FLOOD OCCURRENCE AND ADJUSTMENT STRATEGIES IN OYO STATE: A CASE STUDY OF OGUNPA DRAINAGE BASIN*

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(*Received*: September 2007, *Accepted*: April 2008)

Abstract

Floods are among the most dramatic forms of interaction between man and his environment, and they emphasize the limitations of man in his attempt to control the sheer force of nature. When they occur, whether in the developed or the developing world, they are always associated with heavy losses of life and property, misery, hardship disease and at times, famine. The Third Order Rivers, the Ogunpa and Kudeti, do break their banks so frequently that flooding in the arrears has been described as the Ibadan Annual Festival. It has been observed that flood occurrence has been aggravated by the deplorable habit of indiscriminate dumping of refuse by people, who have encroached on the floodplain and also waste dumping by ubiquitous street traders, which blocked the drains. The accumulation of wastes and debris increases the roughness of the channel and thereby reduces the hydraulic capacity. This affects the dogging of the culverts and bridges. It was also observed that construction of buildings, roads and bridges were made adjacent to the river channels, occupying the areas where the flood could flow to and obstructing the floodplain and the flood paths. Channel construction is an issue that should be carefully examined by policy and decision makers in our society. This paper therefore identifies that flood menace could be an hindrance to national development and therefore recommends that a collaborative effort by fluvial geo-morphologists, hydrologists, engineers, waste management authorities, planners and politicians should be embraced so as to effectively manage flood risks in Oyo State and the Nation at large.

Key words: Floods; Third Order Rivers, hydraulic capacity, channelization, channel construction, debris.

1. Introduction

Floods are natural phenomenon, their magnitude and impacts can be intensified by human activities. The area 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 flood plain as well as the catchments area and so on. With the interference of man in catchments area and the gradual encroachment of the urbanization is set in place and flooding ushered into the environment.

Flood is a body of water which rises to overflow the flood plain or land that is normally submerged (Ward, 1978). These overflowing rivers and streams regularly cause significant flooding on the adjoining flood plain, whose magnitude and impacts are intensified by human activities.

A floodplain is a strip of relatively smooth land bordering a stream, built of sediments carried by the stream and overflowed regularly in times of high waters (Manning, 1997).

According to some authors, episodes of abnormally high stream discharge known as flood can have major effect on cultural as well as the physical landscape in a river basin. About one eight of the population of the United States now resides in areas of potential flooding. To these people, the advantages of living in a flood-prone area outweigh the risks. The risks however are not only financial but also includes loss of life. The decision to live on or avoid floodplain is not strictly rational.

According to Akintola (1994), some processes of urban development (e.g. Land-use processes, deforestation and concretization) increase the magnitude of flood flows, thus increasing the development and the real extent of inundation. In spite of the risks and hazard involved in living near rivers, Ofomata (1981) noted that man has always chosen sites near rivers, even at the risk of inundation for the establishment of cities.

Floods are being described using two sets of characteristics: They are of hydrological (geophysical) and socio-economic natures. Some hydrological characteristics describe the phenomena in a direct way and are directly measurable e.g. Maximum flow and maximum stage, total volume of a flood wave, duration of flow and velocity of flood rise. Examples of socio-economic characteristics are number of

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* Presented in part at the First Faculty of Science Conference, Obafemi Awolowo University, Ile-Ife, July 3-5, 2007.

fatality, inundated house, lost bridges, total level of material losses, insured losses, uninsured losses, number of evacuees etc.

According to Cunningham (1999), we often try to control flood and reduce their destructive impacts by building floodways to contain water within river banks or by channelization that is deepening and straightening stream channels to increase the velocity or volume of water it carries. These measures may protect, but they often simply accentuate downstream problems.

The aim of the project is to study the occurrence and extent of adjustment to flooding along Ogunpa River in Ibadan. The objectives are to: identify the causes of floods and the sequence of their occurrence along Ogunpa River in Ibadan; assess the extent of damage incurred by the people when flooding occurs along Ogunpa River as well as problems encountered; and evaluate the control measures put in place along Ogunpa River.

