INVESTIGATING THE IMPACT OF WASTE REDUCTION MEASURES FOR JOS, NIGERIA

J. A. Yakubu

School of Environment and Technology, University of Brighton

Lewes Road, Brighton, BN2 4GJ, United Kingdom

A.yakubu@brighton.ac.uk

R. Woodard

School of Environment and Technology, University of Brighton

Lewes Road, Brighton, BN2 4GJ, United Kingdom

rw95@brighton.ac.uk

K. I. Gidado

School of Environment and Technology, University of Brighton

Lewes Road, Brighton, BN2 4GJ, United Kingdom

K.i.Gidado@brighton.ac.uk

E. Aboagye-Nimo

School of Environment and Technology, University of Brighton

Lewes Road, Brighton, BN2 4GJ, United Kingdom

E.aboagye-nimo@brighton.ac.uk

Abstract: With a rising population, limited financial resources and lack of infrastructure, emerging countries like Nigeria face increasing challenges in managing waste. With Nigeria's population growing at 2.8% per annum, by 2025 it is estimated the population will reach 240 million. Often waste is dumped in communities or delivered to dumpsites having a significant impact on public health. The recent UN Sustainable Development Goals highlighted that urgent steps are needed to control the increasing rate of waste generation.

This research investigates the waste management challenges in Jos, Nigeria. Through primary data collection including observations, focus groups, waste analysis, and interviews, the study

analyses current waste management practices. Results show conflicts in local roles and responsibilities leading to waste not being collected. There is lack of equipment and infrastructure for managing waste, and no waste education. High rates of reuse and recycling were observed due to economic drivers.

The research concludes with an overview of potential reduction initiatives and considers what role they may play in improving the management of waste in Jos.

Introduction

The management of waste is a big challenge in both industrialized and emergent countries across the world (Hoornweg & Bhada-Tata 2012). Based on data from the United Nations Environment Programme (UNEP) (2015) an estimated 2 billion people do not have access to basic waste collection and 3 billion people no access to controlled waste disposal. Often municipalities in Less Economically Developed Countries collect and deliver waste to uncontrolled dumpsites while neglecting more sustainable options higher up the waste hierarchy: the 3 Rs - waste reduction, reuse and recycling (Achi et al., 2012). It is important that municipalities give priority to the 3Rs in order to attain sustainable solid waste management.

The need to improve the management of waste has been recognized in the UNEP Global Waste Outlook (2015) and integrated throughout the United Nations Sustainable Development Goals (United Nations, 2015). For example:

Goal 11: Sustainable Cities and Communities: *"By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management"*.

Goal 12: Responsible Consumption and Production: *"By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse"*.

Like other emergent economies Nigeria faces increasing challenges in managing waste. The World Bank (2015) has estimated Nigeria's population to be about 183.5 million. With a growth rate of 2.8% it will rise to 239.8 million in 2025, with more than half of this population residing in urban centres. Such an increase in population will result in rapid urbanization and hence the challenge of solid waste management will become even much more complex. Hoornweg & Bhada-Tata (2012) assessed that in 2010 the lower middle income countries including Nigeria spent about $20.1billion on solid waste management, but by 2025 the cost will rise to $84.1 billion. They also appraised the existing total municipal solid waste generated in Nigeria to be 40,959 tonnes per day, and by 2025 it would rise to 101,307 tonnes per day. The increasing levels of waste will place significant pressure upon the already limited waste collection and management infrastructure.

For example Ogwueleka (2003) suggests that based on the existing available resources municipalities only collect 50-70% of the municipal waste generated. In addition the stress on the national budget from competing priorities makes it very difficult to get sufficient allocation of funds to finance waste management. As a result communities are confronted

with waste dumped in backyards, open spaces, drains, streets, streams and creeks (Agunwamba, 1998, Daffi and Kassam 2013).

