RESPONSIVE BUILT ENVIRONMENT

THE PROCEEDINGS OF ENVIRONMENTAL DESIGN AND MANAGEMENT INTERNATIONAL CONFERENCE

EDMIC 2015

Editors:
Bioye T. Aluko
Henry A. Odeyinka
Oludolapo O. Amole
Babasehinde A. Ademuleya
Oluwole P. Daramola

9th - 12th March, 2015

Faculty of Environmental Design and Management
Obafemi Awolowo University, Ile-Ife, Nigeria

EDMIC 2015

ENVIRONMENTAL DESIGN AND MANAGEMENT
INTERNATIONAL CONFERENCE

RESPONSIVE BUILT ENVIRONMENT

THE PROCEEDINGS OF ENVIRONMENTAL DESIGN
AND MANAGEMENT INTERNATIONAL CONFERENCE

EDMIC 2015

ENVIRONMENTAL DESIGN AND MANAGEMENT

INTERNATIONAL CONFERENCE

RESPONSIVE BUILT ENVIRONMENT
THE PROCEEDINGS OF ENVIRONMENTAL DESIGN
AND MANAGEMENT INTERNATIONAL CONFERENCE

ISBN 978 – 2051 – 31 – 6

THEORETICAL AND CONTEMPORARY ISSUES (353 - 388)

URBAN INFRASTRUCTURE, FINANCE AND URBAN AGRICULTURE (389-480)

WASTE DISPOSAL: EXISTING INFRASTRUCTURE AND THE EMERGING TREND IN IBADAN NORTH LOCAL GOVERNMENT AREA, IBADAN, OYO STATE

Popoola Ayobami A., Ayangbile Oluwabukola A., Adeleye Bamiji M.
Department of Urban and Regional Planning, University of Ibadan, Oyo State, Nigeria

ABSTRACT

Waste generation and management has been part of human activities right from time. One of the effects of urbanization in the third world countries is the high rate of waste generation. The challenge of waste management has been a growing concern for government, environmentalist and communities at large, thus preoccupying the urban man. Effort by the Oyo State Government in managing the collection and disposal of waste generated in Ibadan is seen in the provision of skip bins at specific locations across the city. However, despite the provisions made by the government, an emerging trend is the dumping of refuse along the median of some major and collector roads in the city. This can be attributed to poor effort of people towards environmental sanitation, the insufficiency and or distance of skip bins location to the residential or commercial centres cannot also be overlooked. This study aims at providing a planning framework for the location of waste disposal infrastructure (Skip bins) through the adoption of the planning standard. Both primary and secondary data were employed in the course of this study. The study identifies a total of 37 skip bins located within Ibadan North Local Government, serving a population of about 306,795 (2006 census). Questionnaires were used to identify the factors that contribute to indiscriminate dumping of refuse; the GPS was employed to obtain the spatial location of skip bins within the study area. Nearest Neighbour Analysis was carried out using the points identified and proposal was made for the provision of more skip bins based on the result of the analysis using the Geographic Information System Software. The study highlights efficient waste disposal techniques and recommends adequate provision and location of skip bins to contribute to a cleaner and safer environment.

Keywords: GIS, Median, Nearest Neighbour Analysis, Skip Bins, Waste Disposal

INTRODUCTION

Waste generation and management has been part of human activities right from time. The management of urban centres and keeping it clean of wastes has challenged and preoccupied the urban man. Wastes are 'those substances or objects which fall out of the commercial cycle or chain of utility'. World Health Organization defined wastes as "something, which the owner no longer wants at a given time and place and which has no current or perceived market value". Solid wastes management is the application of techniques that will ensure the orderly execution of the functions of collection, transfer, processing, treatment and disposal of solid wastes (Onu *et al*, 2012). The ever increasing global concern on environmental health demands that wastes be properly managed and disposed of in the most friendly and acceptable way. This is to minimize, and where possible, eliminate its potential harm to humans, plants, animals and natural resources. The challenge of wastes management has been a growing concern for government, environmentalist, and communities at large. A major effort taken by the Oyo State Government in managing the collection and disposal of waste generated in Ibadan is the provision of skip bins at specific locations across the city. Despite this effort, piles of wastes are often

found by roads and many other open spaces in the cities and there is no doubt that a dirty environment affects the standard of living, aesthetic sensibilities, health of the people, and the quality of their lives. Hence, the management of wastes is a matter of National and International concern.

