

Challenges of urban waste management in Uyo Metropolis, Nigeria

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Abstract

Waste generation is an integral aspect of human existence that is unavoidable. It is a product of resource use process that has the capacity to be inconveniencing and harmful leading in extreme cases to pollution with resultant epidemics and catastrophic consequences. Therefore, waste generated through human activities need to be properly managed through concrete efforts, to maintain a healthy and sustainable environment. The purpose of this research is to examine the challenges of waste generation, management, collection and disposal mechanism in Uyo, capital of Akwa Ibom State, Nigeria. Data collection was carried out through a field survey using personal observations, structured interviews and questionnaire administration. Findings revealed that about 30,350 metric tons of Municipal Solid Waste, (MSW), is generated per day in Uyo urban centre. The study further shows that inadequate equipment coupled with understaffing at the State Ministry of Environment and Mineral Resources engender accumulation of waste in several parts of the town. The results of this study will hopefully generate recommendations for sustainable waste management development in Uyo.

Keywords: waste generation. waste collection. waste disposal. waste management. biodegradable.

1.0 Introduction

Waste generation is one of the earliest activities attributable to human beings and a significant part of anthropological and archaeological documentation of past civilizations. The term waste is used to denote any item or object that is no longer suitable for use in the owner's or user's consideration. Waste can be products or by-products of certain processes or remnants of useful items that are considered as no longer useful. It is therefore not possible for human beings to live without generating waste as they engage in diverse activities that naturally result in waste generation. Once waste is generated, it has to be collected and disposed or recycled in order to prevent it from constituting nuisance, health problems to humans and wildlife, environmental pollution or other forms of inconveniences. Waste generation and its disposal and management is a paramount issue in sustainability of the built environment and the future of the planet; particularly as the complex components create greater environmental pollutions and make waste disposal and management more difficult (Jatau, 2013).

Waste comes in three broad forms of solid, liquid and gaseous waste. Solid waste which consists of refuse, garbage, rubbish, dead animals, construction wastes, etc., may either be biodegradable or non – biodegradable, combustible or non – combustible. Examples of solid wastes are; broken glasses, plastics, metals, broken blocks, food remnants, papers, wood, cloth, etc. (Adewale and Litherland, 2011). Solid wastes from households, commercial and industrial sources are called Municipal Solid Waste (MSW), and they are generally disposed of in landfills (Environmental Protection Department, 2011).

Liquid waste which can be discharged from any of various processes which may be industrial, mining, commercial, agricultural, medical and domestic in nature are also known as effluent. Examples are; sludge and chemical effluents from industries, waste oil from workshops, acid waste, waste water from fisheries, sewage, etc. (Eseigbe, Omofomwan, 2007 and Airgbede and Yusuf, 2010). Gaseous wastes are substances carried in air which move without inhibition into any available space and may or may not be coloured. They can be in the form of vehicle exhaust, cooking smoke, cigarette or cigarette smoke, asbestos dust, discharge from factory chimneys or stacks, gas flaring, etc. (Eseigbe, 2007 and Answers.com, 2011).

Biodegradable waste items will disintegrate with the passage of time even when left on their own (see Table 1), but, apart from creating health hazards, the rate of disintegration may be too slow for the rate of generation thereby making the environment aesthetically unappealing. Owing to the multidimensional nature of waste and its attendant negative effects on humans, wildlife and the environment, its management is highly crucial and requires concerted effort.

Waste management practices which essentially covers the collection, conveyance, processing, recycling and disposal of waste items is approached in different ways by different communities all with the same goal of maintaining sustainable environment conducive for healthy human and wildlife habitation. Generally, governments are responsible for the management of non – hazardous residential and institutional waste while, commercial and industrial wastes are managed by their producers under government supervision. The practice of

waste management is different from country to country depending on whether they are developing or developed, it is also different in areas depending on whether they are urban or rural so is it different concerning the source depending on whether they are residential, industrial or commercial. (Adewale, 2011, Andrew, 2011, Fagbohun and Oke, 2011 and Wikipedia 2011).

