Analysis of Spatial Characteristics of Solid Wastes Generation and Distribution in Selected Urban Areas of Kogi East, Nigeria.

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Abstract

In this study, a geospatial assessment of the volumes of solid waste generated and managed in selected locations in a relatively large developing region of Kogi East, Nigeria, was carried out with a view to analyzing their spatial spread. Generally, the relationship between solid waste generation and management and the development of infrastructures in any society grows correspondingly with urbanization. Similarly, as the region's demographic and morphologic character changes and increases, so is the increasing generation and accumulation of wastes. By implication, the need to sustainably manage these wastes also rises. But the most worrisome is the attenuated negative effects of these wastes to the region's socio-economic and biophysical development phenomena, particularly at a time when Kogi East region houses a population of over 1,000 000, with its numerous rural industrial complexes. Kogi East, at an average volume, generates over 6179 tons of solid waste annually. This submission absolutely reflected the background objective for this research. The methods used in this study include empirical survey and theoretical search. Field data were generated randomly from 50 sample locations across the study area and subsequently analyzed using descriptive statistics; the Fishers g_1 and g_2 statistics was then used for analyses. The technique of analysis included data tabulation, frequency distribution and testing, and calculating for normality and moments in the data respectively. The frequency distribution was demonstrated with a histogram that pictorially demonstrated the spatial character of solid wastes generated in the study area. Deriving from the ratios in the test for significance, the statistical assumption was accepted hence the critical f' values were higher than the calculated values of g_1/SEg_1 and g_2/SEg_2, i.e. 1.54 and -0.32. Based on this testing, the distribution of solid wastes generation in the study area has thus been confirmed normal at 95% confidence level. The general interpretation is that there is a correlation between and a corresponding increase in the volume of solid wastes generation and population increase, along the tract of urban growth.

Key Words: *Solid waste generation, solid waste management practices, human consumption of resources, Wastes accumulation, urban waste management.*

Introduction

Waste generation especially in urban and municipal areas has become a matter of serious urgent concern due to the health and environmental implication it does brings. It has been discussed at different for a that solid waste generation and the attendant poor management practices has brought about the destruction of the aesthetics view of the environment, blockage of useful land that would have been used for building construction and other activities, the stench and odor that accompanies the waste dump, the rodents and other health challenges associated with poor urban waste generation and poor management. This has become so worrisome due to the failure of government and the mechanism put in place by the municipal government to manage such waste and the corresponding attitude of the residents where such waste is generated. Suffice this to say that what are the characteristics of the solid waste generated and what are the management practices in place to control, collect, transport and discard such waste? What are the volume and density of waste generated and does each facets of the municipal area generate the same amount of waste? Solid waste can be described as any solid garbage from resources used which do not have immediate need by the owner at that particular time. Solid waste may also be described as any solid unwanted materials which are to be discarded by the original owner since they do not have any use for it again. Solid waste means any garbage, refuse, sludge from any human activities from household garbage, commercial places, waste water treatment plant, water supply treatment plant, or air pollution control facility and other discarded materials including solid, liquid, semi-solid, or contained gaseous material, resulting from industrial, commercial, mining and agricultural operations, and from community activities, (Department of Environmental Conservation, 'DEC', 2018); these include bathing, washing, weeding, brick laying, molding, food preparation, etc. The DEC gave examples of solid wastes to include the following when discarded: vegetable waste, household wastes, waste tires, septage, scrap metal, latex, paints, furniture and toys, garbage, appliances and vehicles, oil and anti-freeze, empty aerosol cans, paint cans and compressed gas cylinders, construction and demolition debris, asbestos etc.Waste is anything, which is no longer of use to the disposer, (Eseigbe et al, 2007;Modebe, Onyeonoro, Ezeama, Ogbuagu&Agam, 2009;Matsumoto, 2011).They are residuals from homes, business premises, educational institutions, commercial and industrial establishments, farms, etc. In addition to the ones mentioned above, they occur in the form of garbage, trash, rubbish, refuse, discards and throwaways that constitute nuisance to the people. Examples include broken bottles, bricks, broken glass, can, plastics, paper, battery casings, rags, plantain skins, scraps of iron, etc.

