



## Solid Waste Management and Disposal (A Case Study of Lokoja Metropolis, Kogi State Capital)

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### ABSTRACT

*The purpose of this study is to investigate and analyse the standard Solid Waste Management Board Service provider in Lokoja, Kogi State Capital. The study also seeks to identify daily average quantity of waste generation, and disposal in order to suggest measures for future effective planning. A comprehensive review assessment of the past and present methods adopted indicates slight differences. Although both systems are unhygienic, dangerous to human health, labour intensive, employees are not protected including Lokoja environment. In order to consolidate Solid Waste Management Board activities, Lokoja local government was divided into Seven Zones and each zone was observed for a period of two weeks to determine the quantity of wastes generated daily and the time of disposal. The total percentage of quantities of wastes obtained in each zone are: Zone1: 8%, Zone2: 24%, Zone 3: 8%, Zone 4: 18%, Zone 5: 6%, Zone 6: 14% and Zone 7: 22%.*

**Key words:** Solid waste material, Perishable and Non-Perishable, Decompose and Non-Decompose, Disposal, and Environment

### 1. INTRODUCTION

Solid Waste Material is defined as rubbish or any material that is rejected, useless and unwanted around human premises or environment. Solid Wastes can also be described as Refuse or discarded materials consisting mainly perishable and non-perishable material. Perishable materials can decompose easily within a short span of time while non-perishable cannot easily be decomposed. In academic environment both perishable and non-perishable materials are not totally rejected because if sorted some can be converted to new products useful for human consumption. Before the commencement of this study, it was observed that refuse are dumped indiscriminately all over Lokoja business district and suburbs especially where both middle and lower class residents reside, heaps of refuse are located everywhere. Observing the situation, the researcher considered it necessary to investigate the problem of waste disposal in Lokoja. It was on this note Solid Waste Management Board in Kogi State was set up to manage, control and disposal of solid waste in Kogi State. It was identified that Solid Waste Management Board and its Subsidiary Agent in Lokoja coordinate all collection and disposal activities in Lokoja Metropolis. In an attempt to gain insight into this Solid Waste Management Board associated service problems, Solid waste management Board was consulted, a meeting of brain storming between the researcher and the Board, was organised and scheduled immediately. The outcome of the meeting, recommended that Lokoja Business District be divided into seven zones to examine the service activities in terms of collection, transportation and disposal of Solid Waste in Lokoja Business District. Each Zone site was visited to assess the activities of Solid Waste Management Board in the area. It was revealed that both Solid Waste Management Board and Solid waste contractors are not efficient in planning and coordinating waste disposal activities in Lokoja. Daskalopoulos. E et al., [1] showed that the poor state of coordination and management of solid waste in urban centers in the world is becoming a major economic and social handicap to many countries. Solid Waste Management Policies are unattainable in Lokoja because there is no Solid Waste Management data to implement any policy in Kogi State. According to Agunwamba, J.C. [2] waste data is almost non-existence in Nigeria, it is only for few isolated cases in Nigeria and they are not easily accessible, if there are, they will be grossly inadequate for decision making. This statement demonstrates that Solid Waste Management Board and solid waste Contractors in Lokoja cannot develop adequate plan and policies to

manage solid waste in Lokoja Business District/ Metropolis. Unavailable waste data may not be associated with lack of fund but management skill and environmental related problems. The existing disposal methods such as landfill and open field combustion cannot eliminate non- biodegradable constituent of solid waste such as metals, plastics, steel, glasses other non-destructive agents or materials. Commercial venture policies such as recycling of scrap metal and glasses and so on, may be necessary to successfully carry out Solid Waste Management operations in Lokoja. The main purpose of this study is to identify the daily average quantity of solid waste generation, disposal policy and suggest measure for effective plan.

## 2. SOLID WASTE AND ITS ASSOCIATED PROBLEMS.

Adegoke. O.S. [3] showed that eighty percent of solid waste composition in Nigeria is organic while twenty percent inorganic. Solid waste material is categorized into metals, bottles, glasses, plastics, concrete, iron and steel, papers, vegetables, food stuff, ashes, dust, toxic and hazardous chemicals. All these materials are industrial and agricultural waste products, they are harmful to human, plants and environment. Some contain toxic waste that can infiltrate into the soil and pollute underground water. Thus pollution underground water becomes dangerous to human, animals and Plants. Moreover, late collection or disposal produces offensive odour which always attracts the attention of flies and other insects that transmit diseases to human, animals and environment. This type of problem is widespread in Lokoja. The Board may not be able to arrest the situation due to the Board inability to effectively plan, design a particular dumping site and put into operation environmental sanitation policy.

### 2.1 Classification and analysis of solid waste

Solid waste can be classified as nature, physical and chemical, composed of: Organic substances, Inorganic/mineral substances, Combustible/carbonaceous matter and Water content.

