



APPRAISAL OF MUNICIPAL WASTE MANAGEMENT DISPOSAL IN KAKURI AREA OF KADUNA SOUTH LOCAL GOVERNMENT

***ISAH ABUBAKAR EVUTI; *BASHIR LAWAL; & **ADAMU Umar Sheshi**

*Department of Building College of Environmental Studies Kaduna Polytechnic.

**Department of Building College of Environmental Studies Federal Polytechnic,
Bida

ABSTRACT

Urban centers in developing countries are still battling with waste management problems owing to insufficient collection and improper disposal of waste. In Kakuri Kaduna South Local Government area, various techniques are still employed in waste management, such as the burning, burying, open dumping and others, but an empirical understanding is needed for the prominent ones. The objectives of the study are to: - examine the characteristics and volume of waste, characteristics of waste management techniques, capacities of waste management agencies, and evaluate the challenges of management techniques in the study area. For administration of questionnaires 90 respondents using random sampling techniques. Data collected were analyzed using percentages, pie charts. Solid waste generated in the study area 72% of organic waste papers and plastics 23%, 3% metals, 1% others. Another finding is that solid waste management techniques in the study area includes burning at 21.71%, burying at 15.90%, open dumping and secondary dumping locations has 61.77% and others at 0.61%. In terms of management capacities 134% of solid waste were managed by private, individuals and companies while 196% is managed by the State and the local authority. This explains reasons why government could not cope with the growing of waste streams. About 53.8% were not satisfied with the management techniques and 46.2% were of the opinion that the government is trying. Management and disposal of waste is commonly done in the study area by dumping on any relative available space or uncompleted buildings, dumping on designated bins by the major road sides and important streets in the study area. The bulk by percentage of the solid waste generated are biodegradables, papers,

plastic and other organic waste such garbage. The Local government should in an effort find a way of converting the organic waste to re-useable manure or materials in farms and gardens by mere adoption of the local technology abound in the study area.

INTRODUCTION

Generally wastes are substances or objects which are disposed off or are intended to be disposed off or are required to be disposed off by the provision of national law (Akos, 2019). Waste are materials that are not prime products produced for the markets for which their initial use has no further use in terms of purpose production, transformation or consumption but ready for disposal (Adedibu, 2015). Waste are generated during extraction, processing of materials into final products and other human activities which can later be recycled ,reused or reduced at the point of generation or elsewhere (Aniko, 2019).

Okecha, (2014) defined waste as matter discarded as worthless, defective or of no further value and is most often derived from places of human or animal habitation, or through a manufacturing process. It is an acknowledged undesirable by product of human settlements and economic, industrial and social development, which has traditionally been collected as domestic or industrial wastes for incineration or disposal in land, water or air (Babatunde, 2019).

Waste was an early problem of mankind and a growing one that is of major concern to every caring nation. Waste disposed on the ground turns to compost in order to improve soil fertility. Solid waste management (SWM) is now a major environmental issue that can be likened “to monster” staring the authorities on the face. Solid waste can be classified on the basis of their sources, environmental risks factors, utility and physical properties, it could be municipal waste or agricultural waste. Kakuri is no exception as it also grapples with heap of waste waiting for evacuation in most streets, Okecha, 2019.

Solid waste could be non-liquid or non-gaseous and consist of organic (biodegradables) and non- organic (non biodegradables) such as metals, plastics, bottles, and broken glasses. Municipal Solid Waste (MSW) are generally waste from household, businesses and institutions, demolition and industrial waste. Agricultural waste are always from the agriculture sector. It has been found out that in most Nigerian cities and villages, chickens, goats, sheep, pigs, and other non-pet domesticated animals are usually sighted in high

populated and commercial areas. With rising urbanization and change in lifestyles and food, the amount of solid waste generated has been increasing rapidly and composition also changing. Industrialization, human activities and economic level of different sectors are relative to the type of waste generated.(Adeyemi, 2019).The composition of municipal solid waste may be broadly categorized into recyclables, inert waste, composite waste, domestic and hazardous waste and household waste produced from daily consumption. Recognizing its importance, a number of developing countries have requested collaboration of external supporting agencies, both bilateral and multilateral, at improving solid 'waste management in their cities. Although some projects have succeeded in providing lasting positive impacts on the management of solid wastes in some of these developing countries and cities, many failed to continue activities after external supporting agencies ceased their support. This un-sustainability of collaborative projects is due to various technical, financial, institutional, economic, and social constraints faced by both the recipient countries/cities and external support agencies (Agbede and Ajagbe 2014).

Municipal solid waste are generally sourced from households, commercial outlets, industrial and manufacturing activities. Other wastes are made up of residual wastes and bulky wastes resulting from biodegradable households, (Doan, 2018). Secondary materials from separate collection such as papers, glass, hazardous waste, street sweepings and litter collections, cardboard, metals, textiles materials, organics (food and garden wastes) wood, where the largest fraction consisting of paper and cardboard at 35% of the waste stream, where printing production prevails ,organic wastes at 25% municipal waste represents approximately 14% of all waste generated (Ali, 2018).

Waste management strategies includes land filling, burning, composting of biodegradables as full recyclables for further use, re-use and reduce the quantity to manageable level and burying. This un-sustainability of collaborative projects is due to various technical, financial, institutional, economic, and social constraints faced by both the recipient countries/cities and external support agencies (Agbede and Ajagbe, 2014).Geoffrey, (2015) These constrains can be categorized as technical, financial, institutional, economic, and social and are discussed, in relation to the sustainability of solid waste collaborative projects.

