Generation and management of solid waste in Udu Local Government Area of Delta State, Nigeria

Jomata Lucky Igben*, Celestina A. Ihayere and Eghosa Igun

Department of Environmental Management and Toxicology,
Western Delta University,
Oghara, Delta State, Nigeria
Email: joma_igben@yahoo.com
Email: cihayere@yahoo.com
Email: igun.eghosa@gmail.com
*Corresponding author

Abstract: This study aimed to examine solid waste generation and disposal as problems of urbanisation in Udu Local Government Area of Delta State, Nigeria. Primary data utilised in the study were obtained from questionnaire administered on a sample selected through a multi-stage sampling technique. The first stage involved a purposive selection of three settlements in the study area. The second stage involved a systematic random sampling of 270 household heads. The questionnaire covered the typology of solid waste, disposal methods and community participation in waste management. This was complimented by physical examination of waste dumps and focus group discussion (FGD) with 15 selected community leaders. The study revealed that a variety of solid waste comprising of biodegradable (68.8%) and non-degradable (32.2%) are generated by households and are disposed in unsustainable ways; manifested by the heaps of refuse in public places and natural features such as riverbanks and forests. In addition, there is a very low level of communal participation in waste management as a result of urbanisation. The study recommends the planning and establishment of dumpsites, and education of the teeming population on the hazards of unsustainable disposal of solid waste.

Keywords: solid waste; dump sites; communal participation; sustainability; Delta State; Nigeria.

Reference to this paper should be made as follows: Igben, J.L., Ihayere, C.A. and Igun, E. (2022) 'Generation and management of solid waste in Udu Local Government Area of Delta State, Nigeria', *Int. J. Environment and Waste Management*, Vol. 29, No. 1, pp.1–13.

Biographical notes: Jomata Lucky Igben is a Senior Lecturer and Acting Head in the Department of Environmental Management and Toxicology, Western Delta University, Oghara, Nigeria. He obtained his BSc and PhD in Geography with specialisation in population and environmental management from the University of Ibadan and an MSc in Population and Manpower Planning from the University of Jos, Nigeria.

Celestina A. Ihayere is a Senior Lecturer in the Department of Environmental Management and Toxicology, Western Delta University, Oghara, Nigeria. She obtained her PhD in Mycology/Plant Pathology from the University of Benin, Benin City.

Eghosa Igun is an Assistant Lecturer in the Department of Environmental Management and Toxicology, Western Delta University, Oghara, Nigeria. He obtained his BSc in Meteorology form the Federal University of Technology Akure, Nigeria and MSc in Sustainable Environmental Management from the University of Greenwich, UK.

1 Introduction

The term 'solid waste' refers to any non-liquid, non-soluble solid and movable substance that is no longer useful to the immediate owner and therefore disposable. This definition presupposes that waste is relative and is dependent on its usefulness to the individual or persons. They include municipal waste, garbage, industrial waste, domestic waste, military waste and mining waste and so on. Solid wastes have been classified into two categories: namely, hazardous and non-hazardous waste based on its effects on the environment. Non-hazardous waste does not pose any serious problem to environment and health of the population while hazardous waste, because of their physical, chemical or biological composition pose dangers to the environment and therefore requires special handling or disposal procedure to avoid risk to human health or other adverse effects on the environment (Akpofure, 2009).

Various types of solid waste are usually generated from the households that constitute the population of any area being it urban or rural, depending on the nature of economic activities of the people. In other words, the type and volume of waste generated by households depends on their level of the socio-economic advancement as people consume the available resources and produce waste. For instance, in rural areas, most of the waste generated by residents are mostly biodegradable, but with increasing urbanisation came new materials like plastic bags, cans and bottles which are thrown indiscriminately in the environment to the extent that some open space meant for recreational and educationally purposes have been used as dumping sites. Consequently, if the population increases rapidly in numbers then there will an increasing consumption of resources, a situation that will inevitably lead to increase in the quantity and variety of waste generated.

The literature is replete with studies on solid waste generation and disposal in Nigeria. For instance, the United Nations Centre for Human settlement (UNCHS, 1996) states that only between 25%–55% of waste generated in major cities in Nigeria is collected by waste authorities. Up to 45% of this waste is thrown into open dumps which degrade the environment and endanger human health. According to Bakare (2018) solid waste management is the most pressing problem faced by urban and rural areas of Nigeria. With its large population of over 170 million, the country generates more than 32 million tons of solid waste annually, out of which only 20%–30% is collected. Thus solid waste disposal is a major challenge in Nigeria. In a similar vein, Uma et al. (2013) opined that there is an increase in solid waste generation by households in Nigerian urban centres as a result of high concentration of people and insufficient availability of houses and growth of shanty towns and slums. This, according to them, has resulted in reduction in standard of living.