Problem and Objectives

Waste management is a visible urban service and thus serves as a good indicator of performance of a municipality or government. Its effectiveness and sustainability serve as indicators for good local governance, sound municipal management and successful urban reforms. This study presents an analysis of the major wastes disposal infrastructure (skip bins) in places within the study area and the new trend of median dumping which can be attributed to certain factors. The aim of the study is to underscore the importance of providing a planning framework for the location of wastes disposal infrastructure (skip bins) through the adoption of the planning standard. Its specific objectives are to:

1. map out the spatial distribution of skip bins location within the area of study;
2. identify routes characterized by median dumping of refuse;
3. identify the factors influencing dumping of refuse along road medians;
4. determine the average travel distance of residents to skip bins location; and
5. to propose new skip bins location within the study area.

LITERATURE REVIEW

As a result of the rapid urbanization in major cities of the world, most of these cities are prone to a lot of spatial, physical and economic problems, *one of which is wastes generation, disposal, collection and management.* Wastes generation is unavoidable in urban regions, as well as in rural regions; it is a constant and hence, it calls for efficient collection system to minimize health hazards, and aesthetics devaluation of the environment. Residential areas or households are the major contributors of wastes followed by markets and commercial areas. Cities in Nigeria, being among the fast growing cities in the world (Onibokun and Kumuyi, 1996) are faced with the problem of solid wastes generation. The implication is serious when a country is growing rapidly and the wastes are not efficiently managed.

Waste Generation

The quantity and rate of solid wastes generation in the various states of Nigeria depend on the population, level of industrialization, socio-economic status of the citizens and the kinds of commercial activities predominant in the different cities. Nigeria, having a population of about 170 million, generates an average of 0.58Kg solid waste per person per day, and in some Nigerian cities such as: Abeokuta in Ogun State (0.60Kg/person/day), Ile-Ife in Osun State (0.46Kg/person/day) and Ibadan in Oyo State (0.71Kg/person/day) (Adewumi *et al.*, 2005). Sources of solid wastes generation in Nigeria among others are commercial, industrial, household, agricultural and educational establishments. Of total solid waste generated in Ibadan, 66.1% are domestic, 20.3% commercial and 11.4% industrial (Adewumi et al., 2005).

Solid Waste Collection

Several states in the country are coming up with various means of waste collection initiated by both public and private sectors. Although the effectiveness of this is largely a function of location, and where the collection is done by private sectors, it is also a function of income of the owner of the wastes to be able to pay the amount charged. Wastes collection systems according to Hann *et al,* (1998) include dumping at designated location, shared container, kerb-side collection, block collection, door to door collection and yard collection. The provision of skips (dumping at designated location) is a major attempt by the Oyo State Government and this is seen in many other Sates in the country.

The Study Area: General Overview of Ibadan North Local Government

The Ibadan North Local Government is located within 3° 59' East longitude and 7° 20' North Latitude. The total land area is about 2633199 m^2 with a population of about 306,795 at the 2006 Census (NIPOST, 2009). The local government area is a metropolitan community and it is the most populated in the state (Official website, Oyo State Government, 2014). It is predominantly a home for small, medium, and large scale commercial activities and also serves as the center for most commercial organization headquarters, such as banks and the State Secretariat among others. The local government area is a host to many educational centres in Nigeria, including the University of Ibadan, the University College Hospital (UCH), the Polytechnic Ibadan, National Horticultural Research Institute (NIHORT) and the Nigerian Institute of Social and Economic Research (NISER). The most notable mode of transport in the study area is road transport; the rail line however cuts across the local government from Sango to Bodija and also hosts the former Ibadan Local Airport.

METHODOLOGY

Data for this study were sourced from the primary and the secondary sources. The primary sources of data include the acquisition of an Ikonos image of the study area, ground picking of skip bins coordinates within the study area and questionnaire administration while the secondary sources of data include information from internet and journals relevant to the study.

