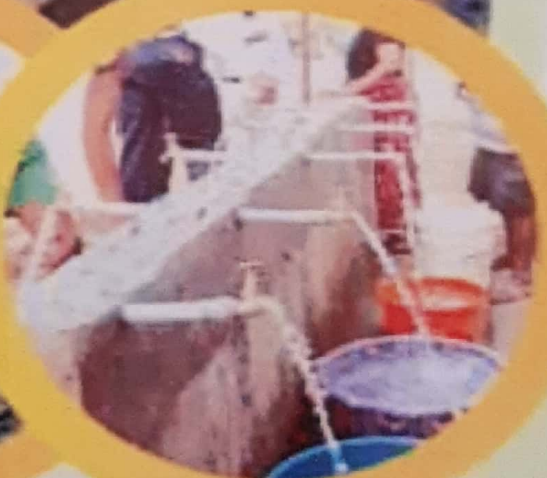


# PLANNING AND MANAGEMENT OF SUSTAINABLE INFRASTRUCTURE DEVELOPMENT IN NIGERIA



*A Book in Honour of*  
**Professor Nurain Bolanle Tanimowo**

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## CHAPTER NINETEEN

### ASSESSMENT OF SOLID WASTE MANAGEMENT IN SELECTED MARKETS IN ILORIN, NIGERIA

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#### ABSTRACT

*Achieving healthy urban environment in Nigeria entails effective management of market wastes. This study was undertaken to examine effectiveness of solid waste management in market places in Ilorin, Kwara State. A total of five markets spread among the three Local Government Areas of the city were selected for study. A structured questionnaire, containing information on the nature of wastes generated in the markets, means of storing waste, frequency of waste disposal, perceived efficiency of the Kwara State Waste Management Authority among others was used to obtain information from 194 market traders systematically selected from the five markets. Descriptive statistics (frequency and percentages) and inferential statistics (Pearson correlation) were used in analyzing the data obtained. The study revealed that paper (34.7%) and vegetable (29.8%) constituted the dominant wastes in the markets, plastic basket (45.3%) and paper cartons (30%) were the dominant waste storage containers used by the traders, majority (75.4%) of the traders emptied their wastes into the public stationary containers provided in the markets, Kwara State Waste Management Authority was solely responsible for waste collection in the markets and collection was carried out every couple of days (53.1%) mostly in the evening (49.8%). The performance of the Authority*

was found to be relatively satisfactory (54.3%). It was established through Pearson correlation analysis that there was significant relationship between traders' income status and the choice of waste receptacle. The wastes evacuated from the markets are carelessly disposed in the only dumpsite maintained by the Authority. Adopting a more hygienic and environmental-friendly waste disposal facilities such as sanitary landfills is recommended.

**Keywords:** Municipal solid waste, markets, waste management, storage containers, authority.

## INTRODUCTION

Solid wastes could be defined as non-liquid and nongaseous products of human and animal activities, regarded as being useless. It could take the forms of refuse, garbage and sludge (Leton and Omotosho, 2004). Also included are by-products of process lines or materials that may be required by law to be disposed of (Okecha 2000). Solid waste can be classified in a number of ways: on the basis of source, environmental risk, utility and physical property. On the basis of source, solid wastes are again classified as: municipal solid wastes, industrial solid wastes and agricultural solid wastes (Ogawa, 2000). It should be noted that commercial (market) solid waste is a component of municipal solid waste. Municipal solid waste refers to materials discarded in urban centres for which municipalities are usually held responsible for collection, transportation and final disposal. Municipal solid waste encompasses household refuse, institutional wastes, commercial wastes as well as construction and demolition debris (UNEP, 2000).

Commercial waste consists of waste from premises used mainly for the purposes of a trade or business or for the purpose of sport, recreation, education or entertainment, but excluding household, agricultural or industrial waste (Mande, 2004). Municipal waste management has been defined as the



collection, transfer, treatment, recycling, resources recovery and disposal of waste materials in such a way as to render them harmless to human and animal life, the ecology and environment and local aesthetics. It is an organized and systematic channeling of waste through practically, economically and technically appropriate recovery and disposal route in accordance with acceptable public safeguards (World Bank, 2009). The goals of market waste management are to promote the quality of the market environment, protect environmental health and support the efficiency and productivity of the economy (World Bank, 2009). According to Medina and Gamse (2010), markets are the second biggest generator of city solid waste after family units as they contribute about 20% of urban waste generation. The peculiar nature of markets (being places where residents procure food items and other consumer goods) has necessitated the need for proper and effective management of waste within the markets. This is required for achieving sound public health, acceptable city's hygiene and adequate urban environmental health.