Similarly, Nnaji (2015) explained the status of municipal waste management in Nigeria. The study covered aspects such as generation, characterisation, collection,

scavenging, open dumping, disposal and environmental implication of poor solid waste management for 31 Nigerians cities. The study revealed that the generation rate varies from 0.13 kg/capital/day in Ogbomosho to 0.17 kg/capital/day in Ado Ekiti. In all, food waste was found to constitute 50% percent of the overall municipal solid waste in Nigeria. According to the study, many of the municipal areas in Nigeria are overrun by solid waste due to failure or dysfunction of many municipal waste authorities. Agunwamba (2003) studied the disposal of solid waste in Anambra State, Nigeria by analysing the state of solid waste recycling by scavengers in Onitsha, a commercial centre in the State and also in other urban areas such as Nsukka, Enugu and Port Harcourt. The study showed that the activities of the scavengers can have a great impact on the economy of the country with respect to resources conservation, creation of job opportunities and reduction in the magnitude of waste disposal problem.

Mbina's (2015) study on challenges of urban waste management in Uyo Metropolis revealed that several residents in the city understand the need to have a clean environment as well as the challenges that might occur if the opposite were the case. The collection and final disposal of waste is fast overwhelming the state's Ministry of Environment and Mineral Resources. There is also a steady increase in the variety of waste coupled with highly ineffective solid waste management system evidenced by waste dumps in public places.

Another study on environmental constraints of waste management in Abakaliki, Ebonyi State by Okwesili et al. (2016) revealed that there were no government approved dumpsite anywhere in the state and that government has not made significant efforts to curtail the tide of indiscriminate disposal of solid waste. Furthermore, the Ebonyi State Environment Protection Agency (EBSEPA), according to the study, lacks the required modern equipment to tackle the waste problem.

However, most of the studies on solid waste generation and disposal focus largely on urban centres with little or no known study of solid waste generation and disposal as a problem associated with urbanisation; hence, this study aims to examine solid waste generation and disposal as problems of urbanisation in Udu Local Government Area (LGA) of Delta State, Nigeria. Specifically, its objectives include:

1 identify the various types of solid waste generated by households in the study area

2 ascertain the disposal methods employed by the households

3 determine the extent of community participation in waste disposal and management.

This study, apart from closing the lacuna in the literature, will be of immense benefit to waste management authorities who are saddled with the responsibility of fostering efficient waste disposal methods. Methods that involve the collection, transportation, dumping and possibly separation and recycling of waste. In essence, data generated from this study would be of significance in planning the management of waste in emerging urban centres.

2 Conceptual framework and literature review

The IPAT model propounded by Ehrlich (1974) is used to explain the generation of solid waste in the study area. In its original postulation, the model considers the fact that

demographic impact on the environment is a product of three factors; namely, population, consumption per person and technology. The model takes cognisance of the relative importance of each of the three factors, and their variation over space and time (Ehrlich, 1974). Furthermore, the factors have multiplicative impact on each other. The interaction between population and the environment, therefore, is represented as:

$$I = P \times A \times T.$$

where I = impact or pressure on the environment, P = population (size, distribution and rate of growth); A = affluence (measured in terms of consumption level of individuals); T = state of technology of the population. The equation depicts that population is not the only cause of environmental degradation. The consumption of materials and energy per person are also important factors. So is the type of technology that people use to make consumption possible, as well as the economic, social and political forces that influence decision making (Ehrlich and Ehrlich, 1990). All these factors are intricately linked by an array of cause and effect connections. The model implies that the urban areas with large populations, but limited economic advancement as predominant in developing countries, the study area inclusive, can generate a big impact on the environment in terms of inappropriate disposal of generated waste; hence, dimming prospects for sustainable development.

