Volume 13 Issue 11
Originally issued as B3

Global Journal of human social science
Geography, Geo-Sciences, Environmental & Disaster Management
Volume 13 Issue 3 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

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GJHSS-B Classification : *FOR Code : 710702p*

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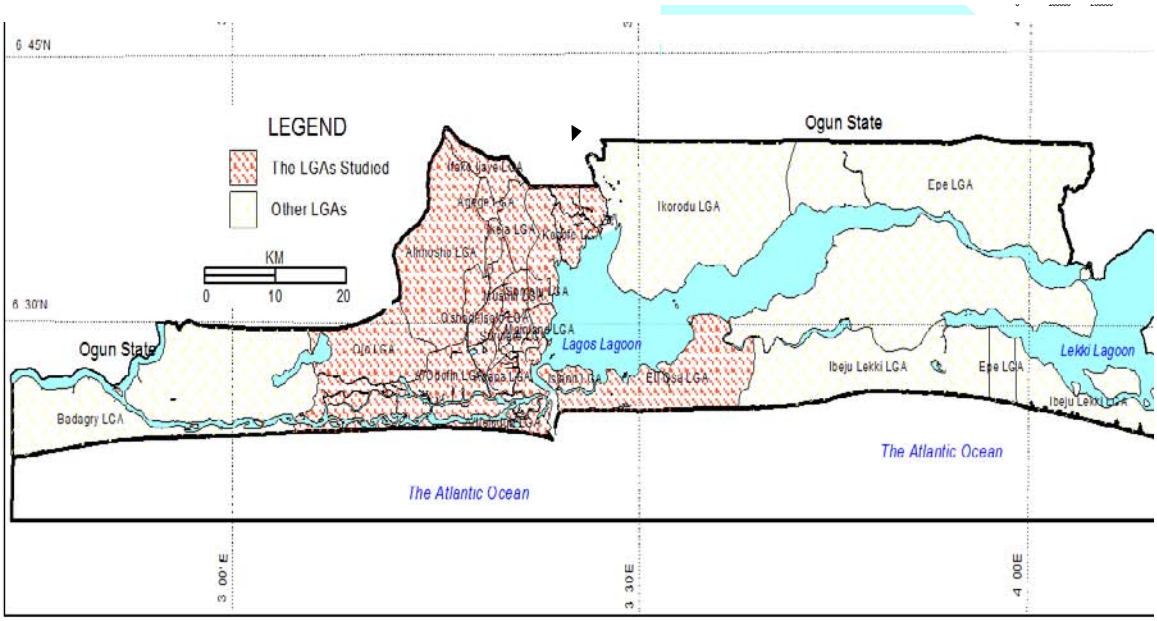
I. Problem Defined

The fact that successive Governments in Nigeria have had to contend at one time or the other with the problem of huge mountains of un-cleared solid waste in the cities is a clear indication that an appropriate solution is yet to be proffered (Adeniji and Kunle, 1996) Saka, 1995; Odumosu, 1995 and Oloke-susi, 1994). Since the populace cannot be stopped from generating waste, the fundamental issue therefore is how to manage, the waste being generated so that it will not constitute health hazard and also meet the aesthetic demand of a decent society (Onibokun, Adedipe and Sridhar, 2000). The search for the appropriate manag-ement techniques has been long and frustrating (Filani and Abumere, 1986; Faniran, 1994). Various modalities have been adopted like the shifting of the managing authority from the state to the local government, to independent management boards and then back to the state (Odewumi, 2002). Currently the approach being experimented upon is the Private Sector Participation (PSP), which, essentially is the involvement of private businessmen in the waste removal. This study is expected to offer suggestions that could assist in making the experiment successful.

II. Aim of Study

It is therefore part of the objectives of this study to examine the existing strategies, propose the inclusion of private sector participation and offer suggestions for mode of operations.



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III. Area of Study

Metropolitan Lagos is the spatial limit of this inquiry (Map 1). The area is located between longitudes 6^0-7^0 east of the Greenwich meridian and between latitude 3^0-5^0 North of the Equator. It has an approximate size of 3,577 square kilometres, shares boundaries with Ogun state in the north, in the west with Republic of Benin, Ondo state on its eastern boundary while the long coastline of about 180 kilometres of Atlantic Ocean constitutes its Southern boundary. The area is a mega-city with high population density and consequently high volume of waste generation.

IV. Factors for High Volume of Waste Generation in the Area of Study

In order to derive a framework for sustainable management, it will be helpful to understand the factors that coalesce to make waste generation so high and the removal so difficult compared with areas of similar size, role, location and stage of development.

The first major factor is the rapid rate of urbanisation. It is the most urbanised and most populous state in Nigeria. Besides the rapid rate of urbanisation, there is a very high percentage of transiting population who come and go out of the metropolis daily to trade, seek employment, transact government business, contact embassies, receive education, visit relatives, receive goods and family at the ports- sea and air- socialise or holiday etc. The sources are both from the country's hinterland as well as the West African sub region. According to LAWMA (1992, p.50) the figure in this category cannot be less than 398,000 people daily. These sets of people contribute in no small measure, to mountains of refuse in the state. Theirs is even more difficult to manage since the facilities do not exist to handle the wastes that are daily generated by this crowd.