However, evidence from the literature indicated that the management of solid waste in various markets in Nigeria has fallen short of acceptable standards. A study of sanitation provisions in selected markets in Benin City by Okojie et al. (2000) demonstrated that sanitation arrangement in all the sampled markets (eight in numbers) was poor. Five of the eight markets had dedicated sites for refuse disposal while three had none. The dumpsites were characterized by open dumping of refuse which took several days or weeks to collect by municipal waste management agency with the attendant problems of rat and insect invasion; transmission of vector and rat borne diseases; devaluation of land values, odour and sharp increase in air, land and water contamination within the markets and their immediate neighbourhoods (Okojie et al., 2000). Also, conclusion from earlier study of Sango Meat Market in Ibadan, Oyo State (Enahoro, 1983), indicated that poor sanitation practice in the market as a result of inconsistent and delayed transfer of refuse and animal wastes renders most of the meat less hygienic for human consumption.

While (Momodu, Dimuna and Dimuna, 2011) have attributed the poor sanitation arrangement in most of the markets to the fact that markets are often built without proper designs, and where such layouts exist, they have been distorted, (Abejegahet al, 2013) have questioned the capacity of the waste management agencies to adequately manage the market wastes. This study was therefore designed to examine the effectiveness of solid waste management in selected markets in Ilorin.

### **CHALLENGES OF MUNICIPAL SOLID WASTE MANAGEMENT**

Municipal solid waste management is a critical problem in Nigeria and it has remained the most intractable urban management challenge to municipal governments in the last few decades (Ayuba et al., 2013). A large quantity of municipal solid waste is generated annually in most Nigerian cities (Ogwueleka, 2009), but the wastes have consistently received less management attention by the concerned authorities (Ajero and Chigbo, 2012; Akor et al., 2013). Studies have shown that poorly managed wastes pose severe challenge to environmental safety, public health and welfare of citizens. As observed by (Odoemene and Ofodu, 2016), improper disposal of untreated wastes can cause air pollution, underground water contamination, land degradation, soil contamination and habitat deterioration. Environments close to dumpsites are constantly exposed to risk of infection, reduced agricultural yield, groundwater contamination, decline in benthic communities due to toxicity and exposure to hazardous compounds (Ukpong, Udo and Umoh, 2015). Also, Nkwachukwu, Chidi and Charles (2010) have linked poor management of wastes to global warming, photochemical oxidant creation, acidification, ecotoxicity of water, eutrophication and abiotic resource depletion. Diaz (2006) has equally argued that inappropriately managed waste can attract rodents and insects, which can harbour gastrointestinal parasites, yellow fever, worms, the plague and other conditions for humans. Exposure to hazardous wastes, particularly when they



are burned, can cause various other diseases including cancers (Singh et al., 2010).

It is also pertinent to note that much of the waste generated in Nigeria is either burnt or left to rot and this constitute a significant source of the country's contribution to greenhouse gas emissions (Uwejamomere, 2003). Gases that trap heat in the atmosphere are often called greenhouse gases. According to USEPA (2012), some of these gases that are emitted to the atmosphere through the burning of solid wastes among other human activities are carbon dioxide, methane, nitrous-oxide, as well as fluorinated gases. These gases are ozone-depleting substances and are sometimes referred to as high global warming potential gases. The consequences of ozone depletion are the various environmental hazards (like flood, tsunami, and fire outbreak) witnessed in virtually every part of the world, including Nigeria in the last few decades (IPCC, 2007). The intensity of these hazards in recent times however calls for greater attention by policy makers and researchers.