Solid waste management is the most pressing environmental challenge faced by urban and rural areas of Nigeria. According to Agunwamba, (2018), Nigeria, with a population exceeding 170 million, is one of the fastest producers of solid waste in Africa. It is estimated that 30 -50 % of solid waste generated within the urban centers in the developing countries are left uncollected, (Onuoha and Akubuo, 2010). Similarly, refuse collection is not officially organized in most Nigerian houses, not to talk of towns and cities at large. This could result to loss of potentially valuable economic resources and recyclable waste materials to be used for more productive purposes (Salam, 2010; Sankoh, Yan & Tran, 2013).

Profoundly, the Harmful waste Act, Cap H1, LFN, (2004) prohibits, without lawful authority, the carrying, dumping of harmful wastes in the air, land or waters of Nigeria. Solid wastes have calorific values. The heating or calorific value is a very important characteristic of fuel since it measures the amount of heat released by complete combustion of unit weight. The calorific value of paper and wood is determined by a bomb combustion method. The generation of energy from solid wastes involves organized processing of institutional solid waste, sorting, separation, drying, compacting and combustion in order to extract the materials with high caloric value. In Kogi East, the generation of solid wastes has increased greatly since the early 1990s in line with rapid economic growth and urban migration. At several instances, the rates at which these wastes are generated outmatch the volume at which they are disposed of. During heavy rains, drains are blocked and may results in monumental flood incidences with loss of lives and property. However, Onuoha and Akubuo (2010) argued that the volume of solid waste generated does not invariably measure the extent to which the environment will be polluted, if the waste can be collected, evacuated and disposed of satisfactorily and as it is generated.

Wan, Shen and Yu, (2015) found that wastes are unavoidable outcome of human activities, their collection and disposal inclusive. The end result of these activities is crucial for the maintenance of the health of the people and the development of a wide range of infrastructure in any locality. Population growth, increasing urbanization and industrialization and rising standard of living have all contributed to an increase in both the amount and variety of solid wastes generated in most countries, (Santra, 2010). Everyone generates some quantities of solid wastes daily; however, the quantity generated is determined by the socio-economic status of the people, (Arigbede and Yusuf, 2010). According to them, among all wastes, solid waste is the most ubiquitous and most difficult to manage locally. This is because, solid wastes do not flow, evaporate, diffuse, dissolve or be absorbed into the surrounding unlike liquid and gaseous wastes.

The attitude and behavior of individuals, both at home and in their work places significantly have a role to play in the amount of wastes generated (Audu, 2017). In behavioral geography, the views of geography counter the simplistic views of geographical determinism and neoclassical economics, suggesting that, far from being an economic man, an individual is a complex being whose perception of the environment may not correspond with objective reality. This view which was put forward by Susan (1998) informs that a distinction is made between the objectively observed environment – things as they are – and of the perceived environment – things as they are seen by the individual. The author maintained that individuals react to their perceptions, rather than to the phenomenal environment. On the connection between people and their environment, Ofomata (2008) observed that the question as to how far the physical features of the earth affect man is an old one; it is also one to which no final answer has yet been given".

Among the ancients, the author further stated, a people and their country were inseparable, and where unusual customs or strange physiognomies were found, a cause was sought in one or other of the physical elements: climate, relief, or soil but in the present discourse, solid waste (Yau, 2010). This component is a result of the utility of this part of the geospace. Among the various sources of wastes, industrial and residential areas generate the highest volume, yet the most difficult in terms of their biodegradable components. Most non-degradable such as plastics and tins are common in Nigerian cities, even though wastes like vegetable leaves appear to be the most common among the wastes generated by the middle-income class, (Arigbede and Yusuf, 2010).

Yin, Gaoand Xu, (2014) posited that by implication, improperly managed solid wastes in most urban areas of KogiEast are a cause of worry to the people, hence they constitutes real and potential hazards, which include obstruction to traffic flow, the release of offensive odors to neighborhood areas, physical obstruction to community development projects and unpleasant sight to the people. They include ground water contamination, which have caused the outbreak of diseases (e.g. typhoid fever, dysentery, cholera and stomach disorders). The result of a recent research confirms that many countries are now faced with dealing not only with greater volume of wastes, but also more dangerous solid wastes materials. A section of the United Nations Environment Programme 'UNEP', (UNEP Environment Data Report) was concerned principally with the generation and disposal of solid wastes arising from liquefied effluents, (Santra, 2010). This trend of course calls for concerted efforts at developing strategies to mitigate the resultant negative effects on our environment.