Study Area

Ibadan city is located between latitude 7°152 and 7°212 and between longitudes 3°452 to 3°562 . Ibadan is second largest city in tropical Africa and was formerly the capital of the old western region. It is located in the heat of the Cocoa and Kola belt of Nigeria. the city is a major trading and industrial center and has one of the largest open air markets in Africa. Ibadan is a city of learning with the oldest University in Nigeria, and many research institutes and colleges. The total population of the city according to the 1995 estimate is 1,250,000 people.

The geology of Ibadan is made up of basement complex moves which are mainly the metamorphic types of pre-Cambrian age, but a few intrusions of granite and porphyries of Jurassic age. These rocks can be grouped into major and minor rock types. The major rock types are quartzite's of the meta-sedimentary series and the migmatites complex comprising banded gneisses, augen gneisses and migmatites. The minor rock types include pegmatites, quarts, aplite, diorites, amphibolites and xenoliths.

There are four main drainage bases in the study area. These are- the Ona River basin to the west, the Ogunpa and Kudeti Streams in the central portion of the city and the Ogbere river basin in the east.

Rainfall over Ibadan as the annual rainfall ranges between 1000-1500 mm. There is a relatively high temperature throughout the year due to the location of the city. The average annual maximum temperature is 31 °C and annual minimum is 23 °C. Ibadan falls within tropical rainforest with ferralitic red-yellow soils of humid tropical equatorial areas. A major land use which aids flood is the closure of the pore spaces in open spaces urban areas. Top layers of soil become as compact as concrete surfaces. Sporting grounds, motor traffic routes, market places, schools, hospitals, churches and other heavily used open surfaces have tiny spaces for infiltration into and through soils.

The study area was chosen as suitable for the project because the river drains through most part of the ancient city and the availability of flooding history. Similarly, the availability of information about the channelization project embarked on by the state government since 1978 is an area of interest in this study. Has this project contributed to the sustainability of the inhabitants of this area?

It has been observed that a scourge of political instability with its attendant frequent change of government has contributed immensely to the slow pace of the channelization project along the Ogunpa River. If the government of Oyo State will not set their priority right and see to the completion of this project, flood will not cease and the inhabitants of this area will ever be at risk.

2. Methodology

The data used were basically primary and secondary data. The primary data includes those data obtained from field survey conducted in the area. This was acquired through the administration of questionnaires in the study area. The secondary data were derived from documented sources which include published works, unpublished ones, magazines and Journals, past plans and maps of the study area from the Ministry of Oyo State Affairs.

The technique used for data acquisition was random sampling; the random sampling gives each and every member of the population in the study area an equal chance of representation.

Four main areas were selected from the long profile of the area which the river cut across. The areas selected are Mokola, Oke-Padi, Omitiwiju and Ogunpa business districts. Thirty respondents were selected randomly from Mokola, Omitowoju and Oke-Padi while sixty respondents were selected randomly from Ogunpa business district because of the wide area extent of the market and their uncontrolled waste disposal habit.

The data obtained from the questionnaires were subjected to analysis using frequency table and percentages. The method of Chi-square was employed to test for the hypothesis: The chi-square is a process that examines the relationship that exist between two or more variables.

This formula is:

$$\chi^2 = \Sigma((O - E)^2 / E)$$

Where O is the observed frequency, E is the expected frequency.

3. Result and Discussion

This section discusses the analysis and presentation of the data obtained in this study. The data are presented in form of frequency and percentage

distribution tables. The variables are also described using bar and pie charts.

Table 1 shows that 20 out of 79 respondents, who had experienced flood before, indicated that the flood was at the floor of their building, (25.3%), while 22.8% and 46.8% were fully submerged and partially submerged respectively.

Respondents were given list of options of causes of flood out of which some of them selected more than one causes of flood. Table 2 above shows that out of 150 respondents, 116admitted that bad drainage and uncontrolled waste disposal contributed significantly to flood occurrence along Ogunpa River channel. Likewise 98 respondents also identify heavy rainfall as one of the causes of flood.