Geospatial Techniques and Post Processing

Geospatial based techniques were used in the research. In the first phase, an "Ikonos" image of 1meter and 4 meters panchromatic and multispectral visible bands respectively was obtained. The administrative map of the study was scanned and the raster image was imported to Arc-GIS 10.2, the raster image was geo-referenced and the boundary of the said map was digitized. The boundary shape file for the study area digitized was over laid on the "Ikonos" image and the area of interest (Ibadan North) was "Sub-set" thus the extent of the study area was determined. An on-screen digitization of features (road network, road medians and water bodies) was done on the "sub-set" image using Arc-GIS 10.2. Coordinates (X, Y) of skip bins within the study area that were picked, were recorded on excel sheets and these coordinates were later imported into Arc-GIS 10.2 software environment. Hence, the spatial locations of the refuse dump along road medians and locations of skip bins within the study area were displayed on the image. To examine the distances between each point of the skip bins and the closet point to these skip bins, a Near Neighbour Analysis was carried out at the Second Phase by using the "Spatial Statistics Tools" on Arc-GIS 10.2. An analysis pattern of Average Nearest Neighbour was selected with a Euclidean distance which is found under the "Spatial Statistics Tools" on Arc-GIS 10.2. The Average Nearest Neighbour tool on Arc-GIS 10.2 software measures the distance between each feature centroid and its Nearest Neighbour centroid location. It also averages all these nearest Neighbour distances. Whenever the average distance is less than the average for a hypothetical random distribution, the distribution of the features being analyzed is considered clustered. In a situation where by the average distance is greater than a hypothetical random distribution, the features are considered dispersed. The average nearest Neighbour ratio is calculated as the observed average distance divided by the expected average distance (GISC, 2014). At the third phase of the study, three maps were produced, that is, the map showing the spatial distribution of the skip bins within the study area, refuse dump points on median within the study area and the map showing the proposed skip bins within the study area. All these maps were embellished on the layout view of Arc-GIS 10.2 software.

Data Processing Techniques

The data processing techniques used for this research include: Display of Coordinates, Data Sub-setting, Geo-Referencing and Average Nearest Neighbour.

Field Survey

Field survey was corroborated with the geospatial analysis so as to have an adequate conclusion and recommendation. A total number of 50 questionnaires were administered within the study area covering the major areas where refuse are being dumped along the median. These includes Ojoo, University of Ibadan, Sango and Mokola area, Iwo Road, Gate and Roundabout area, Sango-Eleyele area, Bodija and Beere area, Ashi-Bodija area, Ikolaba area and UI-Agbowo express area. Simple random sampling method was used to select interviewees. Global Position System and Camera were used in picking coordinates and taking photographs on site respectively.

FINDINGS AND DISCUSSIONS

Wastes disposal/Existing Infrastructure in Ibadan North Local Government

Wastes, as defined by Sridhar (2007), is "any unavoidable material resulting from domestic activity, or industrial operations for which there is no economic demand and which must be disposed of". A total of 37 skip bins were identified during the course of the study. 66% of the total respondents see dumping of waste along road medians as a reflection of government's insufficient provision of skip bins at required locations while the remaining 34% consider it as a reflection of peoples' dirty habit and also opined the notion that government wastes collectors frown at this attitude. They are unable to bypass a heap of refuse seen along the road when their rounds of wastes collection are being made. Another 66% believe that the skip bins are located far from their homes/shops; only about 12% of respondents travel less than 150m to the nearest skip bin, 18% travel between 150m to 250m, 58% travel over 250m to the nearest skip bin while 12% do not have any skip bin location within their reach. Also, the study reveals that the rate at which skip bins in different locations get full vary from less than a day (36%), to a day (38%), to two days or more (26%) and this is mainly based on the population the skip bins serve, as well as the frequency of collection by the State Wastes Management Board. For example, skip bins in the densely populated areas of the study area like Agbowo and the market areas often get full in half a day or a day. Wastes are collected on Mondays and Thursdays by the Board but sometimes, collection is delayed and so, skip bins overflow and waste covers a major part of the road. When collection is however made after the delay, skip bins get full again in a short while due to the refuse that have been set aside in days to be disposed when the skip bins are eventually emptied.