**2.1.1 Organic substances:** can be described as liquid, gases, living organisms and solid. Liquids can further be classified as fuel, chemical, Oil, Paints and food. Likewise Gases into Carbon dioxide, Carbon Monoxide and Solid into Living Organisms Polymers, Natural Resin Soils and Food. Connel A. [4] pointed out that organic waste materials are not checked against decomposed and non-decomposed materials before disposal. In Lokoja wastes are not checked against decomposed and non-decomposed materials before disposal.

**2.1.2 Inorganic Substances:** can equally be classified into liquids, gases and solids. Inorganic liquids can be defined as Acids, water, bases and drugs while inorganic gases be characterized as Chlorine, Argon, and Helium and Inorganic solids are classified into metals, ceramics, composites, glasses, clays, cement and stone. Henstock, [5] argued that there are various solid substances that are formed naturally in the earth and they are useful to humans even if they have been used and discarded, lost virginity still they can be recycled to produce another product that can be consumed by humans.

**2.1.3 Combustible:** Combustible solid waste materials are always found and discarded without considering the consequences of the effect. Most of these materials do generate heat energy that can eventually ignite fire. These types of materials are dangerous to human, animals, plants and environment.

**2.1.4 Water content:** water content in solid waste is relatively small, vegetables, fruits and leaves can easily decompose to form water.

### 2.2 Sources of Solid Waste

Adegoke, O. S. [3] showed that solid wastes originate primarily and secondarily from industries these include domestic, agricultural, and commercial, manufacturing, processing and so on. Each source produces different kinds of wastes such as Ashes and Dust, Demolition and Construction waste, Hazardous wastes, Food wastes and other stuffs described as wastes

**2.2.1 Industrial Solid Waste:** Industrial waste consists of hazardous, demolition and construction waste materials.

**2.2.2 Hazardous wastes** are chemical, biological, explosive, radioactive, waste flammable and others. Hazardous wastes are dangerous to humans, animals and plants owing to their compositions. These types of wastes are constantly appearing as sludge or semi-solid state.

**2.2.3 Demolition and construction wastes** are wastes from demolished structures and waste materials on construction sites. They are equally dangerous to human and animal health sometimes can cause accidents, especially if they are disposed nearby road pavement.

**2.2.4 Domestic Solid Waste:** Domestic waste is described as foodstuff leftover which is no longer useful, discarded as wastes or rubbish. Most of these wastes are hospitality industry's wastes created by cafeterias, restaurants, hotels, hospitals, prisons, recreational centres and other facilities connected to markets buying and selling of food items.

**2.2.5 Agricultural Solid Waste:** Agricultural wastes are junks from poultry farms, planting and harvesting of raw foodstuff materials described as farm produce, trees and vine crops, the production of milk (Agro-Industries). These types of wastes are easily decomposed and become nuisance to the environment if they are not quickly collected and disposed.

**2.2.6 Commercial Solid Waste:** The commercial solid wastes can be associated with commercial activities relating to processing and manufacturing industries including workshops, sawmills etc.

### 3. REASONS FOR SOLID WASTES DISPOSAL

Solid wastes are defined as useless, unwanted or discarded materials that have completed their original services. The main objective of solid wastes disposal is to prevent the spread of diseases such as cholera, water pollution to minimize the vulnerability of fire outbreak, and to reduce the discomfiting odour and water contamination. WHO [6] identified the following diseases attributed to solid wastes and classified them as epidemic diseases such as plague, typhus, leptospirosis, histoplasmosis, trichinosis and many other diseases. Olarenwaju, A. O. [7], identified that when wastes are deposited in water, a more unpleasant odour can arise from the release of hydrogen sulphide, dangerous to human health and environment. He indicated further that higher percentages of house flies population in cities breed in open garbage cans, ash pits and open refuse dumping sites. According to scientific literature books flies can travel up to eight to ten kilometres (8 – 10km) and eggs and larva incursion can be found 550mm below the surface of the dumped refuse site. This is one of the reasons why quick and proper disposal of refuse is necessary. Correspondingly, WHO [6] showed that flies are mostly responsible for widespread diseases like dysentery and diarrhoea while mosquitoes on the other hand, have their eggs batched in broken pots, abandoned tyres and tins containing which transmits malaria. According to WHO [6] burning of solid wastes in open area can increase air pollution? Likewise smoke coming out of burning waste is very dangerous to human's lungs and other sensitive organs of human body. Moreover, the odour coming out from the burning refuse has always been nuisance to the environment; equally, surface water becomes polluted/contaminated if mixed with open dumping refuse.

### 4. Research Methodology

The research approach is designed specifically to determine how to improve Solid Waste Management Board services in Lokoja the Kogi State Capital. The method used in collecting the data for this study includes meetings, interview, and extensive field work/observation and laboratory measurements. The purpose of collecting the data via extensive field work/observation and laboratory measurements was to determine the waste in terms of its composition by taxonomy. Additionally, the aim of the meeting and interview was to obtain information on previous waste disposal methods, quantities of wastes generated and frequency of disposal etc. In an attempt to determine the quantities of wastes produced, time of collection and disposal, Lokoja Business District was divided into seven sanitation zones and they are: Murtala Mohammed Way; Adankolo Junction; Kabawa Area/Old Market, Taiwo Road Nataco Area, Ganaja Junction and Felele Area.