Most developing and least developed nations are currently and recently on the increase of municipal solid waste generation which is about 0.5- 0.9% per capita/per head/kg. Similarly Blight and Mbande, (2016) observed that high

density, large amount of organic content, small sized particles and large amount of dust and dirt characterizes waste generated in developing countries. Municipal centre produces great variety of solid waste often a mix of potentially useable and recyclable and may consequently be put to re-use, and largely non-recyclable materials wastes such as the plastics, leather and rubber, though may be re-use when recycle, but requires a certain level of technological process.

Urbanization is on the rise in Africa, and this trend of 3.5% annual growth might increase in future. Of concern is the inability of infrastructure and land use planning methods (including for waste management) to cope with this urban growth, this is particularly urgent in slum which constitute a big part of many of the cities and towns in Africa.

A typical solid waste management system in a developing country displays an array of problems including low collection coverage and irregular collection services, crude dumping and burning without air and water pollution control, the breeding of flies and vermin, and the handling and control of informal waste picking or scavenging activities. These public health, environmental, and management problems are caused by various factors which constrain the development of effective solid waste management systems

Although, refuse disposal and waste management are the constitutional responsibilities of local government councils it has become obvious that they are clearly incapacitated because they do not possess the financial capacity nor do they have the required human resources and organized to effectively tackle the problem. The matter is made worse for the metropolitan cities that have more than one local government are or council jointly tackle waste management sustainable. Alongside this environment problem has emerged health hazard posed by the mounting waste heaps, at the same time poverty is ravaging in Nigeria and in most cities in Africa.

RESAERCH METHODOLOGY

The research method adopted a descriptive research approach. It considers the study area under the following themes. Location and physical settings, climate, soil and vegetation, relief and drainage, people and socio-economic activities such as agriculture, commerce and industry, sports and recreation, education, health, water supply and transportation and communication the methodology comprises nature of data, data sources, sampling techniques and method of data analysis.

THE STUDY AREA

Location and size

Kaduna has a literal meaning of „Kadduna“the plural of (crocodile) because, the number of crocodiles were found along the river Gurara banks, a river that crosses the main town of today's Kaduna. Kada means a crocodile and Kaduna (plural of crocodiles). This is the historical origin where Kaduna got its name. The location of Kaduna is on latitude 7025IE and latitude 7o25IE and on longitude 10° 25IN and 10o32IN and was created in May, 1967 (from the former north central state) and was further subdivided into Kaduna and Katsina states in 1987, with the capital remains Doka with a land mass of 46,053 Km².

Kaduna South LGA is a central local government area in the heart of Kaduna main town with its head quarters at Makera village. Kakuri is a community in Kaduna South LGA. Kakuri is situated south of Makera and north of Romi, Tirkaniya to the west and Barnawa to the east, it has a land mass of 46.2km². Kakuri Kaduna South LGA is a city undergoing rapid expansion in economic growth, population and urbanization characterized by high density and low income populations especially in the indigenous core areas, this is due to better job opportunities and rising or improved standard of living.(Akos, 2019). Kaduna metropolis has been ranked number 13 on the list of the most populous cities in West Africa and number 5 among Nigerian cities behind Lagos, Kano, Ibadan, and Abuja. The city has been over the last few years experiencing rapid physical growth with an annual growth rate of 5.72% (Akpu and Tanko, 2017). Kaduna is an industrial centre of the northern Nigeria, so many products are manufactured in Kaduna which include textile materials, machineries, Steel processing and Aluminium products. There is also a refinery which refines petroleum products, others are bearings and pottery is highly prized from Kaduna; especially from Nokculture . The main high way through the city is Ahmadu Bello way. Many of the places were named from the past Sultans, Emirs and decorated civil war heroes, while others were named after the majority tribes that inhabit such places such as Ungwanmakama, Barnawa, Ungwan sarki, Ungwan kanawa Ungwan Fulani. Kakuri Kaduna South has a large market which is under construction.

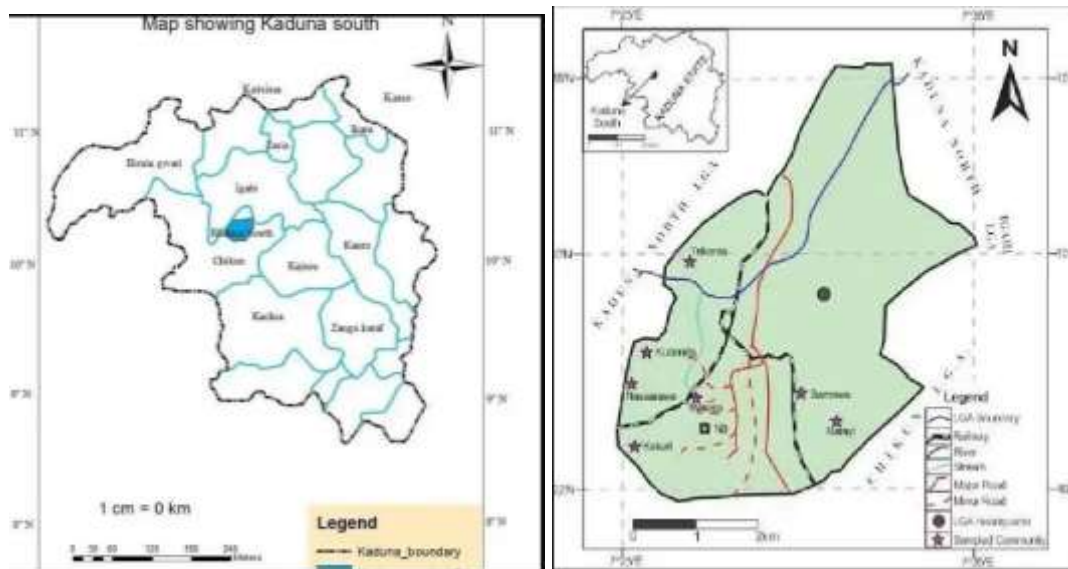


Figure 1: State showing Kaduna South inset.