Presently, waste generation and management in Uyo are haphazardly carried out with no clear responsibility pattern between government and waste generators. This paper attempts to examine the management challenges associated with waste in Uyo. Effort was also made to appraise the level of participation of government vis – a-vis the generators. Government participation in waste management is not vibrant hence; the objectives of the study are;

- (i) To determine the institutional challenges associated with waste management and
- (ii) To determine the socio – cultural challenges associated with waste management in Uyo

It was discovered that gaseous wastes are not of significant consequences as there are no industries producing them in large quantities in the town, same goes for liquid waste which comes largely in the form of domestic liquid waste that is drained into septic tanks, soak away pits and drainages. Consequently, the study will focus on Municipal Solid Waste Management (MSWM).

Table 1: Rate of Degeneration of Waste Items

Type of Waste	Time Needed to Degenerate, if left Untreated
Organic wastes (vegetable, fruit, food, etc)	7 – 15 days
Paper	10 – 30 days
Cotton cloth	2 – 5 months
Woolen cloth	12 months
Tin, aluminium and other metal cans	200 500 years
Plastics	100 – 1000 + years
Glass	Not determined

Source: Global Development Research Centre, 2013

2.0 Conceptual framework

Standard of living, economy, climate and cultural disposition are strong determinants of household waste generation. Everett (2011) states that United States has the highest waste generation rate of 2.0 kg/person/day while Europe and developing regions of the world have 0.9 – 1.70kg/person/day and 0.3 – 1kg/person/day respectively. This waste must be collected and disposed for the environment to be safe for human occupation.

2.1 Solid Waste Collection

The whole process of waste management commences with waste sorting and collection. Litherland (2011) explains that, there is need to appropriately sort out waste into recyclables and non – recyclables using different collection materials as this will make disposal easy on account of the fact that, in some places the disposal process is separated along that line. He further posited that, in the collection process, varied waste receptacle options such as individual household trash bins, communal trash bins for apartment complexes, county recycling containers, etc., are available for use in the collection of solid waste. Waste collectors can then go from house to house or community to community to pick up these items of waste. These waste collectors can be private or public sector driven, but their activities must be properly regulated as illegal waste collection companies that do not have appropriate equipment like tippers (see plate 1.1), trucks and protective clothing for staff, can emerge with such consequences as indiscriminate dumping of waste resulting in danger to humans and the environment (Banda, 2011).



Plate 1.1: Waste Dump and Collection Method

The timely collection of waste is highly crucial in order to prevent accumulation and its attendant consequences of environmental degradation, possibility of epidemic outbreaks with devastating consequences, ground water contamination, odour and distortion of aesthetic quality of the environment. When the rate of collection of waste does not exceed or at least, match the rate of generation, facilities are over – stretched with resultant negative effects such as neighbourhood air pollution, occasioned by illegal burning, etc. Omuta (2005) asserts that, the real problem with solid waste is not the rate of generation but the rate of evacuation as the difference between them is a measure of the degree of effectiveness of solid waste management.

2.2 Solid Waste Disposal

The apparent end of the waste management system is disposal which can be carried out through any of the following methods; landfill, composting, thermal treatment and recycling. The common practice of waste disposal in most countries is land filling which entails waste burial. Land filling method of waste disposal is in two forms of sanitary land filling and composting, which are the permanent means of disposal as other means just basically reduce the volume of waste. Biodegradable wastes which constitute the largest group of waste are most suitable for landfills. In the sanitary landfill, waste is compacted in layers of about 3 meters with the aid of earth moving equipment and covered with a thin layer of soil which is also compacted before another layer of waste is brought.