Despite the negative impacts of waste to the environment, the need to manage waste for sustainable development has also been given attention by some scholars. It must be re-emphasized that the volume of solid wastes generated per se does not invariably measure the degree to which the environment will be polluted, (Eseigbe et al, 2007). They maintained that if the wastes can be evacuated and disposed of satisfactorily and as fast as it is generated and deposited, there would be no accumulation and hence no insult, abuse and pollution. They explained that it is when evacuation and deposition perpetually lag behind the rate of generation that solid wastes become environmental nuisance.

In this part of the world therefore, due to the unwholesome, ignorance and neglect attitude by the people to sustainable waste management, the varied problems associated with wastes continues unabated. Despite of the introduction of new technologies and the expansion in size of settlements in the study area, the possible way to manage solid wastes sustainably looks very difficult. In this study therefore, there is every assurance that an appropriate way would be developed on suitable solid waste management.

Composition and characteristics of Solid Wastes

Solid wastes are characterized with the following features: Composition, Density, Moisture, Particle Sizes and Chemical makeup, (Uchegbu, 2002; Aatamila,2010). The composition of solid waste is the most important characteristic of waste affecting its treatment which varies from one region to another. Soon as the living condition of the people improves, the volume of waste generated increases significantly. That is the reason waste generated in the urban areas outweighs those generated in the rural or less industrialized areas, where packaging contributes about 30% of the weight and 50% of the volume of household waste. People living in cities tend to throw away little organic substances, paper, glass and metals than those in the rural or village areas. In the rural areas, solid waste comprises of materials such as wood, charcoal, waste food, yard scraps, discarded plates and broken pots and feces (Eneji, 2017).

Waste density describes the volume of waste generated per the area of the region. It varies from one region to another and it is determined by the socio-economic activities of the inhabitants.A moisture concentration of 20% is usually considered as normal for municipal solid waste, (Uchegbu, 1997). It can vary between 15 and 30% water. The mixture is measured by drying a sample at 77^0 C for 24 hours and calculating it as:

$$M = \frac{w-d}{w} \times 100$$

Where M = moisture content (%)

W = Weight of sample

D = final (dry) weight of sample

Solid Waste Composting

Composting is one of the techniques for managing wastes, (Uchegbu, 2002). He maintained that man, in his social, economic, industrial and other activities unavoidably produces wastes. In recent times, he maintained, the multiplicity in types and quantity of wastes produced has been terrifying.Madu,(2007);Eneji, Onnoghen, Edung& Effiong, (2018) variouslylinked waste generation to be one of the major environmental problems of urbanization in Nigeria. He remarked that the most important threat to Nigerian urban environmental quality is solid waste from domestic and industrial activities. A visible feature of most urban centers in the country, he says, are the *refuse mountains* which often take over part of motorable roads, built-up on river banks and swamps, emit foul odors as well as breeding grounds for pathogenic agents.

Solid Waste Programme

Eneji, (2017) posited that specific programmes across the globe have been designed for solid waste management. The New York State Materials management program (2018) for example, is administered as a regionalized programme with components for solid waste management. According to googleweblight.com, (2018), all part of 360 permits, registrations, variances and other permits related to determinations regarding the construction and operation of solid waste management facilities are issued on a regional basis(Eneji, 2017). The New York State DFR part 258 Federal criteria for municipal solid waste landfills, and to address legal, technological and policy developments that occurred after 1988 is also geared towards urban and municipal solid waste management. The 1993 part 360 Regulations also provide more regulatory flexibility and reduced regulatory burden than previous versions of part 360. Additionally, the current part 360 regulations include a registration process for certain types of municipal solid waste management facilities such as recyclables, handling and recovery facilities and land clearing debris and landfills which the department has concluded do not require the extensive scrutiny and evaluation of a full part 360 permit process (Asmawati, Norand Yusooff, 2011;Eneji, Eneji, Ngokaand Abang, 2016).