## **STUDY AREA AND METHODOLOGY**

### **Study Area**

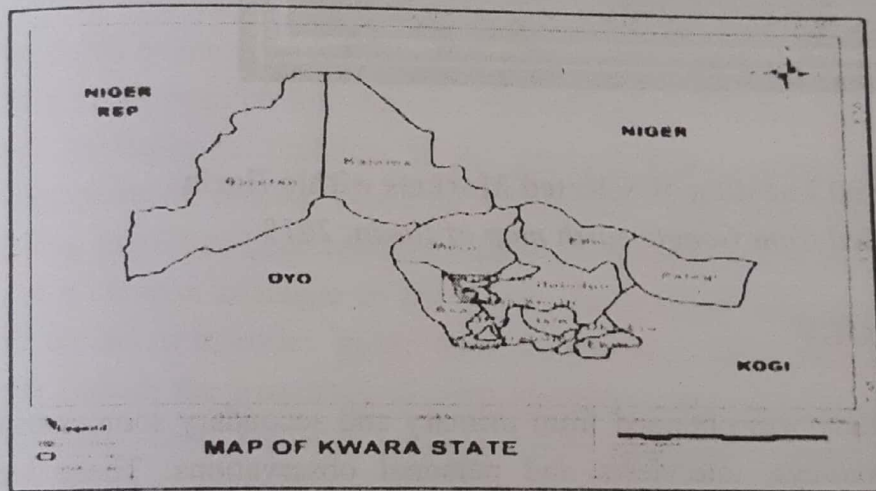
This study was conducted in five main markets of Ilorin municipality. Ilorin is the major city and capital of Kwara State. It is bounded in the South by Oyo and, Osun States, in the North by Niger State, toward the East by the Kogi State and toward the West by the Benin Republic. It is located on Latitude  $8^{\circ} 30'N$  and Longitude  $4^{\circ} 35'E$  (World Atlas, 2019). The weather of Ilorin is tropical affected by the two trade winds prevailing over the country. The climate of Ilorin is characterized by two seasons: wet and dry seasons. The rainy season is between March and November and the yearly precipitation differs from 1000 mm to 1500 mm. The mean daily temperature ranges from  $25^{\circ}C$  in January to  $27.5^{\circ}C$  in May. The vegetation of Ilorin is Guinea savannah with riparian woodland along the river bank (World Atlas, 2019). The most

important river in the city is Asa River that flows from the northern end of the city southward. Ilorin is the sixth largest city in Nigeria with 2019 projected population of 814,192 (Encyclopedia Britannica, 2019). It is strategically located at the geographical and cultural confluence of the North and South. The Entire Ilorin community comprises of three Local Government Areas namely- Ilorin West, Ilorin South, Ilorin East (Fig. 1). Ilorin is 300km from Lagos, and the coastline, 160km from Ibadan, Africa's largest indigenous city, and 300km from the Federal Capital, Abuja (Encyclopedia Britannica, 2019). Ilorin is linked with many other major cities with a good road network. The north/south railroad passes through it, and it also enjoys the transportation functions of an ultramodern international airport and the forest area some distance to the south of Ilorin (Encyclopedia Britannica, 2019). Ilorin was developed as an administrative centre but both economic and social activities have greatly influenced its growth in recent times. A considerable number of markets dotted the city's landscape. However, the largest and the most prominent are five. These are: Oja Oba, Ipata, Oja Tuntun, Ago and Kulende (Fig. 2).

Oja Oba is the largest market in Ilorin. It is a daily market that derived its name from its closeness to the Emir's royal residence. Like other Yoruba Oja Oba, it is located in front of the Emir's palace in Ilorin West Local Government Area, with 1270 stalls and pulls a colossal number of marketers from all over the state and beyond each day of the week (Ibrahim, 2007). A variety of goods such as food items, textile products, electronics and other manufactured products are sold in the market. Oja Tuntun famously known as Baboko Market is a daily market in Ilorin West Local Government Area. It is significantly served by the Abdul Azeez Attah Road and offers buyers a wide a wide variety of goods. The market is the second largest in Ilorin with 864 stalls. Ago is located in Ilorin West Local Government Area with 740 stalls. Food items and manufactured products are sold in the market. It is a traditional market the derived its name from the name of the settlement it is located. Ipata



is also a daily market situated in Ilorin East Local Government Area. It is the fourth largest market in Ilorin with 612 stalls. Marketers from various parts of the state patronize it. Agricultural produce are the dominant Items sold in the market. Kulende is located in the Sango area of Ilorin East Local Government Area. It is a weekly market that is opened every Sunday. That is why it is sometimes called Sunday-Sunday. It is a modern market with 214 stalls. Manufactured goods such as textile products, electrical materials, electronics and leather products (bags, shoes etc) are the dominant products in the market.



