

## **MODELING OF STAGES OF LANDFILL SITES DEVELOPMENT IN METROPOLITAN LAGOS**

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### **ABSTRACT**

The location of the landfill sites determines the distance to be covered in waste collection and disposal. Nineteen sites have been officially designated landfill/dumpsite by Lagos State government in the metropolis; all have been except for the three currently in use. It is the aim of this article to examine the site selection decision-making process, the life cycle of the dumpsites and their spatial efficiency. Interviews were conducted with the host Chiefs of the dumpsite areas and the managers of the sites. The study revealed a five staged evolutionary sequence: first, land acquisition and mining; second, pit-site abandonment; third, pit-filling/restoration; fourth, government acquisition and designation; fifth, official closure/conversion. The article suggested adoption of a more rational approach for dumpsite selection, development of more transfer loading stations located for spatial efficiency, adoption of transitory community dumps and location of a major landfill in the southwest end of the state.

### **INTRODUCTION**

A major problem of urban management all over the world is how to dispose the various types of wastes that are generated. The problem tends to be more acute where there is rapid rate of urbanization. According to the World Bank (1996), the share of Nigeria's urban population jumped from 20% in 1970 to 38% in 1993. It was further stated that while the national population was growing at 2.9% between 1980 and 1993 the urban growth rate was 5.5% and it was

asserted that this rate is among the highest in the world. This situation is further compounded by the finding that 75% of Nigeria's urban population live in slums, many in shanties and derelict structures, and as high as 56% live in grossly sub-human condition and absolute poverty (World Bank, 1996).

This scenario presents a background for an endemic waste disposal problem as corroborated by Onibokun, Adedipe, and Sridhar (2000) in Ibadan, and Ogu (2000) in Benin. With specific reference to Lagos, numerous studies had come to the same conclusion that the problem is indeed almost intractable: Odumosu (1995) Odewumi (2002), Oyewale (1997), Aina, Etta, and Obi (1994). This made Werlin (1995) to agree with Piel (1991, p. 188) that the listing of Lagos in the 1983 Guinness Book of Records as "the dirtiest city in the world" may be justified.

The aim of this study is to determine the evolutionary stages or the life cycle of dumpsites in metropolitan Lagos. The objectives to be achieved are:

- (a) Identifying and tracing the history of major government designated dumpsites and transfer loading station;
- (b) Determining the site selection decision-making process and the consequent distributional pattern;
- (c) Evaluate the waste intake and distributional efficiency of the dumpsites relative to the urban morphology; and
- (d) Derive the sequence of evolution and suggest ways of improvement.

## **STUDY AREA**

Lagos State is the larger system within which this study is situated but the metropolitan Lagos is the spatial limit of attention (see Figure 1). It excludes the less urbanized Local Governments Areas (LGAs) of Epe, Ibeju Lekki, Ikorodu, and Badagry more so because their wastes are not part of those that end in the dumpsite of the metropolis. The state is located approximately between latitudes 6° 22' N – 6° 42' N of the Equator and between Longitudes 2° 42' E – 4° 20' E. It has an approximate size of 3,577 square kilometers (Balogun, Odumosu, & Ojo, 1999, p. 1). It is straddled from the northern boundary to the east by Ogun state and Republic of Benin to the west. The southern limit is marked by about 180 kilometers of the Atlantic Ocean's shoreline. Twenty-two percent of the state, or 787 square kilometers, is made up of Lagoons and Creeks, a major factor that cannot be overlooked in waste disposal practices and landfill site selection. The population density is 1,590 persons per square kilometer using the 1991 census figure of 5.68 m. The figure for the state was estimated in 1998 at 11.3 million (United States Bureau of Census, 1998) and projected to be around 21.1 million by 2010 (UNDP, 2001); and 25 million in year 2015.



