

Mitigating the Effects of Flood in Ondo Town, An Urban Centre

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Abstract

The problem of flooding in urban centres in Africa has become an issue of concern to stake holders in recent times and Nigeria is not exempted. Flooding is one of the environmental problems of urban areas especially in developing countries. Urbanization, increase in surface runoff, building on flood plains, blocking of drainage e.t.c. All contribute to flood. This paper seeks to investigate how urbanization and some other associated factors have contributed to flooding in urban centers using Ondo town in Ondo state an urban centre in south-western part of Nigeria- as a case study. With the use of structured questionnaire, attempts were made to review the occurrence and management of flood in the study area vis-à-vis the problems associated with it especially its effects on the economy at the times of occurrence in the study area. The cause, effects on the economy and adjustments of people to flood was properly looked into. 200 structured questionnaires were administered using stratified sampling techniques in areas identified to be prone to flood. The study shows that urban center as much as it is desirable for people, is not without its problems. Findings show that urbanization is a principal factor in the causes of Flood; factors like wrong waste disposal methods which causes blockage of drainage, increase in impervious surfaces, building on flood plain, change in weather patterns that leads to increase in rainfall quantity caused by climate change e.t.c. The paper suggests ways of managing flood in urban areas and improving sustainable development in Nigeria. Educating the masses on the issues of flood, proper planning design of urban centres and adherence, improved solid waste disposal, maintenance of drainage structures, etc are some of the suggested ways of reducing the menace of flood in urban centres.

Keywords: Flood Management, Urbanization and Sustainable Development

Introduction

In recent times, flooding has been one of the major problems of most urban centers in Nigeria. The Encarta Dictionary (2006) defined Flood as an overflow of water that submerges land which is normally dry. The European Union (EU) Flood Directives in 2007 defines a flood as a covering by water of land not normally covered by water. Floods are natural events caused by the interplay of changes in climatic and edaphic factors, channel characteristics of rivers, and human factors (Akintola, 1982). Flooding may occur as an overflow of water from water bodies, such as a river and lake in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries and flowing to the floodplains, or it may occur due to an accumulation of rainwater on saturated ground in an area flood. These overflowing rivers and streams regularly cause significant flooding on the adjoining flood plain, whose magnitudes and impacts are intensified by human activities.

A floodplain is a strip of relatively smooth land bordering a stream, built of sediment carried by the stream and overflowed regularly in times of high waters (John & Mannings, 1997). Episodes of abnormally high stream discharge known as floods can have major effects on cultural as well as the physical landscape in a river basin.

Flood and Man

Floods are natural phenomena, but their magnitude and impacts can be intensified by human activities. The areal extent of the floodplain on which the excess water from the river spread is decided by the river and where there is no human existence no losses, damages or loss of life are experienced. Hence flooding is absent and the flood checked by natural checker in place such as open surface in the soil, grasses and trees of the floodplain as well as the catchments area and so on. Where the flood plain is restricted to less intent purposes, which may not distort the hydrological equilibrium, the implication for flooding may not be direct. But where the houses are built directly in floodplain, especially the flood plains very close to the riverbank, then flooding is likely to occur (Eze and Akintola, 1999). With the interference of man in catchments area and the gradual encroachment of urbanization, most of which cause an increase in impervious surfaces, the stage is set and flooding ushered into the environment.

The structures built by man on the floodplain are subjected to damage and loss when inundated by flood water. Men have chosen to build on so many floodplains that flooding is the most universal natural hazard in the world (Botkin and Keller 1998). According to Summerfield (2008), Floodplains of large rivers have been attractive to settlers because it provides a fertile soil in which crops grow and also easy routes for communication and so promote trade between the coast and the upper part of the river valley.

Some floods have been related to failures of man-made infrastructures and over-reliance on the safety provided by flood control works such as reservoirs, bridges and culverts. The channel of the river would experience constriction due to the reduced rate of spread of the flood or water on the adjacent floodplain (Arthur 1991). Akintola (1974), referred to deforestation of hilly catchment's area as an intensifying factor in the flooding phenomenon. Kundzewicz and Takeuchi (1999) also referred to the development of residential areas, road construction in hilly areas as intensifying factors.

Destructive flood have been a major calamity since the dawn of civilization jeopardizing settlements causing loss of life and property; for example, flooding associated with two cyclones that struck Bangladesh in 1970 and 1991 killed more than half a million people (Botkin and Keller 1998). In 1972 flooding in India caused damaged exceeding £300 million. In August 1973, the worst flood for a century hit Mexico when the tail of Hurricane Brenda lashed the south of the country and left 240,000 people homeless (Ward 1978).