The initial conceptualisation of this model is considered inadequate in explaining the link between population and environmental impact but takes the amount of resources or pollution produced as a proxy for environmental damage. In many situations, an extra factor has to be added to arrive at the true damage – the sensitivity of the environment (Harrison and Pearce, 2001). The model was consequently expanded to accommodate more variables, thus;

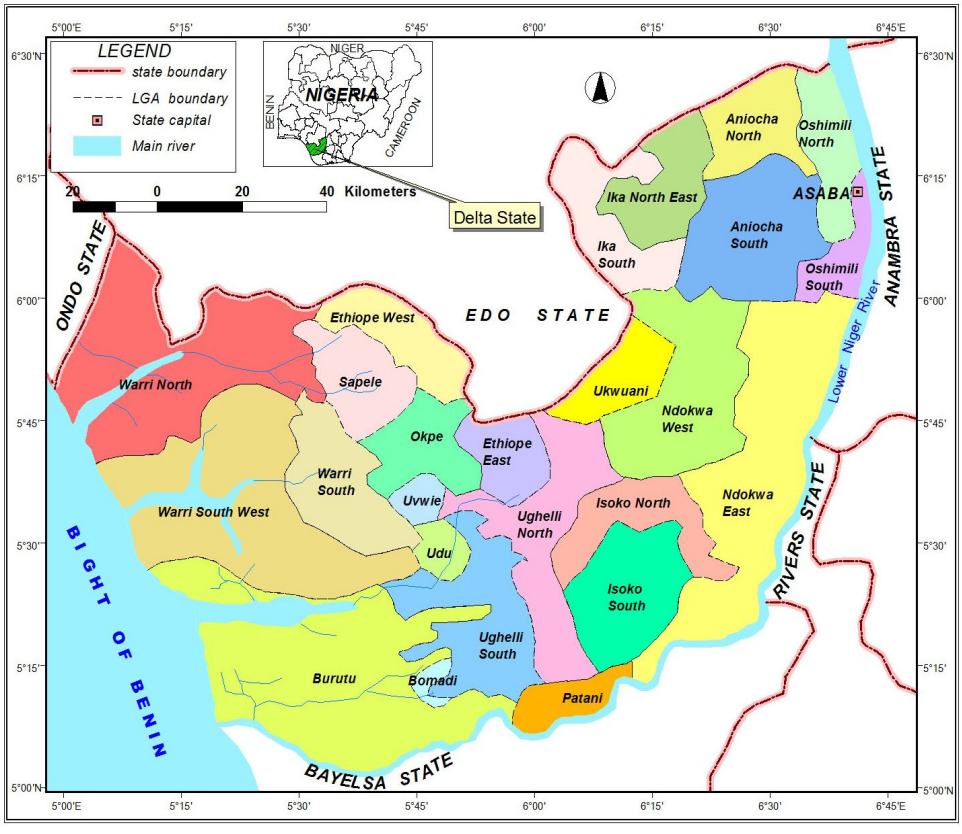
$$I = P \times A \times Tr \times Tw \times S.$$

where I, P and A are as used in the first equation, Tr = technology of resources, Tw = technology of waste management, and S = change in the environment as a result of resources extraction or pollution.

The expanded formula encompasses the consequences of changes in the environment vis-à-vis changes in the population. The expanded IPAT model is of direct relevance to this study as it emphasised the environmental and health impacts of poor and inadequate waste disposal particularly on the human population, including the consequences of the multiplying effects of the population size, characteristics and quality, which is urbanisation. The volume of solid waste that is visible at the outskirts of the study settlements emitting nauseating smell and causing aesthetic nuisance is a measure of the failure of the current practice of waste disposal.

However, the introduction of waste management technology which in the study area is still at a rudimentary stage, contributes significantly to aptness of the model to the study. The affluence level of the households, measured by the level of consumption and well-being of the individuals, depends on the state of technological advancement, socio-economic and demographic characteristics and lifestyle of the population. It determines the typology of waste generated, which include both biodegradable and non-degradable solids. In sum, there is a two-way relationship between household waste generations and the environment.

