

**PROLIFERATION OF UNSANITARY SOLID WASTE
DUMPSITES IN URBAN AND SUB-URBAN AREAS
IN NIGERIA: NEED FOR THE CONSTRUCTION
OF REGIONAL SANITARY LANDFILLS**

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ABSTRACT

The proliferation of uncontrolled solid waste dumpsites in Nigeria has become a major public health concern. This study was carried out in fourteen towns in the South-East and South-South geopolitical zones. In each of these towns, a systematic survey was carried out to identify, enumerate and characterize dumpsites in terms of age, nature of site, distance from roads and human habitations, and operational methods. Information was obtained through sidewalk surveys, mechanical counts and measurements, photographic records and careful observation. Results showed that the dumpsites served as conventional "landfills"; as they received all sorts of wastes which were neither sorted out nor controlled. The dumpsites have variable ages, are located on voids, gullies, river banks, and swampy areas, provide breeding grounds for disease vectors, and pose significant dangers to human health and environment. The study recommended the setting up of a National Landfill Development Commission to improve the effectiveness of programs and instruments for new regional landfill projects in Nigeria.

INTRODUCTION

The National Policy on the Environment, launched in 1989 by the defunct Federal Environmental Protection Agency (FEPA), and maintained in the 2005 National

Environmental Sanitation Policy document, prepared by the Federal Ministry of Environment (FME) in 2005, guides environmental protection and management in Nigeria [1, 2]. These policies were formulated under the axiom that the improvement of health and well-being of Nigerians will stem from the protection and effective management of the environment. The underlying logic of these policies is that an integration of ecological systems is paramount to the achievement of sustainable development: that meets the needs of the present generation without compromising the ability of future generations to meet their own needs [3].

Advocates of this concept agree that it comprises three major components which are inextricably interconnected; namely, growth of production (economic development), fair distribution of wealth (fight against poverty), and the maintenance of the production functions of the environment (ecological sustainability) [4]. This means that sustainable development would imply the protection of all environmental resources.

Expanding populations, industrialization, and urbanization have placed a demand for the increased consumption of these resources. The continuous degradation of our environment, accelerated by unsanitary disposal of various waste substances, is giving a hard knock to achieving the ecological sustainability in our development process. Unsanitary and uncontrolled dumpsites, scattered all over the country, continue to receive the bulk of the waste generated, especially in the urban areas.

Although publications are available on some technical aspects of waste management, little in the way of actual *de novo* studies has been carried out to specifically characterize waste dumpsites proliferating around urban and sub-urban areas of the country. Mechanistic interpretations of their nature and character are often speculative, usually deceptive; and not data-driven. Empirical research is urgently required as project partners in waste management seek to integrate knowledge and understanding in this field [5].

This article makes a case for a systematic study of existing waste dumpsites with the view to improving waste management services in the country. It argues that at this stage of national development, Nigeria needs to improve on these unregulated “facilities” and develop them into modern regional sanitary landfills for sustainable disposal of wastes generated in her burgeoning urban regions.

METHODOLOGY

1. Study Area

This study was carried out in 14 towns located in the South-East and South-South geopolitical zones of Nigeria. Three reasons made the choice of this area for study: it is among the highest densely populated zones in the country;

industrial and commercial activities are springing up at a rate higher than national averages in most of the urban centers in the area, and land is becoming a rare natural resource as a result of the fast population pressures, urbanization, and land degradation due to natural and human forces.

The urban centers chosen for the study include Aba, Ahoada, Asaba, Awka, Calabar, Eket, Enugu, Okigwe, Onitsha, Owerri, Port Harcourt, Umuahia, Uyo, and Yenagoa. These are mainly major towns located in each of the two zones (see Appendix 1).