Each zone was observed for two weeks.

#### 4.1.1 Zone One: Murtala Mohammed Way

Murtala Mohammed Way is a small scale business activity zone where buying and selling activities exchange hands including Church Service activities.

#### 4.1.2 Zone Two: Adankolo Area

Adankolo Area is famous for Fish Market, Warehouse and Mini-Super Markets. Business activities in this zone include wholesalers, distribution and other business activities where buying, and selling exchange hands.

#### 4.1.3 Zone Three: Kabawa Area

**Kabawa zone** is considered as a residential zone where different ethnics groups reside. In this abode people dumped wastes indiscriminately. Kabawa zone has sanitation problem.

#### 4.1.4 Zone Four: Taiwo Road

Taiwo Road zone is defined to include NTA Junction, Police Barracks, Alheri Junctions, Paparanda Square and New residential Layout. The quantities of solid waste materials generated are of different types, contained both dangerous and non-dangerous wastes. Some of the waste materials are toxic, combustive and non combustive.

#### 4.1.5 Zone Five: Nataco Area (Abuja Road)

Nataco zone is not designed for bus station but it is used as a bus station for loading and off-loading passengers and goods by different transporters. Types of solid wastes generated in this zone are partially food stuffs, drinks and littered papers.

#### 4.1.6 Zone Six: Ganaja Junction

Ganaja junction zone is the most populated business district in Lokoja. This zone is noted for road side traders, hawkers, Tools shops, and Construction and Building materials Offices, Business Centres and Eatery. Types of Wastes generated here at Ganja Junction are combination of food stuff, empty cans, water bottles and litter papers.

#### 4.1.7 Zone Seven: Felele Area

Felele zone is a mixture of small scale business Centre neighbourhood of Kogi State Polytechnic main campus. Business activities in this zone vary from hair dressing saloon to dress making, beautician, eatery and others. The quantities of debris generated in this Zone 7 vary from day to day business activities.

### 4.2 Method of Collection and Storage of Solid Waste

In residential building areas, collection and storage of solid wastes are determined by the quantity of waste generated. Residents dispose their refuse by storing them in rubbish bins and ash pots in front of their buildings not further away than 200m from their place of abode. In commercial zones where buying and selling exchanging hands all wastes are deposited and collected through central collection chambers.

#### 4.2.1 Transportation of Solid Wastes

Sanitation Trucks and Multi-purpose vehicles were used to convey solid waste materials from the collection sites to the dumping sites. Sanitation Trucks were normally provided by the State Government while multi-purpose vehicles were supplied by refuse contractors, depending on the types of wastes and distance between the collection sites and dumping site. Volume/quantities of wastes were considered in selecting waste disposal vehicles because solid waste materials are not allowed to spill on the street while on transit.



Plate 1: Sanitation and Multi-purpose Trucks



Plate: 2 Sanitation truck deposit on dumping site



Plate 3: open dumping and Incineration site

**4.2.2 Disposal Site in Lokoja**

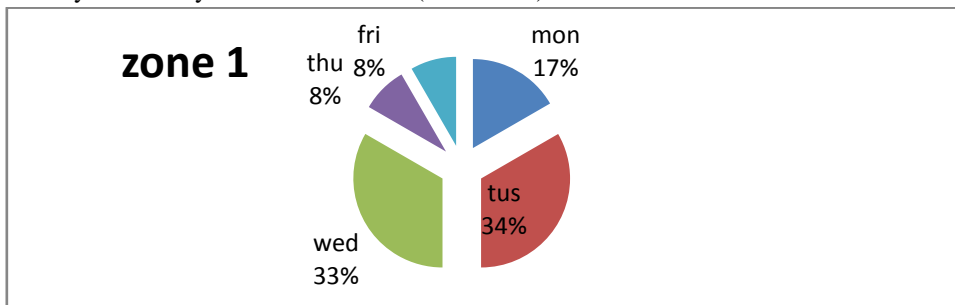
The incineration site is located along Agbaja Road of Felele which is about few kilometres away from the city centre which was observed to be very close to residential buildings. Using this area for open burning can put the health of people living close open dumping & Incineration site in danger due to contaminated air and underground water pollution.

**4.2.3 Solid Waste Handling in Lokoja**

Solid Waste Management Board in Lokoja has the option of using the following methods, waste collection, transfer and reuse, recovery, recycling, landfill and incineration etc. Currently, only three methods are adopted by the Solid Waste Management Board.