Figure 1 LGA map of Delta State (see online version for colours)



Source: Igben (2011)

3 Methodology

3.1 The study area

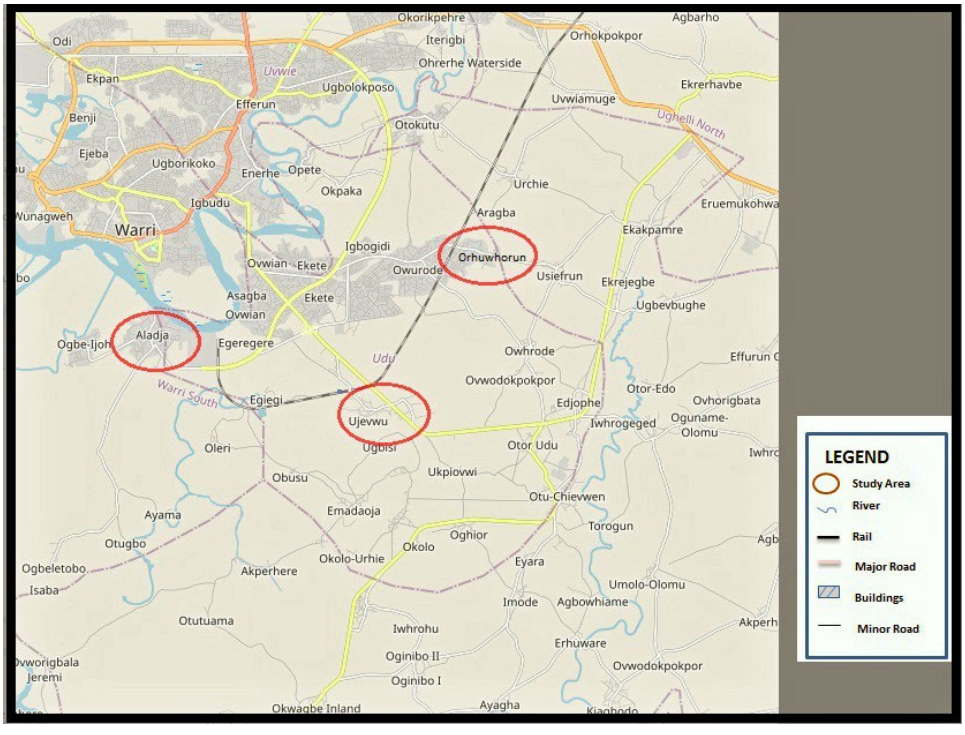
Udu is one of the 25 LGAs in Delta State, Nigeria as shown in Figure 1. It lies roughly between latitudes 5°45” and 5°50” north and longitudes 6°20” and 6°50” east over an area of about 138 square kilometres. It is bordered in the North by the Warri River, Ughelli South LGA in South and East, while the Forcados River is its western border. The LGA occupies the plain land between the Warri River and the Okpare Creek, with a vegetation of freshwater swamp, and a general land elevation of less than 10 metres above sea level. The clan is drained by the Warri River and numerous creeks such as Oleri, Oghoje, Krokoto, Ogbivwie, etc. (Igben, 2014). The total population of the LGA in 2006 was 142,480 persons, made up of 71,813 males and 70,667 females spread across 32 towns and villages (NPC, 2006). The projected population of the study area in 2016, using the national population growth rate of 2.7% is 180,959 persons. However, following the creation of the LGA in 1991 coupled with the rapid influx of people from the neighbouring Warri Township, the population of the area is estimated to be over

300,000 persons, with some of the settlements undergoing rapid urbanisation, as indicated by the extent of build-up areas shown in Figure 3.

Furthermore, the urbanisation of the study areas is manifested in the increase in economic activities such as number of markets. The area had only one daily market (Udu market) prior to the 2006. But the number has increased to six daily markets located at Aladja, Ubogo, Ekete, Orhuwhorun, Ovwian and Ohwase in the LGA.

Data for this study were obtained from both primary and secondary sources. The former was from the questionnaire administered on a sample population. This was complemented by focus group discussions (FGDs) with five community leaders each in the sampled settlements.

Figure 2 Map of Udu LGA in 1991 (see online version for colours)