Figure 2: Kakuri Kaduna South LGA Showing Study Area.

Source: Ministry of lands and survey

Physical Setting

Kakuri Kaduna South LGA is located on the Hausa-plains of Northern Nigeria. Though, a clustered settlement, generally Kakuri does not experience variety of agricultural practices due to its industrial and urban nature

Climate

Kaduna metropolis has a tropical continental climate(Aw) with distinct wet and dry seasons reflecting the oscillation of Inter-tropical Convergence Zone (ITCZ) which is a clear zone where moist tropical maritime air mass (mT) meets dry tropical continental air the mass (cT). The mT originates over the Atlantic Ocean, while the cT originates over the Sahara

Desert. Northward incursion makes cT to prevail in the area and this marks the rainy season.

The zone is characterized by relative moderate temperature of between 27° - 35°C during the extremes of the year in the months of April to May. The rainfall received in this zone is about 1750-2000mm during the course of the year with intense rainfall received in the months of June through to August, which eventually fades from September to October. The dust-devil is always experienced from the month of January to February which is accompanied by intense cold and very thick layer haze which reduces visibility for about between 2-3 kilometer. Sani, (2015). The rain has the advantage of causing fast

decaying of biodegradable waste thus reducing the quantity waste and as well add manure to soil voids and increase farm yield, to some controlling the generation of solid waste in the study area.

Relief

Kakuri is an area which is part of the extensive but gently undulating pene plain, capped at high elevation by patches of laterite terraces of iron oxides concretions of broken up concretion of ironstones and some quartz. Jatau, (2016) The eastern part of the city which is mostly bounded by the River Kaduna has a mean elevation of 622m above mean sea level. The north western part is comparatively higher with mean elevation of 620m above mean sea level.

Drainage

Kakuri is drained by river Kaduna which divides the city into North and South and its major tributaries. River Romi with its wide and steep valley in the East and River Mashi in the west. Other tributaries include Ruruwai, Keke, Danhonu, Kuba and Kuyi. (Jatau, Fadel, and Agelaga, 2016). After passing through Kaduna Metropolis River Kaduna moves southwards to Zungeru and finally into River Niger near Pategi.

People

The people of Kakuri are enterprising simply because the people are mostly heterogeneous, because all human aspects of Nigeria are found in this local government along with the indigenous tribes. The dominant people are the Hausa-Fulani's, Gbagyi who are the origins of Kaduna Town, Adara, South Ward, Agworok, Bajju, Kaninkon, Atyp, Jabas as the origins of Kaduna, outside these tribes, the major tribes are Yorubas, Igbos, Idomas, Igala, Ebiras few Efik, and Ibibios tribes. All practice one or the other type of trade to keep body and soul together. The population of Kaduna State is 6.066 million people and Kakuri is 47,533 people on expanse of 46.2Km².

METHODOLOGY

Reconnaissance Survey

The researcher carried out a reconnaissance survey in December 2021. It helped in getting familiar with the study area. Some spot assessment were

made with respect to the economic activities of the people that generate waste. Other activities done included visiting the dump sites of the solid waste and preliminary interaction with residents of the study area. The outcome of the reconnaissance survey guided other aspect of the research.

Types of Data

- i. Household solid waste characteristics, waste generation and management technique for different categories of waste.
- ii. Capacity of solid waste management institution to manage the volume of waste generated.
- iii. Bio-physical and socio-economic characteristics of Kakuri Kaduna south and prompt generation of Waste.
- iv. Data on challenges faced by individuals and agencies, capacities and challenges of waste management techniques. Management of waste such as staff strength, operational capacities, machineries and so on.

Sources of Data

The data for this research were primarily sourced. The primary sources of data include questionnaire administration, field observation, and personal interview with the respondents.

Literature materials were obtained from the internet, journals, Unpublished materials, Magazines, Serials and other related literature materials and Newspapers.

Sample and Sampling Techniques

The study area has a population of 47,533 (NPC, 2009). It covers three Wards within the Kaduna South Local Government area namely: Kakuri Hausa, Kakuri Gwari and Makera. The sample size is based on population of the study area. The Krejcie and Morgan (1970) table of determining sample size was conducted and adopted where an area with population of 47,533, the sample size could be 400. Hence for this study 400 samples were use to determine the sample size for the study. (Yamene, 1976) N

$$1 + N (0.05)^2$$

Where N= Total population understudy 0.05 or (5.0%) is accepted error margin.

$$N = 47,533$$

$$EM = 0.05 \quad 1+47533(0.05)^2$$

$$= 399.99158497$$

$$\text{Approx.} = 400$$

The total population of the three selected settlement is 47,533 using the formula above gave rise to the breakdown on 400 respondents was sampled (see Table 3.1). More so to obtain the proportion of questionnaires to be administered in the selected settlement Yamene, (1976) sampling method for determination of respondent was used.

