An Empirical Evidence to the Urban Storm Water Crisis and the Way out in Akure, Nigeria.

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ABSTRACT
The paper reports the result of an academic investigation of the plight of people living in the flood-prone areas in Akure town. Urban flooding has been a major problem in urban centres in Nigeria and in most cities of the world. Urban flooding is caused by some factors. Some of the factors are anthropogenic in nature while others are related to meteorological vicissitudes and geomophological tectonics. This study pigeonholes the foremost flood-prone sectors in Akure town and highlights the depth of the trauma of flood victims in the area. The method of investigation was that of systematic sampling and the sampling frame was 300 respondents, drawn from ten flood-prone areas in the town. The paper adumbrates same structural and non-structural strategies for mitigating the effect of floods on city residents and urban infrastructure. Specific recommendations on how to take the edge off the incidence of floods in Akure town are articulated in the paper.

Keywords: Empirical, Urban, Storm water, Akure town, Nigeria.

1.0 Introduction

In a foremost natural environment, the soil infiltration capacity is often very high, higher than the rainfall intensity. Consequently, rainwater reaching the surface of the earth percolates very easily into the ground, and there is therefore no problem of overland flow. In the urban environment, the infiltration capacity of the soil is reduced by the replacement of the natural ground cover with impervious urban concrete surfaces (Odemerho, 1988). In the urban areas, therefore, surface overland flow or run-off is the dominant method of disposal of excess rainwater. If this excess rainwater is not properly disposed of, it turns to flood.

Flood is essentially attributable to two major causes, namely: climatological and anthropogenic factors. The climatological aspect has to do with heavy and prolonged rainfall. The anthropogenic causes of flooding are traceable to man's interaction with his environment in the form of urbanization, agricultural activity and deforestation. In most urban areas, the major cause of flooding is anthropogenic. This is so because as urbanization intensifies, natural surfaces are replaced by buildings, paved roads, and concrete surfaces which do not allow water to percolate readily into the ground. The consequence of this as Ayoade (1979) noted, ''is that a large proportion of the rainfall which should normally infiltrates into the soil, or be intercepted by

the vegetation and thus delayed for sometime before running off, is immediately available for surface runoff into streams and rivers, making them flood''

In developed countries, storm sewers are incorporated in urban design to convey surface runoff to nearby stream channels. In the developing countries, storm sewers are poorly developed in urban centres. As a result, excess stream storm water flows freely along the streets, leading to urban floods and flash floods. Urban floods have been reported in many Nigerian urban centres for instance in Ibadan, Lokoja, in recent years, and in some towns like Ondo, Ado-Ekit, among others; it has reached such a parlous state that it now constitutes an urban crisis. In some Nigerian coastal towns like Lagos, Calabar and Port Harcourt, flooding is attributable to diversity factors, principal among which are geomorphic factors and the littoral locations of the towns. In most towns in Nigeria, flooding is largely anthropogenic in nature. It occurs mostly in areas of the town occupied by the poor, which incidentally is the part of the town where the highest level of development control violation is recorded. The poor, according to Main and William (1994) often reside in informal settlements located on marginal land – riverbanks, low-lying land, floodplains and steep hillsides – that the formal housing market does not want or need. Furthermore, UN-HABITAT (2003) noted that due to the high intensities of rainfall during the rainy seasons, the lack of drainage infrastructure and the failure to maintain existing systems, the impacts of flooding are widespread in the tropical countries and it is the poor who are most susceptible and most vulnerable.

The urban poor, though often aware of the fact that their areas of habitation are prone to disaster, often find it difficult to relocate. This is so, because of their circumstance as poor people. They have limited financial access to better sites, and this have to contend with the incessant and menacing problem of floods. Parkinson (2002) noted that although the sites where the urban poor live are vulnerable to the impacts of flooding, the benefits of living nearer sources of employment and urban services generally outweigh the disadvantages associated with flooding, which is generally perceived as a natural and seasonal event.

Flooding is a common global environmental problem. Urban flooding, in particular is not the exclusive preserve of the developing countries alone, rather it runs through the entire gamut of the developed countries of the world as well. For example, on the 24th of August 2005, there was massive flooding in Switzerland, washing away houses, railway lines properties, vegetation and lives. Also the case of the horrendous hurricane Katrina floods in the Gulf Coast regions in the United State of America is unsullied in the annals of flooding. New Orleans, for example, was swept away by floodwater around September 2005, leading to a colossal loss of lives and properties.