**Fig 1: Ilorin within Kwara State.**

**Source: Adapted from Google Earth imagery 2019.**





**Figure 2: Spatial Location of Selected Markets within Ilorin**  
*Source: Modified from Google earth map of Ilorin, 2019*

## METHODOLOGY

Data for this study was obtained from primary and secondary sources using questionnaire surveys, interviews and personal observations. These were supplemented with information obtained from the government report and other public and private documents. The primary data were collected from the selected markets in Ilorin between March and April, 2019 with structured questionnaire. Also, information were obtained from the General Manager of the Kwara State Waste Management Authority with the aid of interview guide. The population sample comprised two categories of respondents, category one included the shop owners while category two included the General Manager of the Kwara State Waste Management Authority. Data obtained from the Kwara State Ministry of Commerce showed that there were thirteen (13) regular markets in Ilorin. Based on the number of stores, regularity of the markets, variety of products being traded in the markets, location of the markets and the

observed volume of solid waste generation in these markets, the five (5) largest markets were selected for survey. The selected markets are: Oja Oba, Oja Tuntun, Ago, Ipata and Kulende. The sample size was based on the number of stores in the markets. Oja Oba, Oja Tuntun, Ago, Ipata and Kulende had 1270, 864, 740, 612 and 214 stores respectively, making a total of 3700 stores in all the markets. A total of 194 stores (5.2%) were selected for survey with 67 stores from Oja Oba, 45 stores from Oja Titun, 39 stores from Ago, 32 stores from Ipata and 11 stores from Kulende. The reason for using stores as the basis for taking samples was because store owners were considered as the permanent market users who are naturally consulted on the affairs of the markets and who are expected to have sufficient information on waste management practices in the markets. Questionnaire was distributed using systematic random selection where every fifth store was selected after the first store has been randomly selected. Interview was equally conducted with the General Manager of the Kwara State Waste Management Authority with the aid of interview guide. Specific questions addressed by the interview guide include the frequency of waste collection, provision of stationary waste containers, cost recovery among other questions. Descriptive statistics (frequency and percentages) was used in analyzing the data collected.

## RESEARCH RESULTS

The findings of the study are presented under the various sub-headings below. All the tables in this section were generated from the survey carried out by the authors in 2019.

### Type of Waste Generated

Analysis of the type of wastes generated in the sampled markets revealed that paper and vegetable constituted the dominant waste with 34.7% of the respondents generating paper waste and 29.8% generating vegetable waste (Table 1). Other types of wastes generated in the markets include: plastic



(15.3%), wood (8.6%), cans and other aluminium wastes (7.5%) and glass (4.1%) (Table 1).

**Table 1: Types of Wastes Generated by the Traders**

Waste Types	Freq.	%
Paper	67	34.7
Vegetable	58	29.8
Plastic	30	15.3
Wood	17	8.6
Cans	14	7.5
Glass	8	4.1
<b>Total</b>	<b>194</b>	<b>100.0</b>

**Source: Authors' field survey, 2019**

#### **Waste Storage**

From the results obtained, it is evident that majority (91.8%) of the traders had waste storage containers in their respective shops as against 8.2% that did not have waste containers. This indicates a positive attitude of the traders to sanitation of the markets' environment. Furthermore, plastic basket constituted the predominant waste storage container in most of the sampled markets as 45.3% of the sampled traders used plastic basket for storing waste. This is followed by empty paper carton used by 30.0% of the sampled traders (Table 2). Other waste storage containers used by the traders are galvanised dustbin (13.3%) and metal drum (11.4%) (Table 2). The preponderance of plastic basket as waste receptacle suggests a relatively high income status of the traders.

**Table 2: Wastes Storage Containers**

Waste Containers	Freq.	%
Plastic Basket	88	45.3
Empty Carton	58	30.0
Galvanised Dustbin	26	13.3
Metal Drum	22	11.4
<b>Total</b>	<b>194</b>	<b>100.0</b>

**Source: Authors' field survey, 2019'**

To empirically determine the effect of income on the traders' choice of waste receptacle, an hypothesis was formulated and tested as follows:

$H_0$ : There was no significant relationship between traders' income status and the choice of waste receptacle.

$H_1$ : There was significant relationship between traders' income status and the choice of waste receptacle.

The hypothesis was tested using Pearson correlation analysis. The traders' income status was correlated to choice of waste receptacle. The result is presented in (Table 3). The correlation analysis shows that the P-value of  $0.868 > 0.01$ . This indicates rejection of the null hypothesis and acceptance of the research hypothesis that there was significant relationship between traders' income status and the choice of waste receptacle. In other words, the relatively high income status of the traders influenced their decision to employ modern and more hygienic waste receptacles.