Another method of waste disposal is thermal treatment which involves the application of heat. The two most common forms of this method are incineration and pyrolysis. In incineration, which can be on a small scale, the application of combustion is employed as waste items are burnt converting them into heat, gas, steam and ash. In pyrolysis which is also known as destructive distillation, solid waste is decomposed by chemical means through the application of heat in an atmosphere with reduced oxygen content to produce a gas stream basically of hydrogen, methane, carbon monoxide, carbon dioxide, and various other gases and inert ash, determined by the organic characteristics of the waste constituents. The use of this method is, however, controversial due to issues such as emission of gaseous pollutants (Huang, 2009 and, 2011).

Recycling is an age - old process which involves the recovery of reusable item from waste and consists of different forms with increasing number through continued development. In recycling, raw materials may be extracted or calorific content may be converted to electricity. Some of the recycling methods available today are shredding, magnetic separation of metals, air classification that separates light and heavy fractions, screening, and washing, and wet pulping.

3.0 The study area

Uyo Local Government Area was developed as an administrative centre between 1900 and 1906, with Mr. R. B. Brooks as the first Assistant District Commissioner (Assistant District Officer). Its core area included Akpayak, Ikot Afia, Nung Uyo, Aka and Oku. Uyo was not given the status of an urban centre until 1919 when it was upgraded to a third class township with a prescribed coverage of 16 square kilometers (Ema, 1989) and included the township areas of Ikot Oku, Ikot Ntuen Oku, Ewet, Anua, Ibiaku Offot, Adaha Eyop, Iboko and the present Four Towns. When the Local Government Ordinance of 1950 which created counties, districts and local councils in the country became operational, Uyo became the Headquarters of Uyo County Council. Uyo is located between latitudes 4° 53' and 5° 04' north of the equator and longitudes 7° 48' and 8° 02' East of the Greenwich Meridian. The estimated population of Uyo based on 2006 population census is 273,000.

Uyo city acts as both a State and Local Government Headquarters. The study area is located within Uyo Capital City Development Authority (UCCDA) as shown on fig. 1 (map of Uyo).

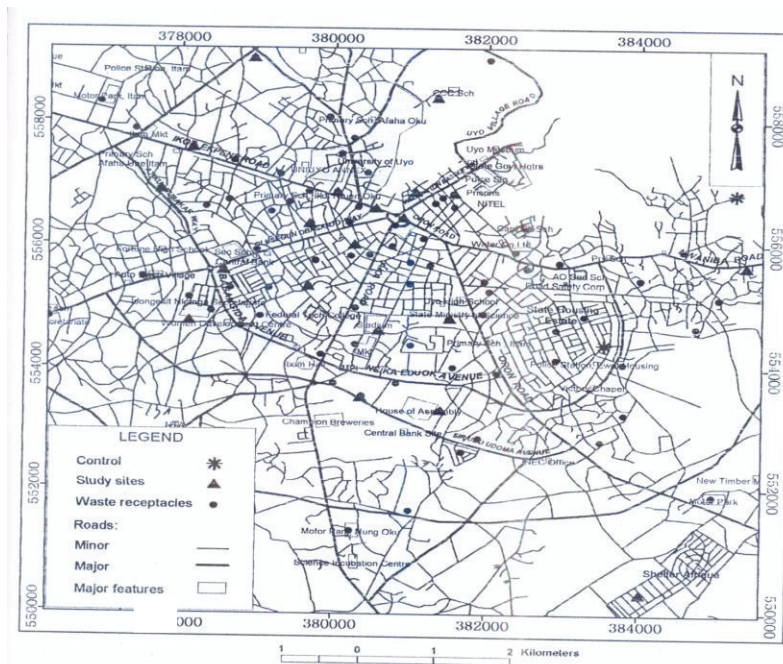


Fig. 1.1: Locations of waste receptacles and the sample sites on the map of Uyo Municipality

The study area is gradually acquiring the attributes of a cosmopolitan city and has witnessed a rapidly increasing influx of strangers, especially since the advent of the present civilian dispensation. In essence, although the study area was originally homogeneous in socio- cultural attributes and inhabited by the indigenous Ibibio ethnic stock, the area has gradually transformed into an ethno-multilingual population with a growing influx of other Akwa Ibom ethnic groups, Igbos, Hausas, Yorubas, etc. Nevertheless, the Ibibio indigenous stock constitutes more than 80% of the population (Ukpong, Akpan and Akang, 2001).

