Environmental Research Journal 2 (3): 99-103, 2008
ISSN: 1994-5396

Responses of Some Basin Parameters to Landuse Changes in Ilorin City, Nigeria

H.I. Jimoh and O.D. Ajewole
Department of Geography, University of Ilorin, Ilorin, Nigeria

Abstract: This study is an assessment of the responses of some basin parameters to land use changes in Ilorin, Nigeria. To achieve this central tenet, the following specific objectives have being pursued as follows: to examine the relationships between the basin channel morphometries, to identify the land use types and their effects on the catchments; and to evaluate people's awareness on land use management problems. Thus, data were generated through direct measurement of some basin properties such as width and depth and also using simple random sampling technique questionnaires were also administered. Further, the use of multiple regression analysis and descriptive statistical techniques were employed for the analysis of the data collected and thus, the results show that: General channel enlargement occurred in width dimension in all the 4 drainage basins, which can be attributed to high sediment yield within the 4 drainage basins. Also, there is a significant difference (95%) between mean upstream channel width and mean downstream width in the 4 basins which confirms an increase in channel width with distance and channel depth decrease. Further, channel changes in the downstream areas below the urban areas are generally substantially larger than predicted from the natural channel cross sections upstream. Thus, the basins exhibited different spatial pattern downstream, which can be associated with differences in degree of land use pattern within the basins. Generally, different measures have been suggested to curb the menace of land use problems, within the drainage basins. This includes the evacuation of the areas close to drainage basins, legislation against riverside building, diversion of river course from residential areas, engineering methods among others.

Key words: Responses, basin parameters, landuse changes, Ilorin, Nigeria

INTRODUCTION

Drainage basin relates to the entire area that provides runoff and at the same time sustains the stream flow (both the consequent and subsequent streams). In addition, Cooke and Doornkamp (1974) emphasized the need to recognize the component parts of the drainage basins that are significantly responsible for the development of surface run offs and the continued sustenance of mainstream and their tributaries.

Essentially, drainage network system depends on the interrelated activities of climate, bioclimatic and lithological factors within the framework of time (Walsh, 1985). Importantly, the basic inputs into basins include precipitation, which powers the movement of water and subsequently the transportation of sediment materials (output). Basic to further understanding of drainage basin is the fact that, human based activities can better be appreciated and indeed understood within the framework of a drainage basin. This is because, both the input and output of a basin are known and can be predicted too. However, the broad spectrum of human activities capable of initiating basic changes in land use mixes includes farming operations, construction activities such as road networks, sinking of wells or boreholes, bridges among others and other clearing efforts to pave way for a number of activities and thus giving rise to deforestations and the attendant consequences too.

Aim and objectives of the study: This research aimed at assessing the degree of the response of some basin parameters to the changes in land uses. Thus, to achieve this central tenet, the following specific objectives have being investigated as follows:

- To examine the relationship between the basin morphometries.
- To study the sizes of land use types and their impact on the catchment.
- To assess the awareness of people on land use management problems.

MATERIALS AND METHODS

Three basic methods were employed in this study as follows:

Corresponding Author: H.I Jimoh, Department of Geography, University of Ilorin, Ilorin, Nigeria

- Direct hydrographic measurement, in which case the four urbanized drainage basins were divided into 2 parts each (upstream and downstream) and the basis of the division based on differences in the observed landuse activities within the basins; the upstream section were natural and not much land use activities were being carried out there while, the downstream sections were modified with pronounced land use activities. However, 6 bank full cross-sectional channels were marked on each side (up stream/ downstream) for all the drainage basins.
- Data on basin distance and area were extracted on a topographical map of Ilorin N.W on a scale of 1:50,000.
- Questionnaire survey was employed to solicit information on the responses of the people or their perceptions on landuse management problems.