Table 3: Pearson Correlation Analysis (Income Vs Type of Containers)

		monthly income	Which type of containers?
monthly income	Pearson Correlation	1	-.012
	Sig. (2-tailed)		.868
	N	194	183
Which type of containers?	Pearson Correlation	-.012	1
	Sig. (2-tailed)	.868	
	N	183	183

Source: Author's Analysis

Note: The ordinal variables were transformed before analysis.

### Waste Collection

Kwara State Waste Management Authority is responsible for waste collection in all the sampled markets as stated by all (100.0%) the respondents in all the markets. Analysis of the frequency of waste collection by the Kwara State Waste Management Authority shows that the Authority evacuate wastes daily, two days or four days interval. As stated by 19.7% of the respondents, the Authority collected waste daily, 53.1% claimed waste collection was done every two days while 27.2% of the respondents indicated that the Authority evacuated wastes in the markets every four days (Table 4). Waste evacuation is mostly done in the evening by the Authority according to 49.8% of the respondents, although, sometimes it is done in the morning as stated by 23.3% or afternoon, according to 26.9% of the respondents (Table 4).

**Table 3: Frequency of Waste Collection**

Collection Frequency	Freq.	%
Daily	38	19.7
Every Two Days	103	53.1
Every Four Days	53	27.2
<b>Total</b>	<b>194</b>	<b>100.0</b>
Time of Waste Collection	Freq.	%
Morning	45	23.3
Afternoon	52	26.9
Evening	97	49.8
<b>Total</b>	<b>194</b>	<b>100.0</b>

Source: Authors' field survey, 2019

### **Waste Disposal**

Waste disposal shall be discussed from two perspectives: the traders' and the Kwara State Waste Management Authority perspectives.

**Waste Disposal by the Traders:** Waste bins were provided at designated points in all the sampled markets as indicated by all (100%) the respondents. This is to enable the traders and other market users dispose their litters as quickly as possible in order to achieve some level of cleanliness in the markets. Analysis of the adequacy of the waste bins suggested that though a substantial number of the bins were provided but they are not adequate as claimed by 43.6% of the respondents. However, 49.6% of the respondents considered the waste bins adequate in the markets while 6.8% considered the waste bins provision as very adequate (Table 4).

For easy evacuation of the wastes by the Kwara State Waste Management Authority, there was provision of stationary waste containers in virtually all the markets by the Authority as claimed by all (100%) the respondents. Concerning the proximity of the waste containers to the sampled traders,



majority (53.7%) considered the location of the public waste containers close to them. About 46.3% considered the location of the containers far to them. Analysis of the distance covered by the traders to access the waste bins in the markets shows that 24.8% of the respondents traveled less than 51 metres, 8.2% traveled between 51-100 metres, 24.1% covered a distance between 101-150 metres, 19.0% traveled between 151-200 meters while 23.9% traveled above 200 metres to access the public waste containers. Table 4). Thus, on the average, a trader travelled about 126 metres to access the waste bins. Consequently, 75.4% of the respondents emptied their wastes in the public waste containers for collection by the Authority. However, those who did not use public waste containers (24.6%) disposed their wastes in open spaces within the markets (Table 5).

**Table 5: Wastes Disposal**

<b>Adequacy Waste Containers</b>	<b>Freq.</b>	<b>%</b>
Not Adequate	85	43.6
Adequate	96	49.6
Very Adequate	13	6.8
<b>Total</b>	<b>194</b>	<b>100.0</b>
<b>Distance of Waste Containers (m)</b>		
<b>Distance of Waste Containers (m)</b>	<b>Freq.</b>	<b>%</b>
Less than 51	48	24.8
51 – 100	16	8.2
101 – 150	47	24.1
151 – 200	37	19.0
Above 200	46	23.9
<b>Total</b>	<b>194</b>	<b>100.0</b>
<b>Traders Disposal Point</b>		
<b>Traders Disposal Point</b>	<b>Freq.</b>	<b>%</b>
Public Waste Container	146	75.4
Available Open Space	48	24.6
<b>Total</b>	<b>194</b>	<b>100.0</b>

Source: Authors' field survey, 2019

The effect of proximity of public waste containers on the traders' frequency of waste disposal empirically determine through a hypothesis formulated and tested as follows:

H<sub>0</sub>: There was no significant relationship between proximity of public waste containers and the traders' frequency of waste disposal.

H<sub>1</sub>: There was significant relationship between proximity of public waste containers and the traders' frequency of waste disposal.