Flood and Urbanization

One of the most common features in every urban area is an increase in impervious surfaces caused by construction of roads, buildings, driveways and parking lots. Surface imperviousness has an important impact on hydrology. The presence of anthropogenic impervious surfaces do

not allow other substances, water for instance to pass through thereby leading to more surface runoff, which in turn increases floods in watershed. The structures built by man on the floodplain are subjected to damage and loss when inundated by flood water. We have chosen to build on so many floodplains that flooding is the most universal natural hazard in the world (Botkin and Keller 1998).

As a result of man's activity in the establishment and expansion of a city, urban areas experience more frequent and larger floods than do natural systems of similar size, because less water infiltrates soils in the drainage basin, as a result of more impervious surfaces (pavement and building roofs do not allow for infiltration), the groundwater is not replenished as it otherwise should be.

Urbanization changes the basic rainfall / run off mechanism, permeable land is rendered impervious by major land uses. Concretization of land dominates an urban environment. Residential buildings and infrastructures are built with concrete and iron rods, rendering soil surface impermeable to floods or rainfall. Thus, with the top layer of the soil compact, an urban area has a significantly reduced infiltration rate due to land uses. With the excess run off from the impervious surfaces and reduced rate of infiltration of open spaces, flooding is highly intensified within a short period. The study of Leopold (1972) evaluated the effects of urbanization on hydrological cycle. He found out that there are changes in peak flow characteristics, changes in total run off, change in the water quality and changes in hydrological amenities. Modifications of run off patterns are brought about by the increase in the speed by which water is transmitted into the stream channel across urban land forms through storm drains and other installations. The general effect is an increase in the volume of stream flow, characterized by decreased base flow, but marked increase in peak flow.

The flooding phenomenon in an urban area is also greatly intensified by human activities such as waste disposal. Wastes are disposed into the river channels, leading to blockage of the river channel while also obstructing run-off flow on the various parts of the landscape where deposited. This causes a reduction in the river's capacity to transport flood waves down the stream and a faster buildup of flood upstream, intensifying flood damage potential upstream, (Ayodele, 2006)

Apart from the good human beings see in the increase in impervious surfaces as a major way of urbanization, the construction and development of an area is seldom thought of as an impact upon the environmental landscape. However, the negative effects of impervious surfaces are just now beginning to be recognized and understood.

Statement of Problem

The tremendous increase in population, increase in the number of buildings, encroachment on flood plains and increase in impervious surfaces in the past century has placed more people at risk when an extreme weather event like long-time heavy rainfall that causes flooding occurs.

There has been considerable debate as to whether the frequent floods in Ondo town were the

result of rapid urbanization, encroachment on flood plains, increase in impervious surfaces or the result of heavy rainfall during the wettest months. The hydrological changes associated with urbanization have received some attention in Nigeria (Akintola, 1978; 1982; Enendu, 1981; Olaniran, 1983; Oriola, 1994). Various factors including topographical conditions, rainfall characteristics, *and* land use have been adduced by these authors for causing floods in Nigerian towns and cities.

Published works on flooding in Ondo town has mainly been on the causes, effects, frequency, magnitude, and resultant havoc (Oriola, 1994; Babatolu, 1997) in the past few years with little attention paid to the management of flood in Ondo town.

This paper looks at the events of flood in Ondo town and how it has been managed over the years in Ondo town. The paper also looks at the adjustment of people after flood in the study area.

Aim

The aim of this research is to study the occurrence, the effects, the management and the adjustment of people to flood in areas identified to be prone to flood in Ondo town, Ondo state.