II. Criteria Used for Study

The study was limited to major dumpsites within and around these towns. The common fly-tipped wastes often seen along major roads were not considered because of their relative small sizes. Criteria used for the study included age of the dumpsite, distance from major roads and habitations, size of the dumpsite, site characteristics and operational methods. Dumpsites were categorized as either “authorized” or “unauthorized.” Authorized dumpsites are all those approved by the administration of the respective states, while “unauthorized” dumpsites are those that were arbitrarily chosen, especially by waste collectors and urban residents. In each of the urban centers, a systematic survey was carried out to identify and enumerate these two categories of dumpsites; as their number remain an indicator of the level of effectiveness of regulation of waste management. For most of these criteria, careful observation remained our powerful study tool. Information was obtained through sidewalk surveys, mechanical counts, measurements, and photographic records. These methods provided quick insights into waste management practices at the dumpsites. Efforts were also made to see whether there were differences between waste materials dumped in these two categories of dumpsites. Other useful information such as the age of dumpsites, was obtained from oral interviews among either the local population or the waste management authorities in the respective towns.

III. In-Situ Sampling of Waste Types

At each dumpsite visited, samples of waste weighing individually between 5.6 kg and 6.2 kg collected in a specially-designed metallic container and weighed. The variation in weight resulted from differences in moisture content of the waste due to locational differences. The components of the weighed waste were carefully separated and the proportion of the elements (by weight) recorded. This action enabled the study team to infer possible origins of certain wastes (household, commercial, industrial, hospital, etc.). Elements contained in the waste were broadly grouped as organic matter, plastics, paper metals, glass, and miscellaneous waste (biomedical, construction wastes, etc.). Organic matter regrouped all putrescible materials (food waste, leaves, wood, sanitation waste excluding plastics).

RESULTS

I. Site Characteristics of Dumpsites

Site characteristics of dumpsites were variable. Among the 32 authorized dumpsites in the area, 18.8% were sited in burrow pits: Enyimba, (Aba); Olu Obasanjo (Port Harcourt), Avu (Owerri); 15.6% in gullies: Bisala Road, (Enugu), Barrack Road (Uyo), Umueze (Umuahia), Onuseleugu (Awka); 21.8% along river banks: Waterside (Aba), Njoku Sawmill (Owerri), Main Market (Onitsha); 25% on farmlands and open spaces: Ohanku (Aba), High Tension (Awka), Jarret (Asaba), Elekahia (Port Harcourt); and 18.8% on swampy areas: Qua Steel (Eket), Miringi/Tombia Road (Yenagoa) as seen in Table 1.

However, for the unauthorized dumpsites, 13.6% were located in burrow pits: Ndume, (Umuahia), Ibuzo Road (Asaba), Okpara Road (Okigwe); 10.2% in gullies: Owerri Road (Onitsha), Old Umuahia (Umuahia), Umuchima (Okigwe), Emene (Enugu); 12.7% along river banks: Bank Bridge and Swali (Yenagoa); 9.3% on swampy areas: Polytechnic (Eket), Obele (Yenagoa); while the majority (54.2%) were sited on farmlands and open spaces along major roads: Enugu Road (Onitsha), Koka (Asaba), Akaha Road (Uyo), Ehuda Road (Ahoada) as indicated in Table 2.

II. Size of Dumpsites

It was not easy practically to measure the size of dumpsites due to the variable nature of their sites. The sizes of those located in voids (burrow pits, gullies) were the most difficult to estimate due to variations in the depth and width of these voids (Avu, Enyimba, Olu Obasanjo, Owerri Road, e.g.). The same problem was encountered at dumpsites located in swampy areas (Qua Steel, Obele, e.g.). However, the average size of dumpsites located on farmlands and river banks

Table 1. Site Characteristics of Authorized Dumpsites

Site of dumpsite	Number (F)	Percentage (%)
Burrow pits	06	18.8
Gullies	05	15.6
River banks	07	21.8
Open/farmland	08	25.0
Swampy areas	06	18.8
Total	32	100.0

Table 2. Site Characteristics of Unauthorized Dumpsites

Site of dumpsite	Number (F)	Percentage (%)
Burrow pits	16	13.6
Gullies	12	10.2
River banks	64	12.7
Open/farmland	15	54.2
Swampy areas	11	09.3
Total	118	100.0

Source: Field Survey, 2007.

hovered between six hectares (High Tension, Koka, Ohanku, e.g.) to over ten hectares (Njoku Sawmill, Odukpani, Choba, e.g.).