The hypothesis was also tested using Pearson correlation analysis. The traders' frequency of waste disposal was correlated to proximity of public waste containers. The result is presented in (Table 6). The correlation analysis shows that the P-value of  $0.000 > 0.01$ . This indicates acceptance of the null hypothesis that there was no significant relationship between proximity of public waste containers and the traders' frequency of waste disposal. The conclusion here is that proximity of public waste containers to the traders does not influence their frequency of waste disposal. Therefore, there was willingness on the part of the traders to dispose their wastes as fast as possible irrespective of the distance of their shops to the public waste containers.

**Table 6: Pearson Correlation Analysis (Disposal Frequency Vs Distance to Waste Bins)**

		How often do you dispose your waste?	Approximate distance from stall to the waste bin?
How often do you dispose your waste?	Pearson Correlation	1	.540**
	Sig. (2-tailed)		.000
	N	194	194
Approximate distance from stall to the waste bin?	Pearson Correlation	.540**	1
	Sig. (2-tailed)	.000	
	N	194	194



**\*\*.** Correlation is significant at the 0.01 level (2-tailed).

Note: The ordinal variables were transformed before analysis.

Source: Author's Analysis

**Waste Disposal by the Authority:** According to the General Manager of the Kwara State Waste Management Authority, wastes evacuated from the markets are deposited at the only dumpsite located at Eyenkorin along Ogbomoso road. The deposited wastes are not treated or burnt at the dumpsites; they only are left to the effects of the weather elements. He explained further that dumpsite is used for waste disposal because their city does not have any sanitary land fill which is more hygienic.

**Traders' Perception of the Effectiveness of Waste Management Authority**  
The sampled traders were asked to assess the effectiveness of the Kwara State Waste Management Authority in managing wastes in the markets. The result of the analysis showed that 45.7% of the respondents were of the opinion that the market wastes were poorly managed by the Authority. Similarly, 36.3% considered the performance of the Authority in waste management as effective while 18.0% opined that the Authority were very effective in managing wastes in the markets (Table 7).

**Table 7: Perceived Effectiveness of Waste Management Authority**

Perceptions	Freq.	%
Not Effective	88	45.7
Effective	70	36.3
Very Effective	35	18.0
<b>Total</b>	<b>194</b>	<b>100.0</b>

Source: Authors' field survey, 2019

**Challenges of Waste Management in the Markets**

Analysis of the various challenges associated with waste management in the sampled markets revealed that, poor planning and execution of waste management activities by the Kwara State Waste Management Authority was the major challenge hindering effective waste management in the markets as stated by 27.3% of the respondents. Other challenges identified by the sampled traders include: poor enforcement of sanitation laws in the markets by the Authority (14.3%); poor attitude of the traders and other market users to market sanitation (25.1%); inadequacy of waste management infrastructure (28.5%); and inconsistent and unfavourable timing of waste evacuation by the Authority (4.5%).

## DISCUSSIONS

Paper and vegetable constituted the major components of the wastes generated in all the sampled markets. The fact that most of the manufactured goods being traded in the markets are packed with paper cartons with most of these cartons going to the waste stream as soon as their contents are emptied appears to be responsible for high volume of paper waste in the waste stream. Also, the second most traded products in the markets are local food items and agricultural produce. This actually influenced the high component of vegetable waste in the waste streams of most of the markets. It should however, be noted that dominant components of the market waste in Ilorin actually presents great economic opportunities for the state as most of these wastes are either recyclable or can be turned into other usable product. For instance, organic fertilizer can be derived from vegetable while paper can be recycled back to market.

It is interesting to note that a substantial majority of the traders have waste containers in their respective shops for storing waste before disposal. Majority of the traders also used plastic waste baskets. The relative high percentage of the traders using plastic dustbin (a more hygienic and modern method of waste storage) can be explained by a substantial percentage of the sampled traders



relative high-income status as well as awareness of the importance of hygiene in the markets as earlier observed. The substantial percentage of the traders using paper cartons as means of waste storage in the markets can be attributed to the market traders' access to cartons used in packaging goods. They tend to convert the empty cartons into waste storage materials. The widespread use of plastic baskets and paper cartons in the markets is an indication that the traders are conscious of the markets sanitation and are willing to maintain some level of cleanliness within the markets.