Jos City

Jos City is the capital of Plateau State in central Nigeria (see Figure 1) and covers 1,362km^2. It experiences high rainfall, and the rainy season is from April to October, with an average mean rainfall of 1400mm annually. Jos has a temperate climate with an average temperature of between 18°C and 22°C (Wapwera 2015). Jos City is divided into two local government areas for administration purposes, which are Jos North and Jos South. This study was conducted in Tudun Wada and Jenta communities of Jos North local government area. The local governments are directly responsible for planning and overseeing service delivery in their areas of jurisdiction, including solid waste management (Afon 2007). However the state government steps in to complement their efforts especially in state capitals where the urban areas are made up of more than one local government council. In Jos City, the Plateau State Environmental Protection and Sanitation Agency (PEPSA) are responsible for solid waste management.

There is very limited available data on the levels of waste generated in Jos. The last major study was published by the Nigerian Study Action Team (NEST) in 1991. They estimated that in 1990 135,725 tonnes of waste was generated and projected this to rise to 197,660 tonnes by 2000. A more recent study by PEPSA (2013) has put the average waste generation rate in Jos at between 0.55-0.58 kg per capita per day. Eche et al (2015) observed that 45% of waste generation comes from residential areas, with 42% of the waste being mostly ash.

There have been considerable changes to Jos over the past 50 years. In the 1960s and 1970s Jos was a small and well-managed town with services running smoothly (DungGwom et al, 2008). This changed from the early 1980s due to its rapid growth and urbanization, coupled with the absence of controlled planning and effective administration. Whilst Jos had a population of less than 10,000 in 1930 and 20,000 in 1950 by 1973 its population had grown to over 155,000 and to over 600,000 by 1991 (DungGwom et al., 2008). The population of Jos increased to 1.3 million in 2006 according to National Population Commission (NPC) (2008) and Fola Konsult (2009) estimated the population will to rise to 2.7 million by 2025. This growth has seen most of the population living in impoverished slums and squatter settlements like Tudun Wada, Angwan Rukuba, Gangare, Jenta, Angwan Rogo with inadequate provision for infrastructure (Ajiji and Larab, 2016).

The rate of urbanization and urban growth in Plateau State is similar to the national trend. DungGwom et al., (2008) reported that in 1962/63 about 20% of Nigeria's population lived in urban areas; by 1991 it increased to 36%. This again increased to 45% in 2006, and by 2020 it is projected around 60% of Nigerians will live in towns and cities. Even with a conservative growth rate of 5%, the population of Jos will have doubled within a period of 17 years from 2007 to 2025. Peter et al (2014) explained that the urban infrastructure would be strained significantly relative to the required waste management services and facilities, if suitable steps are not taken to accommodate the likely increase in population.
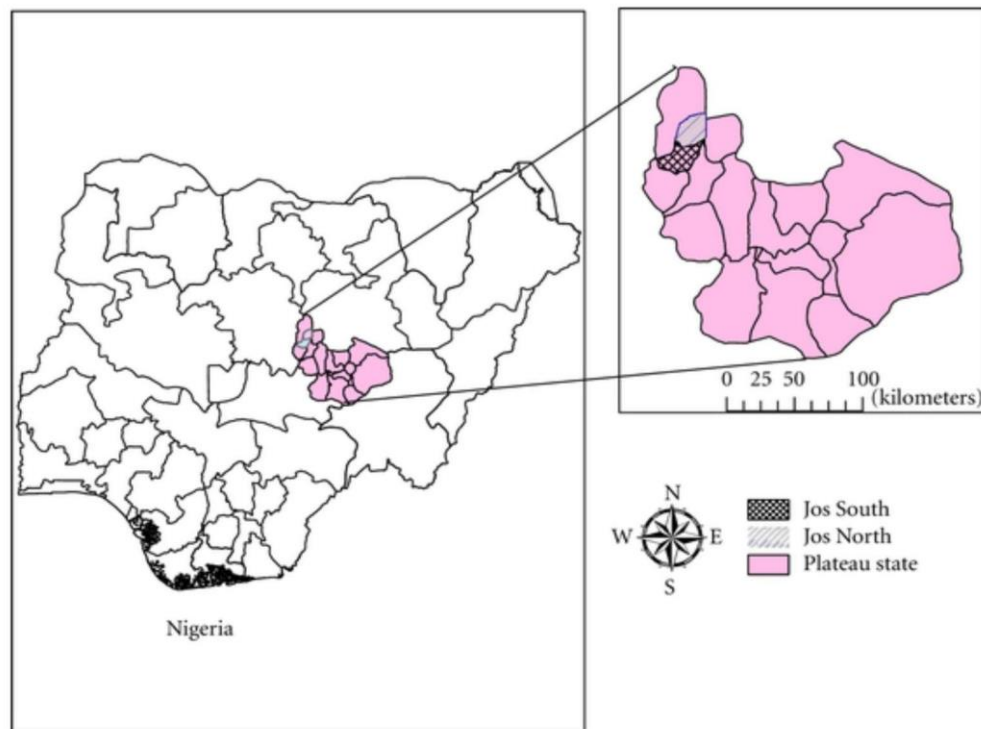
Figure 1: Map of Plateau state showing the study area (Jos North and Jos South) among other fifteen Local Government Areas. (http://www.hindawi.com/journals/isrn/2012)