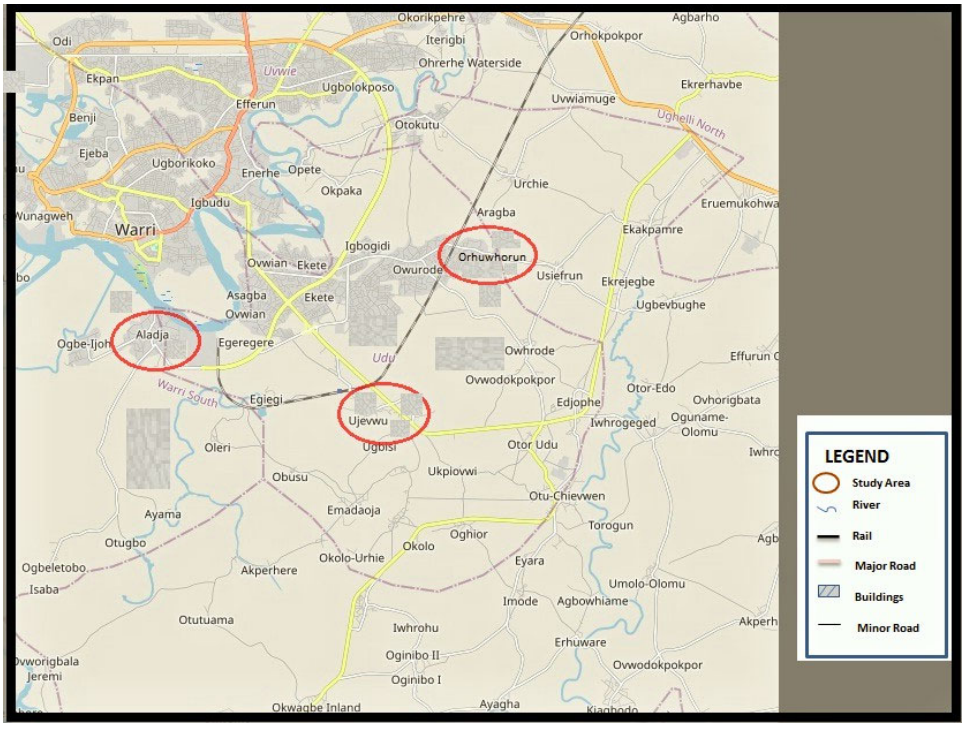


The target population for this study is anyone, male or female who is economically active and resident in the selected settlements. The multi-stage sampling technique was used to select sample for this study. The first stage involved a purposive selection of three rapidly urbanising settlements in the study area. The selected settlements are Aladja, Ujevwu and Orhuwhorun Communities as depicted in Figure 2. The selection of these settlements was predicated on the fact that they have experienced rapid increase in population and physical transformation in the last decade.

The second stage involved the selection of households in the sampled settlement. In the selected settlements, the total number of households was estimated with the help of village head. Estimation of households was further made easier because of the existing sub-divisions in each of the selected settlement called quarters. Thus, enumeration was

done on the basis of quarters until the entire settlement was covered. The systematic random sampling technique was employed for the selection of households in the selected settlement. This required a serial numbering of the households, after which the household was randomly picked. Subsequent ones were picked at a chosen interval until the total number of designated sample size of households was achieved. A total of 270 households were targeted for the three settlements with an average household size of 6.2 persons.

Figure 3 Map of Udu LGA in 2017 (see online version for colours)



The questionnaire forms were distributed to the heads of the sampled households or their representatives. At the end of the data collection exercise, all questionnaire forms (100%) were returned. Furthermore, the data collection process was complemented with physical examination of waste dump and holding FGD with ten selected community leaders in the selected settlement. The questionnaire used for the study covered the typology of solid waste, disposal methods and community participation in solid waste management. Each question was brief and carefully worded so that it was comprehended by the respondents in a way desired by the researcher. The questions were also presented in a systematic manner so that responses could be related to one or other aspects of the study. Data collected for the study were coded and compacted into manageable size. The frequencies of occurrence of events and percentages were worked out and presented in charts and tables.

4 Data presentation and discussion

4.1 Socio-demographic characteristics of sampled household heads

The socio-demographic characteristics of a population determine the lifestyle and the type of solid waste that may be generated. Table 1 show the age and sex composition of the sampled household heads. It reveals that majority of the total sample population, 202 persons representing 74.8% were above the age of 46 years. Out of this percentage, 24.8% of them were in the age cohort of 60 years and above, closely followed by the 56–60 years' cohort (20.0%) and those in the 51–55 years with 18.9%. The younger age groups trailed behind, with 8.5% each for those between 46–50 years, and 41–45 and 36–40 years old. The percentages became lower with decreasing ages, as those between 21–25 years, 26–30 years, and below 20 years formed 2.2%, 3.0% and 1.5% respectively. This distribution indicates an aging population.