Majority of the traders disposed their wastes daily into either the stationary waste containers or smaller waste bins (depending on the volume of wastes) provided by the Kwara State Waste Management Authority within the markets. While it is pertinent to note that the urge to dispose refuse on daily basis by the market traders may be influenced by the need to attract adequate patronage (buyers normally patronize neat shops) it is important to observe that availability, adequacy and proximity of the public waste containers to the traders in the markets also play a significant role in facilitating daily waste disposal by the traders.

Waste collection is carried out by the Kwara State Waste Management Authority in all the markets and it is mostly carried out every two days. This relatively high rate of waste evacuation by the Authority appears to have engendered positive waste management attitude on the part of the traders in all the sampled markets as noted earlier. The relatively impressive performance of the Authority actually reflected on the traders' perception of its effectiveness as a substantial percentage of the traders considered the Authority as fairly effective in the discharge of its responsibility in the markets. However, the Authority engaged in unhygienic disposal of wastes in the public dumpsites. This undoubtedly has serious implications for public health particularly in the neighbourhood where the dumpsite is located. It should also be noted that having only one dumpsite to cater for wastes being generated in the entire city of Ilorin is grossly inadequate.

## CONCLUSION

This study has demonstrated that management of solid wastes within the markets in Ilorin is relatively adequate and encouraging. However, certain challenges associated with waste disposal in the city were identified by the study. The principal problem is the existence of only one dumpsite for the entire city of Ilorin that is located close to built-up areas. Also, wastes disposed at the dumpsite are not treated, burnt or buried, they are left for rodents, flies and other microorganisms to feed on them. This actually constitutes a great danger to the city's public health and the environment. There is the problem of air, water, soil and land pollution associated with such facility and wastes disposal practice. Such pollutions invariably engineer air and water borne diseases. It is therefore, suggested that sanitary landfill be provided in appropriate location to cater for the city's wastes. This is because, sanitary landfills, according to UNEP (2000), is the only wastes disposal option that enables control and effective mitigation of extreme emissions and of surface and ground water contamination. Also, landfills contain garbage and serve to prevent contamination between the waste and the surrounding environment, especially groundwater. Thus, its provision will go a long way in assisting the city manage its wastes effectively.

In acquiring land for landfill, Cointreau (2004) has suggested a land area of 2.8 hectares per annum for 1000 tonnes of waste. In siting the landfill, the following standards developed by the Canadian Ministry of Environment (2003) may be considered:

- The buffer zone between the landfill site and the property boundary should be at least 50 metres;
- The distance between the site and the nearest residence, water supply well, water supply intake, hotel, restaurant, food processing facility, school, church or public park is to be a minimum of 300 metres;



- The distance between an airport utilized by commercial aircraft and a landfill containing food wastes which may attract birds is to be a minimum of 8.0 kilometres, unless bird control measures acceptable to and approved by government are established or the potential for birds causing hazard to aircraft is minimal.
- The distance between the site and the nearest surface water must be a minimum of 100 metres. Greater or lesser separation distances may be considered where justified by hydro-geological investigations or by provision of surface water diversion works to reroute the watercourse of concern.

## REFERENCES

- Abejegah, C., Abah, S. O., Awunor, N. S. and Okoh, C. (2013). Market Sanitation: A Case Study of Oregbeni Market Benin - City Edo State, Nigeria. *International Journal of Basic, Applied and Innovative Research*, 1(2): 26.
- Ajero, C. and Chigbo, U. A (2012). Study on the evaluation of industrial solid waste management approaches in some industries in Aba, South Eastern Nigeria. *West African Journal of Industrial and Academic Research*, 4(1): 103-112.
- Akor, A. J., Ayotamuno, M. J., Aman, L. I., and Enokela, S. O. (2013). Assessment of domestic solid waste generation in PortHarcourt by separator – Receptacle technology. *International Journal of Science and Engineering Research*, 4(1): 1-7.
- Ayuba, K. A., Manaf, L. A., Sabrina, A. H. and Azmin, S. W. N. (2013). Current status of municipal solid waste management practice in FCT Abuja. *Research Journal of Environment and Earth Science*, 5 (1): 295-304.
- Babayemi, J. O. and Dauda, K. T. (2009). Evaluation of Solid Waste Generation, Categories and Disposal Options in Developing Countries: A Case Study of Nigeria. *Journal of Applied Science and Environmental Management*, 13(3): 83 – 88.