In Nigeria, solid waste management has gradually been considered as necessary steps towards saving the country from the frazil ecology. In pursuit of various socio-economic activities, particularly agriculture and the generally development of the physical space, the people have progressively altered the natural geographic space, the problem which have worsened to an extent that property development standards are abused. It is in view of this development that the concept of Sustainable Development was established in Nigeria, specifically embraced by the Federal ministry of Environment some few Decades ago. Essentially, Sustainable Development is a concept globally adopted for the protection of the environment, by which the exploitation of natural resources and the present means of securing livability do not alter or limit the potentials for meeting the needs of future generations, (Santra, 2010) and (Ocholi, 2015).

In the course of this sustainability in the use of resources, the United nations Commission on Environment and Development 'UNCED' in her 21st chapter (section 11) of Agenda 21 addressed the issue of effective management of waste under four programme areas: minimizing waste, maximizing reuse and recycling, establishment of home/community based programmes, including separate collection of recycling household wastes, and extending waste management services that require national planning, international cooperation and funding, (Uchegbu, 2002; Ayodeji, 2010). The vehicles used in achieving sustainable development and preservation of natural resources include preservation and conservation of natural resources, sustainable solid waste treatment/management, especially waste water/sewage treatment and disposal, forestation/reforestation programmes, dependable handling of toxic wastes and the control of air, water, land and noise pollution.

The Study Area

Kogi East, consisting of Igala and Bassa areas, situates in the eastern flank of Kogi State, Nigeria. Kogi East is located between latitudes 06° 05' - 08° 00' N; and longitude 06° 07' — 07° 05' E, (Ukwedeh, 2003). This is shown in figure 1. The area is located in the tropical region, specifically in the middle belt of Nigeria. The region covers an area of about 19,200 sq km (Egbunu, 2009). Kogi East is drained by the two giant rivers: the Niger to the West and the Benue to the north. It is also drained by numerous rivers and streams (e.g., Imaboro river, and streams such as Okura, Inachalo, Ofu, Itemie, Onne, etc.The region lies within the warm humid climatic zone of Nigeria with a distinctive wet-dry season dichotomy. The climate of the area is thus affected by two main air masses: the tropical maritime, **(mT)** and the tropical continental, **(cT)**. Rainfall is heavy within the 6 - 8 rainy months with an average of about 1500 – 2000mm annually, (Ocholi, 2007). Kogi East has a mean annual temperature of 24.5°C.

Kogi East is dominated by older sedimentary rocks of the secondary age. These comprise limestone, sandstones, shale and coal. Also present are tertiary rocks comprising of sands and clays dominating some parts of the study area, particularly the axis of Ankpa, Omala and Dekina LGAs. The general relief of the area comprises of highlands and lowlands. In the northern and central axis, occur numerous chains of hills and ridges at considerable heights. The dominant vegetation communities remain the tropical savanna woodland of secondary types and mixtures of scattered tropical trees and grasses formations. Vegetation distribution in this area follows a pattern that is similar to that of rainfall distribution, (Ocholi, 2015).

Being the largest senatorial district in Kogi State, Kogi East shares boundary with the Federal Capital Territory in the North, Benue state in the East, Enugu state in the South and with its neighbors, the Central and Western senatorial districts in the West. Kogi East comprises of nine local government areas. These include Ankpa, Bassa, Dekina, Ibaji, Idah, Igalamela/Odolu and Ofu. Others are Olamaboro and OmalaLGAs.The population of the region is unevenly distributed. While some areas are densely or thickly populated, particularly the built-up areas, others are moderately or scantily populated. The current estimated population of figure of Kogi East is about two million, three hundred and twenty-two thousand, two hundred and seventy seven (2,322,977) persons (Google Population projection, 2019).