4.0 Methodology

The primary data for this study was obtained from two sources namely; non – participant observation techniques with application of structured interviews for institutional challenges and administration of questionnaires to respondents for socio – cultural challenges. The multi-stage sampling technique was adopted for the study.

4.1 Sample Population

The first stage involved the determination of all the locations of solid waste receptacles in Uyo municipality numbering 100, within the study area as shown on the map. Names of the 100 locations are given on Table 2.0.

Table 2.0. Alphabetical Arrangement of the Locations of Solid Waste Receptacles in Uyo Municipality and Sampling Points.

1. Afaha Ube Primary School Road	38. House of Assembly Road	75. Osonga Ama Road
2. Aka Ida Eyop	39. IBB way	76. Paul Bassey
3. Aka Road by Nepa Line	40. Ibiam Street	77. Peter Ubo Street
4. Aka Road by Crunches	41. Iboko By Ikot Ekpene Road	78. Power City
5. Aka Nung Udoes Road	42. Iboko Street	79. Primary School Mbiabong Anyanya
6. Aka Road Junction	43. Ibom Connection 1	80. Qua Iboe Church Itam
7. AKBC by Udoudoma	44. Ibom Connection 11	81. Ring Road 111
8. Akpakpan Street	45. Idongesit Nkanga Secretariat 1	82. Sanlaw Road
9. Akpan Essien Lane	46. Idongesit Nkanga Secretariat 11	83. Shelter Afrique
10. Akpan Essien Street	47. Ikot Abasi by Obio Imo Street	84. Udi Street
11. Akwa Ima Estate	48. Ikot Ebido Street	85. Udo Edoyk
12. Apico House	49. Ikot Ekpuk Road	86. Udo Obot
13. Atakpo Street	50. Ikpa Road by Ekpanya Street	87. Udotung Ubo Street
14. Atiku Abubakar	51. Ikpa Road Junction	88. Udo Udoma Avenue
15. Ben Udo Street	52. Ita Oboho Street	89. Udo Umana by Akpan Andem
16. Behind Oceanic Bank	53. Itiam Street	90. Udo Umana Street
17. By 149 Ikot Ekpene Road	54. Jobbina Station	91. Udo Usoro Street
18. By Ekpanya Street	55. Johnson Street	92. Udoh by Ebong Street
19. By Akpan Essien Street	56. Labour	93. Ukana Offot
20. By 58 Ikot Ekpene Road	57. Mbeng	94. University of Uyo Teaching Hospital
21. By Mobil Filling Station	58. Mkpung Street	95. Urua Ekpa Junction
22. Calabar Itu Road by Itam Market	59. Ndiya Street	96. Uruan Street
23. Copper Lodge	60. NEPA line by Itiam	97. Uruan Street Junction
24. Effiong Ukpong	61. NEPA line by Nkemba Lane	98. Use Offot Market
25. Etuk Street	62. NEPA line by Okon Essien	99. Utang Street
26. Esuene by IBB Way	63. New Birth Bible Church	100. Uyo Village Road
27. Ekpenyong Street	64. New Park Road by New Park	
28. Enwe Street	65. New Road by Calabar Itu Road	
29. Edem Akai Street	66. New Road by Primary School	
30. Ewet Housing Estate	67. Nkemba Street	
31. Edet Akpan Avenue	68. Noah Udo Street	
32. Ewet Street	69. Nsikak Edouk Avenue	
33. Ernest Bassey Street	70. Nwaniba by Jehovah Witness	
34. Federal Housing Estate 1	71. Nyong Essien	
35. Federal Housing Estate 11	72. Obio Imo by Stadium	
36. Gibbs Street	73. Old Park	
37. Graceland School Road	74. Osonga Ama Housing Estate	