- Canadian Ministry of Environment (2003). *Landfill criteria for municipal solid waste*. British Columbia: Ministry of Environment.
- Cointreau, S. (2004). *Sanitary Landfill Design and Siting Criteria*. Washington D.C., US.
- Diaz, L. (2006). *Solid Waste Management, Volume 2*. New York: UNEP/Earthprint.
- Enahoro, F. O. (1983). *Minimizing Potential Health Hazards to the Local Butchers in Sango Meat Market, Ibadan, Oyo State, Nigeria*, (Dissertation NPMCN).
- Encyclopedia Britannica (2019). Ilorin: Location, History, Facts and Population. <https://www.britannica.com/place/Ilorin>.
- Ibrahim, H. (2007). Nigeria: Inside Ilorin's biggest market. Daily Trust, May 20, 2007, Pp. 13.
- Igoni, A. H., Ayotamuno, M. J., Ogaji, S. O. T. and Robert, S. D. (2007). Municipal solid waste in PortHarcourt, Nigeria. *Applied Energy*, 84(6): 664-670.
- IPCC.(2007). *Climate change 2007: Impacts, adaptation and vulnerability. Inter- governmental Panel on Climate Change Report*. M. Parry, O. Canziani, J. Palutik, P. Linden and C. Hanson. Eds. Cambridge university press.
- Leton, T. G. and Omotosho, O. (2004). Landfill operations in the Niger delta region of Nigeria. *Engineering Geology*, 73(1&2): 171-177.
- Mande, B. (2004). *Policy Guidelines on Market and Abattoir Sanitation*. Federal Ministry of Environment. Market Inspection form 13.10. Available at [www.ehorecon.org.ng/.../Sanitary%20Inspection](http://www.ehorecon.org.ng/.../Sanitary%20Inspection) accessed on 6 February, 2019.
- Medina, M. and Gamse, T. (2010). Development of Waste Management Practices in Indonesia. *European Journal of Scientific Research*, 40(2): 199
- Momodu, N. S., Dimuna, K. O. and Dimuna, J. E. (2011). Mitigating the Impact of Solid Wastes in Urban Centres in Nigeria. *Journal of Hum Ecology*, 34(2): 125-133.



- Mor, S., Ravindra, K., Dahiya, R. P., and Chandra, A. (2006). Leachate characterization and assessment of groundwater pollution near municipal solid waste landfill site. *Environmental Monitoring and Assessment*, 118: 435–456.
- Nkwachukwu, O. I., Chidi, N. I. and Charles, K. O. (2010). Issues of roadside disposal habit of municipal solid waste, environmental impacts and implementation of sound management practices in developing country "Nigeria". *International Journal of Environmental Science and Development*, 5(1): 409–418.
- Odoemene, U. D. and Ofodu, J. (2016). Solid wastes management in Aba Metropolis. *International Journal of Advanced Academic Research*, 2 (1): 1–7.
- Ogawa, H. (2000). Sustainable Solid Waste Management in Developing Countries. Geneva, World Health Organization.
- Ogwueleka T.C. 2009. Municipal solid waste characteristics and management in Nigeria. *Iran Journal of Environmental Health Science and Engineering* 3: 173-180.
- Okecha, S. A. (2000). *Pollution and Conservation of Nigeria Environment*. Owerri: T-Afrique International Associates.
- Okojie, O. H., Wagbatsoma, V. A., Onwuzuluigbo, A. C. and Onyekwe, I. E. (2000). An assessment of environmental sanitation in Benin City Markets. *Nigeria Journal of Community Medicine*, 12(1): 22-26.
- Singh, R., Ibrahim, M. H., Esa, N. and Iliyana, M. (2010). Composting of waste from palm oil mill: A sustainable waste management practice. *Review of Environmental Science and Biotechnology*, 9(1): 331–344.
- Ukpong, E. C. U., Udo, E. A., Umoh, I. C. (2015). Characterization of materials from Aba waste dumpsites. *International Journal of Engineering and Applied Science*, 6(1): 1–10.
- UNEP. 2000. Municipal solid waste management: A regional overview. Retrieved Dec. 4, 2011 from [www.unep.org](http://www.unep.org).
- USEPA. (2012). Inventory of greenhouse gas emission and sinks. New York: United States Environmental Protection Agency
-

Uwejamomere, T. (2003). *Climate change in Nigeria: A communication guide*. Nigerian Environment Study/Action Team (NEST).

World Atlas (2019). Where is Ilorin, Nigeria? <https://www.worldatlas.com/af/ng/kw/where-is-ilorin.html>.

World Bank (2009). Fact finding report: Solid waste management. *Urban Environment Project*. New York: Oxford University Press.



