

ASSESSMENT OF URBAN DRAINAGE SYSTEM IN NIGERIA: A REVIEW

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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. This study is aimed at reviewing the various challenges of urban drainage systems in Nigeria and to suggest means to reduce these challenges by providing contributory factors to the blockage of drainage systems and how they can be controlled. The review showed 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 review 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, challenges, poor sanitation, contributory factors

1.0 Introduction

Over decades, urban drainage systems have existed as a vital city infrastructure to collect and convey storm water and wastewater away from urban areas (Qianqian, 2014). Storm water drain networks in cities are usually designed to effectively gather and convey excess surface runoff in order to avert urban flooding (Gouri & Srinivas, 2015). Often most of these drains face reduction of functionality and capacity for transferring the runoff flow, and their level of service reduces due to degradation in time, improper maintenance, inappropriate design, aging, sedimentation and siltation, increase in materials' roughness, and structural deterioration (Neginet *et al.* 2016).

Drainage systems are required in urban areas to develop the interaction between human activity and the natural water cycle (David & John, 2014). Urban Drainage Systems are the recommended techniques towards solving three major problems which includes flash flood, water scarcity and water pollution (Nor *et al.* 2007).

Flood can be defined as the discharge that may be expected from the most severed combination of meteorological and hydrologic conditions. They are considered based on the characteristic of the geographical region involved excluding extremely rare combination (Ottiet *et al.* 2013). Practically, most of our storm water runoff especially in urban areas is catered by conventional drainage systems that carry runoff to the downstream by rapid disposal concept (Nor *et al.* 2007).

The residents of informal settlements, particularly slum dwellers, suffer from a wide range of environmental problems related to lack of drainage infrastructure. They are generally most vulnerable to flood because their dwellings are poorly drained and served by urban infrastructure and services (Jonathan *et al.* 2007). Conventional drainage systems are designed to collect and transport water runoff from urban areas as quickly as possible via sewer networks and water conveyance facilities to nearby receiving water bodies in order to avoid urban flooding (Qianqian, 2014).

In a research on drainage on roads by Singh *et al.*, (2014) a well-designed and maintained road drainage is important in order to: minimize the environmental impact of road runoff on the receiving water environment, ensure the speedy removal of surface water to enhance safety and minimize disruption to road users and to maximize the longevity of the road surface and associated infrastructures.

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).

The need to provide proper drainage and sanitation facilities is essential to match up with the ever increasing population growth (Banerjee and Morella, 2011).

This study is aimed at assessing the various types of drainage systems in urban drainage settings and also 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.

2.0 Challenges of urban drainage systems in Nigeria

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.

The drainages that are constructed in Nigeria lack proper maintenance, as debris and waste materials are 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. Some of the peculiar situations are discussed below.

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.

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.

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.

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. 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 programs are necessary but not adequate in eradicating urban drainage problems.

In certain cities in Nigeria such as Abuja, Kano, Lagos, Ibadan, Portharcourt, Aba and Minna, the absence of Environmental Sanitation Day which originally takes place every last Saturday of the month, adopts a systematic cleanup of urban waterways by residents thereby freeing drainages from subsequent blockage. During this process of non-environmental sanitation day, the problems of garbage and sediments in drainage channels remain.

Urban drainage planning and design

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.

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.

Health Implication of Poor Drainage Systems

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.

3.0 Contributory Factors to Blockage of Drainage Systems

Sediments and garbage

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). Wastes generated in various homes and small industries are mostly dumped in ditches and drainage channels. These drainage channels remain unattended to and thereby get clogged. This causes blockage of channels for the subsequent runoffs. Figure 1 shows deterioration of the functionality of the drains in these areas of study.



Figure 1: blocked drains as a result of abuse of drains with waste deposits (Olukanni *et al.*, 2013)

With the existence of blocked drains, road pavement attached to these drains is also under threat. Water builds up on the pavement (flood) thereby causing wear and tear, with washing off of bitumen and other road components into drains thereby causing further damage and leading to drain failures.

Effects 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 from Figure 2 shown below were as a result of poor maintenance of the drains themselves.



Figure 2: Showing a poorly maintained drain (Olukanni *et al.*, 2013)

Design of Drains

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.

Materials carried by runoff

The improperly disposed refuse which comprises discarded plastic, foot-wears, clothes etc. equally block the drains especially at their narrow ends or points. This equally results to overspill or overflow of the storm water in the drains leading to flooding that can burst into people's homes and farms destroying household property and crops (Ejikeme, 2013).

Flood water especially when flowing at a rapid rate or velocity has the capability of displacing objects such as parked and broken down vehicles and can even drown human beings especially children. The storm water up-turn or uproot under laid water pipe lines, electric poles and underground cables (Otti, 2013).

Erection of building on drainage channels

As new buildings sprung up, new landlords began to construct concrete pavement compound to block the drainage ways. The singular act of indifferent, obviously contributed to the erosion menace in the streets and roads as well as rapid rate of generation of flood water (Nwafor, 2013).

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 contributes to the improper discharge of waste materials and as such result in drainage collapse.

4.0 Conclusion

From the review, it can be concluded that poor drainage facilities on highway structures has many devastating effects on the economy of users, as both functional and structural failures due to poor drainage leads to increase in travel time, thus reducing productivity of a community or nation. It also leads to sicknesses such as Malaria fever as most drains are breeding ground.

As a result of poor drainage systems which lead to the destruction of roads, there is increased number of accidents thus leading to the destruction of lives and properties.

Therefore effective road drainage should be taking into consideration during construction of roads alongside the various maintenance practices.

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.

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