Study Area

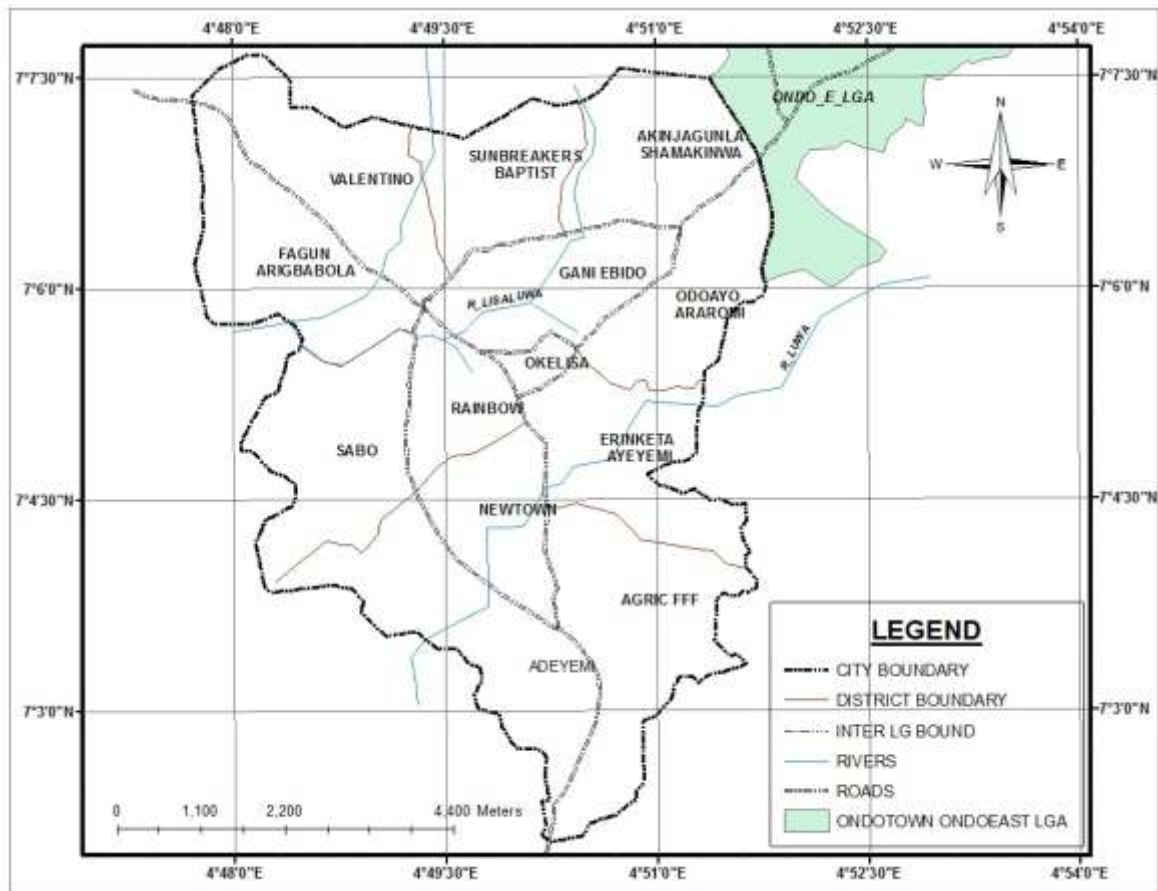
Ondo is one of the major urban centre in Ondo State. The town is located on latitude 06°30'N and longitude 04°45'E. The town is bounded on the north by Oluji/ Okeigbo local government, on the east by Idanre local government, on the west and south by Odigbo local government. The population of the town stood at 113,900 during the 1991 population census.

Ondo falls within the 'tropical wet and dry climate' with a relatively small dry season. Consequently, rainfall in Ondo is seasonal in character with well-marked wet and dry seasons. The dry period comes between November and February, while the wet season lasts for 8 months from March to October; the mean annual rainfall is about 1615mm. The annual mean temperature is 27°C, with a maximum of 30°C.

Ondo landscape is made up of generally undulating hills of granite outcrop of igneous origin, and is marked by few dome-shaped hills. These hills are found to be developed over the basement complex of metamorphic rocks with their summits ranging between 250 and 500 metres above sea level (Akintola, 1982).

The town has no major river; rather it is drained by several streams with fairly wide flood plains. The most important of these streams are Luwa, Lisaluwa, and Mode.

The town falls within the moist/wet lowland forest, i.e. it has thick forested vegetation, but due to human activities most of these original forest has been replaced with secondary re-growth.



Map of the Study Area

Methodology

The nature of this research involves the use of both primary and secondary data. Primary data on the occurrence, frequency and the management and the adjustment of people after flood in the areas identified to be prone to flood were acquired through the administration of questionnaire. The secondary data were derived from documented sources which include published works, unpublished ones, magazines and journals, and the map of Ondo town from the Ondo West Local council.

Forty respondents were selected randomly from each of the five zones in areas identified to flood seasonally, they are: Yaba, Gani Fawehinmi, Odojomu, Oduduwa and Lipakala zones.

A total number of two hundred questionnaires were administered in the selected parts of the study area. Two hundred people were selected from the area because the number is a representation of the total people living in the areas prone to flood. All questionnaires were returned because they were administered by the researcher in form of direct interview. The data obtained from questionnaires were presented using frequency tables with simple percentages and cross tabulation.

The information on the incidence and frequency of flooding in relation to imperviousness in Ondo town was collected through questionnaire. The questionnaire was divided into different sections focusing on the experience of flood, extent of flood, effects of flood and the management of flood.