Essentially, the basis for the selection of the 4 urbanized drainage basins in Ilorin include population, human activities and pattern of land use variation within the studied drainage basins. The topographical map of Ilorin and the catchment, map of the drainage basins assisted in delimiting the aerial extent of the study area (Oyegun, 1995). Further, a careful study of the aerial photograph of the study area and the proposed land use map of Ilorin assisted in identifying the various land use mixes and the reconnaissance survey of the area assisted in updating and checking the various land use mixes and in identifying areas where land use problems are prominent as well as in the identification of bank full channels along the drainage basins.

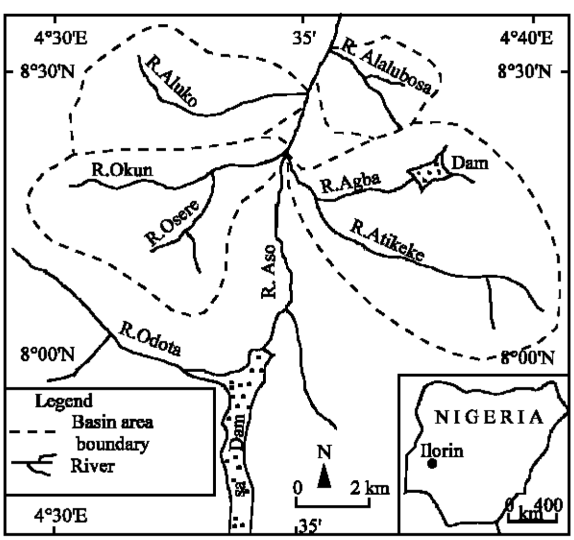

Fig. 1: Ilorin, showing the 4 drainage basins as the study area Source: Oyegun (1983)

The study area: The study area is Ilorin, the capital city of Kwara state of Nigeria and the experimental sites are the 4 urbanized drainage basins (Fig. 1).

It lies on latitude 8°30"N and longitude 4°35"E and it falls within the transition zone between the deciduous forest of the South and the savannah of the North; its accessibility and middle belt position is unique. It is about 57 km North of the watershed between the Atlantic basin and the basin of the river Niger which passes at a distance of 72.41 km further North of Ilorin. Also, it is about 300 km from the coastland area of Lagos and 160 km from Ibadan. Urban development of Ilorin city predates late 60s, when it was pronounced the capital of Kwara State. Hence, the growth rate of Ilorin has been documented by Oyegun, (1983, 1995). Enplan group put the population of Ilorin at 400,000 in 1977, which was about the 6th largest city in Nigeria (Oyegun, 1983). The 1991 population census estimated it to be about 572,178 occupying an area of about 100 km^2 (Oyegun, 1995).

RESULTS AND DISCUSSION

The pattern of spatial variation of the channel morphometries is depicted graphically for each drainage basin (Okun, Agba, Aluko and Alalubosa). To evaluate the relationship between the upstream and downstream channel parameters, Analysis of Variance (ANOVA) was employed and simple regression analysis for upstream channel parameters were used to predict the downstream channel changes in all the drainage basins. Also, attitudes and perception of people resident within the basins on Landuse management problems were discussed.

The spatial pattern of basin channel variation with distance were displayed in Fig. 2-5.

The pattern displayed by these basins were slightly different though Okun, Aluko and Alalubosa appears similar in width dimension, due to sudden increase in width (over a distance of about 1.8-4 km), although there is general width increase in the 4 drainage basins with