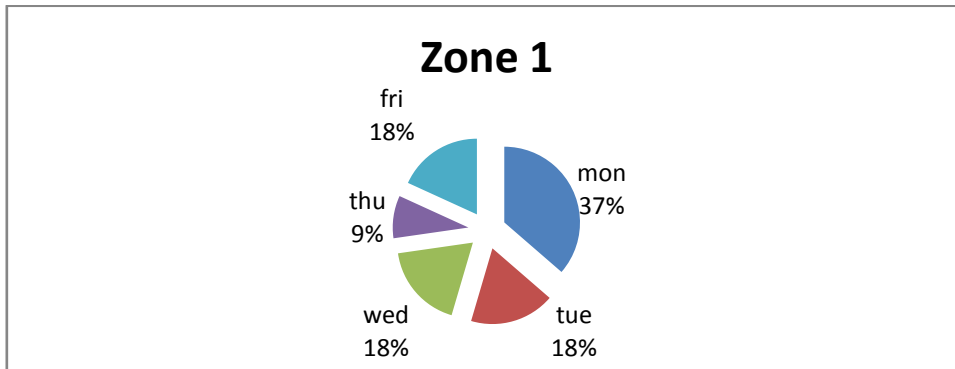
**5. ANALYSIS OF THE STUDY**

The total breakdown quantities of solid waste materials collected and disposed each day was expressed in percentages and is shown in figures 1a and b and c to 7a, b and c, and Figure 8. Figure 1a shows the total quantity of wastes collected in **Zone 1** the first week of observation from Monday to Friday. The figure shows differences in percentages of quantities of solid waste collected and disposed each day from Mondays to Friday. On Tuesday the study recorded 34% as the highest while Thursday and Friday recorded the same (lowest 8%).



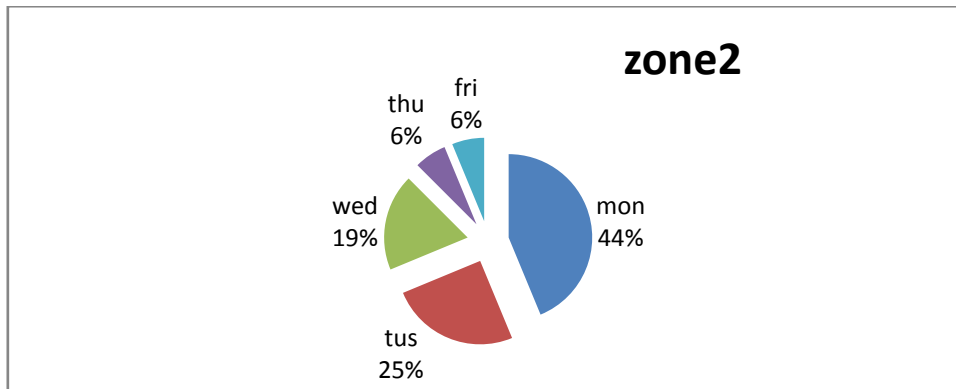
**Fig. 1a** Zone 1: First week observation, total percentage of solid waste collected and disposed

Figure 1b Zone 1 the second week of observation shows the differences in percentages of quantities of solid waste collected and disposed each day of operation stretching from Monday to Friday. The study recorded Monday as the highest 37% while Thursday was 9% the lowest. The study observed Tuesday, Wednesday and Friday turned to be the same quantities (18%).



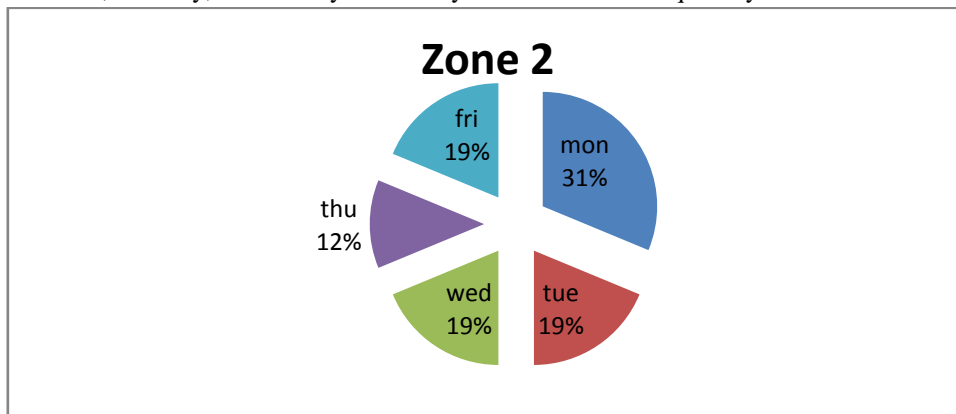
**Fig 1b.** Zone 1 second week total percentage of solid waste collected and disposed.

Figure 2a Zone 2 shows the total percentages of solid waste generated and disposed in Zone 2 for the first week selected for the study. The figure gives details in percentages of the quantities breakdown. It shows that Monday recorded the highest 44% of the total wastes collected and disposed for the week while Thursday and Friday recorded the lowest percentage 6%.



