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Domestic Solid Waste Management in a Rapidly Growing Nigerian City of Uyo

Imoh E. Ukpong and Emmanuel P. Udofia*

Department of Geography and Regional Planning, University of Uyo, Akwa Ibom State, Nigeria
*E-mail: <imohukpong@yahoo.com>, *<udofiaemman@yahoo.com>*

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ABSTRACT This paper investigated domestic waste management procedures in the fast growing Nigerian city of Uyo. The city of Uyo was demarcated into three Zones A, B and C respectively representing high, medium and low income residential areas. The quantity and classes of waste generated in the city were measured. Using questionnaire, relevant information on waste storage, collection, disposal and re-cycling were obtained. The result showed a marked variation in domestic waste types generated across the three zones reflecting the income levels of the inhabitants. The highest total weights were generated in the middle income zone while the lowest values were reported in the low income zone where waste storage in polythene bags was also common. Daily collection of waste was confirmed in the high income zone whereas waste littering characterized by overfilled receptacles was common in the middle and the low income zones respectively. Waste dumping in drain/gutters was the major feature of zones B and C and because less reusable materials formed a greater part of the waste generated in this zone, the activities of scavengers dropped compared to Zone A where more reusable waste was generated. A number of recommendations were made to help improve domestic waste management in the city. These included, among others, the closure of all waste dump sites without liners and the establishment of sanitary landfills for the city in addition to encouraging both private agencies and informal labour waste collection activities.

INTRODUCTION

The problem of solid waste is a universal one as waste exists in every society. Waste management problems only appear more serious in developing economies because of poor management framework. The quantity and type of waste generated depends upon the function which a city performs, its economic status and the level of technological development.

Initially, solid waste management efforts were directed merely at the removal of waste from the urban centres and the subsequent destruction of such waste. Later, attention shifted to waste utilization, waste reduction, re-use and re-cycling, management of hazardous substances and the prevention of pollution emanating form waste disposal. The advanced economies have developed a very rigorous waste management framework which ensures efficient waste collection, storage, transportation and disposal while minimizing the impacts of disposal on the environment. In addition, there is emphasis on waste sorting, re-cycling and re-use including other practices which help to save waste management costs. This however, is not the case in many developing countries. In Kolkata, India, for example, Chattopadhyaya et al. (2011), have reported a complete absence of segregation of waste at source, limited house-to-house collection and the use of very old vehicles in waste collections. In Pakistan, Al-khatib et al. (2007) found out that although municipal solid waste collection service was available for 98% of the residents, no proper treatment or landfill procedure was adopted for the collected waste in most of the area. Instead, waste burning in open dumpsites was the most common practice due to the inefficient collection of waste disposal fees from residents. Municipalities often suspended the collection service due to reduction in its labour force.

In Nigeria, a major feature of the urban environment, particularly from the beginning of the oil boom in the 1970's was the rapid takeover of cities by all kinds of solid waste. Most state capitals and other large cities are littered with solid waste despite the presence of state and local government-owned waste management agencies including private waste collectors. According to the Federal Environmental Protection Agency (1991), about 20kg of domestic waste is generated per capita per year in Nigeria. Nigerian Environmental Study and Action Team (1991) reported that Nigeria generated over 60% of her waste as leaves and food remnants in the 1960's. With the growth of industries in recent years, polythene and paper of various types have replaced leaves a wrapping and packing material.

Ogwueleka (2009) observed that solid waste management in Nigeria is characterized by inefficient collection methods, insufficient coverage

of the collection system and improper disposal while Babayemi and Dauda (2009) decried the complete lack of efficient and modern technology for the management of waste. To make disposal effective, Ogboi and Okosun (2003) suggested the use of informal labour waste collectors who collect metals, bottles, glassware and plastic materials from refuse dumps for re-cycling and re-use. As population increases and waste composition become more non-biodegradable with high recycling and re-use values, the role of informal waste collectors becomes more necessary in the urban solid waste management scenario.

Nwachukwu (2009) has recommended the privatization of solid waste management systems and adequate funding of agencies responsible for refuse collection and disposal in the Nigerian city of Onitsha.

Uyo, the capital city of Akwa Ibom State, Nigeria (See Fig. 1) is not spared the menace of un-evacuated solid waste. The creation of Akwa Ibom State in 1987 had led to the upgrading of Uyo from a provincial and local government head quarters to a state capital. Since then, the city has experienced a great influx of people accompanied by a high demand for both residential and commercial accommodation. These have resulted in urban environmental problems of which the management of solid waste is clearly the most serious. Many areas of the city have become health risk owing to the accumulation of solid waste.