Source: Extracted from Figure 1, (Map of Uyo Municipality)

Table 3.0. Sampling Points and Their Codes

Code	Sample point
WM1	By 58 Ikot Ekpene Road
WM2	Osongama Housing Estate
WM3	University of Uyo Teaching Hospital
WM4	Calabar Itu Road By Itam Market
WM5	Ukana Offot
WM6	Ikot Ekpuk Road
WM7	Ibom Connection 11
WM8	Behind Oceanic Bank
WM9	Aka Road by Crunches
WM10	Ewet Street
WM11	Aka Road by NEPA Line
WM12	Ewet Housing C1
WM13	Ekpri Nsukara C11
WM14	NEPA Line by Okon Essien
WM15	NEPA Line by Nkemba Lane
WM16	Udoudoma by Akpan Andem Market
WM17	Afaha Ube Primary School; Road
WM18	Ekpenyong Street
WM19	Ikot Ebido Street
WM20	Akpakpan Street
WM21	Urua Ekpa junction
WM22	Graceland School Road

4.2 Sample and Sample Technique

The Table of random numbers was used to randomly pick 20% of the streets (that is, 20 streets) and computed as WMI to WM20 (the desired sample size) with two control areas labeled as C1 and C11 (Table 3.0). This sample size is a true representation of 100 as stipulated by Stephens, (1996) and Kamisaka, (1998), which can be used to arrive at a fairly accurate statistical result.

The last stage comprised of the systematic administration of questionnaires to respondents in stratified area of the selected locations. A total of 120 questionnaires were given out, 103 were returned, representing 75% return. These were subsequently used for analysis by applying descriptive statistics tools such as mean frequency, percentages and averages. Further relevant data and information relating to the study were obtained from secondary sources. The variables considered in the course of this study were; for institutional challenges; capacity, resources and public attitude and socio – cultural challenges; awareness of the fact that some waste items can be recycled, those who should dispose of waste, how comfortable respondents were to dispose of waste, opinion on accumulation of waste, frequency of waste disposal and willingness to pay for waste disposal services.

Data on solid waste management strategy were collected through field survey and official records of government from the Ministry of Environment and Mineral Resources through the waste management unit. These data, which constituted the independent variables, include: streets, equipment, waste volume, evacuation rate and receptacles.

5.0 Assessment of solid waste management strategies in Uyo Municipality

The management of solid waste in Uyo is the sole responsibility of the State Ministry of Environment and Mineral Resources. The waste management unit is located at Nung Ukot Itam near Itam Motor Park. Solid waste evacuation team in Uyo municipality is made up of a vehicle, driver and three male casual workers known as evacuators. The total number of staff in the unit is 90 workers, made up of 10 office staff, 20 drivers and 60 evacuators. The management strategy includes the partitioning of the total area of Uyo municipality into twenty two (22) zones for the purpose of waste disposal. In each of the zones, at least one compactor truck and one tipper are assigned for effective evacuation of waste. The dumpsite, which is at the end of Wellington Bassey Street, is located right inside the old stadium via Udo Street or behind the University of Uyo. A caterpillar is placed there to push the waste right into the valley bottom. A recent survey shows that waste categorization is as presented in Table 4.0.

Table 4.0 Types of Solid Waste in Uyo Municipality

Type of waste	Percentage	Core sources
Food remnants/vegetable matter	56.30	Markets, households, hotels/hostels
Cans, Scrap metals	11.40	Mechanic village/workshop, building/construction sites Hotels, Champion breweries
Bottles/glasses	3.70	Schools, housing estates and super markets
Plastics and polythene materials	12.80	Schools, government establishments, Hospitals, clinics -
Wood, carton, paper	7.20	
Medical waste	0.60	
Others, not specified	8.00	

Source: FMEnv, Uyo (2013).