Findings and Discussion

Information on the incidence, causes and effects of floods in Ondo town is discussed in this section. The information was collected through the administration of questionnaire in three selected zones prone to flooding in Ondo town.

Flood Experience in the Study Areas

Flood experience is discussed in table 1 below, the respondents were asked if they had ever experienced flood before; out of the 200 respondents, 188 submitted that they had experienced flood before. The remaining 12 that have not experienced flood before are likely to be relatively new in the area, because these areas are prone to flooding and flood is experienced there every rainy season most especially after every heavy rainfall.

Table 1: Flood Experience in the Study Areas

Zones	Flood Experience		Total
	Yes	No	
Odojomu	39	1	40
Gani	37	3	40
Lipakala	38	2	40
Oduduwa	36	4	40
Yaba	38	2	40
Total	188	12	200

Source: Fieldwork 2013

Frequency of Flood in the Study Areas

The respondents were asked how frequent flood is experienced in the different zones; out of the 200 respondents, 45 people had experienced flood above 10 times, 32 people had experienced it between 6-9 times, 68 people had experienced it between 2-5 times, and 55 people indicated that they had experienced flood less than 2 times (table 2 below). Out of the 40 people in Yaba area, 26 people had experienced flood more than 10 times, an indication that Yaba zone has the highest frequency of flood in the study area with the flood occurring after each heavy rainfall. It can thus be inferred that the high percentage of imperviousness and wrong waste disposal methods in the zone is related to the occurrence and frequency of flood there.

Table 2: Frequency of flood in Ondo

Zones	< 2 times	2 - 5 times	6 - 9 times	> 10 times	Total
Odojomu	8	22	10	0	40
Gani	12	12	9	7	40
Lipakala	14	11	5	10	40
Oduduwa	15	19	4	2	40
Yaba	6	4	4	26	40
Total	55	68	32	45	200

Source: Fieldwork 2013

Causes of Flood in the Study Area

Respondents were given a list of options of causes of flood out of which they were to select from. Table 3 below shows that out of 200 respondents, 26% admitted that bad drainage and uncontrolled waste disposal contributed significantly to flood occurrence in the zones selected for the research work. Likewise 25% agreed that excessive surface runoff from the area contributes to flooding and 19% of the respondents also identify heavy rainfall as one of the major causes of flood. Most times before rainfall can be a cause of flooding in an urban area, it is either the gutters are blocked and the rain water cannot find a path to flow properly or that the rainwater cannot percolate into the ground and flow as surface runoffs. It can be inferred and deduced that poor drainage and excessive runoffs are both related to heavy rainfall.

Table 3 : Causes of Flood in Ondo

Causes of Flood	Frequency	Percentage
Heavy Rainfall	38	19
Bad Construction Of Bridges And Culverts	16	8
Excessive surface runoff	50	25
Construction Of Houses Along The River Course	24	12
Bad Drainage And Waste Disposal Into River	52	26
Construction of houses on flood plain	20	10
Total	200	100

Source: Fieldwork 2013

Effects of Flood in Ondo

The effects of flooding can be identified on people, buildings, infrastructure, agriculture and the natural world. In extreme cases flooding may cause a loss of life. However, the social and emotional costs from flooding can also be significant and are often widespread and indiscriminate in flooded areas. These costs include: displacement from homes, the loss of personal valuables and the fear and insecurity caused by the experience. Potable water supplies may be lost or polluted in a flood and this can have immediate health effects upon people. The economy can also be affected by flooding; which can be as a result of reduced patronage as a result of impeded access to business centers.

From table 5 below the effects of flood on the study area can be seen, about 90 people were forced out of their houses or shops/business centers. 68 people experienced hampered access to their houses or shops/business centers while 30 people had reduced patronage/visit because their house/place of business was flooded and this will surely have negative effect on the economy.

Table 5: Effects of Flood in Ondo.

Zones	N.S.	Forced out of building	Impeded access to building	Reduced Patronage/visits	Others	Total
Odojomu	0	15	20	5	0	40
Gani	0	31	6	3	0	40
Lipakala	1	18	13	6	2	40
Oduduwa	2	12	14	9	3	40
Yaba	0	14	15	7	4	40
Total	3	90	68	30	9	200

Source: Fieldwork 2013

Adjustment of People to Flood in Ondo

After a flood episode, how the people affected by flood had settled down to live their lives again in a 'normal' way as much as possible is very important. The devastating effects of on properties and in rare cases lives cannot be overlooked. There are various ways of adjusting to flood by people living in the areas identified to be prone to flood. Some of these ways include sun drying properties affected by flood water; widening gutters and drains; building embankments for water bodies and ultimately moving out of the house or area in the worst case scenario.