Table 1 Age and sex composition of household heads

Age group		*Males*	*Females*	*Total*	*Percentage*
1	Below 20 years	4	0	4	1.5
2	21–25	7	1	8	3.0
3	26–30	3	3	6	2.2
4	31–35	4	5	9	3.3
5	36–40	12	6	18	6.7
6	41–45	18	5	23	8.5
7	46–50	14	9	23	8.5
8	51–55	39	12	51	18.9
9	56–60	40	21	61	22.6
10	Above 60 years	34	33	67	24.8
Total		*175*	*95*	*270*	*100.0*

Source: Field work (2018)

In addition, majority of the household heads were males representing 64.8% in contrast to a lower percentage of 35.2% females. The predominance of male-headed households is in agreement with the National Population Commission (NPC) documented household statistics of 2000. The statistics showed that 83% of households in Nigeria are headed by males while females headed only 17%. In addition, a majority of 108 household heads, representing 40.0%, that were engaged in farming, fishing, hunting, forestry, including lumbering, tapping of rubber and palm trees. Other occupations include trading, which employed 94 household heads (34.8%); the civil service that employed 32 household heads (11.9%) and 30 household heads (11.1%) were company workers. Lastly, six households representing 2.2% were unemployed.

The majority of the indigenous populations in these settlements are Christians, who accounted for 71.4%. While 18.3% practise African Traditional Religions (ATR), only 0.3% are Moslems. In addition, 15.5% of the sample population had no form of formal education. While 20.2% and 56.4% had primary and secondary education respectively, 3.8% of the sample had vocational training in motor-cycle and motor repairs, welding, tailoring and hair dressing, only 4.1% had tertiary education.

4.2 Types of solid waste

The various types of solid waste identified in the study area can be classified into two categories; namely, biodegradable and non-degradable materials. Figure 4 indicates the various types of waste identified under each category from the physical examination of waste dumps. The physical examination of the waste was done by delineating a small section (4 m by 4 m) of the dump. Thereafter the sample characterisation of the sample was carried out by the researchers.

Figure 4 Types of solid waste (see online version for colours)

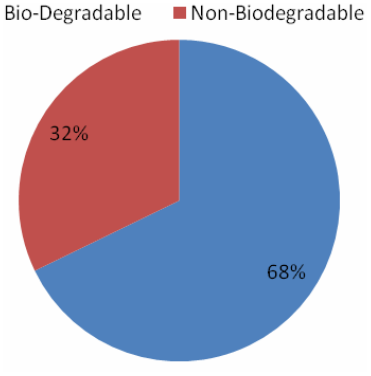
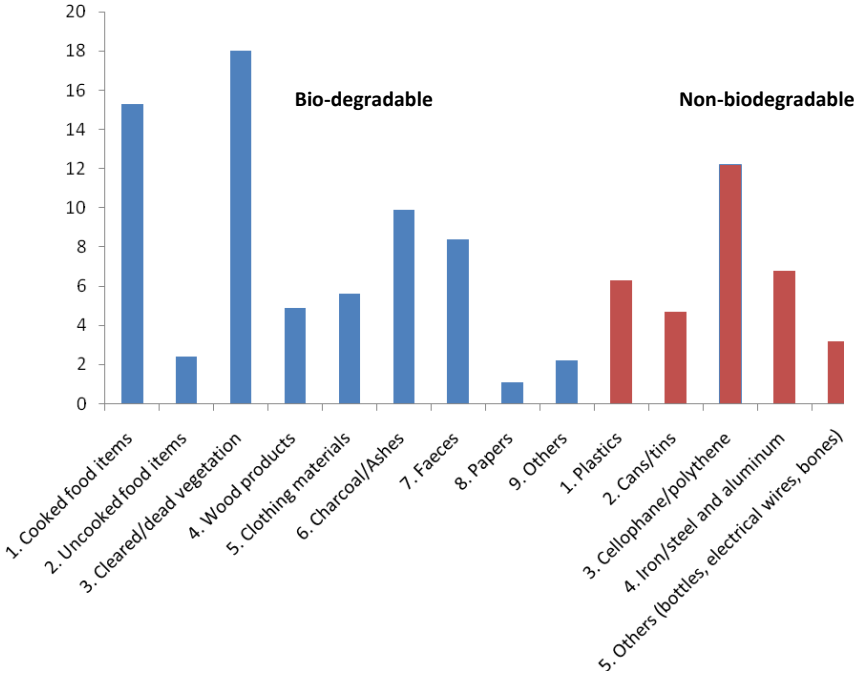


Figure 5 Types of solid waste in study area (see online version for colours)



Source: Field work (2018)