Transportation serves as the lungs through which other sectors of the economy breathe. The death or chaos in the transportation sector indirectly influences other sectors of the economy. Transportation routes provide the accessibility to the use of facilities and infrastructure in space. The wastes management is not an exemption. The median dumping of refuse is an evident fact that the transport infrastructure drives the median dumping of refuse. The perception of respondents towards the distance to wastes infrastructure (skip bin) is a reflection of the importance of transportation.

A total of 37 skip bins were identified within the neighbourhoods of Ibadan North. 10 of which are located along Ojoo, University of Ibadan, Sango and Mokola area, 4 located along Iwo Road, Gate and Roundabout area, 12 located along Sango-Eleyele area, 7 along University of Ibadan, Bodija and Beere area, 1 along Ashi-Bodija area, 1 in Ikolaba area and the others along UI-Agbowo express area. The highest numbers of these skip bins are located along Sango- Eleyele area (12 skip bins). 4 skip bins are identified along Roundabout and Mokola area. The least number (1) of Skip bins were located along Ashi area. These skip bins are located along major routes within the study area, this often occupy

significant portion of the road which in turn often leads to traffic bottleneck. The study also reveals that there is a clustered distribution of skip bins within the study area (fig. 2). With this clustered distribution of skip bins, Some areas are left with no skip bins (Aperin, Oke-Ado, parliament road, UCH, Awolowo, Agodi) while other areas like Sango-Eleyele and University of Ibadan road have a total number of 12 and 7 skip bins respectively. This development often leads to indiscriminate wastes disposal because those in the areas where skip bins are not found would be forced to travel miles before they can dispose their wastes, the resultant effect of this is indiscriminate wastes disposal.
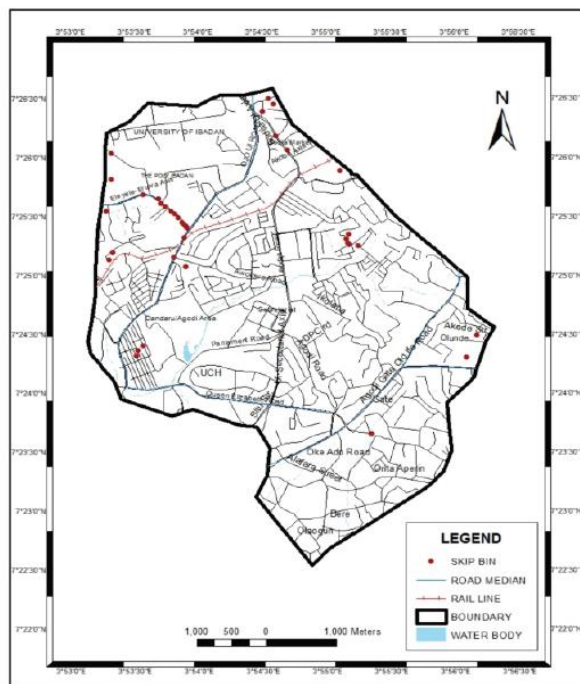

Fig 1: Spatial Distribution of Skip Bins within the Study Area
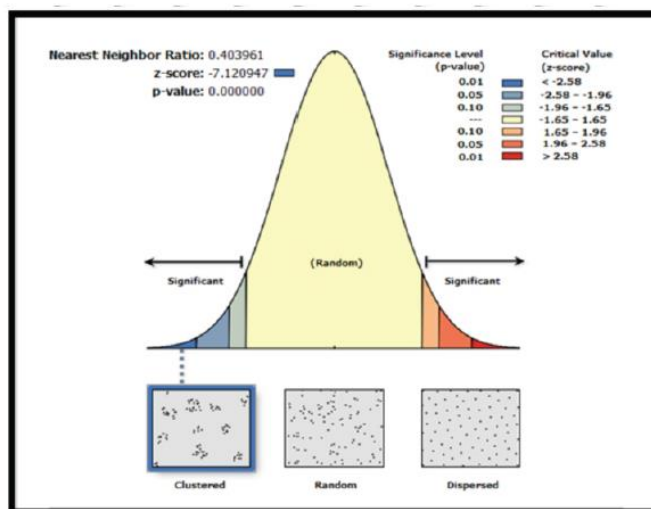Source: Authors (2014)

Fig 2: Average Nearest Neigbour chat for Skip Bins
Source: Authors, 2014.