## **RESEARCH METHOD AND DATA SOURCES**

Secondary data were obtained from LAWMA's record (Lagos Waste Management Authority), from its Departments of Planning Research and Statistics, Personnel, Operations, Transfer Loading Station, and the three landfill sites currently in use. There are those sourced from Reports of Commission of Inquiry, Task Force Reports, Consultants Reports, and past research efforts. For our primary data we had in-depth interviews with the present and past landfill sites managers and some of the indigenes that are the original owners of the land. All the officers at LAWMA were of immense assistance in this research. The information sought was on the history, location factors, size and distribution, method of dumping and environmental health considerations, and impact. Five field enumerators were designated to collect gatehouse and other related data at the three landfill sites that are currently in operation: Solous, Abule Egba, and Olusoshun which is the biggest. The defunct dumpsites include: Achackpo, Ojota, Anthony Village, Agege, and Isolo. Historical and Gatehouse records were also collected from the Transfer loading station at Ebute Elefun, which is the only one of its kind in the country.

## **FINDINGS AND DISCUSSION**

Open dumping and land fillings are the major means of eventual solid waste disposal in metropolitan Lagos. Selected sites in the following areas of the state have at one time or the other been used for waste disposal: Olusoshun (Oregun), Isholo (old and new), Achackpo, Mechanic Village, Agege (Abule Egba), Anthony Village, Ojota, Omole, Ibeju-Lekki, Badagry, Lagos Mainland, and Makoko, Epe, Owutu-Ikorodu, Adeniji-Adele, Igando I & II, Ejigho, Eti-Osa, 3rd Mainland Bridge. The ones that are still in use are Olusoshun, Oregun, Ojota, Somolu Local Government Area (42 hectares), Abule-Egba, Alimosho Local Government Area (10.5 hectares), Solous, Alimoso Local Government Area (3.0 hectares) (see Table 1).

## **OTHER WASTE COLLECTION POINTS AND STRATEGIES**

Beside the landfill sites there are several facilities put in place for waste handling in the state, except for the Ebute Elefun facility, all others are not in use. Even the one that is being put to use is not for the original purpose.

### **Claudius Peters Incinerating Plants**

These two plants were commissioned in the late 70s by the state government and they are one of the greatest manifestations of government's inability to plan. It is often assumed that all that is required is to throw money at any problem and

the problem will disappear. These plants were bought, constructed, and were never put into active use. They were later sold as scraps. One of the plants was located on the Northern side of the Lagos Island near Simpson Street while the other was sited at Ebute Elefun close to Odaliki Street. The plants had a design peak incinerating capacity of 384 tons per day. This plant is now converted to a transfer loading plant as described below.

### **Marine Incineration/Composting Plant**

This facility was located in Oshodi area and like the Claudius Peters plant it was never put to active use. It had manufacturer's peak rating of 640 tons per day. It was expected to incinerate 170 tons, compost 190 tons, recycle 20 tons of ferrous metal, and landfill 100 tons of ash per day. The state government is currently considering converting it to a bailing station. It is the only one that was not dismantled to be sold for scraps.

### **Eric Moore Car Crushing Plant**

The plant was located off Eric Moore Road in 1979 and put to the use of crushing abandoned derelict vehicles. The plant developed a fault in 1985 and was never repaired.

### **The Location Factors of the Landfill Sites**

The distribution pattern of the landfill sites in a given area is a major determinant of the route design of its waste transportation system. The location factors are the process and elements that produce the pattern. In the case of landfill location in Lagos metropolis it was discovered neither the government nor any of its waste management agencies had any input as to the distributional pattern. Whether in the case of the active or the closed dumpsites there was no time that a conscious decision was taken to locate a landfill site at particular place. This is equally true of the Oregon site—the biggest—that has detailed study of the topography, soil, size, prevailing wind patterns, and other related variables.

