

Assessment of Urban Drainage and Sanitation Challenges in Nigeria

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Abstract— One of the observable impacts of rapidly growing urbanization and economic development in emerging cities of developing nations is witnessed in drainage problems connected to poor sanitation. The objectives of this research are to examine the causes and extent of damage on drainage and poor sanitation systems in urban areas, highlight measures to improve health and living conditions of the residents, and propose measures to improve the economic functioning of the cities. Six (6) Local Government Areas (LGAs) in Lagos State, Southwest Nigeria were selected. The descriptive cross-sectional study identified 50 respondents from each LGA through careful selection. Data were collected through validated questionnaire, thorough observations and interviews with residents. The result of the investigation shows that ineffective drainage systems are basically associated with poor maintenance, indiscriminate dumping of refuse in drains, erection of building on drainage channels and alignments that inhibit the flow of water which leads to critical environmental hazards. The study suggests new approach that could be used to achieve sustainable and effective sanitation which would support government's effort in upgrading urban services by preparing plans and feasibility studies, improving drainage maintenance procedures and effectively manage human waste disposal.

Keywords— drainage problems, environmental pollution, government, poor sanitation, private sector, public-sector, sustainable approach.

I. INTRODUCTION

The Rio declaration and the Agenda 21 from the early 1990's introduced the concept of long-term sustainability of our environment. One important ingredient in the new approach is that technical, economic and social aspects of the development are handled carefully. There is today, a consensus that urban water systems should be approached in an integrated way. Surface water, groundwater, water quality, quantity, and ecology should be looked upon in relation to each other. Thus, the introduction of the concept of sustainability has, in the field of urban water systems among others, led to an increased interest for source control and open drainage of storm water within the urban environment (Geldof and Stahre, 2006).

Presently, about 2.6 billion people are living without proper sanitation, of which Africa is not exempted (Olukanni, 2013a; WHO/UNICEF, 2012). The need to provide proper drainage and sanitation facilities is essential to match up with the ever increasing population growth (Banerjee and Morella, 2011). The increase in the population of a settlement and the attendant growth of the needs of the residents in both quantity and variety, bring about intensive exploitation of the resources of the environment. Such exploitation might increase to a level that the resources would not be able to sustain the population, and in some cases the environment would collapse resulting in serious environmental problems (Asoegwu, 2009). This is further buttressed by Belete (2011) who expressed that high urban population growth rate also results in drainage system challenges because an increase in population requires a proportionate increase in infrastructure (roads and drainage systems) of which when not properly catered for, the facilities will be imperfect. Also, inadequate integration between road and urban storm water drainage can be attributed to natural causes such as intense rainfall, flat topography and poor soil infiltration or man-made causes such as improperly laid and graded street, poor and inefficient drainage facilities that aggravate the flooding problem (Jimoh, 2008).

Urban environments in Nigeria are faced with myriad of issues regarding poor drainage systems (Offiong et al., 2009) and water tight structures which are the major causes of flooding (Belete, 2011). Urban flooding which is the inundation of land or property in a built environment, particularly in more crowded areas are caused by rainfall overwhelming the capacity of drainage systems. Although this is sometimes caused by events such as flash flooding (Tucci, 2001).

Urban flooding is a condition characterized by its repetitive and systemic impacts on communities whether or not the affected communities are located within floodplains or near any body of water (CNT, 2013). Sule (2001) described Lagos, Calabar and Ibadan as cities where houses are constructed directly on drain channels and that this practice has resulted to blockage of storm drains and consequently leading to overflow and flooding of streets.

Also, poor drainage systems in Lagos State have caused tremendous environmental challenges. These challenges are basically associated with poor maintenance of drainage system and flood which eventually leads to environmental hazards. Some places were flooded, making the roads practically impassable for motorists. In many instances, torrential rainfall literally submerged the cities, halting human and vehicular activities thereby forcing residents to stay indoors as a pre-emptive measure against human disaster. Therefore, this study seeks to highlight the causes and environmental implications of bad drainage systems in the areas under study, highlights measures to improve health and living condition and make possible solutions and suggestions towards improving economic functions of the cities.

