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Flooding Information System: A Case Study of Asa River, Ilorin, Kwara State, Nigeria

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ABSTRACT
Flooding is one of the environmental problems that have gained international recognition. As civilization increases, environmental problems increase as well. Following the Ogunpa River flooding at Ibadan which claimed about one hundred lives and destroyed properties worth millions of naira in 1988, attention have been given to flooding which constitute a threat to human existence in Nigeria. In 1995 and 2008, Asa river in Ilorin wrecked havoc rendering thousands homeless. The big question is "could they have been prevented? It is evident that settlements in urban areas appreciated with decrease in vegetation cover. Also, the increased settlements led to an increase in impervious surfaces. Hence the available channels were not able to contain excess water during heavy rainfall. This paper examines the remote causes of flooding and application of Geographic Information system (GIS) for the production of flooding information for an effective management of such environmental problem. Flood map showing the flood extent was produced from the geometric/location data acquired as a result of field work.
Keywords: Flooding, GIS, Environment.

INTRODUCTION
Flooding can be seen as a situation when a river channel is inadequate to accommodate discharge from its catchment. It can also be regarded as unusual high rate of water discharge which often lead to the inundation of land adjacent to the river. As a matter of fact, a river as said to be in floods when it overflows its banks (Oriola, 2006). However, in recent time, flooding has become a common feature and part of life in Nigeria not only in the coastal areas such as Lagos, Port Harcourt and Warri but also in the hinterland such as Ilorin, Ibadan, Ondo etc. These towns often experience flooding during heavy rainfall. Flooding may be caused by man's improper utilization of land or abuse of physical environment. For instance, some people ignorantly erect their structures on the floodplain. An example is shown in the figure 3. Blocking of the river channel by vegetation is another factor that may be responsible for flooding. Such example is shown in figure.1. Also, some people who live close to the river are found of dumping refuse in the river channel, as shown in figure 2. Another factor that may be responsible is rainfall. Examples of flooding in Nigeria are Ogunpa River flooding at Ibadan in 1980 and 1988 and Asa River flooding at Ilorin in 1976, 1995 and2008 respectively among others. Flooding have wreaked havoc and caused damages to the environment, loss of properties and loss of human life at various places at different times. The overbearing effects of flooding on the environment of the host areas cannot be emphasized. It has been categorized as one of the major causes of environmental disaster in Kwara State and its environs. Recently, cases of flooding in Nigeria is alarming. "The Nation"- A daily Newspaper in Nigeria reported on the 15th August,2012 that : Kebbi State Emergency Management Agency have concluded an arrangement to set up a camp for flood victims as a result of the flood that claimed many lives and rendered many people homeless as due to a heavy rainfall that lasted for about seven hours. Not less than nineteen states are being ravaged by flood in Nigeria. In order

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to produce an up-to-date information about flooding, GIS is the best tool to be applied. (GIS) Geographic information system is a system for integration of spatially referenced data for decision making in a problem solving environment (Kufoniyi, 1998). Dumping of refuse in the river especially during dry season may lead to blockage of river channel which may eventually introduction of easte disposal system by the Kwara state government, river Asa had been the sources of waste disposal in florin metropolis which led to the blockage of its channel and consequently over flow of its bank at different time. Also vegetation has almost blocked the channel of the river and invariably limit the channel of the river and reduces the speed at which the river flows. An example is shown in figure 1

Figure 1:- Narrowed Channel as a Result of Vegetation cover Source (Author).

Figure 2: Dilapidated buildings and Refuse Dumped on the River Channel. Source (Author)

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Figure 3:- Abandoned Building on Floodplain. Source (Author)

AIM & OBJECTIVE

Aim: The aim is to produce a GIS based map of River Asa through AutoCad which will facilitate quick and easy access to large volume of data for dredging i.e channelization of the river channel in the nearest future.

OBJECTIVE

Acquisition of geometric data of the river channel.
Collection of attribute data by social survey
Generation of different maps
Making relevant suggestions for decision making.

Study Area

Ilorin which is the focus of this study is located within longitude 08 29′21E & 08 29′ 43′ E and latitude 040 30′50″ N & 04 31′48″N with an area of about 100 kilometres square. .It is the capital of Kwara State. It has been experiencing rapid urbanization since 1967 when it became the capital of Kwara State. See the figure 4 above for details.