The model of evolution of any parcel of land as a dumpsite in Metropolitan Lagos is as follows:

#### *Stage One: Acquisition and Quarry*

The procedure for any parcel of land to become a dumpsite could start in any of the following three ways. First it may be that the indigenes/land owners put up a fairly large expanse of land for sale and there happened to be a single buyer whose main objective is not to construct anything on the land but to use it as quarry. The second approach may be that the owners themselves decided to quarry the land to sell laterites/sand on it. The third could be that sometimes an

Table 1. The Distribution of Landfill Sites Existing and Closed

S/N	Site, area, and life span	Used by	Remarks LAWMA: Lagos Waste Management Authority LGC: Local Government Council PSP: Private Sector Participants
<b>ACTIVE DUMPSITES</b>			
1	OLUSOSHUN 42Ha 1992-2027	LAWMA LGC PSP	Partially engineered landfill, 18 m deep laterites pit, pre-designed gas collection, 5,000-7,000 t/d, 8.5 mm <sup>3</sup> current net volume. Intensive excavation of laterites. Landfill design slope of 1:3, 90% of Lagos collected waste is dumped there.
2	AGEGE 5Ha 1983-2006	LAWMA LGC	Originally a laterite pit; relatively low negative environmental impact; cover material available; area could be extended but legal problems, remaining capacity app. 150,000 m <sup>3</sup> .
3	SOLOUS 3Ha 1990	LAWMA LGC PSP	Originally designed as a laterite pit and later converted as local disposal site. By 2000 it was properly fenced and supplied with disposal equipment.
<b>CLOSED DUMPSITES</b>			
1	ISOLO 7,5 HA 1981-1997	LGC	No bulldozer, inaccessible during rainy season; piled up, clay base, only partially operated; surrounded by settlements.
2	ISOLO B 50 HA 1997-2020	—	Acceptable geological and hydro geological conditions; project preparation exists; clay base, government-owned land, but some recent squatter settlements; 80 ft above sea level.
3	ACHACKPO 9 HA 1974	LAWMA LGC	Mangrove swampy area, flood plain, leachate drained channel into Badagry creek; no provisions for base Preparation, gas or leachate collection; inaccessible during rainy season; housing estate near the landfill.
4	MECHANIC VILLAGE	LAWMA LGC	Local disposal site, also partially used by LAWMA; high water table area.
5	A/VILLAGE 8 HA 1979-1992	LAWMA	No bulldozer, drainage channel, swamp land, groundwater contamination.
6	OJOTO 4 HA 1986-1991	LGC	Laterites pit, drains into lagoon, groundwater contamination affect aquatic life, inaccessible during rainy season.
7	OMOLE	—	Industrial waste disposal, surface water contamination.

Table 1. (Cont'd.)

S/N	Site, area, and life span	Used by	Remarks LAWMA: Lagos Waste Management Authority LGC: Local Government Council PSP: Private Sector Participants
8	IBEJU/LEKKI	LGC	Local disposal site, not well-defined project, high water table.
9	BADAGRY	LGC	Local disposal site.
10	MAKOKO 1979	LGC	Local disposal site, not environmentally safe.
11	EPE	LGC	Local disposal site, rural area, not well-defined project.
12	OWUTU 1980	LGC	Local disposal site, laterites pit, maintenance by LAWMA about six times a year.
13	ADENIJI-ADELE 1980	—	Former Lagos island disposal site.
14	IGANDO	—	Housing estate nearby, could not be developed.
15	EJIGBO	—	Petrol depot and high voltage transmission lines nearby could not be developed as landfill site.
16	ETI-OSA 1997	—	High water level.
17	3rd M/RIDGE 1992-1999	LGC	Local emergency disposal site for Lagos Mainland LGA, swampy area.

open swamp or government-acquired land is simply converted to a dumpsite by the local residents basically as a land reclamation strategy.

#### *Stage Two: Pit Abandonment*

After years of digging and selling off of the soil/sand/clay on the land, the water table will be reached, signaling the end of digging. The consequent pit is then abandoned.

#### *Stage Three: Pit Refilling-Unofficial Dumpsite Phase*

The third stage commences as a result of the desire to fill the pit. This desire arises usually for two major reasons. The first is to remove the menace of the open pit; which invariably would have become a hazardous terrain into which

innocent passerby, children and animals regularly fall into. The second reason is to recover the land in order to be able to use or resell it again for a different purpose. The residents around the pit often start this process by filling the pit through the dumping of their solid waste into it.