In the course of pilot survey carried out in the study area, heaps of refuse were observed to be in the river channel. It was also observed that public waste bin in this area were not sufficient. Table 3 above shows that 51.3% of the 150 respondents dumped their waste in the flowing river, while only 12% dumped their waste in the public waste bin.

Table 4 above shows that out of 150 respondents, 112 indicated that the channelization project was an existing measure of adjustment. Similarly, 77 respondents identify dredging the drain in the catchments area as an important measure of adjustment.

Table 5 above shows that 90% of the respondents approved the project to be effective. Their complaint about the project is the slow pace of construction. They also explain that the areas where the channel is yet to be aligned are still experiencing flood though not a heavy one.

The hypotheses to be tested include variation of causes of flood, method of waste disposal and measures of adjustments. The hypotheses were tested using chi-square method.

The formula:

$$\chi^2 = \Sigma((O - E)^2 / E)$$

Where O and E represent observed and expected frequency respectively. The observed frequency is the actual data obtained from the field survey, while the expected frequency is obtained by dividing the summation of the observed frequency by the number of variables.

The different causes of flood were stated in table 1 above. The hypothesis to be tested is stated below.

H_o: "there is no significant difference in the variation between the causes of flood"

H_1: "there is significant difference in the variation between the causes of flood"

$\Sigma((O - E)^2 / E) = 105.65$

$\chi^2_{cal} = 105.65$

To obtain χ^2 tabulated:

Degree of freedom = (h-1), where h is the number of variable

$$(4-1) = 3$$

Level of significance = 5% and 1%

χ^2 tabulated at 5% significant level (0.05, 3) = 7.81

χ^2 tabulated at 1% significant level (0.01, 3) = 11.35

Interpretation

The above results shows that χ^2 calculated exceed χ^2 tabulated both at 5% and 1% level of significance. Therefore we reject the hypothesis of no significant difference in the variation between the causes of flood. This invariably means that the variation is a significant one, it is not by chance. From the above data (table 1), bad drainage and uncontrolled waste disposal has a major contribute to flood occurrence in this area. In a way to establish this fact, the study further analyses waste disposal method in this area. The distribution of waste disposal method in the study area was shown in Table 3. The hypothesis to be tested is stated below:

H_o: "there is no significant relationship between waste disposal method and flood occurrence"

H_1: "there is significant relationship between waste disposal method and flood occurrence"

$\Sigma((O - E)^2 / E) = 40.4$

$\chi^2_{cal} = 40.4$

To obtain χ^2 tabulated:

Degree of freedom = (h-1), where h is the number of variable

$$(3-1) = 2$$

Level of significance = 5% and 1%

χ^2 tabulated at 5% significant level (0.05, 2) = 5.99

χ^2 tabulated at 1% significant level (0.01, 2) = 9.21

Interpretation

Since χ^2 calculated exceed χ^2 tabulated at both 5% and 1% level of significance, therefore we reject the hypothesis of no relationship H_o. This shows that the relationship is not by chance but a significant on whereby majority of the resident of this area dump their waste into flowing river or into the drains in front of their houses or building, such that when rain falls, the waste is being transported into the flowing river. This in turn may block the drains and alter the hydraulic action of the channel.

Moreover, it was observed that waste disposal in the study area is an uncontrolled one. During the study, it was also observed that as congested as the area was, there were no sufficient waste bins to serve the area. Even where found, it usually takes along time before the bin is being emptied. In a nutshell, dumping of wastes into flowing river was the most common mode of waste disposal in the study area and it contributes significantly to occurrence of flood.