433

The result of the Average Nearest Neighbour analysis also affirmed the clustered distribution of the skip bins within the study area (fig. 2). An Observed Mean Distance of 156.8516 Meters, Expected Mean Distance of 388.2837 meters, Nearest Neighbour Ratio of 0.403961 and z-score of -7.1209 which indicate that there is a less than 1% likelihood that this could be the result of a random chance (Table 1). This result also confirmed the distribution pattern displayed in figure 3.

Table 2 reveals that Ojoo-Mokola axis has the highest points of refuse disposal on median with 43 different points. 39, 36 and 34 different points were found along Sango-Eleyele Axis, Iwo Road-Gate-Roundabout-UCH- Mokola axis and UI-Bodija-Secretariat-Beere axis respectively. Points of refuse dumped on road median are shown in figure 3.

Table 1: Average Nearest Neighbor Summary

Observed Mean Distance:	156.8516 Meters
Expected Mean Distance	388.2837 Meters
Nearest Neighbor Ratio	0.403961
z-score	-7.1209
p-value	0.000000

Source: Authors, 2014.

Table 2: Location of Refuse Dumped on Road Median

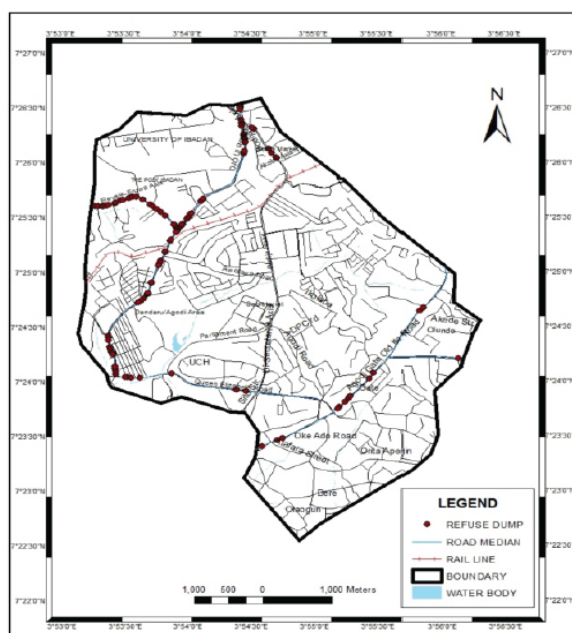| S/N	Location (median dumping of refuse)	Number of points
1	Ojoo-UI-Sango-Mokola Axis	43
2	Sango- Eleyele Axis	39
3	Iwo Road- Gate-Roundabout- Beere- Mokola Axis	36
4	UI- Bodija- Secretariat-Beere Axis	34

Source: Author's Field Survey, 2014.

Fig 3: Refuse Dump Points on Median within the Study Area.
Source: Author, 2014.

Effects of Indiscriminate Dumping

The problems of indiscriminate dumping range from environmental to health and to social issues. Where skips are too far, the communities dump wastes indiscriminately and some disposal points are often overflowing with uncollected wastes. Wastes left out may be scattered by wind, animals, children or waste pickers. Thus, a lot of these wastes actually end up in the environment. When collection services are delayed, wastes are not collected, causing considerable nuisance/air pollution. Also, flies perch on these uncollected wastes and go ahead to settle on food items, contaminating them and impacting on the health of the consumers.