III. Distance and Age of Dumpsites

Results show that 44.4% of all the 150 dumpsites identified were sited within a distance of one kilometer from the serviced towns, 38.9% within a radius of 5 kilometers from the towns and 16.7% beyond 5 kilometers.

However, 87.5% of all authorized dumpsites were sited within 5 kilometers from the serviced towns while only 12.5% were sited beyond 5 kilometers. In the same vein, 80% of all unauthorized dumpsites were sited within a distance of 5 kilometers from the towns while only 20% were sited beyond 5 km from the towns (see Appendix 2).

Information available from local residents and waste management authorities revealed variations in the age of the dumpsites. Only 23.3% of them have been in use for more than twenty-five years; 64.4% of the dumpsites have been in existence between fifteen to twenty-five years, while the remaining 8.35 are less than fifteen years old. About 93.8% of the authorized dumpsites are between fifteen to twenty five year old; while the ages of unauthorized dumpsites are highly variable: 43.3% are between fifteen to twenty years old; 32.2% are more than twenty years old and 24.5% are less than fifteen years old.

IV. TYPOLOGY OF WASTES AT DUMPSITES

The in-situ sampling of waste types in the 150 dumpsites studied show the following aggregate results:

Organic materials (food waste, leaves, wood, sanitation waste, fruits, and vegetables) formed about 69.3% of the total components. This is surprisingly followed by plastic materials (6.7%) and metallic objects (6.2%) while paper contributed 4.6%, glass and textile materials made up 3.8% and 2.3% of the materials respectively. Inert materials such as sand and gravel formed about 2.5%, while miscellaneous objects (biomedical waste, construction waste [asbestos, aluminum, e.g.]) contributed 4.6% of the total waste (see Table 3).

V. DISPOSAL PRACTICES AT DUMPSITES

A number of disposal practices were observed at the dumpsites. All of them served as conventional “landfills” as they received different types of wastes, which were not pre-sorted before disposal. Each day, waste materials were openly dumped on the site, and most times left without any cover material. There was a conspicuous absence of liners. Consequently, leachate seeped ceaselessly into the soil. The sprinkling of lime and maletheion on the decaying waste matter was not done; the heaps of waste provided breeding grounds for different disease vectors such as flies, rats, and rabbits. The putrescible materials produced highly offensive odors at the sites and environs. None of the sites was fenced to carefully delineate the boundaries, so that waste materials were carried around during heavy rains and periods of strong winds. Liquids that oozed and seeped through the heaps of waste found their way into the soil, nearby streams, and swampy areas. In some sites, chain bulldozers were deployed for pushing the waste materials into

Table 3. Typology of Wastes at Dumpsites

Waste constituents	Proportion by weight (%)
Organic matter	69.3
Plastics	6.7
Paper	4.6
Metal	6.2
Glass	3.8
Textiles	2.3
Inert	2.5
Miscellaneous	4.6
Total	100.0

low-lying areas to compress and level them. At some dumpsites in Aba, Onitsha, and Port Harcourt scavengers were seen sorting out waste components (metals, plastics, papers) destined for a “recycling” in the industries in various towns.