As for the resident population there are over 400,000 properties in the city from within each of these properties wastes are daily generated, which should be collected to avoid any backlog. This was obtained during the property enumeration project undertaken as part of the World Bank projects for improved waste management services in the city. It was stated that the state has the highest number of industries in Nigeria. It is estimated that the area generates over 50% of the total industrial/commercial waste in the country. Presently, the Waste Management Authority services only 1,159 industries/commercial premises, which constitute less than 10% of the actual number of industries/companies in Lagos. There are more than 229 markets in the metropolis, all of which are points of high waste generation.

Another factor is lack of and/or improper planning. Most parts of metropolis are developed without a master plan. This led to poor/insufficient/ inadequate road network, poor road condition, and non-provision of space for waste collection operations. Presently, the trucks of the Waste Management Authority cannot gain access into 40% (LAWMA, 1995 p.30) of the inner parts of the city because the roads are too narrow, blocked and at times, are not linked with each other. Many roads are in various stages of disrepair.

Lack of proper drains makes most roads un-motorable during the raining season. Many people have also built shops, markets and houses on the truck paths that waste disposal vehicles therefore find it difficult gaining access to most houses/streets to pick up waste. Poor road network in most cases leads to a situation in which trucks spend more than five (5) hours in traffic hold-up during the day for a journey that might not ordinarily have exceeded one hour. This reduces the spate of work in waste collection.

Topographical factor has significant input. Lagos is located below sea level. Most times, when it rains, most areas are not accessible as flood takes over roads/streets and dump sites within the municipalities. The situation is even worse at the landfill sites, as they are not accessible during the raining season because they become waterlogged. During such periods, rate of refuse collection and disposal drops to about 10%-20% (LAWMA, 1995, p.31) of normal rate and the metropolis becomes littered.

Since most manufactured goods and foods are packaged, the fact that Lagos has the largest volume of importation, manufacture and consumption leads to high rate of waste generation in packages that are more than the rest of the country put together. This has significantly increased tonnage of waste collected daily. These wastes are in plastics, papers, nylons, metals etc of canned food, bottled water, domestic and industrial items.

Due to her large population large volume of agricultural products from the hinterland are brought to Lagos. This explains why at any given day there are over 20 trailers discharging food items packaged in high waste generating materials in various Lagos markets e.g. Ketu, Ikosi, Alaba etc. Also over 70% of livestock brought from the Northern part of the country and those imported into Nigeria from neighbouring countries like Niger Republic and Cameroon find their way into Lagos for sale and consumption. At least 30 – 60% of such agricultural goods end-up as waste to be collected and disposed.

V. Methodology: Archival Data Collection

The sources of data include secondary and primary, The secondary sources are LAWMA Planning Research and Statistics Dept, Consultants Reports: LAVALIN and Resource Consults, Reports of

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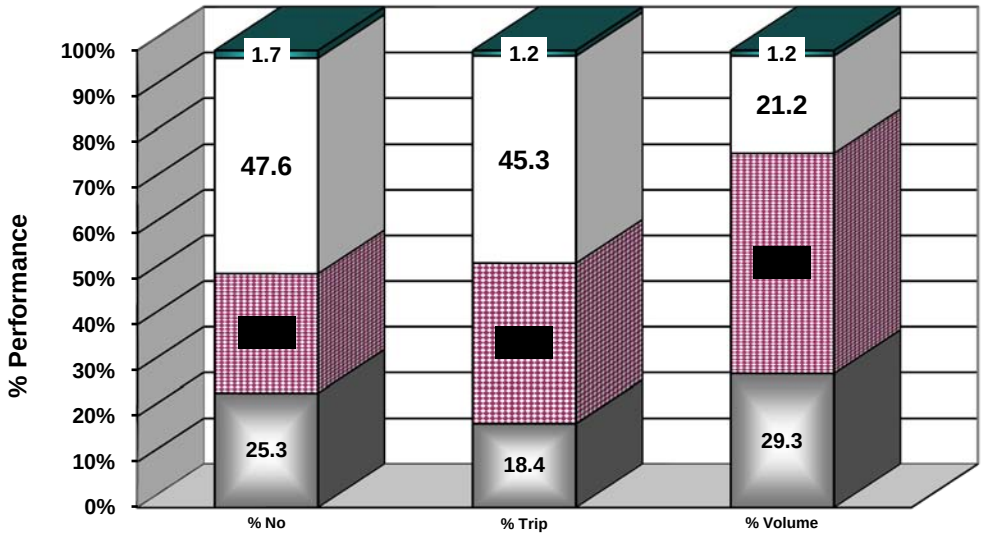
Commission of Inquiry, Academic journals and past research works, Task Force Reports while the fieldwork entail questionnaires, interviews, observations and measurements. Others are websites and Digital Libraries like Solid Waste Technology and Management: www.widener.edu/solid.waste, Recyclers World: http://www.recycle.net/recycle/index.htm/World Environmental Library 1.1, United Nations University Press: www.unu.edu.