The bulk of solid waste generated are mainly biodegradable (food remnants and vegetable matter, either generated from households or rotten vegetable matter) from markets, roadside food canteens/restaurants or hotels. Worthy of note is the large quantity of plastic and polythene bags (12.80%). This trend is the way goods are packaged by supermarkets, traders etc. In Uyo municipality, the aggregate flow of waste material from generation to treatment and final disposal (waste stream) consists of waste collection from households, banks, markets, schools, government establishments etc. into receptacles at strategically located and accessible points; waste disposal by compactors and tippers and final dumping at the Wellington Bassey Street end by Udo Street, right into the ravine.

A recent study by the Federal Ministry of Environment shows that about 30,327 tonnes of solid waste was generated in Uyo in 2013. The data on solid waste evacuation from the study area shows that in September, 2013, the different zones were covered as presented in Table 5.0.

TABLE 5.0. Analysis of Solid Waste Evacuation in Uyo Municipally for the Month of September, 2012.

Route	No of streets X1	No of Tippers/Compactors X2	No of Receptacles X3	Quantity of Waste evacuated per day in tones X4	Frequency of evacuation X5
1	10	5	60	120	5
2	9	5	58	116	4
3	8	3	56	112	2
4	9	5	59	118	3
5	9	5	58	116	4
6	6	3	50	100	5
7	8	5	60	120	3
8	9	3	58	116	4
9	8	3	54	108	2
10	8	5	56	112	4
11	8	3	52	104	3
12(ctr1)	10	5	60	120	5
)	8	3	56	112	2
13(ctr2)	9	5	59	118	4
14	9	3	58	116	3
15	6	5	50	100	5
16	10	3	60	120	4
17	10	3	59	118	4
18	8	5	56	112	3
19	9	3	58	116	4
20	10	5	60	120	5
21	9	5	59	118	4
22					

Key of Frequency scores:

5= Twice a week evacuation

- 4= Once a week evacuation
- 3= Once in two weeks evacuation
- 2= Once in a month evacuation
- 1= No evacuation

The respondent of the survey on socio – cultural challenges consisted of 45.63% males and 54.37% females (see Table 6.0). 33.98% of them were graduates, 57.28% were NCE/OND/Secondary School Leavers/ Grade II Certificate holders, 7.77% had primary school education while 0.97% had no formal education (see Table 7.0). Furthermore, 33.98% were traders, 21.36% were technicians, 4.85% were professionals, 33.98% were civil servants and 5.83% were housewives (see Table 8.0).

Table 6. 0 Gender Distributions of Respondents

Gender	Frequency	Percent
Male	47	45.63
Female	56	54.37
Total	103	100.00

Source: Author’s Survey, 2013

Table 7.0 Educational Qualifications of Respondents

Qualification	Frequency	Percent
Graduate	35	33.98
NCE/SSC/Grade II	59	57.28
Primary Education	8	7.77
No formal Educ.	1	0.97
Total	103	100.00

Source: Author’s Survey, 2013

Table 8.0 Occupation of Respondents

Occupation	Frequency	Percent
Trader	35	33.98
Technician	22	21.36
Professional	5	4.85
Civil Servant	35	33.98
Housewife	6	5.83
Total	103	100.00

Source: Author’s Survey, 2013

The result of the analysis of the data indicated that a little more than half of the respondents were females while the rest were males. 99.03% of the respondents had at least primary education, which means that majority of them had a clear understanding of the questionnaire and required little or no help to respond appropriately.

6.0 Discussion

Institutional Challenges

This study revealed that the Ministry of Environment and Mineral Resources is equipped with twelve 10 tone tippers, three 50 tone compactor trucks are always employed for evacuating solid waste on different schedules. The number of streets in each of the 22 routes was counted through field survey and data from the waste management unit office at Nung Ukot Itam. Waste Volume was measured from the quantity of waste evacuated per day in tones. Evacuation rate was measured based on the frequency of solid waste evacuation in the 22 routes. The calculation of the number of receptacles was made by survey on the number of streets in the different routes.

