44 CHALLENGES OF DRAINAGE SYSTEM IN NIGERIA WITH RESPECT TO GREY WATER USE FOR IRRIGATION: CASE STUDY OF MINNA

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ABSTRACT
This study was conducted to check the menace of failed drainage system in Minna, and to find the causes, effect and the corrective or preventive measures to be taken. Various drainage areas were visited during this research to observe the various causes and effects. It was found that, drainage system of the town is grossly inadequate, with poor sanitary culture, improper layout of houses, blocked drainage paths and indiscriminate dumping of refuse, all contributing to the high rate of erosion and flood problems in Minna. It was recommended that adequate preventive and corrective measures be taken to reduce the problems of erosion, and the improper laying out of the town be noted.

Keywords: *Drainage, erosion, flood, refuse, waste water.*

INTRODUCTION
Majority of the world's population live in the so-called "developing" countries-many of them living in dire conditions in the slums to be found in most towns and cities (Armitage, *et al* 2010). A particular problem associated with these slums is poor drainage. He further stated that many slums are informal settlements that have come about through land invasion and lack of proper planning. Slums arise through a combination of rapid population growth (both though high birth rates as well as large in migration), weak local government (resulting in adequate planning and management). Insufficient investment (perhaps a consequence of a small tax base or/or high levels of corruption) and a lack of skilled personnel (both professional as well as maintenance) (Armitage, 2006).

The beginning of civilization started when man could settle in a place to meet his basic needs. He then intuitively discovered that he could no longer roam the earth to seek for food and fauna because of the rigors, unreliability of such search and the conflicts and confrontations with other roaming groups (Musa, 2012). The establishment of such permanent settlements involved, among other things, a continuous use of the resources of the environment to sustained needs of man. The increase in the population of such settlements and the attendant growth of the needs of man in both quantity and variety generally generated equivalent intensive exploitation of the resources of the environment. Such exploitation might increase to a level when 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). The degree urbanization and extent of impervious area which comprises the roof areas and large expanses of paved surface, where there is very little or no earth surface into which rainfall could infiltrate the volume of runoff obtained from such areas (Musa, 2012). He further stated that, the effect of this (Urbanization) development on elements of hydrological cycle, like precipitation, infiltration, percolation, transpiration, evaporation, and

surface runoff is enormous. Drainage plays a very important role in urban low and medium income housing areas, especially in the developing countries: this is because it removes unwanted water from the site or living area as quickly as possible, thus reducing likely health hazards of flood and erosion to the inhabitants of the areas and the deterioration of other agricultural infrastructures such as farm buildings and roads (FEPA, 1991). Nigeria is committed to be a national policy that ensures sustainable development based on proper management of the environment in order meet the needs of the present and future generations. This demands positive and realistic planning that balances human needs against the potentials that the environment has for meeting them (FEPA, 1991). The continuing increase in urban growth presents a significant challenge as well as a timely opportunity for the application of environmental and conservation management practices for our cities (Uchegbu, 1998). Although problems of flood and erosion are nationwide in Nigeria, the intensity varies in different places. The problem however is most prominent in the Easter and Northern Nigeria, and as a result, arable lands, agricultural produce, landed and household properties have been damaged by gullies created right in the middle of roads and many farm lands, market and communities cut off from one another (Musa, 2012). The researcher further stated that, it is an established fact that flood and erosion are natural occurrence, however, the general apathy shown by people of Niger state towards environmental sanitation is very poor and the use of drainage system as refuse dump sites had over time blocked the drainage paths, thus the purpose of the creation of drainage systems not been achieved. Insufficient attention has been paid by almost all engineers to the debilitating impact of weak social and institutional structures.

The objective of this study is to examine how excess runoff which is inimical to the environment is removed and extreme flood and erosion event (both arising from runoff) are controlled to appraise the general condition of drainage network in Minna in order to minimize the rate of erosion and flood being experienced almost annually by some resident of the area and finally to identify the problems confronting these drainage systems in Minna, Nigeria.

Description of Study Area

Niger State, with Minna as the state capital, is one of the major states in the north central area of Nigeria known for its agricultural activities (Musa, 2012). Minna is located on longitude $9^1\ 37^0$ N and longitude $6^1\ 33^0$ E. Minna has a total population of approximately 506,113 with an average population density of about 3448 persons km^2 (UNDP/NISEPA, 2009). The population growth in the city is higher than the average of the whole country because of its proximity to Abuja, the Federal capital of the country.

MATERIALS AND METHODS

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

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.

RESULTS AND DISCUSSION

Causes and Effects of Failed Drainage

Indiscriminate dumping of solid waste culminates into negative effects on lives and the environment at large (Olukanni, *et al.* 2014). 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, 2013).