A close examination of municipal solid waste management in many developing cities including Nigeria shows that the present strategies are deficient and need to be re-addressed. Rapid urbanization in the developing world, if ignored, can be a threat to health, the environment and urban productivity. Cities are known to be engines of economic growth, but the environmental implications of such growth need a proper assessment, particularly in terms of environmental quality.

Schiopu et al. (2007) and Schwarz et al. (2005) have agreed that there is the need to develop, master and implement a simple but reliable tool that will help decision markers in the analysis process. In the same vein, goals and time frames need to be established, duties of national and local governments and industries clarified, in addition to the allocation of funds in order to produce effective waste management framework in both developing and developed countries in the world (Schwarz et al. 2005).

This study investigates domestic waste management practices in Uyo, an emerging city in Nigeria, with a view to determining the types of waste generated, storage, sorting, transportation, disposal and impacts on environmental quality.

METHODOLOGY

The city of Uyo was demarcated into three zones A, B and C representing high, medium and low income residential areas. Using a table of random numbers, four wards were selected in each zone for sampling. The sample size for the study was determined using the formula:

$$n = \frac{N}{1+N(e)^2}$$

Where

n = present population
N = finite population
e = the level of significance (0.05)

The 2010 population of Uyo Capital City was projected from the 2006 National Population Commission (NPC) figure of 356, 964 using the formula:

$$Pt = Pt\,\frac{(1+r)^n}{100}$$

Where:

Po = projected population
Pt = population of the base year
r = rate of growth (2.3)
n = 4 years.

Applying the formula $Po = 356, 964\,\frac{(1 + 2.3)^4}{100}$

gave a projected population of 390, 947 persons for the study area. This value was then substituted in the Yamane formula as:

$$n = \frac{356, 964}{1 + 356, 964\,(0.0025)}$$

This gave the sample size of 400 respondents for the study.

Four hundred people were interviewed from the four wards in the three zones. Questionnaires were use to capture information on:

(i) Waste storage
(ii) Frequency of solid waste collection
(iii) Method of solid waste disposal
(iv) Evidence of waste separation either by individuals, government agents, private agents and informal agents such as scavengers.

To determine the composition of waste by volume/day for every home, a systematic ap-