Where n = population of each selected settlement

N = Total population of selected settlement

The purposive random sampling and sampling techniques was considered more appropriate for identifying cases for detail investigation Abumere, (2002), Suleiman, (2009) and was then adopted. Copies of questionnaires were administered to the people in the selected settlements until the total number of questionnaire assigned to those wards were achieved. The National Population Commission (2006) population census figure was projected to 2020 and the projection was done using Kaduna state growth rate of 3.5% using the formular (NPC, 2009)

Po = pt Where:

pt = population in the later period

po = population in the earlier period

n = time interval between the two period

r = rate of growth e = exponential sign

Table 3.1: Sample Size per settlements

S/No	Wards	Population of selected areas	Estimated Population 2021	No Questionnaire Administered
1	Kakuri Hausa	15,000	22,350	30
2	Makera	18000	26,820	35
3	Kakuri Gwari	14,533	21,654	25
	Total	47,533	70,824	90

Sources: National Population Commission (NPC, 2009)

Method of Data Analysis

The study made use of descriptive statistics such as the of mean, averages, frequency distribution, and percentages to summarize the data in tabular forms for easy analysis and interpretation. Data will be produced such as graphs and charts that will produce the result of research clearly.

RESULTS AND DISCUSSIONS

INTRODUCTION

This chapter presents the results obtained from the administration of questionnaire in order to analyze the domestic solid waste management principles in the study area. It include the demographic and socio economic characteristics of the respondents, types of domestic solid wastes generated in the study area, domestic solid waste management principles employed in the study area, key players in domestic solid waste management in the study area, effectiveness of the domestic solid waste management techniques employed in the study area as well as a comparison of the types of domestic waste management practices. The chapter is arranged in subsection for systematic presentation.

DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS.

The data obtained from the field showed that 58% of the respondents were males, while 42% were females. This pattern could be traced in part to social and religious factor as a result of less dominant role performed by women especially in Northern Nigeria where a microcosm is the area. According to Jiggins (1994) women"s perspectives and values for the environment are somewhat different than men's. Women give greater priority to protection of and improving the capacity of nature. Dankelman and Davidson (1998) also observed that women play a key role in managing their natural surroundings and adopt several mechanisms to deal with the kinds of environmental crisis they face. In addition, Akwa, (2019) noted that women are generally responsible for human waste disposal of children and cleanliness of latrines and other facilities. Men, on the other hand, tend only to handle waste when they are paid for it, or when it is specific to their activities.

The age distribution of the respondents showed that 8% were less than twenty years of age, 22.3%, 39.1%, 23.5% and 7.0% were between 20 -30, 31-40, 41-50 and above 50 years of age respectively. This showed that majority of the

respondents (about 92%) were above 20 years of age and were able to provide the information necessary for the study. This age distribution corroborates (Olorunfemi, 2009) in that adults can speak authoritatively on behalf of their family members on issues relating to waste generation and management. The information provided by the respondents were therefore valid representation for the entire household.

Similarly, the study shows that the respondents who had attained Quranic and Primary education constituted 37% while the respondents who have attained secondary and tertiary education constituted 63%. This shows that the level of literacy in the study area is high due to the concentration of higher institutions of learning, secondary schools and the migration of educated people in search of employment opportunities and this could have a positive impact on their perception of waste in general and its management techniques.

Also, the study shows that about 13% of them were farmers, 40%, 28%, 6% and 10% of the respondents are businessmen, civil servants, house wives and other activities such as carpentry, driving and welding. This shows that they were engaged in one form of activity or the other that could generate waste. The level of income an individual earns could greatly influence the amount of waste generated. Thus, information on the respondent's monthly income showed that about 12% of the respondents earn below N 20,000; 24%, 42% and 19% of the respondents earn between N 22,000- N 37,000, N 42,000- N 57,000 and earned above N70, 000 respectively.

Their income levels show that 42 over 50% of the respondents earned above N 60,000 (above the Nigerian minimum wage) and therefore, have the capacity to generate household solid wastes. According to Adedibu and Okekunle, (2015) personal income influences waste generation due to its impact on individual consumption pattern. In addition, the rate of solid waste generation per capital increase as the standards of living improves. The management technique such as composting, incineration and recycling is not yet properly put to use, where the management techniques is not sustainable. Majority of the waste materials are disposed on daily basis and respondents complained that the management system is poor.

CHARACTERISTICS AND VOLUME OF MUNICIPAL SOLID WASTE GENERATED IN THE STUDY AREA.

Results in Table 4.1 shows the distribution of the kinds of solid waste generated and the volume in the study area.

Table 4.1: Types of Domestic Solid Wastes Generated in the Study Area

Type of waste	Frequency	Volume (kg)
Paper	76	23.24
Organic	234	71.56
Plastic	9	2.75
Metal	4	1.22
Textile	3	0.92
Others	1	0.31
Total	327	100

Source: Field Survey, (2021)

Table 4.1 observed that about 72kg of all the domestic solid waste generated in the study area were mainly organic wastes in nature, or rather garbage in content with about 85% water content in the area for the fact that the vast majority on the inhabitants of the constituted the low income earner and partly the have nots (poor people) whose daily consumption of food were largely from the organic items, where the items were food waste and yard waste. The waste materials generated were mostly garbage which microbes" acts on to cause decomposition of the waste and the waste materials had about 80% water content which makes heavier than the rest of the waste matter found in the study area. Partly composted waste are bagged and taken to farms to add to the organic matter content capacity. Also 23.24kg, 2.75kg, 1.22kg, 0.92kg were from paper, plastic, metal and textile wastes respectively. The paper waste can be combusted to reduce the waste materials in the study area and can be left to decompose on its own in the presence of moisture and slight heat and is attributed to the presence of different mini markets and eateries in the study area and even at KASU (Kaduna State University) as students tend to generate



Figure 1: showing loading of metal waste to recycling industries at Kakuri Market. Source: Field survey, (2021) paper waste from photocopied materials

(plate.1) and others are empty boxes from packaging of materials, compound waste leathers and used basket from other sources.