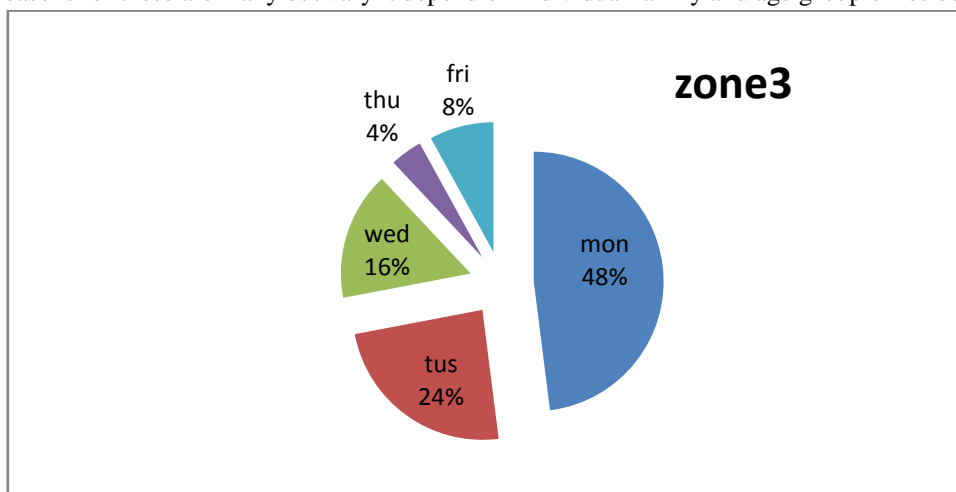
**Fig. 2a** zone 2 First week total percentage of solid waste collected and disposed

In Figure 2b Zone 2, the second week of the study, also Monday recorded the highest quantity 31% while Thursday recorded the lowest 12%, Tuesday, Wednesday and Friday recorded the same quantity 19%..



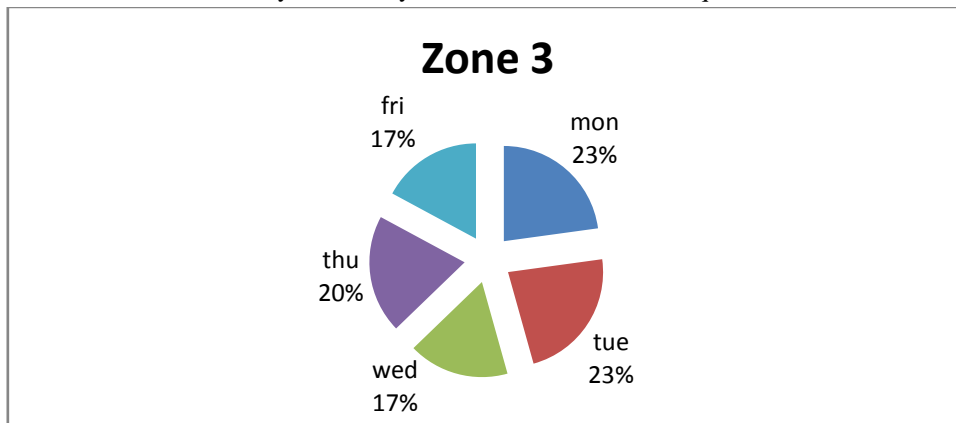
**Fig. 2b** zone2 Second week total percentage of solid waste collected and disposed

**Kabawa zone 3** is a residential Zone where different ethnic groups of people live and work. In this area residents dumped their wastes indiscriminately. The figure 3a shows the first week observation the quantities of waste produced daily is expressed in percentages. The highest percentage of waste generated was recorded on Monday 48% while the lowest was recorded on Thursday 4%. The rest of the week, Tuesday recorded 24%, Wednesday 16% and Friday recorded 8%. Reasons for these are many but vary it depend on individual family and age group of residents.



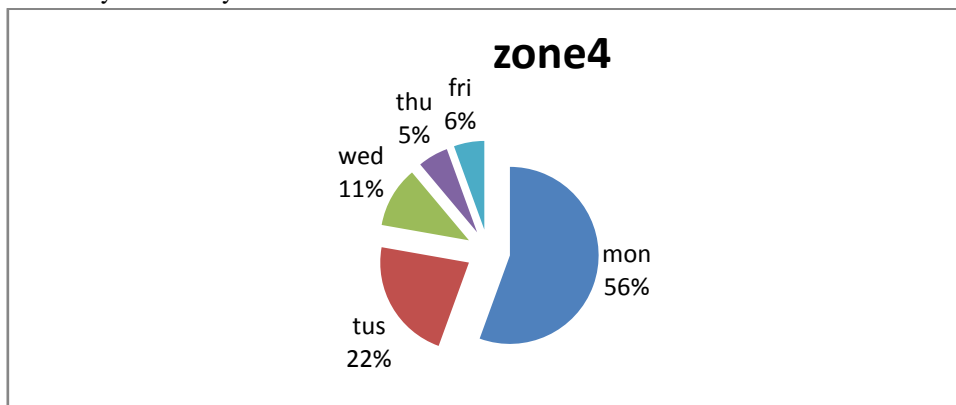
**Fig. 3a** Zone 3 First week of study percentage of solid waste collected and disposed

Figure 3b Zone 3, shows the second week study observation of Kabawa zone 3 on quantities of solid waste generation. It was observed that both Monday and Tuesday recorded the highest quantities of solid waste generated 23%, followed by Thursday recorded 20% while Wednesday and Friday recorded the lowest same quantities 17%.



