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FLOODPLAIN ENCROACHMENT AND FLOODING OF ILESA SOUTH, WESTERN NIGERIA

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ABSTRACT

The relationship between flood Plain encroachment by Urbanization and flooding from Oora river in Ilesa is analyzed for over a period of fifty years (1930-1980) using air photographs, the ages of buildings, history of flood occurrence and serial topographical maps. The result shows that the basin experienced its first flooding when the catchment was 17.5% urbanized and flooding became more serious when urbanization increased to 48.3%. From the result it was concluded that the process of flood plain encroachment by residential land uses influenced flooding significantly. The 17.5% level of urbanization or residential land use which triggered off flooding in the catchment was regarded as the flooding threshold, that is, a point below which flooding does not occur and above which flooding becomes a serious problem. In other words, once a catchment within this environment is urbanized to the level of 17.5%, then there is every likelihood of flood occurrence. This conclusion is however limited by lack of information on discharge, siltation rate, flow rate, channel characteristics, etc. This is because the Oora river basin is not an instrumented catchment.

Keywords: Floodplain, Encroachment, Urbanization, Flooding threshold.

INTRODUCTION

The increasing rate of urbanization as experienced all over the world has not left out the town of Ilesha in Oyo State, Nigeria. Urban growth together with industrial expansion have been experienced at a greater rate than before especially in cities of developing countries. With every passing day, forests are cleared to make room for new developments, land reclaimed from the sea and unbearable pressure for space has led to the occupation of marginal ecological zones by settlements.

One of the marginal ecological zones that has been subjected to uncontrolled urban development is the floodplain. In Nigeria, floodplains are used for irrigation purposes and for market gardening especially within towns and cities. In most urban areas they are also used for road construction and housing settlements.

The most marginal areas of the floodplain, very prone to flooding, are used as squatter settlements by poor urban migrants, urban farmers and fishermen residing in coastal towns like Lagos, Port Harcourt, Warri, etc.

Where the use of the floodplain is restricted to less intensive purposes which may not distort the hydrological equilibrium, the implication for flooding may not be directly evident. But where houses are built directly on floodplains, especially on the major floodplains very close to the river bank, then flooding is likely occur. In spite of the risk 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.

The interplay between urbanization and the environment of the floodplain begins as urban residential growth is extended to the major and minor floodplains, causing changes in hydrological process. According to Scaake (1970), the causes of increased floods in urbanized watershed are:

(a) Increase in the percentage of impervious surfaces;
(b) Paving, straightening or other ways of improving stream channels
(c) Landscaping (decrease in the inundation area and surface roughness especially through removal of vegetation) and sub-division of land into building sites; and
(d) Filling in and human occupation of floodplains.

According to Ayoade (1988), the invasion of watershed by urban development generally increases surface runoff generation leading to increase in river discharge, siltation of stream channels and a reduction in the rivers effort to transport flood waves down stream,. Other distortions which has been observed in urbanized catchments include changes in sediment yields, channel flow, groundwater and underflow processes which will eventually lead to decrease in channel capacity to carry floods (Brooks & Shield, 1996).

Flooding therefore depends on the pattern and rate of structural distortion not only on the floodplain but also in the total catchment area (Bradley, 1997). White (1958) recorded three types of structural distortions on floodplains from studies in 17 cities of the United /states of America. The first involves residential and commercial growth extending into the reach of the floodplains. The second is the location of industrial plants on the valley bottoms following communication lines and the third is the location of the Central Business District (CDD) wholly on the fringes of the floodplain. For any of the cases or pattern of encroachment mentioned above, the implications for flooding is self-evident. It is therefore expected that the rate and pattern or nature of floodplain occupation should play a fundamental role in the eventual flood hazard that may be manifested. This assertion shall be considered in the present study of Ilesa, an urbanized catchment. The study aims at examining the pattern of urban growth over time and its relationship to flooding.

THE STUDY AREA

Ilesa, a town located on the floodplains of Oora River in South Western Nigeria, lies between longitude 4^0 and 5^0E and latitude 7^0 and 8^0N (Figs. 1a - c). It is a growing urban center with about 150,000 inhabitants. The Oora River is the major stream draining the town. The town is an example of a small drainage catchment in a trado-modern setting which while slowly accepting completely new developments, remains attached to its traditional past. The vestige of its traditional past are evident everywhere, although with lesser influence than before.

The area has no distinguishing physiographic location and the greatest structural distortion to the hydrological regime comes from the upsurge of dwelling units within the catchment.

METHODS

The methods adopted in this study are of two types. In the first instance, a questionnaire survey was carried out to obtain information on the ages of buildings, building materials and history of flood occurrence. The second method was to analyze in concise details, serial air photographs and available topographical maps. This was done with a view to mapping the section of the catchment that was built up at different times in the past. This information was then employed to determine the extent of basin development or invasion, by dwelling unit for a 50 - year period from 1930 to 1980 and the result was related to flood episodes.

