IJABR Vol. 4(1&2): 85 -93 (2012)

Short Report

Environmental Appraisal of Drainage System in Minna, Niger State-Nigeria

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Submitted: Aug. 23, 2012; Accepted: Nov. 12, 2012; Published: Dec. 17, 2012.

ABSTRACT

Available records indicated that erosion and flood problems in Minna have assumed such frightening magnitude in terms of loss of lives and properties. This study is in response to the need to find solutions to major waste disposal methods in Minna. Various methods were used for the appraisal, among which were reconnaissance of the town, effect of rainfall on the erosion and flood of the town. Rainfall data were collected and street pictures showing blocked drainage paths and indiscriminate dumping of refuse to illustrate study areas. It was found that, drainage system of the town is grossly inadequate, with poor sanitary culture, improper layout of houses and moderately high rainfall depth, all contributing to the high rate of erosion and flood problems of the town. It is thus recommended that adequate measures be taken to reduce the problems of erosion, and the improper lying out of town be revisited.

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

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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).

Urban drainage systems, for the control of impermeable surface storm water runoff, represent a particular issue for developers, regulatory agencies, and water service companies given the increasing pressure to achieve sustainable drainage solutions. Best Management Practices applied to such drainage systems can offer flow control and pollution removal, as well as secondary benefits of water quality and ecology improvements. Moreover, in addition to being effective in terms of performance, they also can be cost-effective at least in terms of

investment if not operation and maintenance, when compared with conventional systems (Linsley and Franzini, 1992).

The dawn of civilization started when man learnt that he could settle down in a place to fend for his needs. He then intuitively discovered that he could no longer profitably roam the earth to seek for food and fauna because of the rigors and unreliability of such search and the conflicts and confrontations with other roaming groups. The establishment of such permanent settlements involved, among other things, a continuous use of the resources of the environment to sustain the 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 of 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 affect the volume of runoff obtained from such areas. 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 the 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 a national policy that ensures sustainable development based on proper management of the environment in order to 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. 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 (Uchegb, 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 Eastern and Northern Nigeria, and as a result, arable lands, agricultural produce, landed and household properties have all been damaged by gullies created right in the middle of roads and many farm lands, markets and communities cut off from one another. 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.

The objective of this study is to see that 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 residents of the area and finally to identify the problems confronting these drainage systems in Minna, Nigeria.

MATERIALS AND METHODS

Study Area

Niger State, with Minna as the State capital, is one of the major States growing in the

north central area of Nigeria which is known for its agricultural activities. Minna is located about 150 kilometers from Abuja which serves as the capital of the Federal Republic of Nigeria; and 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 per 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 new administrative capital of the country. Figure 1 below shows the extracted map of Minna from Niger State and Nigeria.