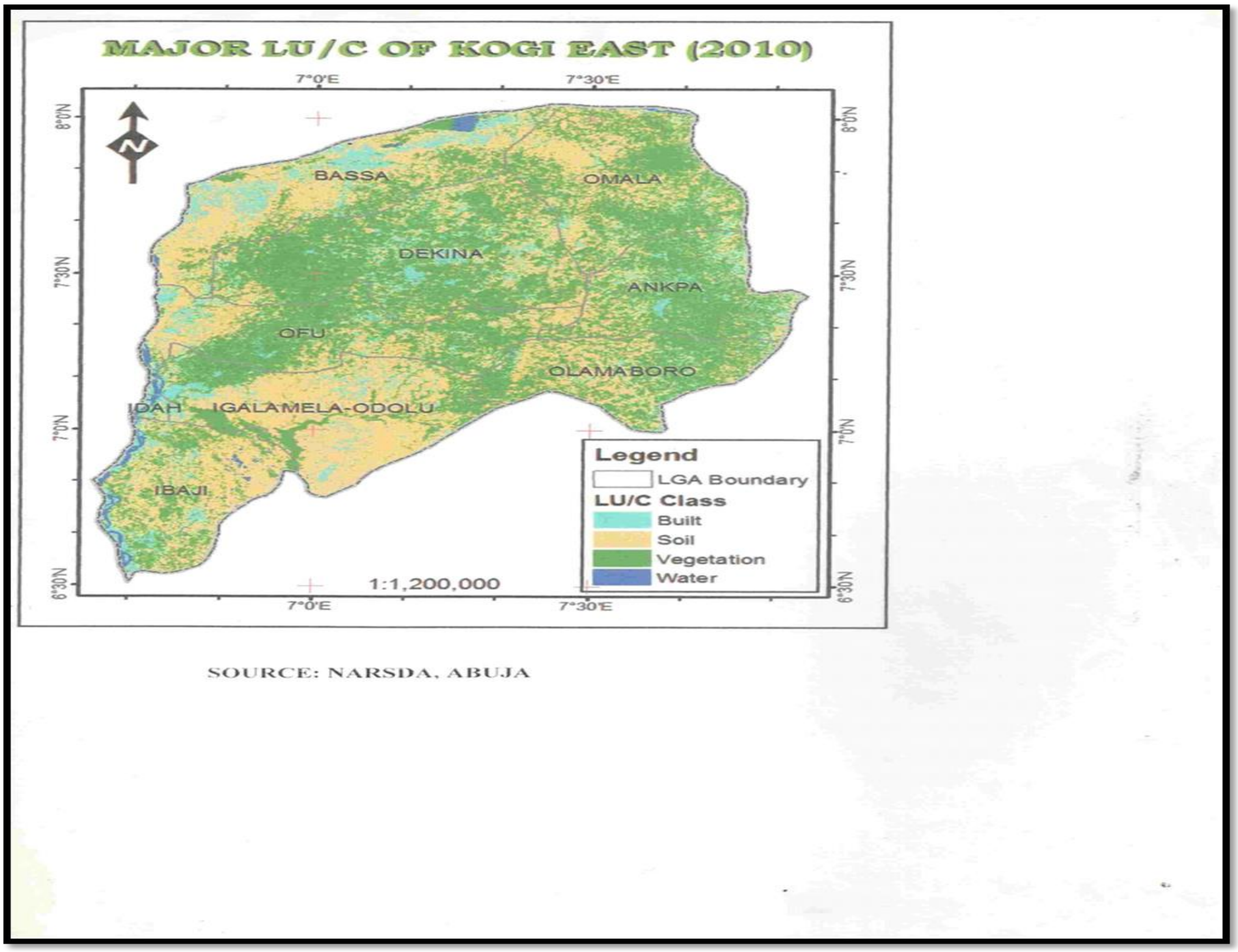

Fig.1: Land use/Land cover of Kogi East (*Source: NARSDA, Abuja, 2010).*

Materials and Methods

Data for this study were randomly sourced in 50 selected locations in Kogi East from field survey. The figure in table 1 were collections done by the inhabitants themselves over some reasonable periods for a whole year, mostly in collection cans at varying measurements, during weekend periods (i.e. on Fridays and Saturdays), usually between 6.00 to 10.00 am. The figure arrived at were the averages of the annual collection in tones. The stratified random sampling Technique was adopted for the study, and in each Local Government Area, at least five sample areas were randomly selected to acquire empirical data based on the solid waste management practices, volume and density.