Figure 2: Showing a huge collection of waste heap which has collected without disposal.

Source: Field survey, 2021



Figure 3: Routine Waste collection at Monday Market Kakuri rear truck collector.

Source: Field Survey 2021.

This means that a very large percentage of the domestic municipal solid wastes generated in the study area were biodegradable material because of the high density per square kilometer and the nature of food consumed and of course the purchasing differs among settlers were about 96% compared to the non-biodegradable wastes generated in the study area about 4%, and this is because feeding habits between the rich and the poor vary to a great extent due to consumptions of packaged and processed foods and value high purchasing power. In a similar study in Calabar, Afangideh, Kinuagbeye and Atu (2012) reported that majority of the wastes generated in Calabar were biodegradable waste compared to non-biodegradable waste which when decomposed and can be harmful to human health

THE MANAGEMENT TECHNIQUES FOR MUNICIPAL SOLID WASTE.

The results on the various techniques for the waste management in the study area are as shown in

Table 4.2.

Table 4.2: Domestic Solid Waste Management techniques in the Study Area

Techniques	Frequencies	Percentage %
Burning	71	21.71
Burying	52	15.90
Open dumping	202	61.77
Others	2	0.61
Total	327	100

Source: Field Survey, 2021

From the Table 4.2 it can be deduced that the major domestic waste management techniques employed in the study area are open dumping, burning and burying. About 62% of the respondents dump their wastes openly, This is not the best practice for soild waste management in the study area ,such waste are dumped in any open field irrespective of whether the open land was a plot or an uncompleted building in the area. About 22% bury their wastes while about 16% burn their wastes. Efe, (2010)a similar research reported that there were no authorized dumpsites in Ughelli and the major method of waste disposal are open dumping, land filling and dig and bury. Plate 2 presents black soil/relics of burnt waste in after rail area.



Figure 4: An area in Makera where partly decompose biodegradables with soil particles (Ready for use as manure in the Farms.) Source: Field Survey 2021

This is an indication that most residents dump their domestic solid wastes on the streets, gutters, channels or any available open space or any uncompleted building where the organic aspect of the waste decomposes. Open dumping could be a source of health problems for the residents and can make roads inaccessible by obstructing the free flow of traffic. It can also lead to flash flooding due to blockage of gutters and other water channels during the rainy season. Burying is also carried out in the area especially around open field at Defense Industry Cooperation of Nigeria (DICON). What all the residents do is to dig a hole and throw their wastes there and cover it when it is filled up, but it is not a practice of composting of waste because the appropriate steps for composting were not taken. Some of the residents reported that burning their wastes is convenient for them but it causes air pollution by releasing Dioxin and Furan into the atmosphere as a result of constant burning of mixed collection of waste in the environment.

This shows that managing domestic solid waste such as recycling and proper composting and incineration are not fully carried out in the study area and the exploration and use local initiatives and techniques which could go a long way to improve solid waste management is not carried out in the study area. It is

also an indication that the domestic and commercial solid waste management techniques in the study area do not conform to sustainable waste management strategy. According to Ayo, Ibrahim and Mohammed, (2018) the domestic solid wastes management techniques usually adopted developing countries result in significant threats to human health and the entire environment in the study area.

CAPACITIES OF SOLID WASTE MANAGEMENT AGENCIES IN TACKLING CHALLENGES OF WASTE MANAGEMENT.

Though the State and Local governments could not properly sustain the general clean up of the waste, private solid waste managers were brought in to partake in pay as you throw in order to achieve the third objective of the study, the results on the key players in domestic solid waste management in the study area is shown in the Figure 4.1. It has become very glaring that both state government and local government authorities could not effectively manage the continuous generation of solid waste which allows for private hands to come on pay as you collect basis. The percentage of individuals and private organization explains the inadequacies of solid waste management in the solid waste management issues. The incapacitation results from inadequate technical and material equipments to effectively manage the solid waste in the area in question.