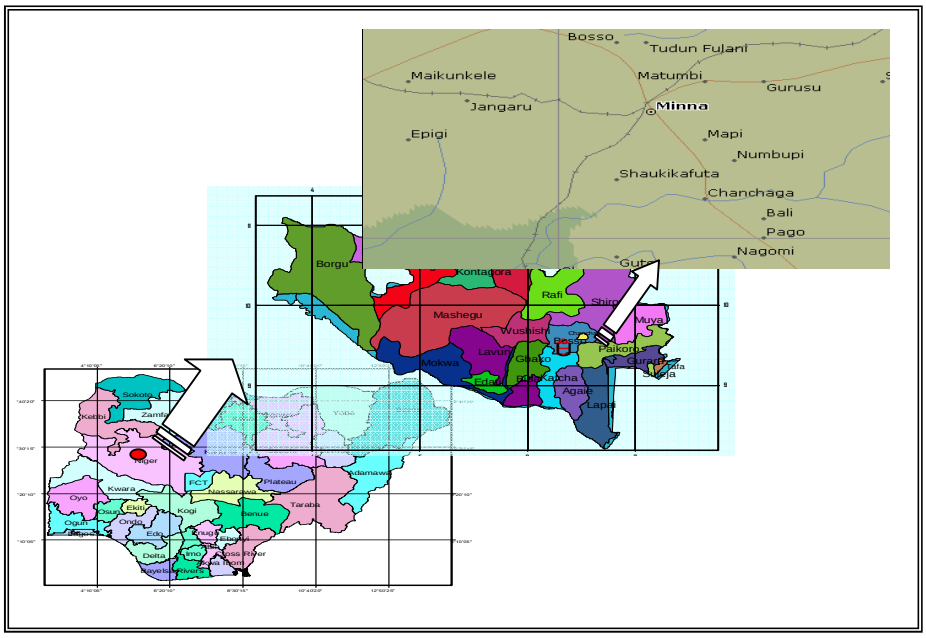

Figure 1: Extracted map of Minna from the map of Niger State, Nigeria.

Precipitation mainly in Nigeria is rainfall which falls from the atmosphere to the earth and flows as surface runoff to the river channels after infiltration, evaporation and transpiration demands have been satisfied. The runoff constituted what is referred to as erosion and flood when it is not accurately discharged.

For the purpose of this study, the best evidence now available is the recorded rainfall data from Metrological Department Minna Airport Station. The record of the immediate past twenty five years rainfall data were collected and used to determine the effects of rainfall on the drainage system of the town mostly within the months of June, July, August and September. These months were considered because of the high intensity of rainfall during those years in Minna. On the spot assessment was carried out to spot out the various blocked, collapsed and unconstructed and possible courses. These spot checks were carried out in location within Minna; these areas are Bosso, Tunga, Chanchaga and Maitumbi.

RESULTS AND DISCUSSION

Table 1 showed the average rainfall for twenty five years in Minna. It was observed that the average rainfall intensity of Minna and its environs over the twenty five years was calculated to be 104 mm/hr. The months of January and February for the whole twenty five years did not receive any rainfall. Also a similar trend was observed for the month of March except for

few years when scanty rainfall was recorded. This goes to confirm that the first three months of the year does not experience much rain that create blockages within the drainage systems neither will the force of the surface runoff be enough to deposit sediments that can create blockage or the collapse of the various drainage system as most of the rain water is generally infiltrated into any available open space of soil. The actual impact rain is felt from the months of April through October.

The highest average mean rainfall value of 143.43 mm for the year 1997 was observed for the twenty five year rainfall period while the lowest was 68.54 mm for the year 1987 was observed. From Table 1 below, it is observed that rainy season within Minna and environs starts mainly from the months of April and ends in October but in some cases extending up to mid November. Minna has a mean annual rainfall of 104 mm taken from a record of twenty five years. It is therefore accepted that the flood and erosion problems experienced since 2006 to 2009 were in response to the precipitation over the town. Moreover, the drainage system on the ground is not adequate and could not accommodate the attendant runoff experienced. All these factors made the impact of erosion and flood most felt during this period.

In this study, waste generated in Minna is classified into two main categories: Domestic refuse (solid waste generated by households, markets, food centers and commercial premises such as hotels, restaurants, etc.) and Institutional refuse (solid waste from various government installations like hospitals, schools and recreational facilities. Waste collection points in Minna are not specified though provisions of waste cans and containers are provided in some specified areas which allow waste from homes to be collected. It was observed during this study that the provided refuse containers are not enough to accommodate the various wastes generated thus some are left around the containers while others end up inside the drains which piles up over time thus obstructing the free flow of drainage waste water. Since the drainage systems have not been adequately maintained, there is bound to be an aftermath effect of flood and erosion occurring in such areas.

For the purpose of analyzing the effects of precipitation in the catchments area in respect to erosion and floods, the mean monthly rainfall of the months of July, August and September over a period of twenty five years (1985 – 2010) was used. For the twenty five year rainfall duration considered, the month of August 1995 was observed to have the highest rainfall depth over the period under analysis. The nearest recorded rainfall depth to this is that of August 2009. Considering the rainfall depths in Minna, it can be observed with blocked drainage systems and fast flowing surface runoffs, flood and erosion processes are evident.