VI. Findings and Analysis

The relevant institutions for analysis are The Highway Managers operating on major federal and state roads; LAWMA working on industrial and public spaces' Private Sector Operators focusing on domestic waste, the Cart Pushers and the scavengers operating from domestic front dumpsites. Highway Managers and PSP are the experiments in the involvement of private sector in waste collection.

The Relative Performances of the Waste Transportation Agencies



OTHERS	1.7	1.2	1.2
PSP	47.6	45.3	21.2
H MAN.	26.4	35.1	48.2
LAWMA	25.3	18.4	29.3

The study derived the daily basic waste collection parameters of the relevant waste collection agencies. The parameters are the number of vehicles available, their trip frequency, the capacity or the size of the vehicles. The major highlights are that in terms of the absolute number of vehicles PSP has the highest average of 97 on the road per day and this constitutes forty-eight percent of the total number of waste vehicles on the road in the study area. But a closer look at their vehicles reveals that 57% of this stock belongs to the small 5tonnes category. The second agency having the second largest number is the Highway Managers with an average of 55 vehicles on the road per day that amount to 26.4% for all. LAWMA came close in the third position with 52, which makes 25.3% of the stock of all the agencies. The least, as in all other respects, is the group classified as others.

On the relative number of trips, the most frequent again is the PSP with a frequency rate of 148 trips per day making 45.3%. The 5ton vehicle makes 90 trips out of this number. The Highway Managers came second with a daily trip frequency of 115. The utility vehicle of the Highway Manager is the 15ton, which made 84 out of the total trip of the agency thereby controlling 73% of the operational movements of the Highway Managers. The vehicle of the second choice is the 30ton making 24 (20.7%) trips daily. LAWMA came third with average daily trip frequency of 60, taking 18.4% of the share of all the trips made. The vehicle of choice for LAWMA is the twenty and thirty tons (Dino, Mammoth and DAF Trailers); 93% of its trips were made by the 20ton vehicle type.

The effect of the type of vehicle is reflected in the total volume of waste transported by the different agencies. While the PSP was leads in the number and trips made, the size of the vehicle of choice is very small such that the Highway Managers with less number of vehicles and trips collects the largest volume of waste daily. They are collecting 2,043 tonnes daily, which accounts for almost 50% of the waste being transported in metropolitan Lagos. LAWMA comes second with daily transportation of 1,243 tonnes of waste, which is about 30% of the total waste moved to the landfill sites. PSP collects 900 tons (20%) while the others were collect only about 1%. The waste transporters in order of capacity and delivery is first, the Highway Managers,

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second is LAWMA followed by the Private Sector Participant. There are some others but their input is marginal.

The findings on the relative performances of the different types of vehicles in the waste collectors' fleet show that the Vehicles of choice for the waste carriers in the study area are the 15, 20 and five tonnes size. The vehicle taking the biggest share is the 15ton size; it accounts for 31% of the total waste removals. Close to this is the 20ton size collecting 30%. In the order of weight transported, the other types of vehicles' share are 30ton, (19.4%) 5ton, (10.9%) 10ton, (4.8%) and 7ton (2.2%). The rest are collecting less than 1% each. The total daily waste collection capacity of all the waste collection agencies in metropolitan Lagos is 4,237 tonnes.

VII. Waste Generation and Collection Differentials

The average per capita waste generation in the area is estimated to be 0.53 kg. The 1991 Census put Lagos population at 5.68 million; the United State's Bureau of Census estimated the figure to 11.314 million. The United Nations projected the figure to be 12 million. From this the daily waste generation in the metropolis will be 12million x 0.53 = 6,360 tonnes.

Given the estimated collection capacity of 4,237 tonnes for all the agencies, the expected left over will be 6,360 – 4,237 = 2, 123. This will be the waste that ends up in unofficial dumpsites dotting the metropolitan landscape. Sometimes the PSP operators dump their collections in many of these places. The Cart pushers, due to their non- recognition have adopted these as the normal dumpsites. Majority of the households, in the city do not see any need for engaging a private collector who will be charging them fees what they believe they themselves can dump in the nearest swamp, open space, Lagoons, the Atlantic, Creeks, roadsides and road junction.

VIII. Conclusion and Recommendations

Given that the private sector which comprises of the highway managers and the PSP collected more than 70% of the waste volume even in the experimental stage is a pointer to the potential of this sector as a strong ally and a more efficient one at that. The LAWMA which is the government agency could only collect less than 30%. It is therefore suggested here that the solution to the problem of waste disposal in urban centres of the country-and equally likely in other cities of developing countries-is the involvement of the private sector participant. However the following suggestions should be noted on the part of the relevant supervising government agency. There should be appropriate legal framework and enforcement to address fee collection for the private operators. There should be adequate provision of basic infrastructure like the landfill site and transfer loading station. Public enlightenment campaign is required to carry the populace along on such concomitant issues like payment modalities, sorting and the general policy thrust of government. It is important to grant the scavengers and cart pushers official recognition and create a niche for them in the scheme. And there should be continuous monitoring and evaluation to accommodate the changes that will necessary occurs overtime.

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