*Stage Four: Official Designation*

Once the existence of a large pit comes to the attention of the government, the government officially designates it as a dumpsite. The government/waste management agency will subsequently study the site, obtain all the necessary site parameters (size, depth, wind direction, EIA, capacity, water table, etc.). Consequent upon the study the government then constructs the necessary facilities (roads, walls, offices, etc.) and brings equipment (Bulldozers, Excavators, Graders, Compactors, etc.) to the site.

*Stage Five: Official Closure, Reclamation, and Conversion*

Once the site is completely filled up there is then the usual aesthetic dress up and resale in the case of an individual and conversion for different purposes by government like markets, recreation parks, or government edifice. Therefore, in all instances the decision to locate a landfill site by the state government is usually taken when the location has become a pit requiring filling up. This situation can therefore not be expected to produce a spatially efficient distribution pattern that is mindful of the factors of accessibility, centrality, and environmental safety.

**Examples from the Functioning Landfill/Dump Sites**

The current three functioning sites are Olusoshun, Abule Egba, and Solous.

*Olusoshun*

Olusoshun is the largest of the three functioning landfill sites in Lagos State. It is about 42 hectares in size, located within the Oregun area of Ikeja Local government area. It is bounded in the north by the Ikosi road that links Alausa Secretariat. In the south, Ikorodu and Oregun road edge it. There is the Lagos Ibadan Expressway along its eastern boundary, while to the western boundary is the east side of Oregun road. It is about 8 meters deep and was expected to be in operation for about 35 years, 1992-2027. It is currently taking about 83% of the waste directly from all the agencies involved in waste collection in the state. In addition it is the final receptor for the wastes from the Transfer Loading Station (Ebute-Elefun), which is handling about 6% of the total waste. Therefore overall it is taking about 90% of the waste in metropolitan Lagos.

The location factors conform to the model built above. The quarry stage went on for years and the pit was large, waterlogged and hazardous. The residents took the decision to turn it into a dumpsite site in order to remove the menace of



children and animals disappearing into the pit trap and possibly reclaim the land. Later detailed study of its environmental impact designation was conducted (LAWMA, 1995); the subsequent design include facilities for the collection of 5000-7000 t/d of gas from the site. The equipment expected to be on site include the following minimum, 2-compactors, 2-Bulldozers, 2-Front end Loaders, 1-Utility truck, 1-motor grader or grader blade to be pulled by a dozer, 1-three quarter tone 4 × 4-crew cab pickup truck, 1-Air Compressor, Portable Water Pumps, and 1-Portable Diesel Generator. However, the usual practice now is to hire one bulldozer in addition to the Komatsu D155 that breaks down on a regular basis. The site is grossly under equipped for the role it is expected to play in waste handling in the state. There is hardly any compactor on this site. This situation will certainly affect the lifespan projections originally intended.

#### *Abule Egba*

The location factors of the site are also in conformity with the model of landfill site emergence described above. It is located to the West of the Abeokuta Expressway at Abule Egba in Agege Local Government area. The total area coverage is about 10.5 hectares, which makes it the second largest taking about 8% of the total volume of waste. Although the site has lifespan which expired in 2006 and was closed officially, a waste dumping is still continuing there because there is no alternative site for the member of the community living in the area. The major users of the site are the Private Sector Participants (PSP) and LAWMA, but there are occasional dumping by the Highway managers. The access road has been re-constructed but the major problem is lack of equipment. There is no permanent bulldozer and Compactor. Mechanical Shovel is sent there on irregular basis, especially CAT P279 and P240. The site operates only during the day.

#### *Solous*

This is the smallest of all the functioning landfill sites taking just 3% of the total volume of solid waste in the metropolis. It covers an area of 3.0 hectares. Like the other two it was originally a laterite collection point abandoned and later converted to landfill site first by the local community. Subsequently it was adopted by LAWMA. It was in 2000 that it was properly fenced as it constituted a terrible environmental hazard to the commuters along Iba-Iyana Ipaja road just opposite the Solous Hotel that gave it the name. It is in Alimosho Local Government area. Like the other two sites Solous is under-equipped and the mechanical shovel that works there regularly break down and not permanently stationed there. There is always unmet demand for grader and bulldozer. The mechanical shovels that operate there on off-and-on basis are CAT P279 and P254.