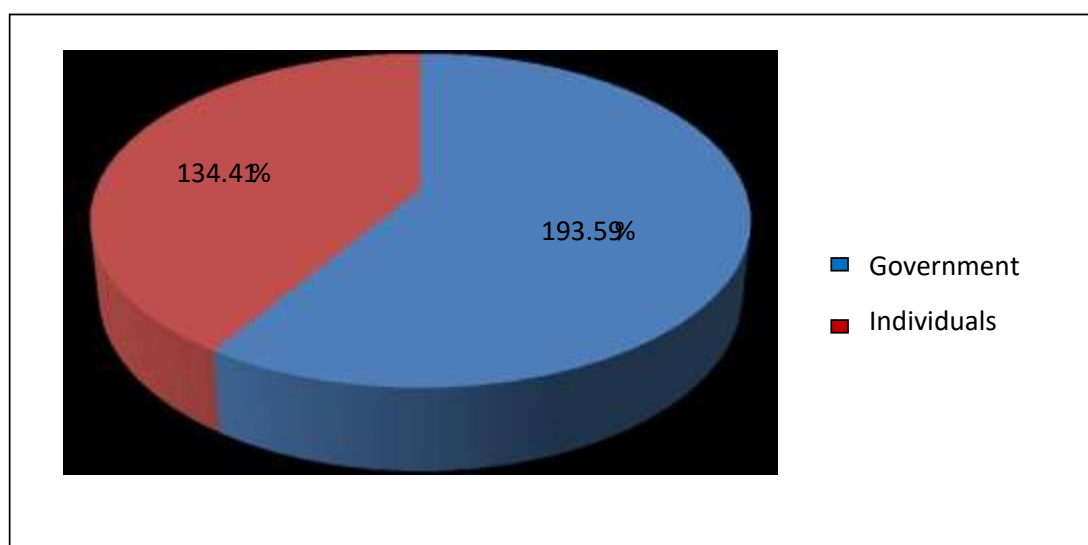


Figure 5: Key Players in the Domestic Solid Waste Management in the Study Area.

Source: Field Survey, 2021

The Figure 4.1, showed that 59% of the respondents reported that the government plays a key role in managing domestic municipal solid waste in the study area through the Kaduna State Environmental protection Agency (KEPA) and Environmental Expression Limited (EEL) while 41% of the respondents reported that individual households play a key role in managing domestic solid waste in the study area through different avenues like the use of trucks and wheel barrows to Secondary dumpsites. This shows that the private sector participation in managing domestic solid wastes is glaring in the study area. See references in plate:3.



Figure 6: Solid waste managers at United Bus stop collecting routine waste generated at Kakuri for dumping at final dumpsites.

Source: Field Survey, 2021

SUMMARY

Green waste, yard waste, plastic wastes, the domestic waste and the flying around types such as papers, leathers, used clothes, textile material, commercial waste, residential waste, manufacturing and processing waste, agricultural waste abounds in the study area. Management strategies in place in the study area are burning, burying and open dumping and others. The key players involved in the management of wastes in the study area are the government,

individual waste managers, private companies and households. The techniques of managing domestic solid wastes in the study area were found to be inefficient and unsustainable. The study analyzed municipal solid waste management techniques in Kakuri Kaduna South Local Government area of Kaduna State, Nigeria. The aim of the research was to analyze municipal solid waste management techniques in Kakuri Kaduna, Nigeria and this was achieved through characterizing the types of domestic solid wastes generated in the study area, examining the domestic solid waste management strategies employed in the study area, identifying the key players in domestic solid waste management in the study ascertaining the effectiveness of the domestic solid waste management strategies employed in the study area and comparing the types of domestic waste management strategies and their effectiveness in the study area. The rate of waste generation was found to exceed the rate of waste disposal in the study area because the frequency in which the residents generate domestic solid wastes was higher than the frequency in which they dispose the domestic solid wastes generated.

CONCLUSION

Waste pickers or scavengers in the informal sector have been fighting poverty through scavenging and creating new areas of employment as well converting waste to wealth as in the many develop societies. In essence, this leads to job creation, poverty reduction, raw material sourcing at reduced cost, resource conservation, pollution reduction and general environmental protection. The findings of this study showed that the techniques of municipal solid waste management adopted in the study area does not conform to sustainable waste management techniques which results in environmental pollution, degradation and health risks. This implies that much attention has not been given to municipal solid waste management in the study area. To ensure a healthy environment, municipal solid wastes need to be properly managed to control or limit pollution; this therefore calls for urgent precautionary measures to protect the population against the adverse impacts of pollutants as well as degradation of the environment.

Researchers willing to carry out further studies can analyze barriers and success factors affecting the adoption of sustainable municipal solid waste management techniques in the study area; analyze the effect of municipal waste management techniques.

RECOMMENDATIONS

From the findings of the research work, it is therefore, recommendable that the products of green waste and food waste should be properly harnessed to generate heat, biogas fuels, electricity in the nearest future as it is being achieved by most developed nations of the world. There is inadequate consensus as to whether the term should apply to re-use, recycle, reduction or refurbishing industries or only to products that cannot be used for its initial intended purpose, informal processing of electronic waste in developing countries of the world may cause serious health and pollution problems though these countries are also most likely to re-use or repair electronic scraps such as stale computers, music sets, stale GSM sets. It was also rightly observed that other forms of material solid waste such as the Aluminium related products could be put to new materials for further use in the local environment such as melted aluminum pots, spoons and metal gates decorations. Based on the above the findings of this study following recommendations would be useful for further research work.

- Partially composted solid waste (mixture of sand and organic) should be used constantly in our farms as organic manure to improve farm yield and its quality. Improves capacity building in training the solid waste management and encourage best practice to sanitized the environment.
- More secondary dumpsites should be provided taken into consideration the increasing number of residents in the metropolis. It should be located even around the nooks and corners of the area where primary sourced waste would have a point of drop.
- Individual agencies, private waste managers and local waste contractors “charged sourced” should be encouraged by the government possibly be allowed to access soft government loans for effective performance to back up their efforts. More incinerators be provided at designate locations in the area to ease collection and burning and the problem of dumping at any available sites such as roadside and uncompleted building at a appoint in time.
- The State and the Local government area of study are grossly incapacitated to properly manage the emerging solid waste. Drainages and Channels should always be checked to take proper charge of environmental maintenance as this may bring about flash flooding in the surrounding area.
- Dumpsites should be fumigated to reduce the menace of breeding of vectors such as mosquitoes (malaria), houseflies (cholera), worms and others.