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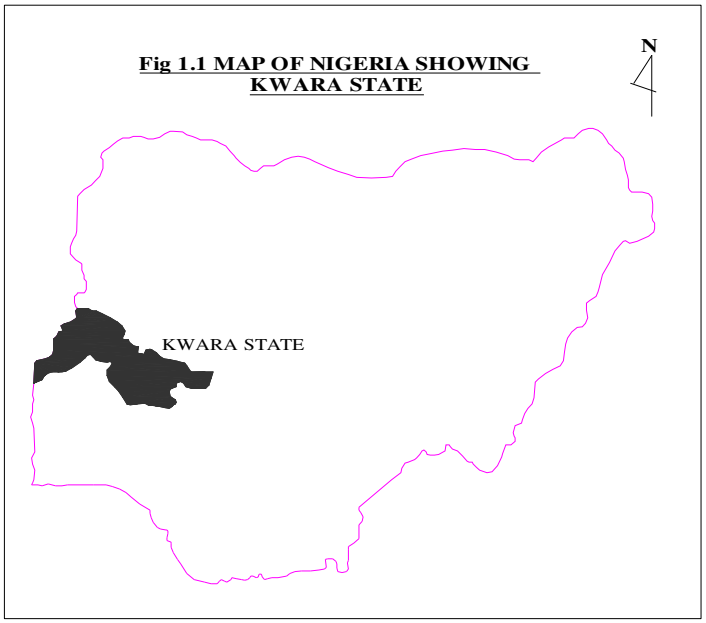

Figure 4: The Study Area. Source: (Asonibare, 2009)

The climate of Ilorin is of the wet and dry tropical type with mean annual rainfall of about 1.318 mm and mean monthly temperature of 25°C, the highest being in March. (Ajibade and Ojelola, 2004). It is also an important commercial, industrial and institutional centre. A contributory factor to the housing problem of Ilorin is its structure. The city has a dual characteristic of an old, clumsy and unplanned traditional area on one side and a planned residential/administrative area on the other side. The buildings in the old traditional area are mainly of mud. The buildings are congested. Sanitation, both public and domestic are generally poor. (Adesina, 2006). The modern sector of the city is well planned and not disorganized as the old traditional area. Almost all the houses here are accessible. Although, it also harbours a lot of commercial activities along its roads, but congestion in the planned area is not as severe as the old traditional core Ilorin. The geology of the area consists of pre-Cambrian Basement Complex. The elevation varies from 273m to 333m with isolated hill (Sobi hills) of about 394m above sea level. The land is mainly drained by Asa River, flowing in a South-North direction forming the dividing boundary between Eastern and Western part of Ilorin. (Ajibade and Ojelola 2004).

METHODOLOGY

This involves the step-by-step procedure adopted in carrying out this research. They are:- Data required and Sources, Data Acquisition, System Configuration/Selection and Data Processing.

Data Required and Sources

The data required for the study was of two kinds. I.e. geometric & attribute data.

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Geometric/locational data describe the geographical location of features (i.e. x, y, or, y, z cords) of spatial relation and the shape and size of the terrain object. X, Y, Z, coordinates are the Northing, Easting's and the Heights of each point. Spatial relation refers to the bearings and distance between one feature and another. The shape and the size are determined from the coordinates. On the other hand attribute data give all other characteristics or properties such as the number of buildings that are constructed on the bank of the river etc. For this study, geometric data was acquired through digital surveying techniques while attribute data was obtained through social survey. The other type of data which was used to compliment the locational data is the information about the buildings that have being submerged in the river and the ones that have being collapsed. These are referred to as secondary data.

Data Acquisition

Advancements in geospatial technology, especially developments in both hardware and software components of GIS, remote sensing and field survey equipment have revolutionalized the data acquisition, processing, interpretation and presentation methods Heywood, (1998) defined data as observation made from monitoring the real world. Data are collected facts or evidence, which may be processed to give them meaning and turn them into information. There are basically two types of data acquired for this research project. They are: - the primary data and the secondary data. Details of the primary and secondary data sets acquired and used are given in table1.1 and 1.2 respectively.

Table 1.1 Primary (Geometric/locational) Data Acquired Data for the River Channel

Station	Northings	Eastings
P1	933967.153	668821.671
P2	934657.099	668975.130
P3	934933.064	668959.784
P4	935224.370	668806.325
P5	936374.263	668898.400
P6	937033.635	668744.942
P7	938781.373	669005.821
P8	939593.964	669420.159
P9	939517.304	669681.038
P10	938444.071	669266.701
P11	937386.169	669097.896
P12	936251.608	669143.934
P13	935684.327	669067.204
P14	935132.378	669266.701
P15	933982.485	669082.550

Acquired Coordinates of the Floodplain

Station	Northings	Eastings
P16	933936.489	672351.215
P17	934687.753	672566.057
P18	935408.353	672443.290
P19	936082.957	672535.365
P20	936849.552	672397.253
P21	938965.356	672627.440
P22	939593.964	673041.778
P23	939195.334	673563.536
P24	937892.122	673149.199
P25	936144.284	673133.853
P26	934411.779	673164.545
P27	933798.502	673026.432

Table 1.2 Secondary (Attribute) Data

Number of Buildings still being occupied on floodplain	12
Number of Dilapidated Buildings on floodplain	6
Numbers of abandoned buildings on floodplain	8

The primary data includes the geometric /locational data, which was acquired with the aid of a Total Station to coordinate the water level before flooding and during flooding respectively. The X, Y, Z co-ordinates (i.e the Northings, Eastings) are in the Universal Transverse Mercator System. Details within 30m to the river were also surveyed. The secondary data was acquired by oral interview (social survey).