### Transfer Loading Station

From the carcass of the Claudius Peter Incinerating plant located at Ebute Elefun emerged the only functioning Transfer Loading Station in the State and indeed the country. Its role is to mop up the waste on the Lagos Island during the day, thereby avoiding the delays of traffic hold ups such that in the night the waste could be quickly moved to the final dumpsite at Olusoshun. This structure is to service the high-density areas of Lagos Island, Eti-Osa, and surrounding local government areas. It makes it easier for smaller vehicles to collect the waste from the catchments areas and having a shorter route by dumping at the transfer station. Quick turn-around time is greatly enhanced and efficiency is increased. At night when the traffic is free, heavy trailers are then brought to the station for the long haul to the final dumpsites at Olusoshun. This particular method is found to be very advantageous in many respects and it is here suggested that it be replicated in high-density areas on the mainland (see Figure 2).

### EVALUATION OF THE RELATIVE IMPORTANCE OF THE WASTE RECEPTACLES

The revealed fact in this study is that wastes are not dumped with regard for spatial optimization but by capacity to receive. This is not unexpected since the site selection process is not based on any rational decision. This explains the difficulty experienced by the waste disposal vehicles that have to take the waste through the chaotic traffic situation from one end of the city to the other. This implies that the waste collectors are not dumping on the basis of proximity but on the available facilities. The highway managers gave three reasons why they

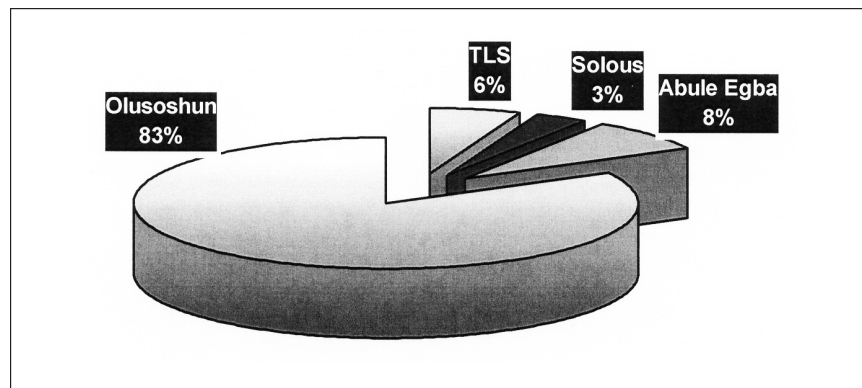


Figure 2. The relative volumes of waste received at the sites.

cannot be discharging at the nearest dumpsite even when it would have saved a lot of time and fuel to do so. The first is that the approach to the dump station is very difficult for large articulate trailers to negotiate. The second is that Solous does not accept waste in the night which to them is a period when they attain maximum turn-around time. The last reason given was that even if all the other two variables are corrected the capacity of the site is very small in which case the entire space will be filled up soon, thus they will return to the status quo. If that is done it will deny the small scale PSP operators the opportunity of dumping close by which will result in a very difficult situation for them if they have to take their waste to the far away Abule Egba or even much farther Olusoshun. So the practice of taking most of their waste to Olusoshun by LAWMA and the Highway Managers appears the most expedient in the present circumstance, however it is not efficient.

### **SUMMARY, CONCLUSIONS, AND SUGGESTIONS**

All the dumpsites have the same stages of evolution: Stage One Acquisition and Quarry; Stage Two Pit Abandonment; Stage Three Pit Refilling-Unofficial Dumpsite Phase; Stage Four Official Designation; Stage Five Official Closure, Reclamation, and Conversion.

In all instances neither the government nor any of its waste management agencies had any input as to the site selection decision-making process and the subsequent distributional pattern. The consistent sequence of events in the model of emergence of a landfill site are that first the location is usually a deep pit caused by digging for laterites or just a swamp to be re-claimed; the local community always initiates the dumping and thereafter the government will then move in and adopt the location as a dumpsite.