Flood Management

Flood Management can be referred to as all the measures (remote and immediate) put in place by stakeholders (government, community and individuals) to either handle or control flood episodes properly before it occurs and during the episode of the natural hazard. According to the National Emergency Management Agency (NEMA), below are some of the measures that can be put in place to manage flood.

Before a Flood

To prepare for a flood, you should:

- Avoid building in a floodplain.

- Construct barriers (levees, beams, floodwalls) to stop floodwater from entering the building.

- Seal walls in basements with waterproofing compounds to avoid seepage.

During a Flood

If you live in an area prone to flood, you should:

- Listen to the radio or television for information.

Be aware that flash flooding can occur. If there is any possibility of a flash flood, move immediately to higher ground.

If you must prepare to evacuate, you should do the following:

Secure your home.

Move essential items to an upper floor.

Turn off utilities at the main switches or valves if instructed to do so.

Disconnect electrical appliances. Do not touch electrical equipment if you are wet or standing in water.

If you have to leave your home, remember these evacuation tips:

Do not walk through moving water. Six inches of moving water can make you fall. If you have to walk in water, walk where the water is not moving. Use a stick to check the firmness of the ground in front of you.

Do not drive into flooded areas. If floodwaters rise around your car, abandon the car and move to higher ground if you can do so safely. You and the vehicle can be quickly swept away.

Flood Management and Sustainable Development

Development as a process of change is necessary in urban centers so that the place can be larger and impressive having aesthetic value. In doing this, the concept of a sustainable environment must be at the back of our mind that is development without destroying the ecological balance of the area. Man may not be able to avoid flood totally being a natural hazard but it can be properly managed in such a way that the sustainable urban center can be achieved. Below are some of the ways of managing flood in urban centers with a sustainable environment paramount to all stakeholders

Land-use Controls

There should be the prevention of the development and building on flood plains which should be enforced by the government. This will provide adequate storage volumes for floods when rivers overflow their channels and reduce the damage and also ensure that drainage channels are not blocked.

Improved Solid Waste Collection and Disposal

An improvement of the solid waste collection and disposal in Ondo will bring about will alleviate the flooding problems in the study area. The capacities of channels that are frequently reduced by solid waste will be reduced for better carrying capacity. The absence of solid waste in drains will ensure the hydraulic performance of the drains and increase carrying capacities.

Channelization Project

The government or Non-governmental organizations can embark on proper channelization of streams and water bodies. The stream channels can be widened like was done for Lisaluwa stream around Lipakala area, where the state government widened the stream channel and built up levee in 2012. This really helped as flood was reduced around this area.

Conclusion

As it was discussed earlier, urbanization has been a major process through which the physical landscape over most of the world especially highly urbanized areas, have been altered. Encroachment on the floodplain of any body of water (stream or river as the case may be) as a result of urbanization brings about constriction of the channel as discussed by Arthur (1991). Increase in impervious surfaces which is an indicator of urbanization also enhances the water proofing nature of land which invariably increases the rate at which water get to the stream or river channel which in turn increases the magnitude of flood flows.

Most of the people interviewed agreed that the occurrence and frequency of flood in Ondo town is man induced. This is because of the rapid rate of urbanization in the town vis-a-vis gradual increase in impervious surface; building encroachment near the streams' banks and the deplorable habit of indiscriminate dumping of refuse by the residents of this area. The accumulation of these wastes and debris increases the roughness of the channel and thereby reduces the hydraulic capacity of the channel. The waste also affects the clogging of the gutters.

Recommendations

From the findings of this research, the following recommendations are made:

Public Enlightenment/Education

There should be re-orientation of Nigerians about the human influence on flood. There should be public enlightenment programmes organized at all levels of government to educate people on the causes of floods and how urbanization as good as it seems if not properly planned, has a major and sometimes negative contribution to floods.

Improvement of Drainage efficiency

The issue of waste disposal should be addressed; the public should be educated that disposing their wastes in gutters during rainfall or into streams will end up blocking the drainage thereby contributing to flooding the areas.

Rain Water Harvesting

Rain Water Harvesting is very old concept that can play a key role in arresting floods. It can also serve the purpose of solving the problem of water scarcity in urban centers. There are many ways of rain harvesting which will go a long way in reducing urban floods.

Flood Plain Management:

The disadvantage of building on flood plains should be emphasized, so the people will stop encroaching on them. Laws against building on flood plains can be put in place for effectiveness and offenders should be prosecuted, this way people will be forced to obey the laws since there are punishment attached.

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