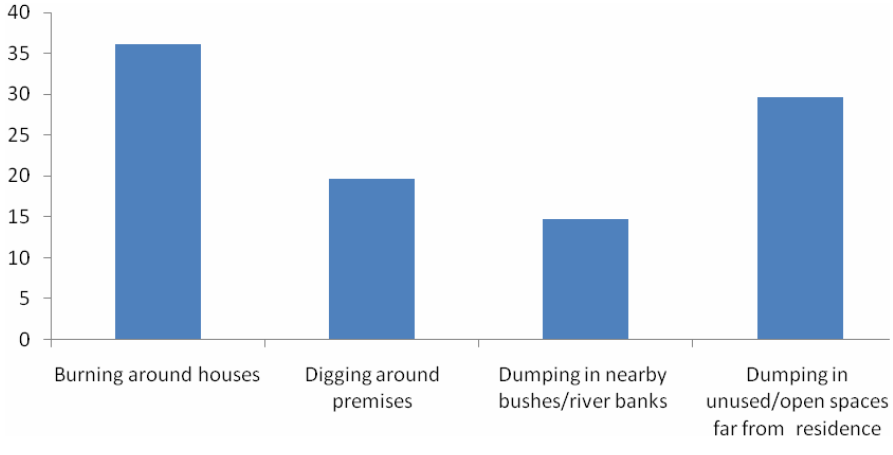
The charts (Figure 4 and Figure 5) reveal that most of the household wastes in the study area are biodegradable. This account for 67.8% of the estimated total waste disposed from households of this percentage, a majority of 18.0% are cleared or dead vegetation, mostly around residence. This is followed by unconsumed or remnants of cooked food items, which account for 15.3%. Charcoal and ashes, bye-product of burning of vegetative matter constitute 9.9% of the waste generated from households. Faeces constitute 8.4% while clothing material constitutes 5.6%. Other types of solid waste generated from households include, uncooked food item (2.4%); papers (1.1%) and other such as dead remains of domestic animals constitute 2.2%.

Another category of solid waste is the non-degradable materials such as plastics, which constitute 6.3% of the total of 32.2% of non-degradable solid waste. Others include cans and tins (4.7%), iron/steel and aluminium wastes (6.8%), and bottles, wires, bones from animals, etc. constitute 3.2%. However, a majority of the non-degradable solid waste generated in the areas compose of cellophane and polythene products. This accounts for 12.2%. This high proportion of this type of waste can be explained by the changing lifestyle of the people.

4.3 Methods of solid waste disposal

Solid waste disposal methods practised in the study area are rudimentary and not technologically driven and therefore unsustainable. With increase in population and variety of solid waste, these traditional methods of waste disposal have become inadequate. This has resulted in the emergence of illegal refuse dumps in unused spaces in the selected settlements. The chart (Figure 6) shows the various methods of solid waste disposal by the population

Figure 6 Methods of solid waste disposal in the study area (see online version for colours)



Source: Field work (2018)

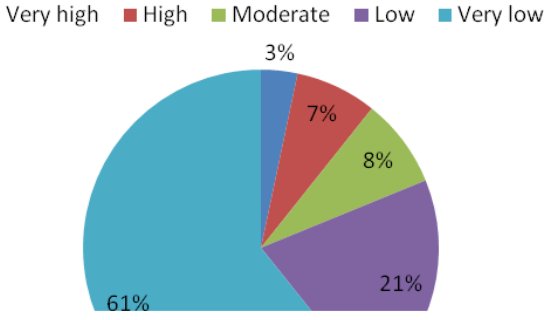
The chart reveals that a majority of 263 households sampled for the study disposed their waste by burning. While 143 households (36.08%) bury waste in pits around their premises, 107 households (14.68%) dump refuse in nearby bushes or rural banks. Waste

is also dumped in unused and open spaces far from residence. This is done by 216 households representing 29.63%. The various ways of disposing waste in the study area have implication for environmental sustainability. For instance, the burning of solid waste around premises debase the aesthetics of the environment and leads to air pollution particularly around residential areas. Furthermore, the practice may lead to the destruction of useable substances in the waste which could have been recycled and put to further use.

4.4 Assessment of community participation in waste management

Community participation in waste management, with particularly reference to proper disposal of solid waste in the rural areas of Delta is carried out mainly by the community youths. In respect of the effectiveness of this function, the opinion of the respondents was sought. Figure 7 shows the responses of household heads to the question on assessment of community participation in waste management.

