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The Environmental Impact of Flooding on Transportation Land Use in Benin City, Nigeria (Pp 390-400)

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Abstract

Environmental problems of flooding on transportation land use manifest as a result of different land use activities of man to earn his living and his livelihood. Natural surfaces were replaced by more impermeable roads and concrete which have very low infiltration capacity, which have hydrological consequences of resulting into flooding problems in the Benin City metropolis. Data for this study were collected through the administration of 200 questionnaires, using the random sampling technique on respondents and through the physical survey of the study area. Simple percentages were used to analyze the data. Two hypotheses were formulated. The student ‘t’ test statistical method was used to test the hypotheses. Results from this study show that illegal disposal of refuse on drainage channels, high intensity of rainfall, the absence or infective drainage channels, poor construction of roads and building of houses on stream channels were identified as the causes of flooding on transportation land use in the study area. The study recommends that good road construction works, controlled dump sites, and

timely response of the Town Planning Authority to flooding menace should be carried out as a matter of urgency to tackle the environmental problems of flooding on transportation land use in Benin City, Nigeria.

Keywords: Environment, Impact, Flooding, and Transportation Land use

Introduction

In general, the environment provides all life support system in the air, water, on land and in the forests (Glasson et al; 1999). However, the Nigeria environment generally, and Benin City in Edo State in particular, today presents a grim litany of woes across the length and breadth of the country.

Environmental problems therefore manifest as a result of different land use activities of man to earn his living and his livelihood. In the urban land use, deforestation has become a peculiar problem in Nigeria and Benin City in particular, which results from uncontrolled logging and tree felling for the purpose of urban development. In many parts of the Southern States of Nigeria, this goes with its loss of precious biological diversity. Afolabi (2005) noted that the environment is itself, the point in which one is found at a time, the surroundings, the more distant places, other earth components, conditions, prospects and problems which account for its flourishing or otherwise.

Flooding can be described as high water stage in which water overflows its natural or artificial banks on the normally dry land, such as stream or river inundating its adjacent lowlands. In this regard, geophysical hazards can be wrought on civil artifacts, facilities, other aspects of human activities and occasionally loss of human lives may be incurred, (www.vision 2010.org, 2009).

Adebayo (1987) recognized four major mechanisms for the increase in the flooding potentials of urban catchments. The first one is increasing the percentage of impervious surface that infiltrates in the ground and increase in the total volume of runoff. Secondly, paving, straightening or otherwise improving stream channels, all of which reduces the time lag between rainfall and channel runoff. Thirdly, landscaping and subdivision of land into building sites, a process that shortens the distance over which the water flows before reaching drainage way and hence reduces the time lag between rainfall and channel runoff. Lastly, filling in and human settlement on flood plains, which reduces the space available for storing flood waters.

The phenomenon of flood hazards, according to Ward (1978), comprises several aspects including structural damage, loss of lives and properties, disruption of socio-economic activities including transport, communication and the destruction of agricultural land. According to Ayoade (1979), floods are natural phenomena rather than natural disasters. They, like drought, form part of the normally occurring range of stream flow conditions. Flood disasters are man-made as they occur when and where man puts himself at risk by developing and occupying floodable areas, there by causing damage, congestion and hold ups to the transportation networks in the area. Man, therefore, develops and occupies flood plains, at risk of flooding, out of ignorance or for economic reasons.

The basic cause of urban flooding is man's modification of the basin network and channels characteristics during the process of settlement on the particular flood plain (Adeleke, 1978). Natural surfaces are replaced by more impermeable roads and concrete which have very low infiltration capacity. The hydrological consequences of this is that water which should normally infiltrate into the ground or be intercepted by vegetation and then delay for some time before running, would be immediately available for runoff. This considerably decreases the lag time between rainfall and storm water and increase the runoff with concomitant increase in peak discharge and total volume of runoff (Adeleke, 1978).

Aim and Objectives of the Study

The aim of this study is to investigate the propelling environmental mechanisms of flooding prevalent in the Benin City Metropolis as they affect transportation land use.

The specific objectives of this study are to:-

- i. Identify the causes of flooding prevalent on transportation land use in Benin City.
- ii. Examine the environmental problems of flooding on transportation land use in Benin City.
- iii. Recommend possible control measures on the problems of flooding on transportation land use in Benin City.

The Hypotheses

- i. There is no significant difference between the causes of flooding on transportation land use in the Benin City Metropolis.
- ii. There is no significant difference between the environmental problems of flooding on transportation land use in the Benin City Metropolis.

Decision Rule

The null hypothesis (H_0) will be rejected, if the 't' calculated value is greater than the 't' table value at (alpha level of 0.05). If otherwise, the alternative hypothesis (H_i) will be accepted.

The Study Area

Benin City has a history of being one of the foremost destinations of Europeans during their exploration of African continent many centuries ago, (www.edo-nation.net, 2008). Some of her flash points have remained enviable tourist attractions for the state.