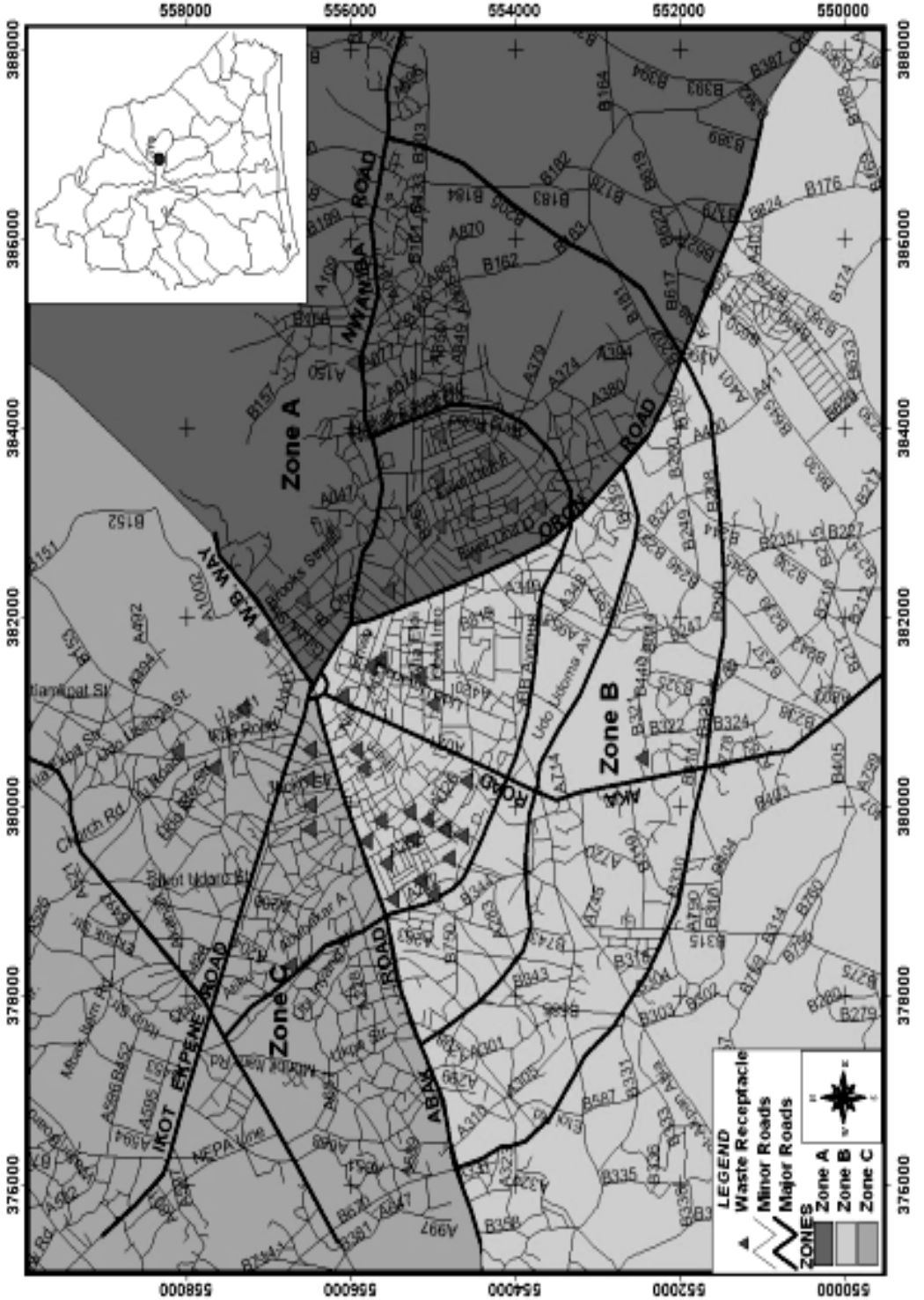

Fig. 1. Uyo capital city showing solid waste receptacle points

Table 1: Volume per weight and classes of domestic solid waste generated in Uyo capital city

	Zone A				*Zone B*				*Zone C*			
	1 (kg)	*2 (kg)*	*3 (kg)*	*4 (kg)*	*1 (kg)*	*2 (kg)*	*3 (kg)*	*4 (kg)*	*1 (kg)*	*2 (kg)*	*3 (kg)*	*4 (kg)*
1 Textiles	1.4	2.1	2.4	1.8	4.5	1.6	2.0	1.6	0.9	1.2	1.1	0.9
2 Vegetables	3.0	1.6	1.9	1.8	2.9	1.8	1.4	1.8	2.6	2.1	2.0	1.9
3 Leather	0.96	0.7	0.7	0.87	0.7	0.7	0.6	0.74	0.4	0.4	0.1	0.20
4 Paper	3.3	3.6	3.1	2.9	4.1	3.7	3.2	2.9	0.4	0.1	0.1	0.19
5 Ceramics	3.92	2.9	1.0	4.9	1.7	2.8	2.9	1.0	0.9	1.3	1.1	0.11
6 Glass/Bottles	3.5	1.9	2.6	2.7	1.7	2.0	1.1	1.4	1.8	2.00	1.9	2.00
7 Food/Remnants	4.9	3.4	2.5	2.8	1.6	2.8	1.9	1.5	1.1	2.0	1.2	1.23
8 Plastic/Polythene	0.6	0.9	0.9	0.7	0.6	0.8	0.7	0.8	3.8	1.6	2.1	2.9
9 Metals/Cans	5.4	4.2	4.9	5.0	4.2	3.9	5.4	4.0	1.3	0.9	2.1	1.4
Total	22.12	21.3	20.0	25.3	22.0	20.1	19.2	15.4	13.0	12.0	11.7	10.8

proach was adopted with households sampled at intervals of five along the streets. At each sampling point, five baskets were placed in the morning and emptied in the evening. Wastes obtained were then sorted into different classes and weighed using a Griffin and George spring balance. The duration of sampling was two weeks in each sampling zone. The total weight of the waste streams was obtained by simple addition of all weights in the study areas.

Information related to personnel, number and state of vehicle, funding, and involvement or otherwise in waste recycling activities, type of equipment and waste generation data were obtained directly from the authorities of Uyo Municipal Waste Management Agency.

RESULTS

Table 1 shows classes of waste and their weight in Uyo Capital City. In the three zones, vegetables, metals/can and glass form the bulk of the waste generated. In Zone A, metals/can, paper and plastic are dominant. In Zone B textiles, paper and metal/cans are dominant while in Zone C vegetables, metals/cans, plastic and ceramics are most common. The variation in waste is apparently a reflection of the income levels. For example glass, food remnants, ceramics and metal /can predominate in Zone A. These are waste items often associated with affluence in Nigeria. Commercial waste, for example, paper and metal/can vegetable dominate in Zone B which is a commercial zone of the town containing several offices and a central market. Zone C is a low income zone with less of food remnants and the dominance of polythene products. The highest total weights are found in the commercial Zone (B) while the lowest values occur in the low income zone (C).