Rashid (1982) defined urban flood as any overland flow over urban streets sufficient to cause significant property damage, traffic obstructions and health hazards. Flooding owes its origin to meteorological factors, such as heavy rainfall, sea swells resulting from typhoons and hurricanes, and snow melts. Geological factors are also possible, for example, bursting of levees and plate tectonic disorder, e.g. the Tsunamis of 2004. Flooding is now a very frequent phenomenon in Nigeria cities, and in the past few decades, it has become incredible severe and devastating. This increasing frequency and severity of flooding cases cannot be attributed to increase in rainfall intensity alone, ''rather, they are in response to an increasing rate of urbanization and the absence of well-articulated and comprehensive physical planning and planning control'' (NEST, 1991).

This paper reports the result of an academic investigation into causes and impact of flooding in Akure town, the capital of Ondo State, Nigeria. The effect of flooding in Akure town is pervading, but the specific areas of Akure town that are badly affected are: Isolo area, Okeijebu area, Ijomu area, Ayedun area, Oshinle area, Isinkan area, Ayegunle area, Gbangbalogun area, Odoikoyi area, and Ijoka area (Fadairo, 2008). According to Babatolu (1996), flood incidences in Akure have damaged residential houses, public buildings, and have washed away many gardens and roads in various part of the town. The investigation for this study came from the devastating flood of 2012, which ravaged many parts of Akure town, and rendered many homeless.

This paper therefore gives a low down on the urban storm water crises with supporting evidences drawn from an empirical study in Akure, Ondo State, Nigeria.

2.0 The Urban Storm Water Crisis and Urban Liveability

It is a truism that flooded urban areas are unhealthy places for human habitation. Flooded urban environments are a sine qua non for the breeding and propagation of diseases. Flooded urban areas are therefore unhealthy places to live in. The World Health Organization (WHO, 1978) defined health as 'a state of complete physical, social and mental well-being, and not merely the absence of disease of infirmity' (WHO, 1978). A flooded city that is capable of causing psychological stress to the residents is by implication, an unhealthy city.

Urban liveability is borne out of the realization that there is a connection between urban living conditions and the health of the residents. This fact was highlighted by McKeown

(1979) who opined that the major factor in improving health was not advanced medical care and technology, but social, environmental and economic changes, the limitation of family size, an increase in food supply, a healthier environment and specific preventive and therapeutic measures. This standpoint was corroborated by Duhl (1986, 1990) and Hancock (1990) who argued that people must now be gauged as being healthy based on the holistic conditions of their everyday lives, and the nature of their physical environment.

The issue of urban liveability received its greatest boost in 1978, when the World Health Organization (WHO) at the Alma Ata conference, endorsed the notion that health is linked to the living conditions of the population (WHO, 1978). Whose standpoint was predicated on the principle that health could be improved by modifying living conditions, namely the physical environment and the social and economic conditions of everyday life (Wema *et al*, 1999). In this holistic view, health is seen as a function of all the factors and activities which impact upon the lives of individuals and communities e.g. urban floods.

One of the major fallouts of rapid urbanization and high population growth in the developing countries is the shortfall in the provision of basic infrastructure and services. Urban dwellers often have to contend with the health hazards arising from flooding. It has been shown that there is a link between the status and operation of the city as an ecosystem and the health of its inhabitants. Duhl (1990) has shown that the urban environment exerts a considerable influence over some determinants of health such as the physical, economic and social living conditions.

There are various typologies of urban floods, and they manifest themselves in a variety of ways in different cities. Parkinson (2003) identified three major types of urban floods, and categorised them as Types A, B and C. According to him, Type A involves localised flooding caused by inadequate drainage of storm water run-off, Type B affects a larger area than the first type and can disrupt transportation and city life; and Type C is a large-scale inundation, which can cause widespread disruption and damage to communities throughout the city (Table 1). The storm water crisis in Nigerian cities has now assumed an alarming and pervading proportion, and virtually all the major cities in the country are affected. The regularity and rigorousness of flooding have reached such a parlous state that it has now become an urban crisis. Transportation is always truncated and paralyzed whenever there is flooding. Whole lengths of urban streets are often rendered impassable to both vehicular and pedestrian traffic. Apart from disrupting traffic, floods also contribute to the structural damage of buildings and other infrastructural facilities. Flooding is a major contributory factor to the collapse of residential buildings usually rendering many poor urban dwellers homeless. Flooding also contributes to loss of personal properties and means of livelihood. Parkinson (2003) put it laconically when he said that, 'the disruption, damage to properties, loss of possessions, as well as financial worries and other stresses from living in damp houses mean that flood events can place a considerable strain on households'. In a nutshell therefore, flooding can lead to a variety of problems

including loss of lives, properties and livelihood. Flood victims, after being rendered homeless, assume the status of environmental refugees, and resides in squalid or makeshift accommodation.