DISCUSSION

In this study, we observed major disparities in the ages and sites of waste dumps. These observations resulted from the fall-outs of major political developments that occurred in the country within the last two decades. The creation of new state capitals in 1985 (Abakiliki, Asaba, Awka, Umuahia, Uyo) with their new ministries and parastatals encouraged urban migration. People trooped *en masse* from rural to urban areas in search of jobs and money [6] majority of them were attracted by “urban illusion” [7]. These new capitals were mainly small towns with little or no existing infrastructure. The construction of new roads and buildings for administrative, residential and industrial functions led to the opening of fragile areas (erosion, flooding, landslides) and the creation of voids (excavation of laterites for road construction) in both the new capitals and the already existing ones. In the absence of controlled landfills, these burrow pits and other accessible areas readily served as disposal sites for wastes collected in the areas. In some towns, waste materials were used to check erosion and control flooding. This phenomenon partly explained the surge in the number of dumpsites with ages ranging between 15 to 25 years.

The problem was exacerbated by the growing importation of foreign goods into the country by the federal government to satisfy local needs. For example, between 1985 and 1991, importation of manufactured products increased by 671%, paper by 18%, tinned milk by 100%, bottled drinks by 3%, and used cars by 320% [8]. The spatial expression of these “newly packaged” imported products was the accumulation of waste components in the various dumpsites. In the wake of the growing quality and diversity of waste generated in these towns, the attention of the waste management authorities was focused more on the technical and financial aspects such as the number of bins and personnel. The whole issue involved the removal of wastes from residential, administrative and industrial areas to the growing number of uncontrolled dumpsites [9]. Today, with a population of more than 10 million people, and per-capita waste generation per day hovering around 0.5 kg, these towns certainly generate more than 5,000 tons of waste per day and roughly 60,000 tons per year. About 70% to 80% of this quantity is collected and dumped in the various dumpsites identified, and probably in new ones that may be emerging.

For various state and local governments to remain complacent, and show little or no concern for the proliferation of these dumpsites is a clear indication that open dumping is officially accepted as the main waste disposal option despite its dangers and concerns. The accumulation of wastes in these dumpsites has increased accidents on roads and highways [10]; degraded urban landscapes [11],

contaminated underground and surface water [12, 13], contaminated terrestrial and aquatic food chains [14], and affected human health and welfare [15-17]. The co-disposal of non-hazardous waste components (organic biodegradables, bottles, plastics, rags) with hazardous elements (asbestos, hospital wastes, batteries, resins) increasingly form the “toxic tort” categories, in which personal injuries are caused by exposure to nearby populations [18]. Various pathways through which open dumping can affect the environment are well documented by Dockerty, Redfean, and Roberts [19].

The increasing incidence of fly-tipping and the proliferation of uncontrolled dumpsites is not only a manifestation of poor solid waste management on the part of waste management authorities, but also an indication of the total failure in the implementation of the *twelve comprehensive measures* for effective solid waste management as contained in section 5(g) of the National Policy on the Environment prepared and launched by the defunct FEPA since 1989. It is also a total breach of Chapter 2, section 20 of the 1999 Constitution which mandates that *the state shall protect and improve the environment and safeguard the waters, air and land; forest and wild life in Nigeria.*

These developments are therefore clear testimonies that the waste sector is facing an *implementation conundrum* mainly because of absence of regulatory certainty. In order to deliver effective waste disposal management, this sector needs certain regulation, additional funding, and a planning system to deliver enough infrastructure in a timely fashion. There is need for the design and construction of modern regional sanitary landfills, to serve in each of these growing urban centers. A more rational approach to the provision of such landfills could start by upgrading one or two of the existing dumpsites to controlled landfills, making them last longer and more safely, thus helping to reduce existing on-site problems. Rushbrook and Pugh [20] argued that the upgrading of uncontrolled dumpsites into controlled ones and eventually into sanitary landfills is neither too difficult nor too expensive; the process is three to eight times less expensive than open dumping [21]. The argument in favor of controlled dumpsites and regional sanitary landfills arose from the high costs of operating open dumpsites: higher indirect costs of effects from environmental pollution, continuous loss of land values, high cost of treatment of infected people in proximity or in contact with waste dumps (etc.)—problems that are reduced to minimal levels in the former. For example, within a period of less than ten years (since 1996), Israel moved from open dumpsites to state-of-the-art landfills, closing all its 77 large dumpsites; moving from 2% to 3% in 1996 to 20% recycling rate in 2005 [22]. That case shows that landfills could double as locations where selected solid waste fractions could be separated for material recovery. Even with the development of the recycling sector, not all materials can be recycled indefinitely; a portion of the recycle becomes waste again and is brought for disposal. Besides, the national market capacity for absorbing the segregated materials for processing is still weak. On this note, experts argue