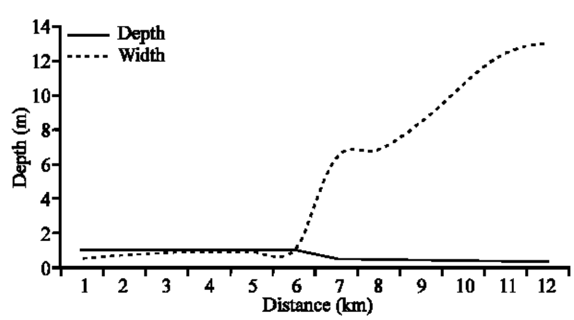

Fig. 2: Spatial variation of Okun drainage channel morphometries

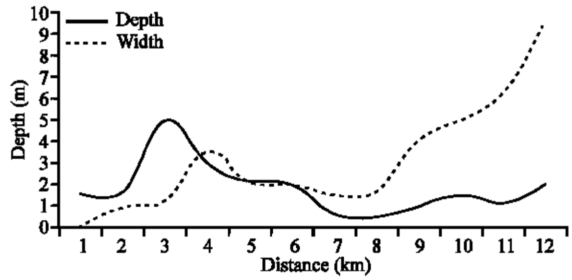

Fig. 3: Spatial variation of Agba drainage channel morphometries

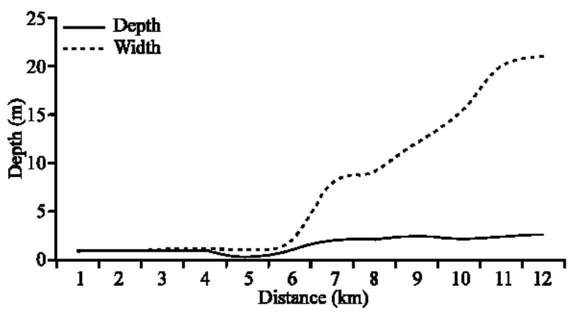

Fig. 4: Spatial variation of Aluko drainage channel morphometries

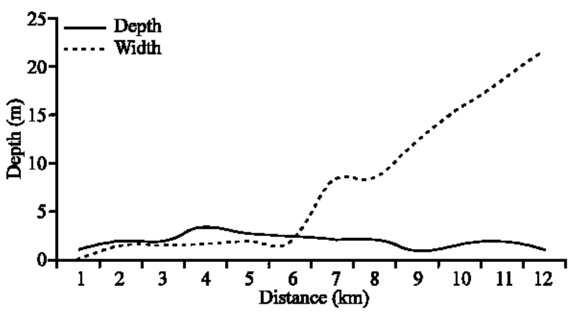

Fig. 5: Spatial variation of Alalubosa drainage channel morphometries

distance but the pattern differs from one basin to another. The increase was sudden and continuous in Okun, Alalubosa and Aluko over a short distance but systematic and undulating in Agba up till a distance of about 6 km where the increase was sudden and continuous. The pattern of channel depth variation differs from width greatly. In Okun drainage basin, the depth of the channel was fairly uniform up till a distance of about 4 km and a gentle decrease at about 5 km where it assumed a fairly regular decreasing pattern. Also, the depth of Alalubosa basin displayed an undulating and irregular pattern throughout the entire basin length. In the case of Aluko basin, the depth of the channel is fairly uniform over a distance of about 2 km but later assuming an increasing undulating profile from 2.2 km and throughout the entire basin length. Hence, the depth pattern displayed by Agba basin is in contrast with the other basins. For instance, the depth is fairly uniform up till a distance of 1.2 km where it assumes an unusual increase of about 5 m and then an undulating and irregular pattern is seen throughout the basin as the distance increases. Hence, the spatial pattern displayed in the width dimension by the 4 drainage basins are slightly similar, because they all exhibited general width increase with distances and this increase may be as a result of rivers trying to overcome flow constraints and thus leads to lateral erosion activities to contain the seemingly displaced water due to the constraints. Eventually, this incidence leads to increase in basin width, which may be traced to the varying effects of landuse on the drainage basins especially as observed by Richard and Greenhalgh (1984) and Knighton (1981).