Many residents also dump waste into flowing rain water and when rain is over, waste is seen on roads and other spaces in most parts of the town. In some traditional parts of town, house had been built without planning which has created problems of location for municipal services facilities such as waste dump sites. The belief that rain water washes away all dirt thrown into it is a serious problem, as the Ministry is saddled with the burden of avoidable additional work of clearing waste from the roads and drainages in the rainy season.

Socio – cultural Challenges

The survey revealed that 49.51% of the respondents were not aware that some waste items can be recycled, while 50.49% were aware. However, none of these respondents separate their waste into recyclable and non-

recyclable and non-recyclable items. Educating Uyo residents on the gains that can accrue from the separation of waste into recyclable and non-recyclable items can yield beneficial results to the waste generators. Human scavengers foraging through dump sites in search of recyclable waste items such as unbroken bottles, aluminum, steel, etc. that can be sold for money are a common sight in the town.

On how comfortable the respondents were to dispose of waste, 3.88% claimed to be comfortable, 80.54% claim to be uncomfortable and 15.54% claimed to be indifferent. Responses to opinion on accumulation of waste on streets or neighbourhoods showed that 91.26% considered it to be very bad, 7.77% considered it to be bad while a minute 0.97% expressed indifference. Although a large proportion of the respondents felt uncomfortable to collect and dispose of waste, accumulation of waste on the streets was generally considered as very bad.

Responses to frequency of waste disposal by respondents revealed that 20.38% dispose of their waste daily, 38.83% do every other day, another 38.83% do weekly, while 1.96% do so monthly. This indicated that frequency of collection and disposal of waste by the respondents ranged from daily to every other day to weekly and to monthly with every other day ranking highest.

Willingness to pay for waste disposal services by the respondents recorded 58.25%, while 41.75% of them were not willing to pay. This showed that over half of the respondents were willing to pay for waste disposal services, if such services were readily available.

Recommendations and conclusion

Recommendations

1. Equipment and staffing at the waste management Ministry should be increased as that can guarantee adequacy of their services.
2. The State Sanitation and Management Board should step up control to prevent dumping of waste items in undesignated and unauthorized locations.
3. The Ministry should also increase its advocacy on the gains of separating waste into recyclable and non-recyclable items and the hazards associated with indiscriminate disposal of waste.
4. The State Government should sponsor people to learn the technology of recycling these waste items into useful harmless products.
5. Government should encourage massive private sector participation in waste management as this will engender employment generation opportunities for the unemployed and the competition that would consequently arise would enhance reduction of the cost of waste management for the residents.
6. Waste should be evacuated from the collection sites regularly and disposed of adequately by the Ministry to avoid accumulation its fallouts.

Conclusion

The survey reveals that several residents in Uyo 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 Ministry of Environment and Mineral Resources. Steady increase in waste variety and quantity coupled with highly ineffective solid waste management system evidenced by waste dumps in drains and public spaces have called for the need for improvement.

The deterioration of Uyo urban environment remains a challenge to the government especially to State Ministry of Environment and Mineral Resources that is constitutionally responsible for managing the waste. The system is based on temporary storage of solid waste in the designated receptacles and the subsequent evacuation and dumping in the dumpsite along the Wellington Bassey Street end, inside the old stadium via Udo Street or behind the University of Uyo.

A comprehensive assessment approach is essential towards improving the existing strategy, establish the performance of present strategy and improve the knowledge base through provision of information to stakeholders and creating a platform for discourse (Anschutz, 2004). While the generic principles of sustainable development is especially relevant in Uyo, an emerging city whose viability can only be established through sustainability experiences in its knowledge, attitudes, beliefs and practices in the face of an emerging economy and legislature and ambiguity in the regulations (Ayotamuno and Gobo, 2004).

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