Data were analyzed with Descriptive Statistics. This was first done by grouping the data into 6 classes while we produced a Frequency Distribution Table and a Histogram. Data were tested for Normality using the Fisher's g1 and g2 test statistics. The Fisher's g1 and Fisher's g2 statistics is amultivariate statistic meant to demonstrate the spatial character of solid wastes generationacross geographical space. The sample areas within Kogi East were mostly the city centers, with high concentrations of population. They includeAnyigba, Egume, Abocho, Iyale, Dekina,Ajiyolo, Ologba and Agbeji, Ejule, Aloma, Umomi, Ugwolawo, Itobe, Ochadamu,Ajaka, Odolu, Akpanya, Ayija,Alade, Inachalo-Idah, Ega-Idah,Ogodu, Ojeh, Agojeju-Odo and Abejukolo-Ife. Others are Aloji, Alo, Adumu, Adikafane,Alome, Ahi, Ikefi, Ugbedomagu, Ala, Keffi, Alakwa, Ojuwo-Obele, Angba, Edimigo, Ofabo, Ijabe, Ubalu, Onitch-Igo, Ogbagebe, and Ogbulu. Also included areAgojeju-Ejule, Ajataga, Olla, Elubi and Ojofu-Anyigba.

Table 1: Average volume of solid Waste (in tons) generated in Kogi East between 2013-2017.

Waste measurement Sites	2013	2014	2015	2016	2017
1	136	96	02	133	154
2	125	125	117	126	126
3	108	136	124	114	150
4	120	110	126	130	168
5	100	123	118	152	122
6	110	155	114	117	125
7	125	127	107	124	128
8	148	131	93	123	118
9	120	114	132*	155	102
10	108	111	120	115	116

(a) Grouping the data into 6 classes by producing a frequency distribution table and a histogram; then, (b) Testing for normality in the data using Fisher's g1 and g2 statistics.

N = 50

K = $\sqrt{N} = \sqrt{50} = 7.07$

Range = 168 – 93 = 75

Class interval = 75/6 =12.50, approx. 13.

Table 2: Normality in the data using Fisher's g1 and g2 statistics.

Classes in tons	Frequency (f)
93 – 105	5
106 – 118	15
119 – 131	18
132 – 144	5
145 – 157	6
158 – 170	1
	∑f = 50

Below is the histogram on the volume of solid wastes generated in volumes per day in Kogi East between 2014 and 2016.Using the data above, produce a histogram was produced thus:

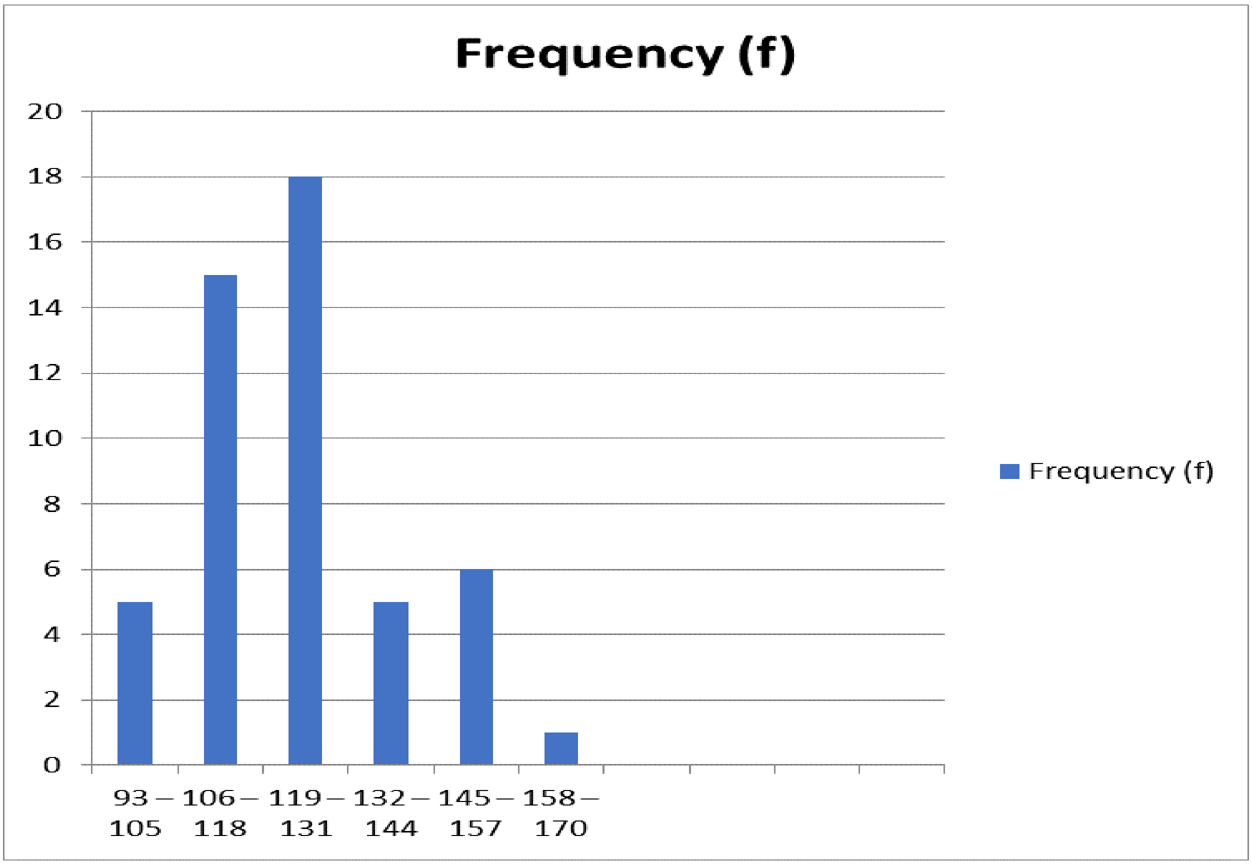

Figure 2: Histogram on the Frequency of Solid wastes generated (Source: Field work, 2016).

Figure 1: Testing for Normality using the Fisher's g1 and g2 statistics.

Classes	F	U	U^2	U^3	U^4	Fu	Fu^2	Fu^3	fu^4
93 – 105	5	-2	4	-8	16	-10	20	-40	80
106 – 118	15	-1	1	-1	1	-15	15	-15	15
119-131	18	0	0	0	0	0	0	0	0
132 – 144	5	1	1	1	1	5	5	5	5
145 – 157	6	2	4	8	16	12	24	48	96
158 – 170	1	3	9	27	81	3	9	27	81
	$\sum f = 50$					$\sum fu = -5$	$\sum fu^2 = 73$	$\sum fu^3 = 25$	$\sum fu^4 = 277$

Calculating the intermediate values, we have:

$h1 = \sum fu/N \quad = h1 = \quad -5/50 \quad = -0.10$

$h2 = \sum fu^2 \quad = h2 \quad = \quad 73/50 \quad = 1.46$

$h3 = \sum fu^3 \quad = h3 \quad = 25/50 \quad = 0.50$

$h4 = \sum fu^4 = \quad h4 = 277/50 \quad = 5.54$

Next, we calculate the Moments:

$M2 = h2 \; - \; h1^2$

$M3 = h3 \; -3h1 \, h2 + 2h1^3$

$M4 \; = h4 \; - 4h1h3 \; + 6h1^2h2 - 3h1^4$

$M2 = 1.46 - (0.10)^2$

$= 1.46 - 0.01$

$= 1.45$

$M3 = 0.50 - 3\,(-0.10 \text{ x } 1.46) + 2\,(-0.10^3)$

$= 0.50 - (-\,0.44) + (-0.00)$

$= 0.50 - (-\,0.44)$

$= 0.94$

M4 = 5.54 – 4 (-0.10 x 0.50) + 6 (-0.10^2 x 1.46) – 3 (0 - 10^4)

= 5.54 – (- 0.20) + (0.09) – (0.00)

= 5.54 + 0.20 + 0.09 – 0.00

= 5.83

Calculating the g1 and g2 Fisher's statistics;

g1 = M3/(M2√M2) = 0.94/ 1.45√1.45 = 0.94/ 1.75

g1 = 0.54(schewness).

g2 = ($M4/M2^2$) – 3 = (5.83/2.10)) – 3

= 2.78-3

= - 0.22

g2 = -0.22 (kurtosis).