Aim and objectives

This paper presents the results of a study looking into the management of waste in the City of Jos in Nigeria with a focus on low income unplanned areas. The paper aims to understand how waste is currently managed in these areas and identify opportunities to reduce the amount of waste generated thereby helping to reduce the pressure upon the already inadequate infrastructure. The objectives are to:

1. To identify the barriers to sustainable waste management in Jos;
2. To understand how citizens currently manage their waste including waste prevention, reuse and recycling activities;
3. To understand the composition of waste in Jos and identify priority low cost interventions to reduce waste levels.

Methodology

To satisfy the aim a mixed methods approach was used (see Table 1). In addition to reviewing existing literature on the management of waste in Jos direct observation was undertaken to map out how waste was being managed in the community. Primary data was collected directly from the field using both qualitative and quantitative methods. The qualitative methods used for this research were direct observation, focus group discussion

and semi-structured interviews with key officials, whilst quantitative methods were used for collecting data on waste composition and undertaking a household questionnaire.

Table 1: A summary of data collection methods and corresponding objectives

Data collection method	Respondents	Objective		
		1. Barriers to sustainable waste management in Jos	2. Understand how citizens currently manage their waste	3. Composition of waste/identify priority interventions
Literature review by the researcher	N/a	✓	✓	✓
Direct observation by the researcher of how waste is being managed	N/a	✓	✓	
Focus group to obtain views and opinions of householders on waste management	Household members in Tudun Wada and Jenta. Two groups each involving 32 people in total.	✓	✓	
Face to face interviews to understand how waste is managed, barriers and opportunities	Representatives from: - State Ministry of Environment - PEPSA - University of Jos -A waste bank (informal sector) -Local recycling company (informal sector)	✓	✓	
Face to face questionnaire	678 households	✓	✓	
Waste characterization	A weeks sample from 75 households			✓

Results and discussion

The following section presents an overview of results and key findings from the data collected as set out in Table 1.

Barriers to sustainable waste management

A combination of information gleaned from the literature review, observations and interviews shows there are a range of barriers impacting on the management of waste in Jos.

Lack of resources
In the case study area households do not have waste collected from the doorstep but have to take waste to collection points throughout the community. Despite this data from observations and interviews show that PEPSA has insufficient resources to collect the waste which leads to the accumulation of refuse in the bin areas. Moreover as these bins are not being serviced properly there is a lack of motivation from citizens to even take waste to these communal points leading to waste being dumped throughout the community. Binbol et al., (2013) asserts there is the need to provide more designated collection points in all areas of the municipality to make it more convenient for householders in order to reduce environmental pollution.