Figure 7 Assessment of community participation in waste management (see online version for colours)



Source: Field work (2018)

Figure 7 reveals that a majority of 164 respondents or 60.7% are of the opinion that community participation is very low. This is followed by 55 respondents (20.4%) who attested that participation of the community as low. While respondents (3.3%) are of the view that community participation is very high, 20 respondents (7.4%) are of the view that community participation is high. The remaining 22 respondents or 8.1% are of the opinion that community participation is moderate. The high percentage of those who are of the opinion that community participation is low is justified by the presence of heaps of refuse along the main access road leading to the communities and on the bank of the Warri River along which the study area is situated.

Corroborating the opinions of the respondents from the participants of FGDs, it was gathered that the traditional strategy of mobilising the youths in the study area to clear refuse periodically is no longer very effective as most of them have taken up paid employment as a result of urbanisation and do not have the time to obey such traditional calls; hence, the very low level of communal participation in solid waste disposal.

5 Conclusions and recommendation

There is a variety of biodegradable and non-degradable solid waste which is disposed in unsustainable ways in the study area without considering the implication on the environment and health of the people. This is attributable to the increasing population and changing life style of the people as a result of technological development and increased standard of living; reflected in the consumption of manufactured food items as against natural food from the environment. However, with very low level of community involvement in management of solid waste, the emergence of heaps of waste dump in public places would pose a threat to the well-being and health of the population.

Following from the above, this study recommends the planning and establishment of dump sites in strategic and accessible locations in the study area. This would enable the households to move their waste to the nearest dump site. In addition, the statutory waste management agencies such as the Delta State Waste Management Board and the Udu Local Government Council should embark on education of the population on the hazards of unsustainable disposal of solid waste. These waste management agencies should also make provision for the collection and transportation of household waste to the designated dumpsites. The overall objective of community participation in waste collection and disposal is to promote efficient waste management with a view to enhancing sustainable development in the study area. This would also increase the level of community participation in waste management.

References

Agunwamba, J.C. (2003) 'Analysis of scavengers activities and recycling in some cities of Nigeria', *Environmental Management*, Vol. 32, No. 1, pp.116–127.

Akpofure, R. (2009) *Environmental Science: An Introduction*, KraftBooks Limited, Ibadan.

Bakare, W. (2018) *Solid Waste Management in Nigeria*, Bio-energy Consult. [online] http://www.bioenergyconsult.com (accessed 13 May 2019).

Ehrlich, P.R. (1974) *The Population Bomb*, Ballantine Books, New York.

Ehrlich, P.R. and Ehrlich, A.H. (1990) *The Population Explosion*, Simon and Schuster, New York.

Harrison, P. and Pearce, F. (2001) *AAAS Atlas of Population and Environment*, University of California Press, Beckley.

Igben, J.L. (2011) *Petroleum Exploitation and Labour Force Dynamics in Delta State, Nigeria*, PhD thesis, Department of Geography, University of Ibadan, Nigeria.

Igben, J.L. (2014) 'Inland sand dredging and economic activities in the Niger Delta, Nigeria', *Sacha Journal of Environmental Studies*, Vol. 4, No. 1, pp.1–7.

Mbina, A.A. (2015) 'Challenges of urban management in Uyo Metropolis', *Civil and Environmental Research*, Vol. 7, No. 2, pp.196–20.

National Population Commission (NPC) (2000) *Nigeria Demographic and Health Survey 1999*, NPC and ORC/Macro, Calvertin, Maryland.

National Population Commission (NPC) (2006) *Provisional Population Census Report*, Vanguard, Wednesday, 10 January 2007.

Nnaji, C.C. (2015) 'Status of municipal solid waste generation and disposal in Nigeria', *Management of Environmental Quality: An International Journal*, Vol. 26, No. 1, pp.53–71.

Okwesili, J., Ndukwe, C. and Nwuzor, C.I. (2016) 'Urban solid waste management and environmental sustainability', *European Scientific Journal*, Vol. 12, No. 23, pp.155–183, DOI: 10.19044/esj.2016/vl2n23p155.

Uma, K.E., Nwaka, I.D. and Enwere, G. (2013) 'Restructuring urban solid waste management and housing problems for economic development: a case of Nigeria', *Business System Review*, Vol. 2, No. 3, pp.54–68.

United Nations Centre for Human Settlement (UNCHS) (1996) *An Urbanizing World; Global Report on Human Settlement*, Oxford University Press.