780	Disagreed
Metals	23	221	4	129	4	3.3412	Disagreed
Plastics	23	347	0	11	0	4.0026	Agreed
Leather	50	329	0	2	0	4.1207	Agreed
Used Clothing	26	343	0	12	0	4.0052	Agreed
Rubbish	16	349	0	16	0	4.0000	Agreed
Product Packaging Materials	16	347	9	9	0	3.9711	Agreed
Market Wastes	14	367	0	0	0	4.0367	Agreed
Polythene Bags	22	354	5	0	0	4.0446	Agreed
Papers	6	360	7	4	4	3.9449	Agreed
Rubbers	0	270	39	58	14	3.4829	Disagreed
Textiles	0	96	59	200	26	2.5906	Disagreed
Batteries	0	75	55	217	34	2.4488	Disagreed
Waste tyres	0	56	57	221	47	2.3202	Disagreed
Spoilt Toys	0	61	46	217	57	2.2913	Disagreed
Spoilt Appliances	4	75	36	210	56	2.3727	Disagreed
Tin Cans	37	220	14	83	17	3.4121	Disagreed
Expired Pharmaceutical Drugs	36	270	14	49	12	3.7060	Agreed
Total						64.1573	

Source: Field survey, 2024.

keys: Strongly Agree (SA) Agree (A) Undecided (UD) Disagree (D) Strongly Disagree (SD).

Table 4: Solid Waste Management Systems in Yola North LGA of Adamawa State.

Variables	SA	A	ND	D	SD	Mean (X)	Remarks
Sanitary Landfills	34	133	2	208	4	2.9606	Disagreed
Mechanical Landfills	2	45	18	294	22	2.2415	Disagreed
Recycling	42	329	0	4	6	4.0420	Agreed
Open Burning	105	254	8	6	8	4.1601	Agreed
Pyrolysis Processing into another type of fuel	4	61	36	244	36	2.3517	Disagreed
River Dumping	32	283	15	47	4	3.7664	Agreed
Incineration Method	11	34	29	295	12	2.3097	Disagreed
Open Window Composting	11	42	16	296	16	2.3071	Disagreed
Mechanical Composting	9	26	14	314	18	2.1969	Disagreed
Vermicomposting	0	23	14	302	42	2.0472	Disagreed
Ploughing into the fields	0	28	10	285	58	2.0210	Disagreed
Disposal by hog feeding	2	34	10	275	60	2.0630	Disagreed
Salvaging Procedure	0	34	25	266	56	2.0971	Disagreed
Fermentation Biological Digestion	5	48	20	242	62	2.1830	Disagreed
Total						36.7473	

Source: Field survey, 2024.

keys: Strongly Agree (SA) Agree (A) Undecided (UD) Disagree (D) Strongly Disagree (SD) .

DISCUSSION

Characteristics of Solid Waste in Yola North L.G.A of Adamawa State

Cloth, trash, leather, and plastic were the main types of solid waste found in the study region; these materials had the highest mean score, which was consistent with the findings of Gharibi *et al.,* (2020). Due to its non-biodegradable nature and potential for long-term contamination of land and aquatic bodies, plastic waste is recognised to present serious environmental issues. According to Anifowose *et al*. (2011), waste is any material or substance that needs to be disposed of because it is damaged, worn out, polluted, or otherwise spoilt and has lost its purpose. It could be in liquid or solid form and could be hazardous. These categories include trash or refuse from residences and other locations where people or animals reside. However, according to the State of Vermont Agency of Natural Resources Department of Environmental Conservation (2012), solid waste is any item that is palpable does not flow freely and is the consequence of human activity. Only a small portion of Nigeria's annual solid waste generation—more than 32 million tons—is collected, according to records (Bakare, 2020). One essential first step in efficient waste management is the generation and characterisation of waste. Different locations have different solid waste characteristics. The average income level, the sources, the population, social behaviour, the climate, industrial production, and the waste materials market are some of the factors that affect the composition (Akafia, 2014). A comparative analysis of municipal solid waste (MSW) composition in three local government areas in Rivers State revealed that the waste generation rate was 0.45, 0.98 and 1.16 kg/capita/day for Emougha, Obio/Akpor and Port Harcourt, respectively (Babatunde *et al*., 2013). Paper, nylon, and biological trash were the most common categories found. In the LGAs of Emougha, Obio/Akpor, and Port Harcourt, the mean percentage composition was 59, 65.5, and 65 for organic waste, 6, 11, and 13% for paper, and 14, 16, and 12% for nylon. They emphasised the possibility of energy production and resource recovery.