Generally, it can be deduced that the blocked drainage systems and rainfall basically influenced the disastrous erosion and floods problems experienced since 2006 to 2009 over the town and her environs during those years. It is therefore accepted that the flood and erosion problems experienced since 2006 to 2009 were in response to the precipitation over the town.

Table 1: 25years rainfall data within Minna and its environs (mm/hr)

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	AVERAGE
1985	0.00	0.00	0.00	30.00	127.00	132.00	262.00	205.00	331.00	24.00	0.00	0.00	92.58
1986	0.00	0.00	13.40	58.80	66.40	186.90	277.60	279.00	350.20	60.10	34.50	0.00	110.58
1987	0.00	0.00	13.50	44.60	104.50	83.00	143.70	238.50	94.60	100.10	0.00	0.00	68.54
1988	0.00	0.00	0.00	0.00	81.50	132.00	218.30	350.10	403.60	33.10	0.00	0.00	101.55
1989	0.00	0.00	5.00	49.50	287.80	193.70	193.70	248.70	202.00	79.00	0.00	0.00	104.95
1990	0.00	0.00	0.00	177.20	225.20	80.50	256.30	185.80	145.60	110.50	0.00	0.00	98.43
1991	0.00	0.00	0.00	15.00	334.80	180.00	192.20	269.70	192.00	34.10	0.00	0.00	101.48
1992	0.00	0.00	0.00	1.20	158.10	177.00	161.20	195.30	231.00	229.40	48.00	37.20	103.20
1993	0.00	0.00	0.00	0.00	173.60	171.00	189.10	269.70	177.00	62.00	0.00	0.00	86.87
1994	0.00	0.00	0.00	75.00	114.70	240.00	142.60	365.80	261.00	207.70	0.00	0.00	117.23
1995	0.00	0.00	0.00	102.00	124.00	144.00	155.00	409.20	189.00	136.40	24.00	0.00	106.97
1996	0.00	0.00	0.00	48.00	164.30	225.00	260.40	257.30	192.00	127.10	0.00	0.00	106.18
1997	0.00	0.00	41.60	63.30	191.90	190.10	308.70	271.10	473.20	180.70	0.50	0.00	143.43
1998	0.00	0.00	1.20	69.10	102.90	185.50	278.60	280.80	194.90	142.10	0.00	0.00	104.59
1999	0.00	0.00	0.00	36.50	110.50	221.10	200.50	196.10	410.70	181.80	0.00	0.00	113.10
2000	0.00	0.00	0.00	90.70	112.80	181.60	213.80	364.70	168.20	99.70	0.00	0.00	102.63
2001	0.00	0.00	0.00	3.00	136.40	162.00	207.70	310.00	303.00	151.90	0.00	0.00	106.17
2002	0.00	0.00	0.00	97.60	138.90	159.40	316.70	212.70	360.00	60.10	0.00	0.00	112.12
2003	0.00	0.00	0.00	58.60	118.10	145.20	208.30	351.50	251.90	187.10	0.00	0.00	110.06
2004	0.00	0.00	0.00	31.30	99.40	165.70	236.40	215.10	214.80	57.60	0.00	0.00	85.03
2005	0.00	0.00	0.00	56.20	81.60	245.70	229.70	174.10	247.10	72.10	0.00	0.00	92.21
2006	0.00	0.00	0.00	49.10	87.00	207.00	294.20	127.80	226.40	94.80	0.00	0.00	90.53
2007	0.00	0.00	0.00	218.40	86.50	223.60	214.50	332.30	282.80	80.60	0.00	0.00	119.89
2008	0.00	0.00	0.00	28.90	128.90	153.90	305.70	373.50	297.60	53.70	0.00	0.00	111.85

2009	0.00	0.00	0.00	106.50	128.40	105.90	173.90	398.00	254.00	199.20	0.00
0.00	113.83										
2010	0.00	0.00	0.00	46.30	131.50	109.80	260.90	248.30	230.80	161.10	13.00
0.00	100.14										

Source: MAMS (Minna Airport Meteorological Station), 2010

During the reconnaissance, it was observed that most of the drains were converted into dumping grounds where all sorts of waste material can be found. Plat 1 below show refuse in the channels which is the ingredient of flood disasters within most communities.