Poor drainage system in Minna has caused tremendous environmental challenges (Musa, 2012). These challenges are basically associated with poor maintenance of drainage system which eventually leads to environmental hazards. Some areas of Minna are easily flooded, making the roads practically impassable for motorist; I give example here. In many instances, torrential rainfall in some raining season literally submerged some section of the city, halting human and vehicle activities thereby forcing residents to stay indoors as a pre-emptive measure against human disaster.

During the reconnaissance, it was observed that most of the drains were converted into dumping ground where all sorts of waste material can be found.

Figure 1: showing filled drainage system along Mypa road due to lack of adequate maintenance of the drainage system and provision of refuse dump sites, culverts constructed for easy passage of traffic and human have collapse further hindering the free flow of water in the drainage system vehicles and human. An example of this is that found along Ibrahim Sarki Randan Ruwa in Bosso.

Fig. 2: Ibrahim Sarki Unguwan Biri Bosso

Fig 3: Union Bank Road Minna

Figure 3 shows collapse drainage system which has lead to chopping off road, residential lands and building, the effect of soil erosion caused by collapse drainage is very enormous and dangerous, if serious control and corrective measures are not taken to fix these drains, the hazard may even be beyond what we are seeing today.

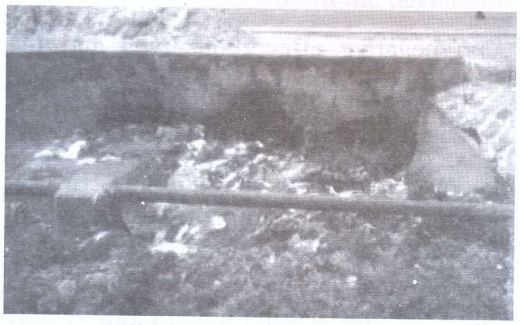

Fig. 4: filled culvert along Mechanic road

Fig. 5: filled Drainage along ketaren Gwari road.

Figure 4 and 5 shows how refuse and heap of sand take over water ways. In plate 5, the residents around the drainage system are responsible for dumping refuse inside the drain forgetting the negative effect and hazard it may lead to, while for figure 4, these refuse and sand are transported by rain, if these refuse and sand that fills these drain are not control, it may lead to partial or total taking over of the drain, disallowing free flow of water thereby leading to over flow and erosion. Most of the above scenarios are simply caused by improper designs, lack of maintenance culture by the residents, abuse of use of drainage as dumping sites and blocking/building along water ways leads to menace facing the Minna community. If these problems are not properly addressed, these might lead to outbreak of diseases, floods and destruction of valuable properties of the residents of Minna.

A. Excess Sediments and Garbage

After each occurrence of flooding and storm, wastes are dumped in ditches and drainage channels. Theses drainage channels remains unattended to and thereby get clogged. This causes blockage of channels for the subsequent runoffs and other contents. Fig. 1, 4 and 5, shows the deterioration of the functionality of the drains in these areas of 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. Fig. 1, 4 and 5, shows the severity of the issues in each of the area, 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(Olukanni *et al.* 2014).

B. 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.

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)*

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

C. Health Impacts

Flood related issues are experienced majorly during the raining seasons in Minna 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 (Olukanni, *et al.*, 2014). 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.

D. 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

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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.

E. 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 Minna and especially the areas under listed 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.

F. 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. Fig. 2 and 8, shows a collapsed drainage wall with weeds growing on it.

CONCLUSION

The review showed that the drainage system in Minna are not adequate and the available once have not been properly used for the purpose that they have been constructed for, because the drainages have been turned into refuse dump sites as the inhabitants of the various areas who continue to indiscriminately dump refuse and other solid materials in the drainage system, thereby increasing the tendency of flood and erosion problems within the area.

Enforcing environmental laws and regulations regarding littering and improper disposal of solid waste should be put in place and stronger penalties should be imposed on offenders. Environmental education and public awareness through public orientations, workshops, public hearings and seminar for residents be increased, the public should also participate in cleaning activities that will improve the system in weekly or monthly basis. Such activities will lead to clean environment and reduce the risk of erosion, flood and disease out breaks.

The government should emphasis on the construction of drainage systems with adequate discharge capacity around residential and non-residential areas which should be channeled into bigger drainage systems that will transport the surface runoff into collection points for treatments.

The Government should make provision of designated refuse dumping sites near possible areas where they are expected to be used. Health and sanitary officers should go around every street at least once in a week to ensure that residents and inhabitants comply with the laws on effective uses and management of drainage and refuse disposal systems. The Land survey department of Ministries of Works, Housing, Land and Survey and Niger State Urban Development Board should

ensure that everybody abides strictly by the State or city development plan. They should ensure that construction of any type is not carried out or allowed on drain paths, and where such exist they should be removed.

When policies are developed, the community should also ensure 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 improving drainage maintenance procedures.

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