As found in this study and research by Daffi & Kassam (2013) waste is commonly disposed in open dumps which can be seen on road sides, backyards, uncompleted buildings, open spaces, street corners, drainages, rivers or streams. Similarly in terms of disposal there are no sanitary landfill sites in Jos. The dumping of waste is a potential source of flooding, air, water and land pollution, and also serve as agents of infections and diseases. The impacts can be seen in parts of the Jos urban area where people dig shallow wells very close to sewage systems with little or no concern for pollution. A survey of ground water quality in hand dug wells in Jos metropolis and environs, by Beka et al (2009) observed nitrate values which exceeded the threshold value of 3.0mg/l while some exceeded the WHO health standard of 45mg/l. The high nitrate values were attributed to sewage, pit latrines and refuse dumps.

Information from interviews highlights the problem of resources – there were only 5 working vehicles for 1.3 million people at the time of the fieldwork in 2014. In addition budget proposals were made and approved but with no financial backing.

Service planning
How the service is planned is also a barrier to effective waste management. As shown in Table 2 for 34.5% of households questioned children were responsible for managing waste and taking it to communal bins. However the bins are high and therefore children cannot physically deposit the waste. Daffi & Kassam (2013) also found that there is a lack of logistical plan for collecting bins and therefore they may be filled up and not emptied on time. Likewise trucks used for the collection of waste are often open so waste is blown out along the route to the disposal site.

Conflicts in roles and responsibilities
Information from the interviews conducted with government and industry stakeholders' shows the management structure for waste is confused leading to conflicts in local roles and responsibilities. DungGwom et al (2008) came to similar conclusions that there are a plethora of institutions in the state that performing overlapping functions, and work at cross purposes rather than addressing different issues and problems. Examples include the Jos Metropolitan Development Board (JMDB), PEPSA and the Direct Labor Agency.

Lack of awareness of waste issues

Results from interviews show that there has not been a waste education programme in Jos since 2000 and as such throughout society there is a lack of awareness of waste issues. There are numerous public health problems associated with the management of waste which the public are largely unaware (Egbere et al., 2001). For example 44.8% stated they burnt waste in their back yard thereby having a significant impact on public health. Binbol et al (2013), Daffi and Kassam (2013) and Peter et al (2014) have all advocated the need for communication campaigns increasing the public's awareness of waste and the impacts on public health and the environment of poor waste management. As shown in Table 2 citizens questioned cited a community education programme as being the biggest improvement which could be made in Jos.

How citizens manage their waste

Table 2 provides an overview of key results from the face to face questionnaire. Out of 678 respondents, 346 were drawn from Jenta and 332 from Tudun Wada. 67% of residents had spent more than 2 years living in the study area followed by those who had spent 1-2 years (20%). 50.9% households had between 4-6 members with 54.9% having a child under 3 years of age.

Respondents rated the waste management service as very poor (67.9%) or poor (26.3%). As a result of waste not being collected, households are forced to burn the waste in their backyard (44.8%), throw it into the stream/drain (31.3%). Only 22.0% stated that they took waste to the communal bins throughout the community to be collected by the municipality. The results show a similar trend to the work of Oladosu et al., (2015) who reported that 88.1% of residents dispose their refuse either by way of burning or open dumps.

Residents stated they disposed of their waste in this manner because there are no facilities (49.3%), and also for convenience (22.1%). Respondents believe that waste management could improve if communities are educated (41.7%) on how to properly manage waste or communities are involved in the management of waste. 30.8% mentioned that effective house to house waste collection could also improve waste management.

Despite the lack of formal municipal recycling services recycling was prevalent with 68.6% stating they recycled. This was through individuals going door to door buying recyclables such as metals or householders taking materials to entrepreneurs or businesses and selling materials. An example is a metal pot manufacturer in Jos. When buying a new pot citizens can give cans and tins in partial payment. Similarly the level of reuse was high with 77.6% stating that they were engaged in some form of reuse activity. Examples of reuse include reusing shopping bags, plastic bottles and packaging, furniture and repairing electrical items. 54.9% of households included a child of less than 3 years of age with 59.4% of these using reusable washable nappies.