RESULTS AND DISCUSSION

Table I provides the ages of buildings in Ilesa town and the dominant building materials. Only very few buildings (4.8%) are aged 81 years and above and such buildings were constructed between 1900 and 1920 with thatch and mud walls. Only very few houses had zinc or iron roofs. By 1960 iron roofs had virtually replaced thatch all over the town and this sudden and significant change in roofing material also affected the hydrological balance of the area.

Fig. 1a: Floodplain Occupance Situation Before 1930 - Oora River Basin

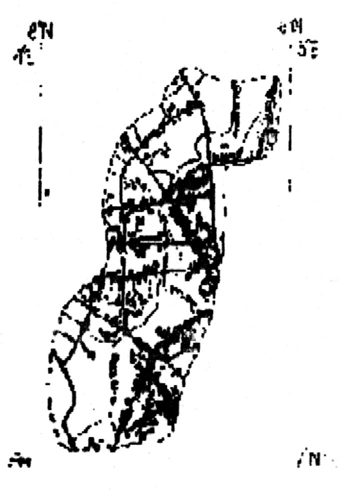

Fig. 1b: Floodplain Occupance Situation As at 1950 - Oora River Basin

Fig. 1c: Floodplain Occupance Situation as at 1980 - Oora River Basin

TABLE I: Ages of Buildings in Ilesa.

AGES OF BUILDING	YEAR OF CONSTRUCTION	NUMBER OF BUILDING	% TOTAL	DOMINANT BUILDING MATERIALS
81 Years and above	1900	87	4.8	-Thatch & few iron roofs-mud walls
80-60 Years	1920	185	10.3	-Thatch iron roofs-mud walls
61-40 Years	1940	254	14.0	-Sun-baked mud bricks - iron roofs-few thatch
19 Years & below	1990	974	53.6	-Iron roofs-Cement blocks

Source: Fieldwork Authors.

This is because thatch roofs can absorb, store and gradually release rainwater during and after rainfall whereas the use of cement and iron roofs with its accompanying paved surfaces and cemented gutters impede infiltration and accentuate run off. All these contributed to the urban flood catastrophe which has been experienced in the area. Table 2 shows the changes in land uses within the Oora River floodplain where Ilesa town is situated. This was obtained from the analysis of air photographs.

TABLE 2: Changes in land uses within the Oora river **Floodplain**, Ilesa

YEAR	LAND USE CHANGES	(%)	
	AGRICULTURE**	RESIDENTIAL**	OTHERS
1940	96.0	4	0
1940	82.0	13.5	4.5
1950	78.7	15.1	5.6
1960	76.2	17.0	6.8
1970	75.5	17.2	7.3
1980	43.3	48.3	9.4

**r = - 0.9941, P<<0.01 , n = 6.

The two dominant land uses in Illesa from our investigations are Agriculture and Residential land uses. Even though Residential uses were secondary as the figures in table 2 shows, they had the greatest influence on the hydrology of the small catchment of Oora stream. The invasion of the Oora River river basin by residential land uses was not significant until 1970 when 17.5% of the area was occupied by houses. As at now, over 48.3% of the total basin area is under residential occupation. Also significant is the fact that most of the buildings were constructed at unsafe distances from the river bank as compared to the hilly and up land sections of the drainage area. This we observed in the field. The correlation between the Agricultural and Residential land uses was calculated (r = - 0.9941) and found to be significant statistically at Pr << 0.1, this indicating that the change in land use from Agricultural to residential is quite significant and exacerbate flooding since the latter is a great modifier of waters sheds. Indeed, agriculture may modify a catchment but housing contributes more to flood occurrences within Basins since it is a greater modifier of catchments. This is because the sinking of especially heavy foundation on floodplains which are necessary for building construction impedes inter flow within the soil, thus keeping them under semi-permanent saturation (Akintola, 1981).

TABLE 3: Flood episodes in Ilesa town, Oora river basin

YEAR	NO. OF FLOOD EPISODE	MAGNITUDE
1930	-	-
1950	-	-
1970	2	Low
1980	3	High

Source: Field Work by Authors.

Table 3 shows the flood episodes so far recorded for the small urban catchment of Ilesa. Ilesa actually experienced its first flood in 1965 during the rainy season.