Stagnant waters should also be treated to block the tracheal systems of insect larvae and to control to some extent the spread of diseases and also to prevent the waste water from eutrophication of the stagnant waters which may be polluted somehow.

- Optimizing the efficiency of the collection and transport system bears a huge cost and improve bin distribution and finally switch to evacuated bin volume as it may lead to polluter pays principle. Residents should be advised to sort out their wastes before disposing them to facilitate effective waste management and disposal and to enhance the re-use and reduction of mass wastes for other purposes.

REFERENCES

- Abubakar, S.A. (2020). Effects of Municipal Solid Waste in Kaduna South Local Government area of Kaduna State. Unpublished Research Report. Submitted to the Department of Geography, Ahmadu Bello University, Zaria.
- Adedibu, A.A.(2015). Development Control and Environmental Protection: A Case Study of Ilorin. A paper presented at 20th Annual Conference of the NITP, Kano. 25:27, 1990. Advance Centre for Engineering, (2000).
- Adeyemi A.S, Olorunfemij.F.,andAdewoye,T.O.(2019). Waste Scavenging in Third World Cities; A case study in Ilorin, Nigeria, *The Environmentalist*,21(2) 93-96.
- Afangideh, A.I., Kinuagbeye, U. and Atu, J.E. (2012).Attitude of urban Dwellers to Waste Disposal and Management in Calabar, Nigeria .*European journal of Sustainable Development*.1: 22-34
- Agbede, O.A. and Ajagbe, W.O. (2014) Solid Waste Management in South Western Nigeria. *International Journal of Environmental Issues*. 2:92-100
- Akpu, B and Tanko, A.I.(2017) Determining the rate and pattern of the spatio-temporal growth of Kaduna metropolis, Kaduna State, Nigeria. A paper presented at the 54th Annual Conference of the Association of Nigerian Geographers, Kano University of Science and Technology, Wudil.19-23 November.
- Aliyu, B.N. (2015). An Analysis of Municipal Solid Waste in Kano Metropolis, Nigeria.*Journal of Human Ecology*. 31(2): 111-119
- Akinola, S.and Salami, R.,(2019). An Assessment of the Effectiveness of Private Sector Participation Initiatives in Solid Waste Management in Mushin Local Government Area, Lagos State. *Nigerian journal of Social and Educational Research*. A Publication of Nigerian Association of Social and Educational Research, University of Ado- Ekiti, 2001.
- Akpu, B. and Yusuf R.O. (2019). A Rural-Urban Analysis of the Composition of Waste Dumpsites and their Use for Sustainable Agriculture Management Society of Nigeria held at Merit House Agui-Ironsi Way, Abuja. (2009).
- Akos, W. J. (2019) The Environmental Problems of Waste Refuse and Dumpsites in Kakuri Sub-Settlement, Unpublished MSc. Research Report proposal submitted the department of Geography, ABU, Zaria. 2009.
- Akwa, N. K. (2019) Waste generation and management in Dala Local Government Area of Kano Municipal, a BSc. unpublished Research Report submitted to the department of Geography Bayero University, Kano , 2009.
- Ali, A.J. (2018), The Problem of Solid Waste Management in Kaduna Metropolis. A Case Study of Ungwan Rimi, Unpublished, Research Report, submitted to the Department of Geography Ahmadu Bello University, Zaria.2008.