Table 2 shows that waste storage in plastic and paper bags is most common in the low income area (Zone C) with 71.4% and less popular in the high income area. Waste storage in wheeled dustbins is the common practice in Zone A with 53.7% while waste storage in galvanized dustbins predominates among residents of Zone B.

From Table 3, 69% of the residence of Zone A confirmed daily collection of waste. This dropped to only 11% in Zone C. Only 16.6% of the respondent in Zone A acknowledged weekly collection of waste although this increased to 36% in Zone C. About 20.3% of the inhabitants of Zone C reported twice weekly collection of waste while 10% reported in Zone A. In Zone B, 21% had irregular waste collection while only 5% experienced such in Zone A. Waste littering is most common in zones A and B, characterized by overfilled receptacles. About 15.7% of the respondents in Zone C were not sure of the frequency of waste collection in their zone.

Table 2: Response on domestic waste storage

	Zone A	*Percentage*	*Zone B*	*Percentage*	*Zone C*	*Percentage*
Plastic/Paper bags	26	19.4	78	58.7	95	71.4
Galvanized dustbins	36	26.9	45	33.8	34	25.6
Wheeled dustbins	72	53.7	10	7.5	4	3.0
Total	134	100.0	133	100.0	133	100.0

Table 3: Response on frequency of domestic solid waste collection

S.No.	*Location*	*Zone A*	*Percentage*	*Zone B*	*Percentage*	*Zone C*	*Percentage*
1	Daily	92	69.0	48	36.0	15	11.0
2	Weekly	22	16.0	21	16.0	48	36.0
3	Twice Weekly	10	7.5	23	17.0	27	20.3
4	Irregular	5	3.7	28	21.0	22	16.0
5	Non-response	5	3.7	13	9.8	21	15.7
	Total	134	99.9	134	99.8	193	100.0

Table 4 shows that open burning of waste was most popular in Zone C with 18.8% of the respondents involved but less so in Zone A and B where there are few open spaces. As expected, open dumping was reported more in the same Zone C with 24% of the respondents involved. This is a Zone of inefficient waste collection with pockets of surrounding bushes and underdeveloped plots. Dumping of waste in drains/gutters was also reported in the two zones with 15% for Zone B and 13.5% foe Zone C. The wide and inviting open drainage channels in Zone B seems to encourage this practice in this zone. As evidenced in Table 5, respondents across the three zones reported the absence of waste separation at source. They also indicated that neither government nor any organized private sector was involved in waste sorting. However, waste sorting at dump sites by scavengers is reported across the three zones. These scavengers are more regular in Zone A with 75%, followed by Zone B with 58.6%. Their involvement in waste sorting, however, dropped to 37.6% in Zone C. The reason is that more re-useable waste is generated in the high income zones of A and B. Scavengers were noticed in all the Zones.

DISCUSSION

The management of domestic solid waste in Uyo as evident from this study indicates some major problems. There is a general paucity of data on key waste variables such as generation rates, composition, densities, storage and transportation. Availability of accurate information on these attributes is a prerequisite for effective waste management in any environment. There is also a lack of specialized waste collection and disposal vehicles such as till trucks for conveying waste to disposal sites. Wastes are rather conveyed using inappropriate vehicles such as sand tippers and trailer trucks. In fact, on investigation, it was discovered that the waste management unit of the state as a whole has only one functional waste truck in its inventory. It has no monitoring vehicle, no bulldozer nor grader. This does not only make waste collection and disposal very ineffective but goes to betray the complete apathy on the part of the city administrators towards waste management.

Another serious problem is the lack of standard refuse bins for the collection of domestic waste. This makes is somewhat difficult to esti-

Table 4: Response on method of solid waste disposal

S. No.	*Location*	*Zone A*	*Percentage*	*Zone B*	*Percentage*	*Zone C*	*Percentage*
1	Open burning	06	4.4	04	3.0	25	18.8
2	Open dumping	10	7.0	30	22.6	32	24.0
3	Dumping in drains	01	0.7	20	15.0	18	13.5
4	Dumping in receptacles	117	88	79	59.4	58	43.6
	Total	134	100.1	133	100.0	133	99.9

Table 5: Evidence of waste separation

S. No.	*Agency*	*Zone A*	*Percentage*	*Zone B*	*Percentage*	*Zone C*	*Percentage*
1	At point of collection	00	0	00	00	00	0
2	Government involvement	00	0	00	00	00	0
3	Private involvement	00	0	00	00	00	0
4	Scavengers (regular)	100	75	78	58.6	50	37.6
5	Scavengers (irregular)	33	25	55	41.4	83	62.4
6	Scavengers (non-existent)	00	00	00	00	00	00
	Total	134	100	133	100.0	133	100.0

mate the waste generated in the city. Also, waste collection is so irregular and in-frequent those refuse bins at the receptacle points spill over for weeks, particularly in Zone C, before they are emptied. evacuated.