The dismal picture of flooding is not the exclusive preserve of cities of the developing countries; rather it covers the gamut of all countries of the world. The universal spread of flooding is attributable to the global climatic change, occasioned by the depletion of the ozone layer. The scenario has inevitably resulted to the new famous greenhouse effect. The greenhouse is as a result of the trapping of the long-wave electromagnetic radiations by atmospheric carbon dioxide. This development has led to global warming and a corresponding melting of icebergs all culminating in an alarming increase in the ocean levels. The net result is that coastal towns all over the world are exposed to unabated hazards of flooding.

The inter-connection between flooding and health has dominated the literature in recent years. It is common knowledge that when it rains, human and animal faeces get in contact with the surface run-off. This mixture eventually gets to the source of drinking water, thus spreading pathogenic organisms. In some cases, the polluted run-off seeps into the ground and pollutes sources of underground water thereby leading to gastrointestinal disorders. As Kolsky (1999a) observed, 'wet soils in poorly drained areas, which become feacally contaminated due to poor sanitation, also provide ideal conditions for the eggs of parasitic worms, such as roundworm and hookworm, which can cause debilitating intestinal infections', UN-Habitat (2003) also affirmed that there is considerable empirical evidence to indicate that flooding and poor drainage have a significant impact on the prevalence of illness, and that large-scale flooding may disrupt water supply and sanitation systems and result in outbreak of diseases and epidemics.

Floodwater also provides breeding places for mosquitoes that are responsible for malaria. Examples of such mosquitoes includes: culex mosquito, which is responsible for filariasis and elephantiasis; aedes mosquito, which transmit yellow fever and dengue haemorrhagic fever; and anopheles mosquito, which transmit malaria. These species of mosquitoes lay their eggs in containers which fill with water during rain, such as domestic water storage containers, discarded cans, tyres, plastic bags and water pods which are commonly found where drainage is poor (Kolky, 1999b).

In most urban centres in Nigeria, the urban poor are the worst hit whenever there is flooding. In the first place, their dwellings are built using substandard building materials and these sub-standard building materials are easily swept away by floodwater. Since they are poor, they often find it very difficult to raise money and rebuild their house. In most cases, the items they hawk in the informal market to earn a living are also swept away by the rainwater, thus making them more and more impoverished. Since transportation channels are the first to block during flooding, the urban poor are usually trapped in their neighbourhoods and suffer the full onslaught of the menacing flood.

Urban floods are largely result of poor urban drainage planning and engineering. The topography and physical characteristics of the town can also exacerbate flooding, if, for instance, drainage is controlled in the high-income, low-density neighbourhood, and the storm-water from the zone is not properly channelled, but is allowed to flow to the high-density, low-income neighbourhoods, it will ineluctably lead to flooding in this latter zone, occupied by the urban poor. Anjelkovic (2001) commenced along this line when he said that 'more affluent communities often contribute to the flood problem by investing in drainage infrastructure which exacerbates flood problems elsewhere. Though the urban poor are generally the worst hit by flooding, the degree of vulnerability to the hazards of flooding varies among community members. Generally, those that are at great risk are the children, women the elderly, and the disabled. These people suffer adversely from the physical and health effects of flooding. They also have to contend with the problems of economic devastation, disruption of livelihood systems, disease and food shortages that invariably occur in the aftermath of floods (Parkinson, 2003)

3.0 The setting and The Study Area

The research that is reported in this paper was conducted in Akure town, the capital of Ondo State, Nigeria (Figure 1). The town is in the South Western part of Nigeria. It lies within Latitudes 7^0 15'N and $7^0$28'N North of the Equator and Longitudes $5^0$6'E and $5^0$21'E East of the Greenwich Meridian. It is located approximately 700 kilometres South West of Abuja, the Federal Capital of Nigeria and about 350 kilometres to Lagos the former capital of Nigeria. It is located within the tropical rain forest region of Nigeria. It became the capital town of Ondo State and a Local Government headquarters in 1976. Akure has three residential settlement patterns – the core area, the peripheral neighbourhoods to the core and the suburbs. The town has witnessed immense growth in the size of built-up areas, number of immigrants, transportation, and commercial activities and has attracted both major investors and private developers into the city. The total area is approximately 41.2km2 and it lies on a relative plain of about 250m above the sea level. The population of the town grew from 38, 852 (Thirty two thousand, eight hundred and fifty two) in 1952 to 71,106 (Seventy one thousand, one hundred and six) in 1963. Its population was estimated to be 112,850 (One hundred and two thousand, eight hundred and fifty) in 1980; and 157,947 (One hundred and fifty seven thousand, nine hundred and forty seven) in 1990 (Ondo State of Nigeria, 1990). The last census conducted in 2006 put the town's population at 353,211 i.e. Three hundred and fifty three thousand, two hundred and eleven (NPC, 2006).