A similar study conducted by Balogun *et al*. (2020) on the impact of improper solid waste disposal in some areas of Kogi state, revealed three major sources of solid waste generated in the study area, these are Domestic, Agricultural and Commercial wastes. Domestic wastes are generated from the households; agricultural wastes are generated from farming activities, falling of leaves from trees and animal grazing in the study area, and commercial wastes are generated from markets, shops and other commercial activities in the study area and it was discovered that nylon was the most common waste generated in the area followed by paper, leaves and plastic. The finding from our study shows that paper, plastics, and nylon (polythene bags) have a mean score higher than 3.50 that is it is these wastes are prevalent in the study area which is in line with the work of Babatunde *et al*., (2013).

Solid Waste Management Systems in Yola North LGA of Adamawa State

After waste is generated, collected and transported, the final step in the management process is the disposal of the waste. According to Nnaji (2015), a poor waste management system has resulted in the ongoing emergence of illicit dumpsites in several Nigerian cities. The loss of aesthetic attractiveness, the danger to humans and the environment, the spread of diseases, and environmental contamination are all consequences of illegal dumpsites (Momodu *et al*., 2011). Nigeria's solid waste management requires urgent attention and the implementation of the most environmentally friendly strategy possible in order to protect the environment. Every stage of the management process needs to be completely operational and efficient in order to have a sustainable solid waste management strategy. These consist of the production and characterisation of solid waste, the collection and transportation of solid waste, and the disposal and treatment of solid waste.

Researchers (Sha'Ato *et al*., 2007; Uwadiegwu, 2013; Onuigbo and Bello, 2014; Somorin *et al*. 2017; Balogun *et al*., 2020) have reported a similar pattern of management which is in line with the management systems obtainable in Yola North which are recycling (4.0420), open burning (4.1601) and river dumping (3.7664). Recycling is one of the management systems practices by the respondents in the study area having a mean score of (4.0420) as seen in Table 4. According to reports from the World Encyclopaedia (2015), recycling is the greatest way to dispose of waste because it reduces environmental hazards, helps manage waste, and allows for reuse. It is important to encourage people to turn their garbage into compost and other beneficial agricultural inputs. According to respondents in the study region, incineration is one solid waste management strategy; this finding is consistent with that of Somorin *et al*. (2017). who went into greater detail on the possibilities of using incinerators to convert garbage into energy. They calculated the electrical generation, which ranged from 31 to 205 MW, based on the quantity of trash produced in the various Nigerian states.

From our findings, most of the respondents disagreed with sanitary and mechanical landfills as solid waste management systems. Despite being the most affordable and practical method of disposing of garbage, landfilling has considerably more negative effects on the environment and human health than recycling and waste recovery (Onwughara *et al*., 2010). As shown in Table 4, open burning is the most prominent solid waste management system in the research area. It has the highest mean score (4.1601), which is in line with the findings of Balogun *et al*. (2020) and Somorin *et al*. (2017). Both people and the environment are seriously harmed by this kind of management approach. According to Adeyemi *et al*. (2011), open burning, open dumps, landfilling, reuse/recycling, and garbage are the primary methods used in Nigeria to handle municipal solid waste.

CONCLUSION

Waste generation is a daily occurrence, and if it is not adequately managed, it will result in an environment of very bad quality, impact inhabitants' lives and living conditions, and degrade the environment's attractiveness, as the study found. According to the report, improper solid waste management has an impact on the local economy as well. Pollution of water, air, and soil happens when these areas are tainted by garbage or other harmful chemicals.

Residents of the study area frequently dump their waste by the side of the road, in close proximity to bushes or vacant plots, in an open dumpsite, etc., which not only defaces the environment but also contributes to dangerous air pollution that attracts mosquitoes and other harmful insects and flies. Additionally, accumulated waste produces smog and soot in the atmosphere, which lowers oxygen levels for plants and vegetation, degrades air quality.