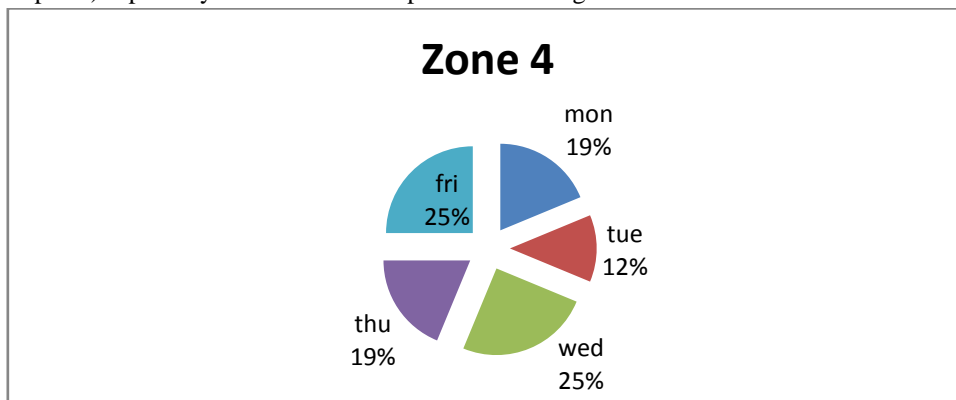
**Fig. 3b** Zone 3 second week of study percentage of solid waste collected and disposed

Zone 4 is also a residential community in Lokoja Metropolis; the nature of Solid wastes produced in this Zone can be described as domestic refuse. The first week observation the quantities of solid waste generated contained both dangerous and non-dangerous wastes. The figure 4a Zone 4 documented all quantities of solid wastes daily from Monday to Friday. The study recorded highest quantity 56% for Monday, Tuesday recorded 22%, Wednesday recorded 11% while both Thursday and Friday recorded 5% and 6%.



**Fig. 4a** Zone 4 first week of study percentage of solid waste collected and disposed

Figure 4b Zone 4 illustrates the second week observation of Solid waste generated at Lokoja Metropolis collection and disposal site. For daily recording the study recoded on Wednesday and Friday as the highest 25% each, Monday and Thursday recorded 19% each while Tuesday recorded 12% the lowest for the week. There was a little shift between the first week and second week, the little shift will assist the Solid Waste Management Board to be flexible in her action plan and implementation (collection and disposal) especially collection and disposal scheduling.



**Fig. 4b** Zone 4 second week of study percentage of solid waste collected and disposed

Figure 5a zone 5 Nataco area (Abuja road) shows the quantities of wastes generated in the first week of the study in the area. It was observed that 69% of total waste awaiting for collection and disposal in this Zone 5 the highest was recorded on Wednesday week, Monday 15% while Thursday and Friday was recorded 4% each the lowest in the first week. Zone 5 Natco Area (Abuja road) is illegally occupied by transport operators, who are using the zone for loading and off-loading their passengers and goods (stop over and boarding). Types of solid wastes generated in this zone are partly food stuffs, drinks and littered papers.

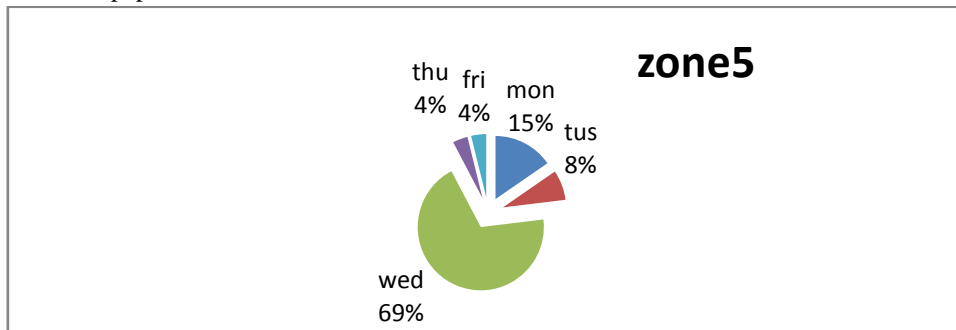


Fig. 5a Zone 5 First week of study collection and disposal

Figure 5b Zone 5 represents the second week selected for the study. The quantities solid wastes generated this second week appeared to be totally different from the first week. The figure 5b shows that the percentage of wastes generated on Monday and Tuesday were the same 29%, each while Wednesday, Thursday and Friday 14% each. The analysis showed nature of service provided in this Zone. The results obtained put the solid waste management Board in a tight corner of action plan to make sure that her serve met the demand of the people without extra time and cost considering the nature business activities in the area.