that recycling and reuse are *time-delay mechanisms* instead of waste reduction programs [23]. It seems likely that landfills will be required for a very long time, even if used only to accept the largely non-polluting treated residues [24].

Modern sanitary landfills are carefully engineered to include a system of multiple barriers such as clay and plastic liners to limit the movement of leachate, surface and sub-surface drainage systems to collect leachate, systems to collect methane gas produced during waste decomposition, and groundwater monitoring systems to detect leakage of leachate below adjacent areas of the landfill. Conversion from open dumpsites to sanitary landfills is therefore seen as a critical step for protecting public health and environment as no amount of careful waste collection or treatment will reduce the health hazards from disposal if the final resting place of wastes is uncontrolled dump [20]. Results from this study have shown that Nigeria is presently at the stage in which United States and Western Europe found themselves in the 1960s in terms of waste disposal. Ever since, their uncontrolled dumpsites have been systematically replaced with controlled regional and private landfills. In the case of Nigeria, this could only be achieved through a well-articulated waste management policy backed by political will.

CONCLUSION

This study tried to examine the character and nature of the solid waste dumpsites existing in major towns in the South-East and South-South regions of Nigeria. It found out that many dumpsites were arbitrarily chosen by local authorities and that the proliferation of these uncontrolled dumps is endangering human health and the entire environment. There is need to analyze existing practices and develop new approaches instead of the current *ad-hoc* methods of waste disposal in wrong places. The construction of regional sanitary landfills will go a long way toward reducing the dangers associated with the increasing number of uncontrolled dumpsites.

The results obtained in the two zones are not unique; they are eloquent testimonies of the general waste disposal practices prevalent in other parts of the country. There is a need for setting up a National Landfill Development Commission. Through the exchange of knowledge and experience, as well as joint development of policy programs, its aim would be to improve the effectiveness of programs and instruments for regional landfill projects in Nigeria. It also would control the issuance of licenses for landfill sites, prepare closure reports on sites (quantity of waste land filled, capping, future use of sites, etc.), and take the responsibility of training multidisciplinary expertise with three-dimensional analysis skills to fully manage these projects [25]. Time is ripe for market forces to play their part in the provision of waste disposal facilities for the increasing municipal and industrial wastes and in promoting environmentally-friendly solutions. All these tasks are challenging, but with strong strategic management and political will, they are achievable.

APPENDIX 1
Population of Towns with Numbers of Authorized and
Unauthorized Dumpsites

S/N	Population	Name of town	Authorized dumpsites	Unauthorized dumpsite	Total
1	513,330	Aba	4	13	17
2	166,747	Ahoda	0	4	4
3	251,375	Asaba	1	6	07
4	112,608	Awka	4	5	9
5	389,022	Calabar	1	6	7
6	236,258	Eket	1	11	12
7	344,852	Enugu	1	12	13
8	132,237	Okigwe	3	6	9
9	261,604	Onitsha	5	12	17
10	302,508	Owerri	2	9	11
11	541,115	Port Harcourt	6	7	13
12	220,660	Umuahia	2	11	13
13	309,573	Uyo	1	10	11
14	2,533,344	Yenagoa	1	6	7
			32	118	150

Source: Field Survey, 2007. Population figures from National Population Census, May 2007.