Benin City is the capital of Edo State. Benin City lies approximately between latitude $6^{\circ}20'$ North of the equator and longitude $5^{\circ}37'$ East of the Greenwich meridian. The distinct relief regions in Benin City are the swamps/creek. In the Benin low land is found sandy coastal plain and alluvium clay with some hills in the East. River Osse, Orhionmwon and Ikpoba drain the area.

Soil types in the Benin low land ranges from loose poorly productive sand in the South-east to fertile clayey soil in the North-east close to the Niger, the Osse and Benin drainage basins have alluvial and hydromorphic soils. The climate of Benin City is typically tropical with two major seasons. The wet (rainy) and the dry seasons. The wet season lasts from April to November and the dry season from December to March.

The natural vegetation of Benin City consists of tropical rainforest in the Benin low lands. Human interference has, however, led to the presence of plantation for rubber and oil palm as well as forest reserves. The main ecological problem in Benin City is flooding, soil erosion and scarcity of water and out crops of basement rocks. Flooding and erosion are acute in Oredo, Egor and Ikpoba-Okha local government area of Benin City. Rainfall and the removal of vegetal cover and unplanned land use development are the main cause of the problem (www.edo-nation.net, 2008).

Transportation in Benin City is mainly by road and to some extent by air and water. On road transportation, Benin City is transverse by a network of Federal (Trunk A), State (Trunk B), township and rural earth roads (Benin City 2005).

Conceptual Framework/Literature Review

The concept of Homer Hoyt's sector land use model of 1939, is applicable to this study. Hoyt's model states that different income classes in a city tends to be found in distinct area describable in terms of sectors of a circle centered on the Central Business District (CBD). The reason is that the similar land use is usually concentrated along a particular route radiating from the centre of the city. Thus, just like a high class residential district radiates from the city centre, so does a low class one.

Homer Hoyt's (1939) land use model modified that of Burgess (1925) land use model, following the development of public transport. Burgess (1925) model suggests that transport and physical features were important, with industrial areas developing outward in sectors along main transport routes (roads, rivers and canals) and housing growing up around these.

Land use can be defined as the series of activities in which a particular land is used, for the purpose of socio-economic and regional development. The various land use activities carried out are transportation, agricultural, industrial, economic, commercial, administrative and religious land use activities.

These series of land use activities and their improper planning produce distinct distribution of environmental problems, such as flooding and erosion, therefore serving as a clog in the wheel of development on transportation land use activities. Thus, the improper integration of land uses such as industries, residential land use etc and urban drainage at all stages of urban planning handicap free disposition at the rightful places.

Udeh (2001) opined that flooding is a major man-made hazard. It is an extreme geographical event greatly beyond human expectation in terms of magnitude, frequency and causing major hardship with significant damage to man and his works (Adebayo, 2005). Udeh (2001) further stated that in an expanding urban environment, the reduced infiltration capacity of urban impervious surface is likely to be counteracted by change in a number of other variables such as flattening of hill slope for construction puposes and the blockage of drainage channels and other temporary storage provided by roof and buildings and similar reservoirs. This shows that an increase in

urban impervious surface without simultaneous provision for an adequate runoff disposal system actually leads to pounding of surface runoff which eventually results into flooding.

Floods in Nigeria are identified as the most commonly experienced man-made disaster involving large spatial impact and greater loss of life than other disasters (Odemerho, 2004). Studies have shown that increasing intensity of flood problems in space and time, is related to rapid and unplanned rate of urban expansion, where adequate urban runoff disposal system is lacking (Ayoade and Akintola, 1980).

Hossain and Davis (2007) opined that flooding is considered to be one of the most catastrophic forms of natural disasters. The adverse effect of flooding is recognized when it disrupts the road transportation system of a country, since it is considered as a country's socio-economic lifeline.

Road transportation is considered as an integral part of a nation's infrastructure and often termed as its "socio-economic lifeline" since it is used to promote social and economic activities more than any other form of transportation (Solway, 1999; Bruton, 1995). A road transportation system comprises facilities and activities domains.

Methodology

Data for this research were collected through the administration of 200 questionnaires. The data were generated through the use of 200 questionnaires and physical survey that were used by the researchers and upon such information further analysis were done. This study therefore employed the primary source of data collection, with the random administration of 200 questionnaires on respondents within the study area, to obtain the needed data for this research. The physical survey method was carried out in this work to observe the conditions of the roads.

The data collected for this study were analyzed using the simple percentage statistical method to analyze the rate at which flooding problems affects the transportation land use in the Benin City Metropolis. The student t-test statistical method was employed to test the stated hypotheses.