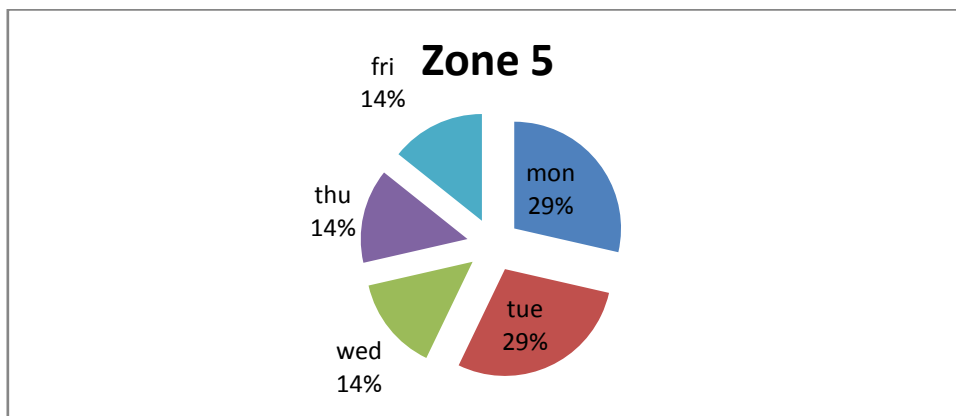


Fig. 5b Zone 5: Second week study collection and disposal

The figure 6a zone 6 (Ganaja Junction) shows the percentages of solid wastes generated in most populated business district in Lokoja Metropolis the first week of study. It shows that Monday accounts for 37% the highest, both Wednesday and Friday recorded 27% and 18% while Thursday and Tuesday recorded 9% each the lowest of the first week observation.

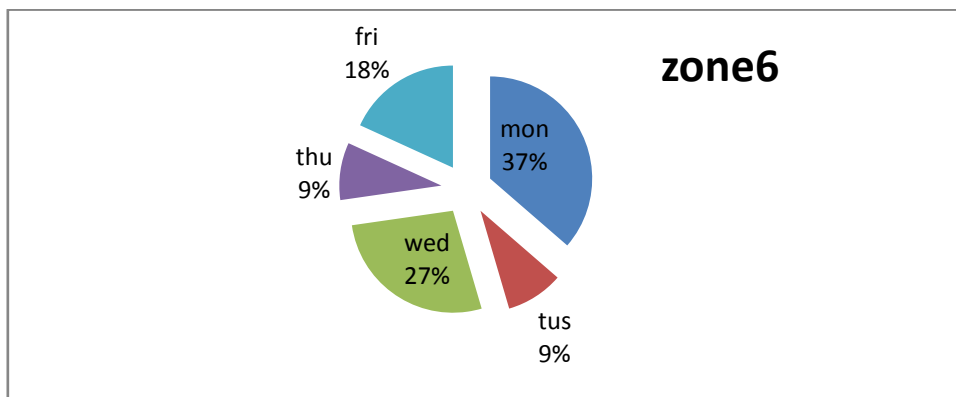


Fig. 6a Zone 6, First week of study collection and disposal.



Figure 6b zone 6 shows the second week observation of experiment. There were slight differences in quantities of solid wastes generated daily between the first week and second week.. The figure shows that on Tuesday 40% of quantities of wastes generated second were recorded as the highest, followed by Monday 27%, and both Wednesday and Thursday recorded 13% each while Friday recorded 7% the lowest for second week observation

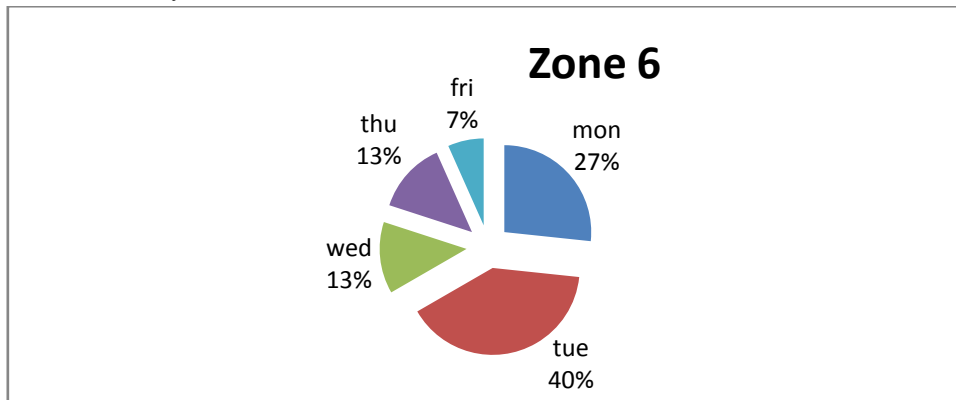


Fig. 6b Zone 6 second week of study collection and disposal

Figure 7a Zone 7 (Felele Area) shows the total percentage of wastes generated the first week selected for observation. The figure also shows that the quantities of wastes generated vary from Monday to Friday. The analysis showed that the highest quantities of solid wastes generated were recorded on Monday 48% followed by Tuesday 24%, both Wednesday and Friday recorded 16% and 8% while the lowest was documented for Thursday activities 4%.