Akure community consist of hills, which developed over the basement complex rocks. Ala River and many streams take their origin from these hills, and overflow their banks after long hours or days of heavy rainfall. Such urban streams include: Elegbin, Ukere and Omiyeye. Ala River and these streams have small basins and when municipal wastes obstruct their valleys, their prosperity to overflow their banks becomes enhanced. Though flanked by some hills, the topography of the town is relatively flat, and this has, over the years, abated flooding in the town. The flooding situation has also been aggravated by very dense development in certain parts of the town where drainage channels are either lacking completely, or have been blocked by litter and refuse.

Akure town is an ancient Yoruba town that has witnessed a rapid rate of urbanization due to its status as state capital, local government headquarter the establishment of agro-based industries, presence of University of Technology and natural increase in population, in recent years. Like in most Nigerian cities, the level of poverty in Akure town is very high, with most people living in overcrowded and squalid conditions, where sewage and refuse management machineries are lacking. The road in the town are narrow and in some cases, not surfaced. Most of the urban roads lack drainage channels and are often choked up with refuse. This scenario has implications on the level of flooding in the town.

The high rate of urbanization in the town also means a high rate of housing construction thus creating a greater area of concrete surfaces. The large coverage of concrete surfaces in the town means that a greater portion of the rain water flows off as run-off, with very little percolation. This contributes immensely to the flood situation in the town. Moreover Akure town is situated in the south western part of Nigeria which is synchronous with the rain forest zone. The rainfall is usually very heavy, especially during the rainy season (April to October). In a town like Akure where there is no proper storm water drainage, the volume of run-off is always a problem to contend with. This problem is further exacerbated by the low-lying topography of the town, which does not permit easy passage of the run-off by gravity.

The physical development of Akure town is the responsibility of the local planning authority in the town. However, the development control division of the local planning authority does not seem to have the necessary machinery to check illegality in the housing sector in the town. Buildings are created on flood plains and wetlands in the town with the tacit concordance of the local planning authority. This has ineluctably aggravated the flood situation in the town. The high rate of urbanization in the town is manifested in high population concentration, high room densities, the emergence of new and mostly

unplanned neighbourhoods, and the erection of informal settlements and slums (Plate 1). A common feature i most of the informal settlements and slums in the town is the complete lack of absence of waste disposal facilities, lack of development control machineries, and poor drainage facilities. In the face of all this, the municipal authority lacks the wherewithal to respond promptly and effectively to the problem of flood in the town.

This study concentrated on some flood-prone parts of Akure town. These areas suffer incessantly from unmitigated flooding, often resulting to: disruption of communication, structural damages to buildings, and loss of lives and properties. The 2005 flood in Akure town was of epoch-making dimensions, and it provided the impetus for this research. The major parts of the town that were greatly devastated by the 2005 flood incident include: (i) Isolo area, (ii) Okeijebu area, (iii) Ijomu area, (iv) Ayedun area, (v) Oshinle area, (vi) Isinkan area, (vii) Ayegunle area, (viii) Gbangbalogun area, (ix) Odoikoyi area, and (x) Ijoka area. These areas constituted the sampling area for the research. In each of these areas, thirty (30) respondents were systematically selected, bringing the sample frame for the study to three hundred (300) respondents. Every fifth (5^{th}) house on the streets in each of these flood-prone areas was interviewed, and the actual respondent in each case was the household head.

The choice of sample sizes for each of the neighbourhoods was influenced by the need to actually target those who have been feeling the impacts of floods in the area. The research instrument that was employed in the study was the questionnaire technique and field observation. The questionnaire sought information on such issues as the household's socio-economic and demographic profile; perception of food hazards; household vulnerability; household adjustments and hazard management mechanisms; infrastructural profiles of the neighbourhood; and the impact of flood on property household members. This was supported by site observation and informal discussions with the residents and flood victims in the study area. Field assistants (indigenes and residents of Akure town) were employed to assist in collecting data for this research.

Since the research is largely behavioural in nature, the analysis is mostly qualitative and descriptive in nature. The specific analytical tool that was employed in the study is a summated rating scale, called the Likert scale. This scale is particularly useful in measuring the intensity or degree of agreement by the respondents to a statement that describes a situation, phenomenon, item or a treatment (Asika, 1991). The Likert scale is usually graduated on a five-point basis, but in this study, the positive-negative Likert scale was used to measure qualitative responses. Responses were generally grouped into three i.e. agree (+1.0), undecided (0.0), and disagree (-1.0). This technique is amendable to statistical analysis, and the responses could also be converted into frequencies and percentages for some non-parametric statistical analysis.