APPENDIX 2
Names of Towns, Location, and Site Characteristics;
Distance and Types of Waste Received in Major Dumpsites

Town/name of dumpsite	Location	Site characteristics	Distance from town	Types of waste received	Observation
Aba					
Enyimba	Behind Ariaria Market	Burrow pit	1.5 km	Mixed	Very poorly managed
Aba River	Water side	River bank	200 m	Slaughter waste	Unsanitary
Ohanku	Owerri/Aba Rd.	Farmland	5 km	Mixed	Poorly managed
Ahoada					
Igbuoshi	Over Bridge Along Gov't. Girls Sec. Sch. East/West Road	Open land road side	1 km	Domestic agricultural	Close to residential area
Ehuda Road		Open land road side	1.5 km		Close to a River Risk of pollution
Asaba					
Delta Dumpsite	Benin/Asaba Expressway	Burrow pit	5 km	Domestic commercial	Very close to New Federal Housing Estate
Ibuzo Road	Ibuzo Rd.	Burrow pit	200 m	Domestic commercial	Close to residential area
Jarret	Jarret Junction	Along the road	—	Domestic commercial	Causes traffic jam
Cheweta Okogba	Okogba Street	Open land	100 m	Domestic commercial	Unkempt
Koka	By Koka Junction	Open land	—	Domestic commercial	Close to motor park
Awka					
Onuseleogu	Agu/Awika Old Rd.	Gully	4 km from town	Mixed	Not well managed
Ministry of works High tension	Works Rd. Ifite Rd. by Amuku Gen. Hospital	Farmland Farmland	Within town Within town	Mixed Domestic commercial	Blocks the road and very unsanitary Poorly managed, unsightly

APPENDIX 2 (Cont'd.)

Town/name of dumpsite	Location	Site characteristics	Distance from town	Types of waste received	Observation
Eket					
Qua steel	Afaha Eket off Eket Ibeno Rd.	Swampy farmland	About 2 km from town	Domestic and industrial scraps; construction wastes	Leachate seepage not properly managed
Airstrip	Eket/Oron Road	Abandoned pond	1 km	Domestic commercial	Close to residential area
Polyclinic	Hospital Road	Clogged diversion channel	Within town	Hospital and human waste	Close to office of Environmental Health
Guinness Depot	Atabong Road	Guinness loading depot	Within town	Broken bottles, discarded containers, papers, etc.	Negative effect on underground water
Enugu					
Ugwuaji	Independence Layout Phase II	Burrow pit	1.6 km	Mixed	Poorly managed
Lagos Street	Off-Ogui Road	River bank	Within town	Domestic and commercial waste	Scattered and poorly managed
Bisala Road	Independence Layout	Gully	Within town	Commercial waste	Poorly managed
China Town	Ogui Road	Gully	Within town	Domestic and commercial waste	Unsitely and poorly managed
Bus Stop	Emene	Gully	1.5 km	Mixed	Untidy
Apostle					
Bus stop	Agbani Road	Along the roadside	Within town	Mixed	Poorly managed
Uwani					
Bus stop					
Okigwe					
Okpara Rd.	Okigwe/Ow. Road	Burrow pit	3 km	Mixed	Many vultures, scavengers are common
Umuchima	Umuchima/Okpara Av.	Natural valley	2 km	Mixed	Unsitely and poorly managed
Agiriga	Along the road side	Open land road side	2 km	Mixed	Lowers the aesthetic quality of the beautiful scenery