Only 5.2% of respondents stated they composted with reasons being the lack of space and knowledge. This was corroborated by the representative of PEPSA during interview when he stated that composting does not take place in Jos presently.

Table 2: Overview of main responses from the questionnaire by residents

Question	Response	Number (total 678)	Percentage (%)
How long you have lived in the community?	6 Months	89	13.0
	1-2 years	133	20.0
	Above 2 years	456	67.0
Number of people living in household?	1 Person	0	0.0
	2-4 People	136	20.0
	4-6 People	345	50.9
	>6 people	197	29.1
Who is responsible for waste management in the household?	Child	234	34.5
	Female	441	65.0
	Male	3	0.4
How to you rate the waste collection service?	Very poor	460	67.9
	Poor	178	26.3
	Don't know	27	4.0
	Satisfied	12	1.8
	Very satisfied	1	0.2
How does your household manage waste?	Burn at backyard	304	44.8
	Throw in the stream/drain	212	31.3
	Takes to communal bin	149	22.0
	Throw in pit	13	1.9
Why do you dispose of waste in that manner?	Lack of facilities	334	49.3
	For convenience	150	22.1
	For proper disposal	149	22.0
	Lack of awareness	26	3.8
	No penalty	16	2.4
	To save cost	03	0.4
What could improve the management of waste in the community?	Community education	283	41.7
	Community involvement	209	30.8
	Effective house to house collection	152	22.4
	Workshops	20	3.0
	Incentives	14	2.1
Do you recycle?	Yes	465	68.6
	No	213	31.4
Do you reuse?	Yes	526	77.6
	No	152	22.4
Do you compost?	Yes	35	5.2
	No	643	94.8
Who is responsible for waste reduction?	Individuals	387	57.1
	Manufacturers	196	28.9
	Don't know	57	8.4
	Shops	20	3.0
	Councils	18	2.7
Does your household have a	Yes	372	54.9

child under 3 years?	No	306	45.1
If yes what type of nappy do they use?	Real washable nappies	221	59.4
	Disposables	151	40.6

Waste composition

Waste was collected from 75 households over a week and the composition analysed (see Figure 2). Waste sampled was made up mainly of food waste (27.9%), followed by plastics (16.3%), ash (14.7%) and soil (6.9%). It should be noted that the majority of food waste was unavoidable consisting of fruit and vegetable peelings, yam peels and bones. The results support previous work analyzing the Nigerian waste stream which identified organics to be prevalent (Agunwamba et al 1998; Dauda & Osita, 2003; Ogwueleka 2003). The waste stream is high in organics and which could be composted in order to reduce the quantity of waste that needs to be managed.