Results and Discussion

From the survey, out of 200 respondents interviewed, 62 representing 31.0% of the respondents stated that the cause of flooding in the area was narrow / shallow channel. 45 representing 22.5% of the respondents noted that the cause of flooding in their area was the illegal disposal of refuse on drainage

channels. 40 representing 20.0% observed that it was due to heavy / high intensity of rainfall, and 53 representing 26.5% of the respondents noted that the absence or ineffective drainage channels was the major cause of flooding in Benin City. The implication of this is that, flooding problem was highest in the area where it was caused by narrow / shallow channels.

Table 1 shows that 61.5% of the respondents indicated that flood had affected their properties in the area, while 38.5% of the respondents stated that flood have not affected their properties in the area. This suggests that majority of the inhabitants within the study area had suffered from the problem of flooding due to its high incidence in the area.

The result of the study revealed that 122 representing 61.0% of the 200 respondents stated that one of the major causes of flooding on transportation land use in the area was poor construction of drainage channels, 49 representing 24.5% of the respondents stated that it was as a result of too much of rainfall in the area, 28 representing 14.0% of the respondents observed that it was as a result of dumping of refuse on drainage channels, and 1 representing 0.5% of the respondents stated that it was due to the building of houses near stream or water courses. This suggests that the major cause of flooding problems on transportation land use on the study area was the poor construction of drainage channels.

Table 2 shows that 16.5% of the respondents observed that the resultant effect of flooding on transportation land use in their area was accident. Furthermore, 17.0% of the respondents stated traffic jam, 42.0% stated slow vehicular movement and 24.5% of the respondents stated few vehicles on the road. The implication of this is that the effect of flooding on transportation land use had led to the slow vehicular movement in Benin City, resulting to waste of precious time of the road users.

Testing of the Hypotheses

Hypothesis 1:

There is no significant difference between the causes of flooding on transportation land use in the Benin City Metropolis.

From table 3, the 't' calculated value (47.807) is greater than the 't' table value (1.960), we therefore reject the null hypothesis. Therefore, there is a significant spatial difference between the causes of flooding on transportation land use within the Benin City Metropolis. Thus, poor construction of drainage channels, too much of rainfall, dumping of refuse on drainage

channels and building of houses near stream were discovered as some of the causes of flooding in the study area.

Hypothesis 2:

There is no significant spatial difference between the environmental problems of flooding on transportation land use in the Benin City Metropolis

From table 4 't' calculated value (35.008) is greater than the 't' table value (1.960). We therefore reject the null hypothesis and conclude that there is a significant difference between the environmental problems of flooding on transportation land use in the Benin City Metropolis. Thus, some of the identified problems of flooding on transportation land use in the study area were traffic jam, slow vehicular movement, accident, few vehicles on the road and increased travel time.

Recommendations

From the foregoing, there is need for the Town Planning Authority to be active in discouraging property construction on areas liable to flooding. Also, quick and timely response to flooding hazards in the study area would help in reducing the incidence of flooding on transportation land use in some parts of the city.

Adequate funds should be provided by the government to carry out studies on annual rainfall input and the prediction of resultant flooding problems in the area.

Covered containers and controlled dump sites should be provided by the Town Planning Authority, so as to discourage the dumping of refuse on drainage channels.

Most of the untarred roads, if not all, should be properly tarred in the study area, so as to avert the prevailing problems of flooding in Benin city.

There is need for the construction of more drainage channels and the rehabilitation of old drainage system within the study area.

Finally, government at all levels should place more emphasis on the construction of flood control works whenever there is flooding menace. Although the incorporation of the biological aspect with that of flooding control measures had proved to be somewhat effective, a more sustainable control of flooding problems should be advocated.

Conclusion

Flooding menace has now become annual phenomenon in Benin City, Nigeria. In view of the findings in this study, it will be of benefit, if the recommendations are given serious consideration. If accepted, implemented and enforced, it will lead to the adoption and adaptation of possible measures to redress the already initiated and future problems of transportation land use, which emanates from flooding in the area.

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Table 1: Effects of Flood on House Properties.

	Frequency	Percentage
Yes	123	61.5
No	77	38.5
Total	200	100.0

Source: Authors' field work, (2008).

Table 2: Resultant Effects of Flooding on Transportation Land use

	Frequency	Percentage
Accident	33	16.5
Slow Vehicular movement	84	42.0
Traffic jam	34	17.0
Few Vehicles on the road	49	24.5
Total	200	100.0

Source: Authors' field work, (2008)

Table 3: Testing of Hypothesis 1

Paired Groups	Mean	Standard Deviation	Degree of freedom	^t Cal	^t tab
Causes of flooding					
Transportation Land use	10.3700	3.06760	199	47.807	1.960

Table 4: Testing of Hypothesis 2

Paired Groups	Mean	Standard Deviation	Degree of freedom	^t Cal	^t tab
Environmental Problems of flooding					
Transportation Land use	7.9400	3.20747	199	35.008	1.960