The study further revealed that some other facilities were put in place for waste handling in the state. Almost all have been abandoned. Some were even never put to operation for a day. These include Claudius Peters Incinerating Plant at Ebute Elefun now converted to Transfer Loading Station, Marine Incineration/Composting Plant, located in Oshodi area, Eric Moore Car Crushing Plant, off Eric Moore Road built in 1979 for crushing abandoned derelict vehicles. This is the only plant that worked at least for a while before it was abandoned. The three currently operational dumpsites are Olusoshun, Abule Egba, and Solous.

It is suggested that there should be another big landfill site of the equivalent of Olusoshun at the southern part of the mainland. This site should operate both day and night like Olusoshun. Although the major problem of the southern part of the metropolitan area is the topography and high water table that could easily contaminate the underground water of the state if wastes are dumped on such swampy ecosystem. Some locations along Badagry Axis are worthy of study to determine

their suitability. The advantages of this axis are many. First it is the zone with considerably large open spaces. Second, the population density is still light when compared with the other areas of the state. Also the perennial traffic hold ups in the state does not extend beyond Okokomaiko. Even those at Okokomaiko, Alaba, Iyana-Iba, Volkswagen, and FESTAC gate could be improved if alternative routes to this main artery like Old Ojo bypass is made to link up at the Federal Government College in Ijanikin. The Iyana Agboroko shortcut if tarred will circumvent the perennial traffic bottlenecks at Alaba Raga and Okokomaiko. Another point for this view is that this artery is having many residential estates that make the zone contain high-density population. The Old Ojo local government area has the highest population figures that even surpassed some state governments' population. Therefore, the domestic waste from these areas could quickly be taken out with the collection agencies having more turn-around time compared with the circumlocutory trips to Olusoshun.

In addition, Solous and Abule Egba are already at the end of their life span and there is, therefore, an urgent need for alternatives. If these are not provided even Olusoshun may not last the estimated lifespan. A transfer loading station is recommended along with the new landfill site so that it could provide the same type of back up that Ebute Elefun is offering the people on the Island before the final transportation to Olusoshun. For the Transfer Loading Station (TLS) we suggest conversion of the abandoned incineration plant at Oshodi that is a hub of commercial activities on the mainland.

Another suggestion is the need for Community Dumpsites squares. The idea is to have community dumpsites to serve as the first layer of waste collection. The suggestion is important so as to make the job of the PSP collectors faster and more financially sustainable. It will provide an official window of opportunity for the recognition of the Cart pushers that have been having a running battle with both the state/ local governments and the PSP operators. It is a veritable window of large employment opportunity for the millions of youths roaming the streets of the metropolis.

The arrangement being recommended here is that the Cart pusher will collect domestic waste directly from individual households who will in turn pay a fee. This was the practice until the government tried to ban them from the scheme in order to give the PSP operators a free space to operate profitably. The small-scale nature and the need for direct contact gave the Cart pusher an edge over the PSP. The door-to-door type of service that this collection entails significantly reduces the turn-around time of the PSP. This is the reason that despite prohibition, the Cart pushers and the households are still doing business to the discomfiture of the PSP who cannot match the small scale Cart pusher in price fixing and efficiency. Hence, the PSP have not been able in many instances to break even as envisaged because they have to compete with a rival who in many respects is ideally positioned for the service.

The problem of lack of official recognition for the Cart pushers make them operates illegally. Although they are largely tolerated by the law enforcement agents, they dump their waste indiscriminately. Hence, the majority of the waste ends up on the highways for the Highway manager to carry, and at public and commercial areas for LAWMA to transport. The rest ends up in the swamps, lagoons, and the Atlantic Ocean.

It is in order, therefore, to solve these multifaceted problems that an official window should be created for them to operate. The Cart pusher, after being registered, should be linked with the community dumpsite of a PSP operator where he will be dumping his waste. He will then pay the PSP an agreed percentage of the money he has collected from the households. A specific number of streets are then officially allocated to the Cart pushers as his exclusive territory of operation. A group of these Cart pushers will be the servicing clients for the PSP operators. The PSP will have fewer collecting points and it will be a lot easier to collect their levies from the Cart pushers than the individual households.

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