Data was collected on the demographic make-up of the households sampled which permitted rates of generation to be calculated. The quantity of waste generation was 0.45 kg per capita per day similar to the average waste generation in Nigeria calculated by Solomon (2009) of 0.49 kg per capita per day but less than the PEPSA (2013) estimate for Jos.
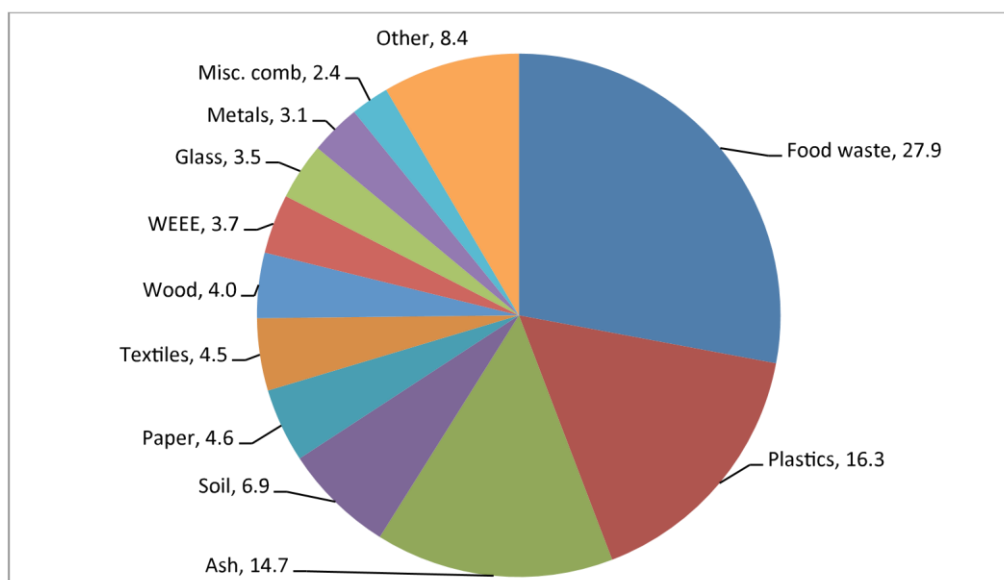

Figure 2: Percentage composition of waste in Jos – breakdown by weight

Conclusion

With the population of Jos expected to double in just a 17 year period it faces significant waste management challenges. The paper aimed to understand how waste is currently managed in low income informal areas of Jos and to identify opportunities to reduce the amount of waste generated thereby helping to reduce the pressure upon the already inadequate infrastructure.

The results have shown that at present there are significant problems in how waste is being managed. Due to the inadequate collection service 44.8% of people surveyed stated they

burned waste in their backyard and 31.3% indiscriminately throwing waste into streams and drains both of which have significant impacts on public health and the environment. Barriers to improved waste management services include a lack of resources inhibiting both collection and controlled disposal – indeed there are only 5 working vehicles for a population of 1.3 million. Other barriers include conflicts in roles and responsibilities and in general a complete lack of awareness of waste issues.

Despite the lack of services and an absence of a formal recycling collection, citizens surveyed showed there is an abundance of reuse and recycling activity. 68.6% stated that they recycled mainly through selling recycling to entrepreneurs and recycling businesses. Moreover 77.6% actively reused materials either through reusing shopping bags, plastic bottles and packaging, furniture and repairing electrical items. Indeed throughout Jos there are thriving businesses selling second hand clothing and electrical products.

Few households currently compost and the results show there is significant opportunity to set up home or community based composting systems. Food waste alone makes up 27.9% of the waste stream and therefore composting could remove a significant fraction of the waste thereby helping to relieve some of the pressure on the waste infrastructure.

It is clear that the Jos waste management system is inadequate and this will only escalate with the projected waste growth. All stakeholders including the Ministry of Environment, PEPSA, residents, local, state and national governments need to work together to plan and develop an effective waste management system making best use of the available resource. Further work is being undertaken by the authors on developing low cost waste prevention interventions and considering their impact to help reduce waste generation in Jos.

References

Achi, H. A., Adeofun, C. O., Gbadebo, A. M., Ufoegbune, G. C. and Oyedepo, J. A. (2012) An assessment of solid waste management practices in Abeokuta, Southwest Nigeria. Journal of Biological and Chemical Research, Vol 29 (2), 2012.

Afon, A. O. (2007): An analysis of solid waste generation in a traditional African city. The example of Ogbomosho, Nigeria. Environment and Urbanization, 19 (20, pp.527-536.

Agunwamba, J.C, (1998): Solid waste management in Nigeria, problems and issues. Environmental management 22(6) pp 849-856.

Agunwamba, J. C., Ukpai, O. K. and Onyebuenyi, I. C. (1998): Solid waste management in Onitsha, Nigeria, Waste Management Research, 16 (1), 23-31.