A. Study Area

Lagos State lies between the sedimentary belt of South-Western Nigeria on longitude $2^{\circ} 45'E$ and $4^{\circ} 20'E$ and latitude $6^{\circ} 2' N$ and $6^{\circ} 4' N$. It is the most urbanized State and its cities are ranked amongst the major growing cities in Nigeria (Mabogunje, 2002). It has a land area of 3577.28km^2 and population density of 4906.78 persons per km^2 (Source: Surveyor-General Office Secretariat, Ikeja) and has a population of about 17,552,942 (Census, 2006). Figure 1 shows the map of the study area.

II. MATERIALS AND METHODS

For this study, information and data collection were obtained via two sources which include: Primary and secondary sources.

A. Primary sources

i) Administering of Questionnaires:

The questionnaires designed respects the rights and anonymity of the respondents thereby ensuring confidentiality of the respondents. A total of 300 copies of a well compiled questionnaire addressing the most likely causes, effect of water drainage challenges as well as environmental challenges relating to the improper utilization of the drainage systems in the chosen locations were used.



Figure 1. Lagos State Map showing the selected locations under study

ii) Study Area Observations:

For this study, pictures of different scenario as it relates to different drainage issues were taken to show the true state of things in the study area. Observations and discussion with residents were also made and recorded. This also gave an insight to the major challenges encountered within these areas of study.

B. Secondary Sources

Vital information was also retrieved from interviews that were held with the frequent road plyers and local community members. This was pertinent to harvesting information on the over-looked causes of poor sanitation system and drainage challenges. Other secondary sources of information that was used include books, journals, conference proceedings etc. Both quantitative and qualitative techniques in data collection and analysis were utilized as main instruments. A total of 300 questionnaires were distributed using stratified random sampling method to the six (6) local governments (50 each) and 100% recovery was recorded.

III. RESULTS AND DISCUSSION

Indiscriminate dumping of solid waste culminates into negative effects on lives and the environment at large. Estimates have shown that 30 – 50% of solid wastes generated in Nigerian cities are uncollected and disposed of indiscriminately (Falade, 2001; Olukanni and Akinyinka, 2012; Olukanni, 2013b). Table 1 displays the response of residents as regards to the drainage problems experienced within the study area.

Table 1:
Response On Drainage Challenges From Residents.

Percent %							
Locations	Agege	Mushin	Ikeja	Alimosho	Apapa	Ifako Ijaye	Average Percent (%)
YES	72	80	52	80	79.2	79.2	75
NO	28	20	48	20	20.8	20.8	25

The lack of adequate waste collection and disposal system cause poor sanitation as it leads to the blockages of drains. Increased population, human activities and inflow materials into the area results in the generation of larger volumes of waste, coupled with irrepressible location of physical infrastructures such as offices, facilities, markets and residential structures which are located and built along natural erosion routes and drainage channels. From the results obtained in the study, 59.1%, 61.9%, 55 %, 44%, 80 %, 54.2% of the respondents in Agege, Mushin, Ikeja, Alimosho, Apapa and Afako Ijaye, respectively, agree that the abuse of drainage system is the most likely cause of drainage problems in all the local governments under study.

The drainages that were constructed in these areas lacked proper maintenance, as debris and waste materials were dumped into the drain thereby inhibiting flow of water in the drains. This indiscriminate attitude occurred majorly by road users who drop waste materials into the drains owing to insufficient waste bins around. Figure 2 shows the severity of the issues in each of the local government.