In using Likert scale for this study, all the responses for a particular question were scored accordingly and the average score for a question was determined mathematically. If the average score has a positive value, then the respondents are believed to be in agreement with the issue at hand. If the average value is negative figure, then it means that the respondents were not in agreement with the issue. A summated rated value of zero means that the respondents were undecided. The level of agreement or disagreement or neutrality (i.e. whether agree undecided or disagree) was determined by the computed summated value. The computed average values in this research must normally lie within the range of +1 through 0 to -1 for a meaningful interpretation of the results.

4.0 A Discussion of Empirical Findings

It could be safely said, based on empirical observations, that the problem of flooding in the study area is all-pervading. This problem has been exacerbated by the high rate of urbanization in the town. The fallout of urbanization in the study area is the palpable shortfall in the supply of adequate housing and well designed and laid-out neighbourhoods. Consequently, people are forced to set up squatter settlements in the

ecologically unacceptable sites like wetlands and floodplains along water bodies. These squatter and slum settlements are characterized by lack of technical infrastructural services like drainage, sewage disposal and water supply. This scenario greatly enhanced the vulnerability of these areas to flooding and the poor health status of the residents. It is therefore no wonder that in addition to flooding, the study area also suffers from such water-related diseases like enteritis, diarrhoea, worm infestation and malaria. The flood problem in the town has not really attracted the attention of the Government. Flood mitigation efforts are therefore enforced by individuals. The neighbourhoods affected have also not been able to come together as a body to map out comprehensive measures for flood mitigation. Furthermore, there is no evidence of the presence of community based organisations (CBOs) or development non-governmental organizations (NGOs) in Akure town involved in flood abatement programmes.

All the respondents were unequivocal in their assertion that numerous factors contributed th the high incidence of flooding in Akure town. These factors are discussed in this paper, but it suffers to mention them as : poor storm water drainage system, erection of structures on unauthorised sites, non-compliance with town planning guidelines, inability of the appropriate government agencies to sanction those violating building regulations, improper refuse disposal, etc. the effect of flooding in Akure town is enormous. It includes the disruption of transportation network, damage to buildings and infrastructure, loss of personal possessions and means of livelihood, and damage to landed properties. The health consequences of flood include illness and disruption of sanitation systems.

It was garnered from the respondents that the major causes of flooding in the study area were poor drainage control and management. It was also noticed from personal observation that in most parts of the study area, drainage channels were either not provided, or were blocked by refuse. Storm water from residential areas could not flow to drainage channels because of blockage. Another major cause of flooding was the encroachment on the floodplain of some urban streams by developers. A sizeable number of the flooded properties in the study area were constructed on the flood plain of streams or on wetlands.

The incessant cases of flooding in the study area have inflicted a lot of damage to the residents of these floodable areas. However, one noticeable and surprising fact is that, over the years, most of the affected people have not thought of relocating to other places. They prefer to remain in situ and contend with the vagaries of flooding. Is is no wonder therefore menace. Out of the 300 respondents that were sampled, 208 (69%) agreed that the severity of flood was always great and bothersome whenever it rained, while 65 respondents (22%) felt otherwise and 27 respondents (9%) were undecided on the issue. The Likert score for this variable had a positive value of +0.4766. This Likert score confirms that the people of the area actually perceived flooding as an environmental problem, and yet for some inexplicable reasons, they find it difficult to relocate to better sites.

The responses for this variable were subjected to a chi-square (X^2) analysis. The aim was to find out whether there was a significant difference in the three response categories, or whether the responses were basically the same. The analysis showed that there was actually a significant difference between the numbers of respondents who agreed and those that disagreed or remained undecided on the issue of the intensity of floods in Akure town. With a computed value of 181.154 and a degree of freedom of 2, the null hypothesis that there is no difference in the frequencies of those who agreed, remained undecided or disagree was rejected at 5% and 1% significance levels. The difference in the response classe was therefore established as significant. It is thus clear that some people really perceive flooding in the study area as a problem, and yet they are unwilling to move or are constrained by some factors to stay in their flood-prone environments.

One of the urban infrastructural facilities that is always seriously affected by floods is transportation. Whenever there is flooding, urban roads are rendered impassable, and consequently, traffic is disrupted. The result is that commuters have to travel longer distances than necessary to their destination. The economic cost of flooding in terms of excess commuting is yet to be investigated by researchers, but it could be stated

without any fear of contradiction that, it is high. In the study area, a very high percentage (97.67%) of the respondents acknowledged the unpalatable effect of flooding on transportation and communication facilities in the area. This was confirmed by the equally high and positive Likert score of +0.96 (Table 2). This underscores the fact that transportation network is vital to the efficient functioning of the city.