The distribution of existing measure of adjustment was stated in Table 4. The Hypothesis to be tested is stated below:

H_o: "there is no significant relationship between existing measures of adjustment and flood occurrence in the study area"

H_1: "there is a significant relationship between existing measures of adjustment and flood occurrence in the study area"

$\Sigma((O - E)^2 / E) = 89.75$

$\chi^2_{cal} = 89.75$

To obtain χ^2 tabulated:

Degree of freedom = (h-1), where h is the number of variable

$$(3-1) = 2$$

Level of significance = 5% and 1%

χ^2 tabulated at 5% significant level (0.05, 2) = 5.99

χ^2 tabulated at 1% significant level (0.01, 2) = 9.21

Interpretation

The above calculation shows that χ^2 calculated exceed χ^2 tabulated both at 5% and 1% significant level. Therefore we reject the hypothesis of no relationship means that the relationship between the existing measure of adjustment and flood occurrence is a significant one.

It is obvious that the channelization process, which involves widening and concretizing the channel, has contributed significantly to flood adjustment along the Ogunpa River in Ibadan.

Some information was obtained through verbal discussion with both respondents and other residents and marketers in the study area, as well as through observation.

Urbanization has been a major process through which the physical landscape over most of the world has been altered. The Ogunpa River used to be a river flowing without any harm to the neighborhood but encroachment to the flood plain as a result of urbanization brought about constriction of the channel as discussed by Arthur (1991). Urbanization also enhanced the waterproofing nature of the Ogunpa catchment's area which invariably increases the rate at which water gets to the channel which in turn increases the magnitude of flood flows (Akintola, 1974).

Similarly, the issue of waste disposal method in the study area can be described to be an uncontrolled one as said earlier. Most of the generated wastes in the area including the market waste are being dumped either directly or indirectly into the drains and the flowing river. 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 culverts and bridges.

Likewise, as was earlier discussed by Cunningham (1999), the study was to establish the channelization project embarked upon by the government has alleviated the impact of flood in this area. The deepening and straightening of stream channel has increased the velocity and volume of water the river channel carries.

4. Conclusion

It has been established that flood hazard comprises structural and erosion damage, loss of life and properties, contamination of food, water and other materials, disruption of socio-economic activities including transport and communication, and the spoiling of agricultural land. Despite all these risks associated with flood occurrence floodplain encroachment is on the increase. Rapid increase in population, uncontrolled land use and rapid development in urban areas are some of the factors responsible for the encroachment rate.

Urban flood cannot be completely eradicated it can only be managed. It is therefore important that policy and decision maker in our society give careful attention to the issue of land use change and its associated implications. They should also give people who have adequate knowledge about environmental problems, such as flood, opportunity to be part of the planning process. The problem cannot be solved by engineers alone, it requires an inter-disciplinary approach.

Finally, for there to be adequate planning and management in our society, government cannot do it alone, individuals must also be responsible for their own actions. Land use planning is a framework for rational decision making in the allocation of land for different purposes.

REFERENCES

Akintola, F.O., 1974. The parameters of infiltration equation of Urban Land-use surfaces Ibadan. Unpublished PhD thesis, University of Ibadan.

Akintola, F.O., Filani, M.O. and Ikporukpo, C.O., 1994. *Ibadan Region* Geography Department, University of Ibadan.

Arthur A., 1991. *Nature and resources* Vol. 27 No 1 Living with flood.

Botkin and Keller, 1998. *Environmental Science.* 11th edition Brook/Cole.

Bradley, C., 1997. *River and Floodplain Restoration:* Status practice in progress in physical Geography, 21(4), 606-610.

Cunningham, W.P., 1999. Principle of Environmental Science. 1st edition McGraw-Hill, New York.

Manning, J.C., 1997. *Applied Principle of Hydrology.* 3rd edition.

Ofomata, G.E.K., 1981. *Urbanization in Nigeria.* Geographic constraint in Urbanization process and problem in Nigeria, P.O. Sada and J.s. Oguntoyinbo (Eds), Ibadan University, 121-129.

Urwick, C., 1970. "*Master plan for waste disposal and drainage, Ibadan*". Report for the World Health Organization.

Ward, C.R., 1978. *Flood. A Geographic perspective.* Macmillan press. 113-195.