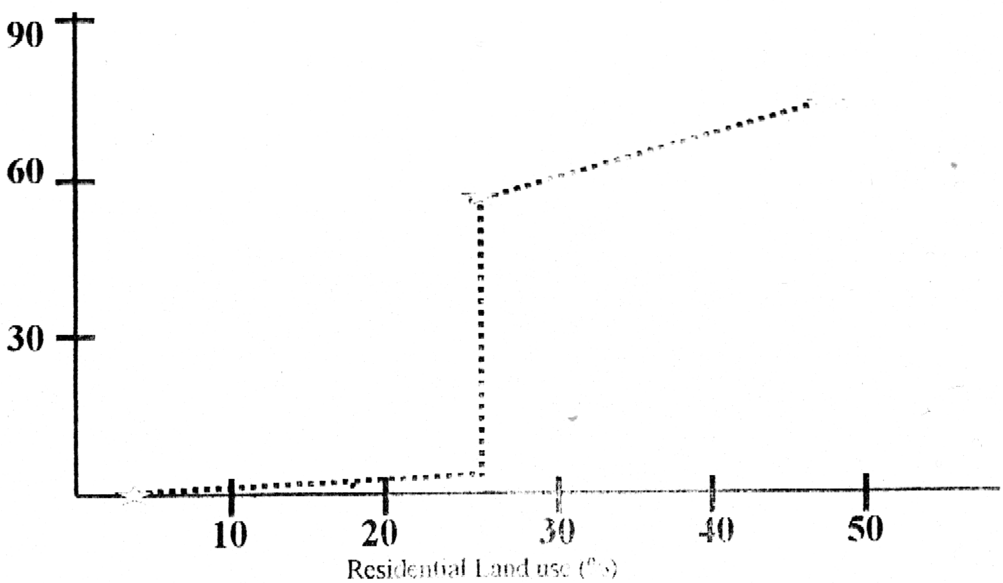

Fig. 2 : Relationship between flood events and residential land use in Ilesa

By 1970 it had experienced two flood episodes and between 1970 to 1980, it was Flooded thrice. The magnitude is hard to quantity as there is no gauging station in The catchment till date. However, from verbal accounts of the residents it can be adjudged to be low in magnitude in 1970 and quite Serious in 1980. The overall invasion of the floodplain by residential units presents a very fascinating picture (see Figs. 1 a to 1 c.) Fig. 1a shows the floodplain occupancy Situation before 1930. As at 1930 the catchment area was almost empty with few Clusters of buildings far away from the floodplain. The earlier settlers, from our Questionnaire survey, lived around the Oba's palace which was set away from the Floodplain. And from table 2, we discover that at this point in time dominant land Use was agricultural (96%) and only 4% of the land use was residential.

This resulted in significant changes structurally within the river basin as Settlers had spilled into the critical sections of the basin. This movement was no doubt encouraged by the major road constructed in 1920 which took advantages of the low - lying floodplain. This in addition to the discovery of gold in the basin led to more commercial activities displacing the farming activities in the area. By 1970, however, at least 17% of the river basin had been covered with Concrete housing units (Fig. 1c) and the encroachment on the floodplain had started to become real especially along the major river channel and its tributaries. This pattern of encroachment has a semblance of what white (1958) described as the extension of Residential and Commercial land uses into the reach of the Floodplain. However, a very significant point to mote is the fact that flooding did not Start in the basin until residential land uses occupied 17.5% of the catchment. The Value 17.5% Residential encroachment is therefore taken in this study to be the Flooding threshold value at which flooding will usually begin for small catchments like Oora River basin and below which flooding might not occur. In other words, A small river catchment which is hitherto undisturbed or whose disturbance is limited to peasant agricultural practices may not experience flooding except when invaded by residential accommodation to the level of 17.5% (Fig. 2). This is because the concretization of drainage floors upset the existing hydrological equilibrium (Brooks and shields, 1996). Indeed, our investigation revealed that by 1960, the structures erected on the floodplain were either wholly concrete or propped up with cement and roofs were mainly iron roofs. Whereas before this time, housing structures were made up of mud with thatch roofs and had very shallow foundations. Since 1980, Ilesa has been experiencing flooding although the basin experienced its worst flood in 1980. This was because as at 1980, over 48.3% of the total basin area had been urbanized, that is, completely covered by dwelling units (Fig. 1c). At that time, the encroachment on the basin had increased dramatically due to demand for more urban space and since 1970 the area had been experiencing an urban growth (floodplain encroachment) rate of about 5% annually (see Table 2). This situation and the drop in demand for agricultural land uses has further worsened the propensity for flooding in the area.

CONCLUSION

This study suggests that urban development in Ilesa town affected the pattern of flooding on the basin of the Oora River. The pattern of urbanization on The basin has been sequential and gradual. The initial phase were the pre- 1930 Phase in which there was no road in the area nor any serious commercial activity and the land use was predominantly agricultural. However, after 1930 and precisely by 1960, the picture of the catchment changed as the area was covered by paved roads, concrete houses with iron roofs, buildings with deep foundations and gold mines. This development which turned the town to a trado - modern city meant taking land from agricultural land uses to residential uses. However, flooding occurred only when residential unit city occupied 17.5% of the entire catchment, the situation grew worse when this increased to 48.3%. The broader implication of this finding is that wherever a small catchment is invaded by settlements in the form of urban growth, a point comes when the hydrological equilibrium of the basin is disturbed and the result is flooding. For this study that point which we call the flooding threshold, was when urban encroachment covered 17.5% of the Oora catchment. Indeed, the urban flood hazards experienced in most tropical cities of the world with its double maxima rainfall, high energy and torrential rain may not be unconnected with the fact that we may have exceeded the flooding threshold in terms of the percentage of urban surface covered by housing vis-à-vis the total area of the catchment.

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