Ajiji, D.N, & Larab, T.A (2016): The growth of urban slums and conflicts in Nigeria: A case study of Jos and Environs 1980-2010. International Journal of Social Science and Humanity, vol 6(5)

Beka, N.C., Aga, T., Eziashi, A.C., (2009): Chemical quality of ground water from hand dug wells in Jos metropolis and environs, North Central Nigeria. The Pacific Journal of Science and Technology, 10 (2).

Binbol, N. L., Ogboji, F. and Lohor, A. A. (2013): An assessment of waste management activities of Plateau State Environmental Protection and Sanitation Agency (PEPSA). From the selected works of Confluence Journal of Environmental Studies (CJES), Kogi State University, Lokoja, Nigeria.

Daffi, R. E, and Kassam, P. R,(2013): Surface water pollution in Nigerian urban areas: A close look at Jos city and its surroundings. A paper presented at the 36th WEDC conference, Nakuru, Kenya.

Dauda, M. and Osita, O. O. (2003): Solid Waste Management and Re-use in Maiduguri, Nigeria. Towards the Millenium Development Goals. 29th WEDC International Conference, Abuja, Nigeria, pp 20-23.

DungGwom, J. Y., Hirse, S. O., and Pwat, S. P. (2008): Four year strategic plan for urban development and housing in Plateau State (2008-2011). A report submitted to the Plateau State Strategic Planning committee.

Egbere, O. J., Itelima, J. U. and Opiah, F. O. (2001): Municipal solid waste segregation and their health hazard: Implication in Angwan Rogo ward of Jos, Plateau State Nigeria. Journal of environmental sciences, volume 4 (1) pp14-20.

Eche, O. F., Ali, A. Y., Vivan, E. L., Danjuma, A. K. and Sohotden, C. D. (2015): An assessment of PEPSA as a waste management institution in Jos city, Nigeria. International journal of scientific and Technology Research, vol 4(2).

Fola Consult (2009): Greater Jos Master Plan, a report by Fola Consult limited for the Plateau State Government of Nigeria (2008-2025), p.94

Hoornweg, D. and Bhada-Tata, P. (2012): What a Waste: A Global Review of Solid Waste Management, World Bank, Washington DC. Available at: www.worldbank.org

Map of Nigeria showing Plateau State http://www.hindawi.com/journals/isrn/2012

Nigerian Environmental study/action team (NEST, 1991): A report of a research carried out by a nongovernmental organization for Nigeria on the challenge of sustainable development.

National Population Commission, (NPC 2008): 2007 population Census figures (online). <http://www.population.gov.ng/index.php.htm>. Abuja (cited 28.08.08).

Ogwueleka, T.C. (2003): Analysis of urban solid waste in Nsukka, Nigeria. Journal of Solid Waste Technology and Management, 29 (4): 239-246.

Oladosu, R. O., Bwala, H. B., Ngalmi, S. M. and Mangga, M. K. (2015): Issues and challenges of urban renewal in Jos, Plateau States, Nigeria. Journal of Environmental Science, Toxocology and Food Technology, vol. 9(1), pp 24-29

PEPSA (2013): Report on solid waste management in Jos, Nigeria.

Peter, G, Hull, A, Jowitt, P, and Adeloye, A, (2014): MSWM in greater Jos, Nigeria. A paper presented at the North American conference on sustainability, energy and environment 2014.Official conference proceedings (www.iafor.org)

Solomon, U. U. (2009): The state of solid waste management in Nigeria. *Waste Management* 29: 2787-2790.

United Nations (2015): Sustainable Development Goals. UN, New York, USA.

United Nations Environment Programme (2015): Global Waste Outlook. UNEP, Nairobi, Kenya.

Wapwera, S.D, Egbu C.O, Parsa, A.G, Ayanbimpe G.M, (2015): Abandoned mines, homes for people: a case study of Jos Tin mining region. International journal journal of Housing markets and analysis, volume 8 (2)

World Bank (2015): http://www.worldbank.org/en/about/annual-report