- Aliyu Z. (2015). Bio-energy Potentials of Agricultural and Municipal Biomass Resources in Kaduna Metropolis, An MSc Research Proposal, Presented to Geography, Department Ahmadu Bello University, Zaria.
- Annan, K., (2015), *Environmental Governance, the Global Challenge*, Island Press, Washindton. 2001.
- Aniko J. D. (2019). An Analysis of the Impact of Solid Waste Disposal on the Environment in Tudun - Wada, Zaria. Unpublished Research Report submitted to the Department of Geography, Ahmadu Bello University, Zaria.
- Ayininuola, G.M. and Muibi, M.A. (2018) An Engineering Approach to Solid Waste Collection System; Ibadan North as case study. *Waste Management*, 28(9), 1681-1687.
- Ayo, B., Ibrahim, B. and Mohammed, R.M. (2018). The Practice and Challenges of Solid Waste Management in Damaturu, Yobe state, Nigeria. *Journal of Environmental Protection*, 1:384-388., 2010.
- Babayemi, J. O. and Dauda, K. T. (2015). Evaluation of Solid Waste Generation, Categories and Disposal Options in Developing Countries: A Case Study of Nigeria. *Journal of Applied Science and Environmental Management*, Vol. 13(3): pp.83 – 88.
- Babatunde, O. (2019). Press Conference on Lassa Fever Out Brake. Ministerial Press Briefing Held at International Conference Centre Abuja. (2009)
- Blight, G.E. and Mbandc, C.M. (2016). Some Problems of Waste Management in Singapore. *Waste Management*, Vol. 22, Pp. 557-567
- Cointreau-Levine, S., and Program, U. M. (2018). Private sector participation in municipal solid waste Management. Conference on Upgrading Urban Slums October 3-5, 2000, Johannesburg, South Africa.
- Daniel Burd, (2017). Daily Trust Newspaper of June, 24, Page 43, Microbes That Eats Plastic, A column in the Daily Trust, (2010).
- Dearmaun, W R, Dayness, F.J. and Irfah T.T., (2018). Engineering Grading of Weathered Granite. *Engineering Geology* (12): 345-374.
- Doan, P.L. (2018). Institutionalizing Household Collection: The Urban Environmental Management Project in Cote d'Ivoire. *Habitat In* Vol.1. 22: 27-39.
- Efe, S.I. (2010). Solid Waste Generation and Management in Ughelli, Delta State, Nigeria. *GRP Journal of Environmental Management and Planning*. 3: 25-35
- Funmilayo T, Ukairo J, Abubakar W, et al (2018) In Daily Trust, The Need For Waste Management, May, 2014 P. 32.
- Geoffrey I. N (2015). The Urban Informal Sector in Nigeria: Towards Economic Development, Environmental Health and Social Harmony. *Global Urban Development Magazine* 1 (1).
- Ibrahim D.M. (2017). Urban Environmental Quality Perception; 11 Gombe Town, Nigerian *Journal of Environmental Science*. Vol. 1 No. 1 of University of Jos, Pp. 89-103.
- Jatau B. S., Fadele, S.I, and Agelaga, A.G. (2016). Groundwater Investigation in Parts of Kaduna South and Environs. Using winner Offset Methods of Electrical Resistivity Sounding. *Journal of Earth Sciences and Geotechnical Engineering* (1): 41-45.
- Joel, A B and Fansen T (2016) Pattern and Disposal Methods of Municipal Waste Generation in Kaduna Metropolis of Kaduna state, Nigerian *International Journal of Education and Research* Vol. 1 of 12, 2013. I
- Kasham, B. T. (2019) Solid Waste Management in Sabon Tasha, Chikun Local Government a BSc. Unpublished Research Report submitted to the Department of Geography Ahmadu Bello University, Zaria.
- Krejcie, R. V. and Morgan, D.W. (1976). Method of Determining Sample Size for Research Activities, *Educational and Psychology Measurement*, page, 607-610.
- Kyessi. A and Mwakalinga, V. (2019). GIS Application in Coordinating Solid Waste Collection; The Case of Sinza Neighbourhood in Kinondoni Municipality, Dar es Salaam City. (2009).

- Lawal Ibrahim, (2015), Refuse Generation and Disposal Problem in Tudun- Wada Kaduna a BSc. Unpublished Research Report submitted to the Geography department, A B U Zaria
- Mmom, P.C. and Mmom, C.F., (2015). Environmental Sanitation and Public Health Challenges in a Rapidly Growing City of the Third World; The Case Study of Domestic Waste and Diarrhea Incidence in Greater Port Harcourt Metropolis, Nigeria. *Asian Journal of Medical Sciences* 3 (3) 115-120.
- Nabegu, A B, (2018), Municipal Solid Waste Characteristics In Three Residential Zone of Kano Metropolis: Implication For Management. In *Geography and Millennium Development Goals. A proceeding Of Association of Nigerian Geographers. National Population Commission,(2009). Federal Republic Of Nigeria Official Gazette No. 24Vol. 94 Lagos Nigeria.*
- Nwocha R.E, Pat-Mbano, E.C. and Dike, M.U. (2016).Evaluating the Efficiency of Solid Waste Collection Services in Owerri Municipality, Nigeria.*International Journal of Science and Nature, 2004-2011 Society for Science and Nature (SFSN).U.S.N. Vol. 2 (1) 20 II; 8995.*
- Okecha,S.A.(2014) Pollution and conservation of Nigeria Environment, T. Afrique International Associate, Owerri, Nigeria.
- Read, A. D,(2015) Delivering of Sustainable Waste Management- a UK Perspective Resources.
- Rushton, L (2019).Health Hazard and Waste Management. MRC Institute for Environment and Health,Leicester, UK 2010.
- Seadon, J K, (2016) Integrated Waste Management; Looking Beyond the Solid Waste Horizon. *Waste Management, Vol, 26,pp. 1327-1336.*
- Sani,U.U. (2015). Spatio-Temporal Variation of Urban Canopy Heat Island in Relation to Surface Composition in Kaduna Metropolis, Nigeria. A Ph.D. Proposal Presented to Geography Department, Ahmadu Bello University, Zaria. Sambo, N. (2018). The Punch National Dailies, November, 12, 2008.
- Seo, S. (2019).:Environmental Impacts Of Solid Waste Treatment Methods IN Korea, *journal of Environmental Engineering* 130(1);81-89
- United Nations Environment Programme, UGA (UNEP) (2018).Contribution from Waste to Climate.http://www.vitalgraphics.net/waste/html_file/42-43_climate_c.
- United Nations Industrial Development Organization, UNIDO (2019) Industrial development report on Nigeria [online]. United Nations Industrial Development Organization, Vienna Austria.[cited 22 July 2018]. Available at www.unido.org.
- UNEP, (2002).International Source Book on Environmentally Sound Technologies Health Organisation, Technical Report Series No. 856
- Wokekoro, E. (2017). Solid Waste Management in the Construction Industry (A Case Study of Port Harcourt Metropolis). *Waste Management, Environmental Geotechnology and Global Sustainable Development, 20: 1-11*
- Yamane, T ,(1976). *Statistics; An Introductory Analysis,3rd Edition, New York Harper and Row.*
- Zakil, (2019). An Analysis Of Solid Waste Generation And Management in Sokoto Metropolis. An Unpublished BSc. Project, Department Of Geography,Ahmadu Bello University, Zaria.