Flooding in Akure town also inflicts some form of structural damages to real estate properties. This ranges from outright collapse of buildings to exposure of foundations, dampness and waterlogged rooms. This problem exerted itself in a pervading manner throughout the study area. Respondents claimed that they were suffering from a myriad of problem relating to the structural fitness of their accommodation. Altogether, 264 respondents (88.0%) admitted that their buildings suffered from some form of structural damage e.g. partially collapsed walls; while 31 respondents (10.33%) said structural damage to their properties was not really a problem. Five (5) respondents (1.66%) were undecided on the issue. The Likert score for this variable was +0.77. This high Likert value substantiates the views expressed by 88 percent of the respondents that structural damage to buildings by storm water is actually a problem in the study area. Associated with structural damage to buildings is the loss of possessions and personal effects during floods. About 24.66% of the respondents claimed that they actually lost their possessions to storm water, while 72.6% started that they had never lost any personal items to floods. A small percentage (2.67%) was undecided on the issue. The high percentage of those who had never lost any item to floods could be explained by the fact that, over the years, the residents have devised means of protecting their personal effects from being carted away by floodwater. Some have achieved this by providing small embankments at the entrances to their houses, while others constructed some contrivances to serve as breakwater at the drainage channels close to their houses. In this way, they were able to mitigate the effect of floods, and protect their personal possessions from being destroyed. It is therefore not surprising that the Likert score for this response had negative value of -0.48, suggesting that respondents did not significantly lose their possessions and personal effects to floods in the study area.

This research also investigated the extent to which flooding had disrupted civic activities in the area. The civic activities here included going to work, market or school. The finding indicated that though flooding obstructed vehicular movement to a significant extent, residents still had a way of gaining access to major roads or streets in the town. Consequently, they carried out a greater part of their civic duties almost unimpeded throughout the duration of the flood water in the environment. This fact was attested to by 179 respondents (56.67%), who disagreed with the question on whether flooding disrupted civic activities. However, 112 respondents (37.33%) asserted that flooding disrupted their civic activities, while 9 respondents (3.00%) were in different. The computed Likert score of -0.22 confirmed, albeit weekly, the storm water crisis in the vicinity did not seriously disrupted civic activities.

There is no gainsaying the fact that a degraded environment is a *sine qua non* for illness. Respondents confirmed that the constant flooding of their environment always expose them to stress and depression. Majority of the respondents (94.00%) admitted that they suffered from stress, melancholy and shame as a result of living in a degraded environment. This was confirmed by a high and positive Likert scale of +0.89. Related to mental stress is the issue of physical illness. It is known fact that flooding usually leaves behind pools of stagnant water. This serves as breeding places for various species of mosquitoes and this fact is well known to the people living in the study area. About 69.00% of the respondents agreed that flooding contributed to the high incidence of malaria in the vicinity. Twenty eight percent (28%) did not agree, and 3.00% were undecided on this. The Likert score of +0.41 computed for this variable confirmed that respondents in the study area were aware of the health risks associated with their environment. The study further revealed that residents in the study area did not really experience loss of livelihood and loss of income due to flooding. The number of people who suffered loss of means of livelihood was very small. This is so because over the years, the people had mastered the technique of protecting their wares from the

ravages of storm water. Consequently, many did not see flooding in their neighbourhood as a menace that could adversely affect their means of livelihood or sources of income. This assertion was corroborated by Likert analysis, which returned a negative score (-0.34) for this variable.

5.0 The Way Out

The case study reported in this paper reveals one fundamental fact- the absence of functional and well-engineered storm water drainage for Akure. Where drainage channels are provided at all, they are shallow, blocked and filled with refuse and sand. This study advances some recommendations as panacea for the menace of urban storm water crisis in Akure town. This recommendations fall into two major classes namely structural recommendations and behavioural recommendations.

One obvious and observable fact about the transport arteries in the town is that they lack drainage channels. Where such channels exist, they are either blocked, or are too shallow. This study advocates a proper drainage plan for the flood prone area of Akure town. The drainage plan must take cognisance of the congested nature of development in these areas and ensure that every street is endowed with drainage channels on both sides. The road construction engineers must ensure that there is proper co-ordination of the drainage channels to guarantee that storm water from the streets is directed to trunk channel. The capacity of the trunk channel has to be commensurate with the volume of storm water generated in the neighbourhood. There is the need to study the characteristics of the storm water so as to know its intrinsic attributes, such as its profundity, duration, frequency of occurrence and the length of time it takes to seep into the ground (infiltration) or flow by gravity out of the neighbourhood. It is therefore necessary and imperative for the residents to open up blocked drainage channels.

A behavioural approach to flood mitigation and storm water management in Akure town is for the local planning authority to declare the flood-prone areas as disaster areas. In that case, residents must relocate to other parts of the town. The local planning authority must prepare layouts for properties elsewhere so as to encourage them to move. Once the people have been resettled, the flood-prone area could be re-planned properly for estate development.