System Configuration/Selection

This comprises of all the hardware and software that is needed for data acquisition, data processing and information presentation.

Hardware requirements include:-

Electronic Total station

Pentium personnel computer with 200GBof HDD, 2GB of RAM, 32-bit operating system.

HP DeskJet Printer

Software Requirements Include:-

Leics survey office for downloading and editing of Total Station data.

AutoCAD for exporting graphics.

Microsoft word 2007

Data Processing

Acquired data was downloaded into the computer through the downloading cable of the Total Station. Editing of the data was carried out and the map of the river channel was first drawn through AutoCAD. Thereafter, map of the floodplain was produced. Subsequently, the two maps were superimposed i.e overlay operation was performed. Figure.5 bellow illustrates.

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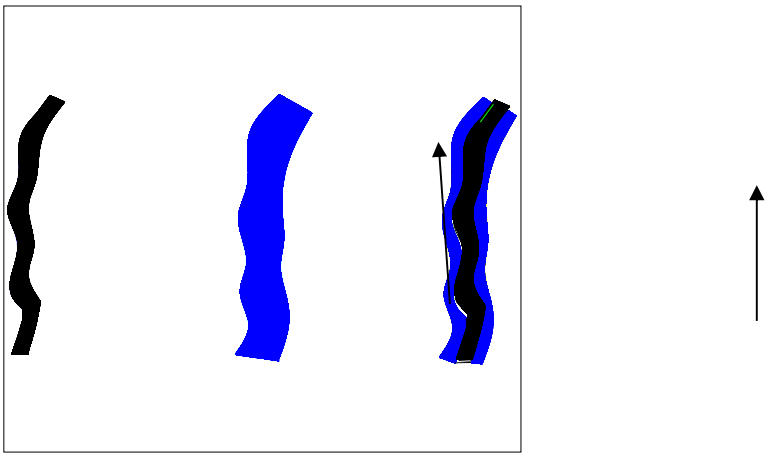

Figure.5:-Asa River Channel and Flood Plain.

DATA ANALYSIS AND DISCUSSION

The spatial analysis function of Geographical Information System (GIS) distinguishes it from other data processing system. This capabilities use the spatial analysis to solve problem or to formulate policies. The principle objective of data analysis which is also applicable to this study is the transformation and combination of data from diverse sources in order to generate useful information which satisfies the requirement of the user or decision makers The study conducted revealed that sporadic increase in settlement at Ilorin led to decrease in vegetation cover and consequently an increase in impervious surfaces. This resulted in the available channel not been able to contain excess water during heavy or prolong rainfall. Also the channels of the river have been narrowed by vegetation-cover and the channel has been widened as a result of silt deposition. Based on the field data acquired with the aid of Total Station and its accessories, mapping of the river channel and the flood extent and determination of the settlements on the flood plain was carried out. Result shows that six buildings have collapsed; eight buildings have been abandoned by the owner or/occupants and twelve buildings on the flood plain are still being occupied.

RECOMMENDATION

Flood events in Ilorin shows that flood disaster have happened several times in the study area and to forestall the possibility of it's re-occurrence, there is the need for government to develop a maintenance culture for the channel by carrying out dredging (i.e channelization) of the river channel from time to time in order to give the channel the ability to contain excess water. Masses should be discouraged from putting up structures on flood plain by Town Planing Authority and the ones that already exist there should be demolished for the safety of lives and properties. Government should relocate the occupants. Government agencies should create awareness on the dangers of blocking the river channel by human activities such as dumping of refuse on the channel. This type of study is recommended for an annual research considering the fact that flooding can only be controlled and not totally eradicated. Annual rainfall data of study area should be acquired by the meteorologist in order to be able to carry out flood forecasting.

CONCLUSION

Flooding – one of the environmental problems that is disastrious in nature have been investigated in this paper. Flooding is an inherent environmental problem which can only be controlled and not eradicated in man's environment. Hence there is the need for persistent environmental awareness by the agencies concerned and continuous study of the environmental hazard for an effective management of man's environment. Results of this study can be used to prevent flooding and carry out sustainable management of the environment.

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