REFERENCES

Anifowose, Y. B., Omole, K. E., and Akingbade, O. (2011). Waste Disposal Site Selection using Remote Sensing and GIS: A Study of Akure and its Environs, Southwest-Nigeria. Proceedings of the Environmental Management Conference, Federal University of Agriculture, Abeokuta, Nigeria (pp. 2-9). Abeokuta: Federal University of Agriculture, Abeokuta.

Babatunde, B. B., Vincent-Akpu, I. F., Woke, G. N., Atarhinyo, E., Aharanwa, U. C., Green, A. F., and Isaac-Joe, O (2013). Comparative analysis of municipal solid waste (MSW) composition in three local government areas in Rivers. *African Journal of Environmental Science and Technology,* 7(9), 874–881.

Bakare, W. (2020). Solid Waste Management in Nigeria. Retrieved March 31, 2020, from https://www.bioenergyconsult.com/solid-waste-nigeria/

Balogun, J., Jean, M.B., and Boro, D.(2022). Solid waste management system. *Journal of Intergrative Environmental Sciences*, 19(1),17-37

Gharibi, H., Rezaei, S., and Sadeghi, F. (2020). Assessment of construction and demolition waste management practices and their environmental impacts: A case study in Iran. *Journal of Material Cycles and Waste Management*, 22(2), 473-483.

Krejcie, R. V., and Morgan, D. W. (1970). Determining Sample Size for Research Activities.

Lema, G., Mesfun, M. G., Eshete A., and Abdeta, G. (2019). Assessment of status of solid waste management in Asella town, Ethiopia. *BMC public health*, **19**: 1–7.

Nathanson, J.A. (2023). Solid-waste management. https://www.britannica.com/technology/solidwaste-management (Retrieved 27th March 2023).

Nnaji, C. C. (2015). Status of municipal solid waste generation and disposal in Nigeria. Management of Environmental Quality: *An International Journal*, **26(1)**: 53-71.

Nwankwo, C. (2021). Environmental literacy and waste disposal behaviour of university undergraduates in Enugu State, Nigeria. Ph.D Dissertation, Faculty of Management Sciences, Nnamdi Azikiwe University, Awka, Anambra State.

Onuigbo, C. I., and Bello, E. A. (2014). Assessment and Selection of Suitable Sites for Solid Waste Disposal using Surveying and Geoinformatics Techniques. *International Journal of Engineering Research and Technology*, **3(8)**: 1685–1692.

Onwughara, I. N., Nnorom, I. C., and Kanno, O. C. (2010). Issues of roadside disposal habit of municipal solid waste, environmental impacts and implementation of sound management practices in the developing country Nigeria. *International Journal of Environmental Science and Development,* **1**(5): 409 - 418.

Public Health (2023). Solid waste. https://idahopublichealth.com/environmentalhealth/solidwaste (Retrieved 25th March 2023). Pulp and Paper Technology (2023). Types of solid waste disposal and management. https://www.pulpandpaper-technology.com/articles/types-ofsolid-waste-disposaland-management (Retrieved 12th July 2023).

Sahabo, A. A. and Mohammed, A. B. (2016). A GIS-based multi-criteria analysis for siting recreational parks in Yola-North Local Government. *International Journal of Applied Science and Engineering Research*, **5**(1): 20 – 29.

Sha'Ato, R., Aboho, S. Y., Oketunde, F. O., Eneji, I. S., Unazi, G., and Agwa, S. (2007). Survey of solid waste generation and composition in a rapidly growing urban area in Central Nigeria. *Science Direct: Waste Management*, 27, 352–358.

Shiksha, E. (2013a). Introduction to solid waste. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2592 (Retrieved 25th March 2023). Air Pollution and Rural Biomass Fuel in Developing Countries. Delhi: Japur Press Ltd.

Somorin, T. O., Adesola, S., and Kolawole, A. (2017). State-level assessment of the waste-to energy potential (via incineration) of municipal solid wastes in Nigeria. *Journal of Cleaner Production*, 164:804–815.

Teshome, F. B. (2021). Municipal solid waste management in Ethiopia; the gaps and ways for improvement. *Journal of Mater Cycle,*167:206-280.