One potent factor that is responsible for floods in the study area is the blockage of drainage channels. The health risks associated with impoundage of storm water is well known. They include breeding of mosquitoes, pollution of surface sources of drinking water, degradation of the environment, stress and psychological trauma. It is recommended here that proper waste management machinery be put in place in Akure to manage solid wastes.

It is a truism that when drains are blocked, the stagnant pools of water inevitably serve as breeding places for mosquitoes. It is important to control or eliminate open water surfaces in order to destroy mosquito-breeding sites. In order to ensure quality environment, control disease vector and promote environmental health, it is important that residents eliminate all the breeding sites of all the species of mosquitoes in the area. This has not yet been done in Akure town, because the residents of the flood-prone areas have no organization in place to do that, and also because there is no government ministry that is officially charged with this responsibility.

In Lagos state, for example, there is the Emergency Flood Abatement Gang (EFAG) organized by the Ministry of the Environment. The Gang is charged with the responsibility of inspecting, desilting and cleaning of gutters and canals all over Lagos metropolis. Workmen are now seen in many parts of Lagos, digging out dirt from gutters and carting them away for safe disposal. This practice is very effective in controlling the incidence of flooding in Lagos state. This is an example that is worthy of emulation by the municipal government in Akure town to attenuate the high frequency of flooding in the town. There is no organization like the Emergency Flood Abatement Gang in Akure town. It is important that this type of organization is set up in Akure town to respond quickly to flooding whenever it occurs. It is also important

top involve all the stakeholders in decision making and in policy formulation on matters that are related to urban flooding in Akure town. Because, there is no formal organization or body, it becomes impossible to collect data on such issues as the frequency and periodicity of flood, areal extent or coverage of the impounded water and the quantum of damage down to properties and infrastructural facilities. These data are necessary for effective monitoring of flood regime in Akure town, and for the formulation of flood abatement strategy.

6.0 Conclusion

The study has highlighted the problem of flooding in Akure town, Nigeria, and its impact on residents of the town. It also identified some of the issues that have contributed to the high incidence of flooding in the town. One of the prominent issues is the high rate of urbanization in Akure town manifested in form of high population and overcrowding. The population is greater than the existing facilities can cope with. Consequently, municipal services like water disposal machineries are lacking, forcing urban residents to dump their waste in drainage channels. In view of this, it is proper to conclude that proper drainage network is one strategy that can effectively mitigate flooding in the area, and its provision must not be toyed with.

Most of the respondents had lived in the study area for considerable length of time, and had witnessed many flood incidents. They have also, over the years, suffered from various afflictions and diseases arising from a flooded environment. Their businesses and education have also been adversely affected due to the poor state of the environment. It is safe to advise that individual efforts at fighting flood are not always efficacious. The community must come together and effect plans on how to keep the drains clear of rubbish always. Individualistic approaches to flood mitigation and abatement must now give way to a holistic and result-oriented approach. This holistic approach must involve all the stakeholders in the local environment. The stakeholders here include Ondo State Government, the Akure Local Government Authority, the landlords or property owners, renters, public and semi-public service providers like the Power Holding Company of Nigeria, Water Corporation, and the Ministry of Works. A formidable team of concerned. Stakeholders can come out with an achievable strategy to mitigate, manage and control the storm water crisis that is presently buffeting residents of Akure town.

The problem of urban storm water management in Akure town has now reached a parlous state, and it now constitutes an urban cataclysm. The existing situation in Akure town is such that there is little or no communal effort at tackling the flood situation. The hackneyed notion that ‘’the Government will do it’’, is spo entrenched in the mentality of the people that members of the community hardly come together to proffer solutions and strategies for mitigating the impact of flooding in the town. There is little or no concerted effort at the community level to address this problem. The involvement of Non-Governmental Organizations (NGOs) in flood mitigation in Akure is also minimal. The attitude of Government to flood mitigation is not unique commendable in Akure town. The NGOs can play a vital role in educating, advising, assisting and providing technical assistance to people living in flood prone areas of Akure town. NGOs are known to have done similar things in degraded, flooded and unhealthy towns in other countries of the world. The absence of NGOs in Akure town to play this vital role is perhaps, one of the reasons for the high incidence of flooding and flood-related diseases in Akure town.

Some municipal governments in Nigeria have attempted to sole urban water problem by providing drainage channels, and by channelizing some urban streams and others have exhibited a non-challant and a do-nothing attitude. Urban residents have also compounded the urban flood problems by dumping refuse in drainage channels, building on the floodplains of urban streams, and by developing and building on urban wetlands without proper engineering works. This study recommends both structural and non-structural strategies for the diminution of flood crisis, and for the amelioration of the quality of the physical

environment in Akure town. If these strategies are faithfully pursued and implemented, the urban storm water crisis in Akure town will be significantly extirpated.