The issue of technical and administrative manpower is very crucial yet this is grossly lacking in Uyo. The city's waste management unit is composed mainly of inexperienced staff with very little or no formal training whatsoever in waste handling issues.

The enforcement of environmental standards and the persecution of defaulters are made difficult because of the non-enforcement of the existing comprehensive legal framework provided in the Akwa Ibom State (2000) for dealing with the problem. Many residents, for instance, dump their waste directly into the urban drainage system and walk away unpunished. Also, the complete lack of waste recycling and reuse arrangements either by government or private agencies indicates clearly that a greater part of still useful materials like paper, plastic and polythene, bottles and metals are being thrown away. The State waste management unit has since inception suffered from poor funding, lack of motivation and incentives in the form of allowances to staff who face all sorts of hazards in the collection, transportation as well as disposal of waste generated in the city.

There is a conflict of interest of all the bodies involved-Uyo Local Government Council, Uyo Capital City Development Authority, Akwa Ibom State Ministry of Environment and Akwa Ibom State Ministry of Lands respectively. The duties of these bodies in effecting a sustainable solid waste management in the city seem not to be properly defined. This has resulted in poor coordination of management efforts. Considering the rising quantity of waste as the city population continues to grow, there is an urgent need for a waste management policy in Uyo Capital City.

CONCLUSION

Due to rapid urbanization in Uyo, waste management has become a major problem. Often, previous unguided development and ineffective solid waste management programme had resulted in environmental degradation, with serious health implications. An environmental management plan with clearly defined objectives needs to be articulated into one holistic approach aimed to achieve a cleaner urban area. This means that greater investment should be made in the area of refuse storage, sorting, collection and disposal. Greater awareness of the need for cleaner environment is needed among the urban population since it will reduce indiscriminate disposal. It is believed that the involvement of both government and private agencies and even individuals in waste sorting at the source will go a long way in helping the recovery of reusable materials from domestic waste in the study area.

RECOMMENDATIONS

The following recommendations flow from this study:

(i) Establishing Data Base of Waste Generation in the City: This is necessary for the proper planning of waste collection and disposal and in deciding the type and capacity of waste management equipment to procure. Analysis of spatial data such as transport network, collection network, distribution of receptacles and population distribution along with information related to quantity and quality of waste generated will enable waste management authorities to properly plan their waste management strategies on fact rather than on assumption.

(ii) Monitoring and Enforcement of Existing Legal Framework: The purpose of the monitoring units is to enforce the laws pro-mulgated in AKS (2000) so as to prevent disposal of domestic waste into city drains and ensure efficient waste management practice.

(iii) Manpower Training, Development and Improved Funding: This is a prominent issue in any establishment. Training of manpower will ensure that the city's waste management system is entrusted to able hands who are capable of running it according to international standards.

(iv) Improve Funding of Waste Management Unit and Provision of Appropriate Waste Collection and Disposal Equipment: Manpower training without improved funding would amount to nothing since it is improved funding that will enable the unit to procure the right equipment such as till trucks, towing locomotives, machine com-

pactors, crawler dozen, tracked mechanical shovels, mechanical excavators etc.

(v) *Encouragement of Waste Re-cycling and Re-use:* Resource recovery from solid waste management has become an important method of solid waste management. It involves the recovery of waste such as plastic, metals, glass, paper etc. These are then washed and sold to scrap dealers or primary manufacturers. Establishing more collection receptacles and regular waste collection. At present, the number of receptacles provided are grossly inadequate and even then, they are not emptied until the waste has completely spilled over them becoming a hazard as a result of the stench they produced. Private agencies need to be encouraged to participate both in reusable waste recovery and in general waste management efforts.

(vi) *Discourage the Construction of Open Drains in the City:* Constructing open drains in cities have become completely outdated and should be totally discouraged. In a city like Uyo, the open drains provide an easy dumping opportunity for city dwellers, a practice which results in the blocking of these drains. This would not be possible where drains are covered.

(vii) *Provision of Sanitary Landfill Facilities:* For a proper deposition of solid waste in a fast growing city such as Uyo, a sanitary landfill is unavoidable. This is because it minimizes pests, disease, air pollution, ground and surface waste pollution in addition to improving aesthetic values. Sanitary landfills truly offer a final resting place for solid waste unlike incineration which results in residue and fly ash, which must eventually be disposed off.

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