Testing g1 and g2 for significance:

Let Ho be: there is no significant difference between the distribution of solid wastes and the normal distribution.

The standard error of g1 and g2 becomes:

SEg1 = √24/N =√(24/50) = √0.48

= 0.69

Determining the Ratios:

g1/SEg1 = 0.54/0.35 = 1.54

g2/SEg2 =-0.22/0.69 =-0.32

The critical value at 95% confidence level is 1.96. Since both g1/SEg1 and g2/SEg2, i.e. 1.54 and -0.32 are less than 1.96, the Ho is accepted. Therefore, there is no significant difference between the distribution and the normal one. It thus means that, the distribution is normal at 95%

confidence level, with the solid waste generation normally distributed. Thus, solid waste generation and managerial ability grows correspondingly with urbanization and settlements morphological changes. Solid waste management, according to the World Bank Group,"WBG' (2020), solid waste management is one thing just about every city government provides for its residents. It maintained that while service levels, environmental impacts and costs vary dramatically, solid waste management is arguably the most important municipal service and serves as a prerequisite for other municipal action. The WBG (2020) reveals that as the world hurtles toward its urban future, the amount of MunicipalSolid Waste 'MSW', one of the most important by-products ofevery urban lifestyle is growingeven faster than the rate of urbanization. This attest to the fact that the system of solid waste management in the study area conformed with the global standard (see Gouveia& do Prado, 2009;Iheanacho, Eneji, Undeshi, Okongor, Okpiliya & Eneji, 2010;Loboka, Shihua, Celestine, Hassan1& Wani, 2013). There is therefore every likelihood that future trend in solid waste management in Kogi East must carefully be managed along the tract of population increase and urban expansion. In its forecast, the WBG (2020) remarked that by 2050, the world is expected to generate 3.40 billion tons of waste annually, increasing drastically from today's 2.01 billion tons. This trend showcases waste generation, which is expected to reach a level that demands concerted efforts by stakeholders to inject huge capital into waste management practices in urbanizing areas. This measure could reduce the numerous risks associated with waste generation in the urban areas.

Conclusion and Suggestions

Due to the varied structural changes in urbanization and the rapid increase in population in Kogi East along the track of industrial growth, substantial volume of wastes has been generated and deposited, a situation which culminated in a numberof management challenges.

Because of its rural nature, solid waste management practices have remained unsustainable. This development grows correspondingly with demographic and morphological changes which at times have resulted in several biophysical and socio-economic problems. These include pollution, disease spread, structural decay and biodegradation. Others are the high cost of waste collection, loss of useful residential and agricultural lands, blockage of drainage path ways, the nuisance of odor from deposited wastes and management problems. It was thus revealed that the distribution of solid wastes generated in the study area was normal at 95% confidence level. The general interpretation is that there is a correlation between and a corresponding increase in the volume of solid wastes generation and population increase, along the tract of urban growth. This thus calls for concerted efforts on the part of government to appropriately address the continued generation of solid waste in a way that is sustainable.

Suggestions

Having observed thus, a probable way of addressing the problems of ever-increasing generation and management of solid wastes in the study area should be met with the following suggestions.

1. It is suggested that government and the people should intensify efforts in creating awareness on environmental protection. This is with a bid to creating the culture of insanitary levying against solid waste mismanagement.
2. It is also suggested that Solid waste management should be privatized for effective performance; hence it requires scientific management and monitoring.
3. Because of the values derivable from solid waste management, solid waste recycling and re-use should be given serious attention, believing that it derives substantial economic values.

4. Finally, considering the hazardous nature of solid wastes to health and environment, landfills or specialized waste dumps should be provided in the major settlement areas as this measure could save affected areas of pollution, avoidance of mosquito breeding grounds and offensive odors. It will also help in promoting good public health and hygiene and produces aesthetically pleasant environment.

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