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Table 1: Typology of Flood Types. Characteristics and Impacts

Flood Types	**Characteristics of Flooding and Impacts**
Type A	Localised flooding caused by inadequate drainage of storm water run-off, which can happen virtually every time it rains where the provision of drainage infrastructure is very poor. The main impacts of these events are related to deterioration in environmental health conditions-notably those related to water-related diseases.
Type B	Flood events of this type occur less frequently than Type A floods, but affect larger areas. The impacts may include temporary disruption to transportation systems and inconveniences to city life. These events contribute to the propagation of water-related diseases and can cause structural damage, but not as severe as those related to Type C events.
Type C	Large-Scale inundation causing widespread disruption and damage affecting communities and businesses throughout cities. These events are infrequent and often reach the headlines due to the dramatic scale of the impacts and structural damage.

Sources: Parkinson (2003). 'Drainage and Storm Water Management' *Environmental and Urbanization, p.116.*

Table 2: Perception of the Impact of Flooding by the Respondents.

S/No	Qualitative Attributes (Variables)	Agree (+1.0)	Undecided (0.0)	Disagree (--1.0)	Total	Likert score
1.	The intensity of flood is always great, whenever it rains.	208 (69.00)	27 (9.00)	65 (22.00)	300 (100.00)	+0.47
2.	Transportation is seriously disrupted during flooding.	293 (97.67)	2 (0.67)	5 (1.66)	300 (100.00)	+0.96
3.	Structural damage to buildings resulting from flooding.	264 (88.00)	5 (1.66)	31 (10.33)	300 (100.00)	+0.77
4.	Disruption of civic activities e.g. going to work, school, etc.	112 (37.33)	9 (3.00)	179 (59.67)	300 (100.00)	-0.22
5.	Loss of possessions and other household items during flooding.	74 (24.66)	8 (2.67)	218 (72.67)	300 (100.00)	-0.48
6.	Flooding leads to stress resulting from living in a damp house and in a degraded surrounding.	283 (94.00)	3 (1.00)	14 (5.00)	300 (100.00)	+0.89
7.	Flooding leads to loss of livelihood and other means of income.	96 (32.00)	5 (1.66)	199 (66.33)	300 (100.00)	-0.34
8.	Flooding contributes to the high incidence of malaria and other diseases in the area.	207 (69.00)	9 (3.00)	84 (28.00)	300 (100.00)	+0.41
9.	Flooding leads to disruption of electricity supply.	271 (90.33)	6 (2.00)	23 (7.67)	300 (100.00)	+0.79

Note: Percentages are given in brackets.

Sources: Field Survey, 2008.

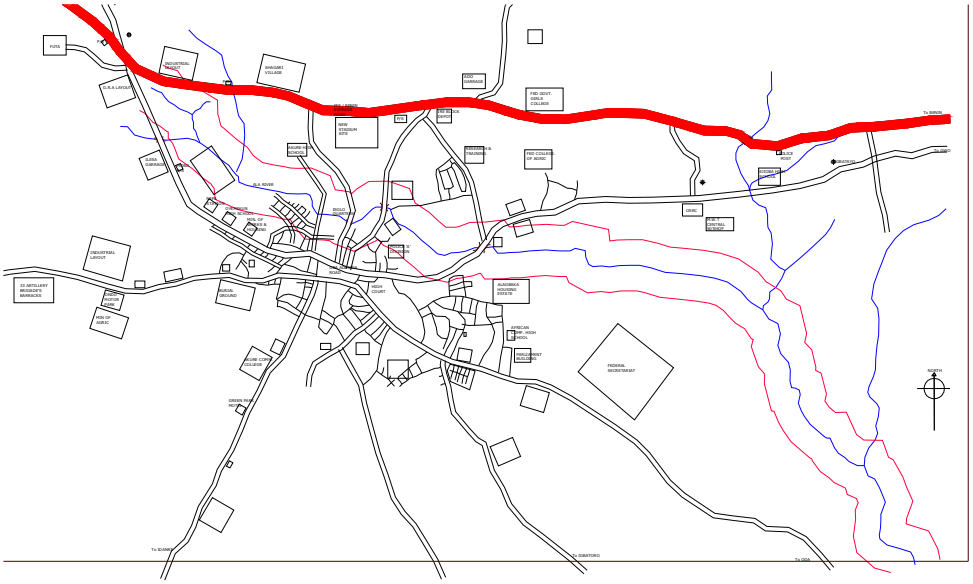

Figure 1: Map Showin Akure Town the Study Area.

Plate 1: Street flood incidence in the study area.