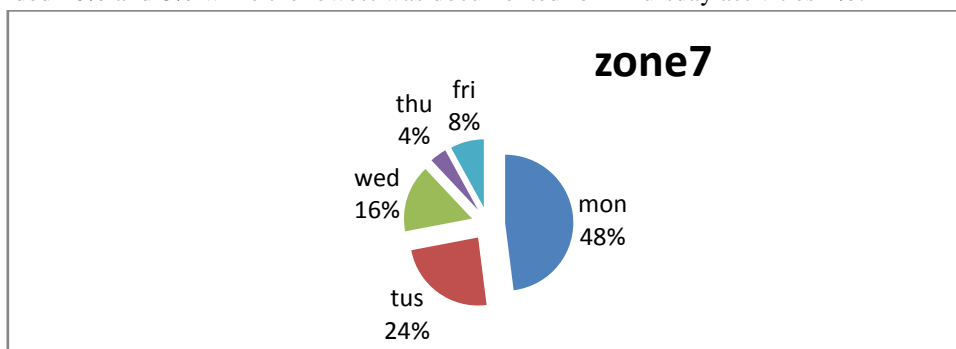


Fig. 7a Zone 7 First week of study waste collection and disposal

Figure 7b zone 7 below shows the quantities of solid waste generated the second week of observation. The highest percentage of wastes produced the second week of study was recorded for both Monday and Tuesday 23% each, while Wednesday and Friday recorded the lowest 17% each.

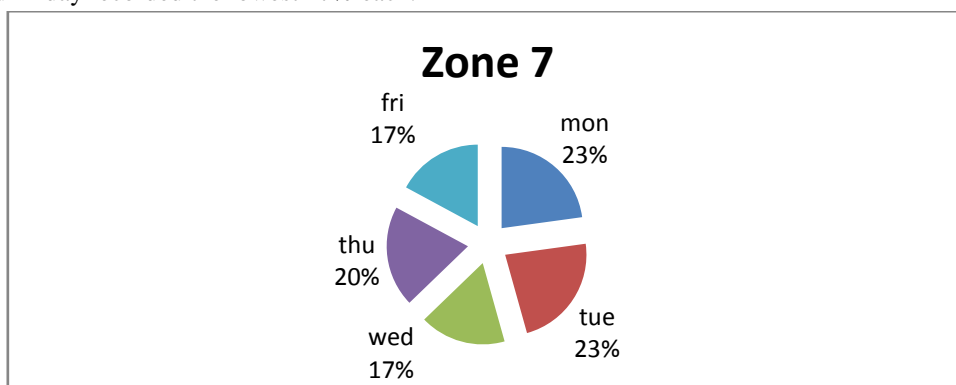
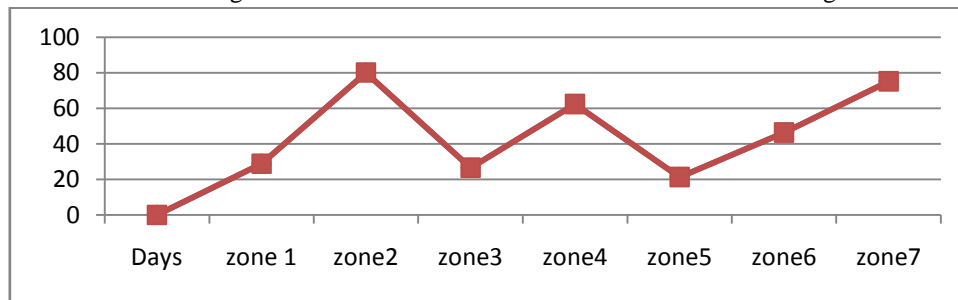


Fig. 7b Zone 7: Second week of study waste collection and disposal

### 6. CONCLUSION AND RECOMMENDATION

The analysis of this study showed that there is no existence of Solid Waste Management Data in Kogi State. It means there is no established policy and regulation to follow in the State. The study also identified two important lapses 'Feedback and Implementation'. Feedback requires attention and skill while implementation requires policy, and advance

data coding framework to develop meaningful strategies for planning and formulating of effective waste management policy profiles. The collective findings for the two week for each zone are indicated in the figure 8 below.



**Fig. 8** Total weight of solid waste materials collected for each two weeks of observation

### Specific Recommendation

The study recommends that Waste Management Board should remove all refuse from inhabited places in a timely manner to prevent the spread of diseases, minimize fire outbreak and to reduce the unpleasant odour arising from putrefying organic matters.

Solid Waste Management Board should encourage public participation, Encourages the use of polythene container, explicitly areas where service is once in a week, Recycling of waste be encouraged, Waste Bins be distributed across all zones and placed them where they can be easily accessed and disposed. Collection or disposal of bins could be done two times in a week across all zones except zone 6 Lokoja Metropolis; Qualified Sanitary inspectors should be employed to oversee all waste bins and Environmental Health officers be empowered to enforce environmental laws and regulations.

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