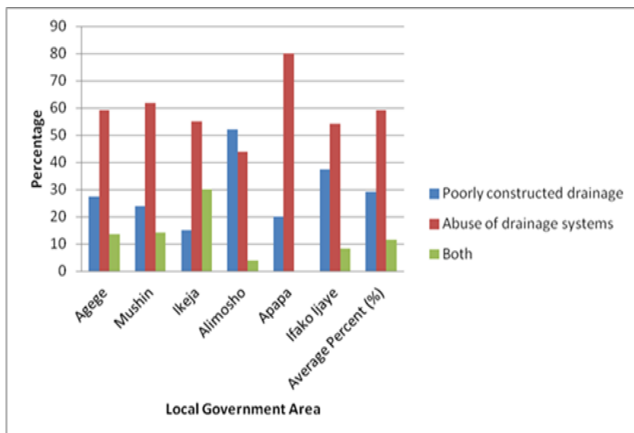


Figure 2: Showing the causes of flood in each of the Local Governments

A. Excess Sediments and Garbage

After each occurrence of flooding and storm, wastes are dumped in ditches and drainage channels. These drainage channels remains unattended to and thereby get clogged. This causes blockage of channels for the subsequent runoffs and other contents. Figure 3 shows the deterioration of the functionality of the drains in these areas of study.



Figure 3: blocked drains as a result of abuse of drains with waste deposits

Also as this blockage exists, the road pavement attached to these drains is also under threat. Water builds up on the pavement (flood) thereby causing a wear and tear, with washing of bitumen and other road components into drains thereby causing further damage and leading to drain failures.

B. Effect of Poor Maintenance

The construction of drainages will be a waste when not properly maintained. The performance of a drain is attributed not only to how effective it is utilized, but also to the conditions therein. These conditions include the presence of waste, the presence of growing plants and leakages. These challenges do not only retard flow in the drain, but they also increase overflow conditions. It was clear that the drainage challenges within these areas were as a result of poor maintenance of the drains themselves. This has created habitats for growing weeds and stagnation of water. Figure 4 shows a collapsed drainage wall with weeds growing on it.



Figure 4: Showing a poorly maintained drain

C. Lack of Community Participation

One of the main obstructions preventing the successful control of storm runoff measures either by structural or non-structural measures is the absence of community participation in providing solutions to urban drainage problems. Community participation simply depends on the desire and ability to organize themselves, strict compliance to societal goals and rules, and providing medium of direct communication by the appropriate municipal administration. This provides linkages in which municipal authorities can pass useful information to residents, and vice versa. It can also develop into participatory function where well-defined priorities that pertain to urban drainage can be evaluated. As a result of compliance, the level of technical information as well as environmental education increases. The absence of community participation gives room for repetition of earlier errors in tackling drainage problems and also low investments in urban facilities

Silveira et al. (2001) identified the biggest difficulty in community participation which is the wide difference in socioeconomic levels amongst those living in the city (Table 2). Poor people living in areas with run-down public services inherently pay little attention to public utilities. It is no news anymore as people regard urban drainages as the place to dispose garbage. The establishment of garbage collection system may not bring change if other public services such as efficient and effective delivery of municipal waste to disposal areas do not exist.

However, environmental education programmes are necessary but not adequate in eradicating urban drainage problems.

In Lagos, the introduction of “Environmental Sanitation Day” which takes place every last Saturday of the month, adopts a systematic cleanup of urban waterways by residents thereby freeing drainages from subsequent blockage. With this participation, the problems of garbage and sediments in drainage channels remains, placing doubts on the effectiveness of such measures, at least in the short term. There is no objective measure to increase the effectiveness of such a programme, yet it cannot be abandoned. The efficacy in the long term would be on the increase when today’s children become adults tomorrow and are adequately taught how to participate in environmental preservation.

**Table 2:
Socio-Economic Factors In Developing Countries**

Socio Economic Factor	Effect	Consequence
Insufficient environmental education of most of the population	Lack of knowledge and care about the impact of trash on streets and in watercourses	Discharge of refuse, sediments and excreta on streets and into watercourses
Social forces of the poorest segment of the population	Illegal occupancy of urban preserved areas	Deforestation, exposure of bare soil, impervious
	Illegal occupancy of urban risk areas	Landslides, production and direct discharge of sediments and refuse into watercourses
		Unacceptable exposure to major floods (life-risking floods)

Source: Silveira et al. (2001)

Community participation in terms of sanitation provides members of the community the opportunity to contribute in the policy and decision making process. In its contribution, the place of planning, implementation, monitoring and maintenance of drainage channels should be given its rightful place as regards to sustainability. Participation in its approach is seen as a means of ensuring augmented social accountability with the involvement of the citizens in decision making as well as creating a close relationship between the “governed” and the “governing”.