Plate i: 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 collapsed further hindering the free flow of water in the drainage systems, vehicles and human. An example of this is that found at the back of the Emir's palace in Bosso.

Plate ii: Showing a collapse Drainage system at back of Emir's house

Plate iii: Broken down fence wall along one of the drainage channels

The picture below show an open well sited close to an unconstructed drainage path. The drainage path is filled with different types of waste both human and animal. It was observed that wastewater from nearby houses runs into the drainage path since it is not well constructed and cleaned, thus such wastewater from the drainage ends up percolating into the nearby open well which contaminates the water inside the well which is being used by the inhabitants of the area.

Plate iv: Drainage system close to an open well in Angwanbiri

Erosion and flood disasters are of dangerous occurrence that threatens the life and properties of the people living along their paths. The picture below shows the condition of the uncompleted erosion along Mypa Bridge in Bosso Local Government Area. During the months of August and September, flooding in this area is due to the fact that the drainage path is not constructed. The erosion ends up spreading wider and causing the collapse of many houses and properties around the Mypa road.

Plate v: Showing an erosion site along Mypa Bridge

The picture below is of a location in Minna which shows the devastating effect of both erosion and flood along an abandoned drainage path and the residents of the area now dump refuse and solid materials inside the drainage.

It was further observed that most houses in Minna were constructed without plans or provision for drainage system. This is because most buildings are not approved by the appropriate authorities before building them. Also the rate of indiscriminate and unplanned building in the community is high. Since these houses have no planed drainage facilities from unset, the waste water and sewage waste are been allowed to flow along the streets thus destroying the face of the streets where they are found.

CONCLUSION

From the study carried out, it can be concluded that drainage system in Minna are not adequate and few ones available have been turned into refuse dump sites as the inhabitants of the various areas continue to indiscriminate dump refuse and other solid materials in the drainage system. Thus, increasing the tendency of flood and erosion problems within the area.

Regulations regarding littering and improper disposal of solid waste should be formulated, and stiff penalties should be imposed on defaulters. Public awareness about the environment should be increased through environmental education so that the public participation in the Bi-monthly or monthly cleaning activities will improve.

It is clear from government and general public actions that there is a need to have a clean environment to reduce the risk of disease out breaks. The government should emphasis on the construction of drainage systems around residential and non residential areas which should be channelled 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.

REFERENCES

Asoegwu, R. N. (2009). Enforcing Environmental Laws and Regulations: Levels of Responsibilities. *Journal of*

Environmental Management and Safety, 26-31.

FEPA. (1991). Guidelines and Standards for Environmental Control in Nigeria, Lagos.

Geldof1, G. D., and Stahre, P. (2006). On the road to a new storm water planning approach: from Model A to Model B (Water Practice and Technology Vol 1 No 1 © IWA Publishing 2006 doi: 10.2166/WPT.2006005).

Linsley, R. K., and Franzini, J. B. (1992); *Water Resources Engineering*. Fourth Edition, McGraw-Hill Book Company.

MAMS. (2010). Rainfall Data for Minna and her environs. Unpublished.

Uchegbu, S. N. (1998). Environmental Management and Protection. Precision Printers and Publishers Nigeria.

UNDP/NISEPA. (2009). Niger state framework for integrated sustainable waste management. Niger State Strategic Waste Management Framework (Unpublished).