Plate 1: Waste dumped on Road median
Source: Authors (2014)

Plate 2: Waste dumped on Road median
Source: Authors (2014) (overflowing to the road)

Plate 3: Refuse overflowing from skip bin
Source: Authors (2014)

Plate 4: Decomposed waste along road median
Source: Authors (2014)

Wastes should be collected more often in hot climate to control fly breeding. Other factors to consider are the odors caused by decomposition and the accumulated quantities. Flooding also results from clogging of drainage channels by dumped solid wastes. This also increases road sedimentation and growth of weeds along the roads which oftentimes damage the roads.

Factors Contributing to Indiscriminate Dumping of Refuse

Dumping of wastes by the roadside or along the median is inappropriate, unhealthy and untidy, it is not environmentally friendly as it causes to environmental disturbance - air pollution, poor sanitation, defacing the environment, and likewise has health implications. Some of the major factors that contribute to indiscriminate dumping of wastes along road medians and by the roadsides identified

during the questionnaire administration include: people's culture or attitude   a careless attitude permeates the thinking of many Nigerians and some people have some superstitious beliefs about wastes generated and thus prefer to burn and dispose them into flowing river/water; distance to skip bins; community population; nearness to market; wastes collectors' route/presence of road sweepers (OYWMA); poor public awareness and ignorance/lack of education are other factors.

Proposal

Based on the problem of median dumping of refuse identified, there is a need for fast planning response to be provided to prevent the emergence of ugly city and ugly outlook in the study area. This study proposes the Sustainable Wastes Management Approach of 3Rs which include Waste Reduction (identify waste minimization opportunities and be committed to action), Waste Re-use (in form of the use of wastes for compost) and Waste Recycle (production of useful materials from waste garbage). The other proposed approach is the redesigning of the location of the waste infrastructure (wastes bin). The planning standard for the location of waste facilities was applied following the Federal Ministry of Environment (FME) policy guideline on wastes management in Nigeria (2005), since none is stipulated in the handbook for Space Standard for Physical Development in Oyo State. It was observed in practice that the location of skip bin differ greatly from one place to the other in terms of thresholds and catchments; space standards; number of users at any one time; and distribution of use through the day and through the week, hence, it is proposed that sites should primarily be chosen for convenience of access to their catchment area in terms of potential users. Small containers can be placed on sidewalks, whereas larger skips require larger sites. FME (2005) proposed that for communal wastes infrastructure facility, a 200-250m walking distance should be observed between the location of one facility to that of another. The FME policy guideline (2005) maintained that detailed information regarding utility performance standards, threshold and nature of activity can act as benchmarks to check the accessibility of utility locations. For these utility points, which are accessed primarily by pedestrians, it assume an average walking speed of 50m/min which denotes a walking distance and time of 200m and four minutes respectively. All these coupled with the space density (population density, residential density and building density), nature of activity (commercial and residential), rate of wastes generation (average of half a day and a full day for a skip bin to get filled), wastes collection (average of a day and half), income of community (High, and low income earners) were used as the basis for the proposal.
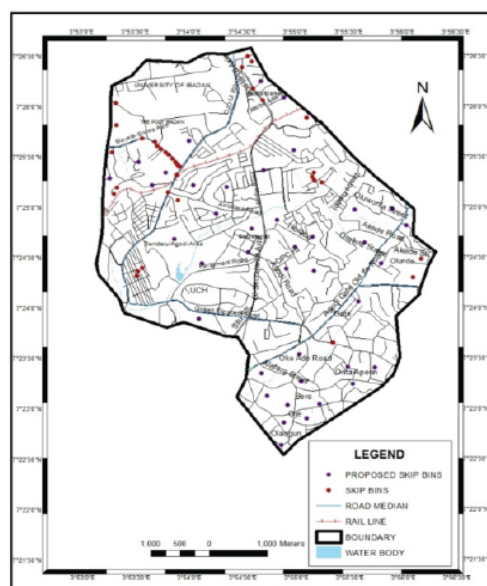

Fig 4: Proposed skip bins within the Study Area.
Source: Author, 2014.