Onitsha									
Main market	Behind Onitsha market	River bank		Few meters from market	Commercial and Domestic		Poorly managed, problem of river pollution		
Owerri Rd.	Onitsha/Owerri Rd.	Gully		3 km	Mixed		Waste used for filling the gully		
Nkpor Express site	Onitsha/Enugu Expressway	Burrow pit		Within the town	Mixed		Poorly managed		
Enugu Rd.	Along the road side	Undeveloped plot		Not far from town	Domestic commercial		Unkempt and poorly managed		
Owerri									
Njoku Saw Mill	Old Aba/Owerri Road	Gully, close to Otamiri River		Within town	Domestic commercial		Poorly managed Risk of River pollution		
Avu Dumpsite	Owerri/PH Road	Burrow pit		5 km from town	Domestic and commercial		Poorly managed, unsightly		
Chukwma	By road side	Reserved open space		Within town	Domestic		Not well managed		
Nwoha Road	Near Amakohia Market	Open land		3 km	Domestic and commercial		Poorly managed		
Amakohia									
Port Harcourt									
Choba	Choba town along East/West Road	Open land		18 km from town	Commercial		Poorly managed burnt, risk of air pollution		
Rivoc	Aboloma road side	Fallow farmland		10 km	Industrial		Waste block Road to Aboloma		
Elekahia	Along Ring Road, Neat Elekahia Housing Estate	Open land		Within town	Domestic waste		Not properly managed		
Olu Obasanjo	Close to Airforce Base	Burrow pit		Within town	Domestic and commercial		Wastes block road and disturb traffic floor		
Stadium Rd.	Stadium Road off Airforce Junction	Open land		Within town	Domestic		Poorly managed scattered waste, many disease vectors (birds)		

APPENDIX 2 (Cont'd.)

Town/name of dumpsite	Location	Site characteristics	Distance from town	Types of waste received	Observation
Umuahia					
Ubakala	Enugu/PH Rd. (Mbarakuma Junction)	Burrow pit	6 km	Mixed waste	Properly managed but not sanitary
New Ubakala	Between Ubakala/Ntigha	Burrow pit	7 1/2 km	Domestic commercial	Abandoned due to site poor characteristics
Old Umuahia	Divinity College Rd.	Gully	3 km	Commingle waste	Waste used to check erosion
Ndume	Behind Nnamdi Azikiwe Secretariat	Burrow pit	1 km	Mixed waste	Poorly managed
Umueze	Behind Girls Sec. School Umuahia	Deep gully	1 km	Mixed waste	Erosion easily washes away the waste during rainy season
Uyo					
Barrack Road	Old Stadium Road	Deep gully	About 2 km	Domestic, commercial, construction, automobile	Poorly managed, unkempt, tendency of underground water pollution
Akaha Road	Beside PHB Bank	Open land/market site	Within town	Domestic and commercial	Degrade the market site
Dominic Utuk	Opposite Ekpenyong Street	Farm land	300 m	Automobile domestic commercial	Poorly managed
Yenagoa					
Yenagoa	Miringi/Tombia Rd.	Former SPDC location platform (swampy)	3 km from town	Domestic and commercial	Swampy site, difficult to manage, Risk of water pollution
Obele	Obele Town	Swampy area	4 km	Domestic/commercial waste mixed with human waste	Swampy site, difficult to manage, Risk of water pollution

All States Bank Bridge Swali	Along Mbiama/Yenagoo Rd. Swali Town	Close to river bank River bank	3 km from Govt. House Few km from Govt. House	Domestic Mixed	Site poorly managed, waste flows on the river Waste flows on the River
Calabar Edibedibe	Small gate by Golden Market 8th Mile	Farm land	2 km	Mixed	Waste flows on the River
Odukpani Central Dumpsite		Gully/swampy area	1 km off	Mixed	Proper disposal in the controlled dumpsite, well managed