This could be achieved through public hearing, workshops, social surveys, reports, public meetings etc. This helps in development of local capabilities which its importance cannot be over emphasized.

D. Health Impacts

Flood related issues are experienced majorly during the raining seasons in Nigeria but they are very pronounced owing to poor sanitized environment during and after the raining seasons. Areas experiencing poor drainages like the areas under study allow runoff from these areas to have an interaction with black water from exposed or overflowing septic tank systems causing outbreak of water-borne related diseases and also, infiltration and percolation of this polluted water into the ground water will cause contamination. This is a conduit for gastro-intestinal diseases such as constipation, anal disorders, and structural disorders amongst others. To curb these hazards, proper cleaning of channels should be done on a regular basis and not only on sanitation days to reduce the habitation of pathogens responsible for these diseases. Also, more refuse dumps (collection points) be provided in this areas understudy and be visited by the agencies responsible on a regular basis to help reduce epidemics.

E. Drainage Designs Problems

Urban drainage system issues are also generated by improper design of these systems. This is attributed to the variance created in rainfall distribution patterns faced by the developing countries as a result of global warming (Silveira, 2001). Most of these drainages were designed with basic hydraulic formula without considering this variance thereby ending up not solving flood cases in these areas. More emphasis has to be made to producing home-grown methods that are related to these areas rather than depending on this formula or assumptions already in use in the developing countries because we have different catchment characteristics. Also, roof catchment methods of rain water collection should be encouraged to reduce peak flows of runoff that should have entered this drainage. There is so much reliance on hydrological data in determining the drainage challenges. Vital information and proper data collection such as water quality of runoff and sediments transport should not be neglected.. This could improve the design and sustainability of these drainage channels.

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G. Urban Drainage Planning

In the study areas, the alteration in the planning has led to buildings being erected on drainage channel and path thereby increasing storm water problems. Also, it has left little or no escape routes for flood water thereby making these structures ineffective and insufficient. Drainage planning in the beginning is essentially a sure way to abate flooding issues. Secondly, due to alteration in urban planning, there is need for a review of the designs of the various drainage networks already in use. Thirdly, the government needs to urge relevant institution in-charge of housing and planning in Lagos and especially the areas underlisted in this research, to do a proper quality assurance in terms of urban planning. The policy should henceforth mandate that only houses which are in accordance with already laid policies which promote well-being and sustainability of the city be approved.

IV. CONCLUSIONS AND RECOMMENDATIONS

The state of urban drainage is of great concern because of the health implications and environmental dangers that it poses. Technical limitation to conventional urban drainage method is a predominant factor that decision makers and planners face. To overcome these limitations as well as preventing ecological problems in the future, there is need to measure today's system. This can be achieved through sanitary approach which involves more of community involvement in actualizing the goals of proper and effective sanitation process. The processes aforementioned should be encouraged at all levels by the government through workshops, public hearings, and seminars for residents.

When policies are developed, the community should also ensure that there is a follow up or else it would be a complete waste. This will help in achieving a sustainable and effective sanitation that would support government's effort in upgrading urban services, and improve drainage maintenance procedures.

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Therefore, in order to ensure a sustainable and efficient drainage system, the following recommendations are made:

1. There should be policy development based on a renewed understanding of the environmental situation in Lagos.
2. Existing waste legislation should be enforced to promote education and awareness amongst the people toward waste disposal issues and its adverse impacts on health.
3. Necessary measures should be put in place to rehabilitate all the bad drainage systems.

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