Hence, 38 additional skip bins were proposed for the study area and these skip bins are randomly distributed within the study area following the FME standard of a distance of 200-250m between wastes infrastructure so as to cushion the effect of indiscriminate waste disposal. 2 were proposed at Sango, 2 along Eleyele axis, 1 around the University of Ibadan, 1 at Agbowo, 3 at Bodija-Ashi axis, 3 at Bodija Estate, 1 at Olaogun, 6 at Bere-Oje axis, 1 along Parliament road, 1 along Queen Elizabeth road, 1 at Oke-Ado, 3 at Orita Aperin, 1 at Dandaru area, 1 at Gate, 2 at Ikolaba, 1 along Akede street, 1 along Orelere Street, 1 along Oyelese Street, 1 along Idowu street, 3 at Agodi and 2 along the State Secretariat road. Figure 4 shows the proposed facility location.

CONCLUSION

The quantity and the rate of solid wastes generation in Nigeria have outgrown the capacity of nature to naturally absorb them (Babayemi & Dauda, 2009). Consequently, the infrastructure put in place by the agencies and the attitude of the people to keeping the environment clean contributes immensely to the state of these cities. To solve the problem of indiscriminate dumping of refuse in Ibadan and in Oyo state at large, solid wastes management policies in Oyo State should be energized and sanitation laws be empowered. The parameters for reprimanding anyone caught violating these laws should be put in place as well so that people can desist from the act of indiscriminate dumping. Education and awareness for the citizens to put off the long-acquired habit of indiscriminate waste disposal is eminent. Public health educators/ environmentalists should be mobilized to educate people on the need for proper wastes disposal and this enlightenment should be done on a continuous basis so that the populace is kept reminded of their responsibilities in building a better, cleaner and healthier environment. Proper location of skip bins should also be ensured. It is wrong and unhealthy that skip bins are placed on roads reducing road coverage that is accessible to people and moving vehicles, and in front of dwellings or commercial constructions where food items are sold. The number of skip bins should also be increased, that is, more skip bins should be made available within short distances. And likewise, the frequency of wastes collection from the available and proposed skips should be on a more regular basis. It is evident that efficient city road network is needed for proper wastes collection and management. Thus, for efficient wastes collection, there is a need for good road network for wastes managers to ply in order to collect the refuse generated.

REFERENCES

Adewumi, IK; Ogedengbe, MO; Adepetu, JA; Fabiyi, YL. 2005. Planning organic fertilizer industries for municipal solid wastes management. Journal of Applied Sciences Research, 1(3): 285-291.

Babayemi J.O; Dauda K.T. 2009.Evaluation of Solid Waste Generation, Categories and Disposal Options in Developing Countries: A Case Study of Nigeria. J. Appl. Sci. Environ. Manage. *September*, 2009Vol. 13(3) 83 - 88

EPA. 1988. Waste Minimisation Opportunity Assessment Manual. United States Environmental Protection Agency, Hazardous Waste Engineering Research Laboratory, Cincinnati EPA/625/7-88/003

Federal Environmental Protection Agency, (FEPA). 1998. Industrial Pollution, Policy and Management Study. A World Bank-funded Project, Geomatics Nigeria Limited, Nigeria.

Federal Ministry of Environment (FME), 2005. Environmental Health Watch:Policy Guideline on Solid Waste Management.

GISC. 2014. Average Nearest Neighbour.www.gisc.com, Accessed 24/10/14

Hann, Christian H, Coad, Adrian, &Lardinois I. 1998.Involving micro- and small enterprises in Municipal solid waste management: Guidelines for Municipal Managers.International Training Center of the ILP, SKAT, WASTE. Turin, Italy. pp 90.

NIPOST.2009.Post Offices- with map of LGA".NIPOST.Retrieved 2009-10-20.

Onibokun, AG; Kumuyi, A.J. 1996.Urban poverty in Nigeria: towards sustainable strategies for its alleviation. Centre for African Settlement Studies and Development, Ibadan, Nigeria. CASSAD Monograph Series 10. pp. 1-2.

Onu B., Price T., Surendran S.S. &Ebie S. 2012. Solid Waste Management: A Critique of Nigeria's Waste Management Policy

The official website, Oyo Sate Government. 2014. Local Governments: Ibadan North Local Government. www.oyostate.gov.ng assessed September, 10, 2014.