REFERENCES

1. Federal Republic of Nigeria, Federal Environmental Protection Agency Decree No. 58, Official Gazette No. 89, Vol. 75, December 30, 1988, Federal Government Press Lagos.
2. Federal Ministry of Environment [FME] Sanitation Policy Document, Abuja, Nigeria, 2005.
3. World Commission on Environmental and Development, *Our Common Future*, Oxford University Press, New York, 1987.
4. Dutch Policy Document, *A World of Difference: A New Framework for Development Cooperation in the 1990s*, Ministry of Foreign Affairs, Development, Cooperation Information Department, The Hague, 1991.
5. Department for International Development, *Progress Report on Urbanization*, DFID Publication, London, 2002.
6. P. Venetier, *Les Villes de l'Afrique Tropicale*, Edition Masson, Paris, 224 pp., 1991.
7. O. Ogbu and G. Ikira, La Crise de l'Urbanisation en Afrique Sub-Saharienne. Development Urbain, *Le Courier*, 149, pp. 25-28, January-February 1995.
8. Federal Republic of Nigeria, Federal Office of Statistics Publications, Federal Government Press, Lagos, 1993.
9. E. Waas, Urban Waste, Multiple Waste: Introductory Note; Africa Environment; Vol. VIII, 1-2, No. 29-30 ENDA Dakar 7:19.
10. O. R. A. Sule, Environmental Pollution in an Urban Centers: Waste Disposal in Calabar, *Third World Planning Review*, 3:4, pp. 419-430, 1981.
11. M. K. C. Shrid'har et al., The Problems and Prospects of Refuse Disposal in Ibadan City, Nigeria, *Waste Management and Research*, 3, pp. 195-201, 1985.
12. B. N. Uba, *Deteriorating Water Quality: A Challenge to Water Resource Management*, Earthwatch Conference, 2003.
13. W. Grant, G. Steel, and S. A. Isorho, Spontaneous Abortions Possibly Related to Ingestion of Nitrates Contaminated Well Water, Lacirage County Indiana, *Morbidity and Mortality Weekly Report*, 45, pp. 569-571, 1996.
14. A. Abdulazziz and F. Duruzoechi, Criticisms of Waste Management in Nigeria: Need for Improvement, IRMTI Conference in Jos, June 23-24, 1992.
15. World Health Organization, *Air Pollution in African Villages and Cities*, Lagos, Nigeria, 1994.
16. World Health Organization, *Solid Waste and Health*, Briefing Pamphlet Series for Solid Waste, WHO European Region, Copenhagen, Denmark, 1995.
17. S. Cointreau-Levine et al., *Occupational and Environmental Health Issues of Solid Waste Management*, in *International Occupational and Environmental Medicine*, Mosby, St. Louis, Missouri, 1998.
18. R. Dahl, A Changing Climate of Litigation, *Environmental Health Perspectives*, 115:4, pp. A:205-207, April 2007.
19. J. Dockerty, A. Redfearn, and R. Roberts, Don't Blame Seagulls, *Wastes Management*, pp. 2-23, February 2005.
20. P. Rushbrook and M. Pugh, *Solid Waste Landfills in Middle and Low Income Countries: A Technical Guide to Planning, Design and Operation*, World Bank Technical Paper, No. 426, Washington, D.C., 1999.

21. S. Cointreau-Levine, *Private Sector Participation in Municipal Solid Waste Services in Developing Countries* (Vol. 1), Discussion Paper No. 13. The World Bank, Washington, D.C., 1994.
22. I. Nissim, Israel's State-of-the-Art Landfills, *Israel Environment Bulletin, Ministry of Environment*, 28, pp. 17-18, 2005. See: www.environment.gov.il
23. N. C. Vasuki, Special Interview; Simple Solutions, *Wastes Management*, pp. 16-17, September 2005. See: www.ciwm.co.uk/publications
24. B. Wood, Special Interview with Gill Weeks, *Wastes Management*, pp. 16-17, February 2005. See: www.ciwm.co.uk/publications
25. L. Arnot, Finding an Exit Strategy: Closing a Landfill is Not as Easy as it Appears, *Wastes Management*, pp. 18-19, December 2005. See: www.ciwm.co.uk/publications
26. National Population Commission, *Results of National Census Figures*, Federal Government Press, Lagos, May 2007.

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