The comparison of drainage basins channel morphometries for the 4 basins shows a significant difference in the upstream means width from downstream mean width at (95%) confidence level in virtually all the drainage basins which implies that there exist a remarkable change between the channel parameters upstream and downstream, which is an enlargement in downstream width and depth reduction. Meanwhile, Alalubosa shows a slightly different pattern, though there is a significant difference between the upstream width while the depth dimension upstream is not significantly different from the downstream depth. It can as well be inferred that Alalubosa basin is more natural than the other basins, though it is slightly urbanized but the extent of Landuse activities within the basins is not pronounced.

Relationships between some channel characteristics: Some interesting relationships have been found to exist between a number of the channel parameters. For example, the upstream channel relationship and the downstream channel changes were carried out for the 4 drainage basins; using the upstream channel relationship to predict downstream channel charges as follows:

Okun drainage basin: The downstream channel width enlargement demonstrates an average enlargement ratio of 9%, although the range of ratio is between 703% and 1271% and most of the channel enlargement occurred in the width dimension where the average enlargement ratio is 983%, which contrast with an average depth enlargement ratio of 43%. Changes in the depth channel parameter is much larger than predicted by natural channel cross sections representing general increase might be attributed to influence in urban land use on river flow and sediment yield into the basin channel.

Agba drainage basin: The observed channel width is substantially larger than predicted and the channel width below Agba reservoir is nearly 300% of the predicted level and it increased to 990% further downstream. Also, downstream depth channel increases are notably less and the average is 37% of the predicted level. The reason for this variation may be traced to the dam reservoir in the upstream section and other land use influence downstream.

Aluko drainage basin: The observed channel sizes are substantially larger than the predicted from upstream. Channel width average is nearly 800% and the ratio ranges between 538-1076%. Also, channel depth increases at an average of 211%. Channel changes below than predicted from the 'natural' channel cross sections upstream is evidenced by man's interference or due to anthropogenic activities within the drainage basin.

Alalubosa drainage basin: The observed channel changes in the width dimension are larger than the predicted. Channels width average is 401% and the ratio ranges between 338-479%. Moreover, the depth increases are notably less and average is 12%. The reason for the channel changes may equally be attributed to the influence of land use activities on the drainage basin.

Perception studies on land use management: The responses of residents within the drainage basins shows that 66% of them adopted the construction of embankments to prevent flooding, 15% employed the use of engineering methods to curb erosion using stones to prevent headword erosion and flooding.

Summary and the planning implications: The result of this survey revealed a number of interesting features as follows:

Firstly, the occurrence of general channel enlargement in width dimension in the 4 drainage basins and a depth channel reduction may be attributed to high sediment yield within the basins. Landuse activities must be controlled so as to reduce the advancement of erosion, sediment and flooding problems.

Secondly, there is a significant relationship between downstream mean channel changes and the upstream channel as the distance increases or decreases. Thus, efforts must be geared towards discouraging basin incursion to reduce further increase in the downstream channel.

Thirdly depth channel changes downstream below the urban areas are generally substantially larger than predicted from the natural upstream depth channel cross section while downstream width channel changes predicted are substantially larger than observed.

Fourthly, the basins exhibited slight inter-basin differences in the spatial pattern displayed; this is linked with the differences in land use patterns within the drainage basins. Hence, land use activities should be seriously controlled.

Fifthly, it was observed that the respondents in the study area made concerted efforts to stop the threats of landuse problems within the study area. The attempts took various forms such as the use of sand bars to control headword erosion, planting of short cover grasses to prevent erosion and sedimentation, the use of engineering methods to curb the problem of erosion and flooding among others.

CONCLUSION

In the recent times, effects of land use on drainage basin has always been a serious one and such problems resulting from land use includes destruction of road networks and most importantly filtration of water bodies.

The severity of these problems would have been less if they were recognized at their incipient stages unfortunately, it was not so. Even most studies in the recent past have failed to recognize the human aspect of drainage study; rather they concentrated more on the study of basin forms and physical processes. Although, works exists on the human aspect but not as common as the physical processes. This implies that awareness of the human influence on the drainage basin only came into reality with the emergence of severe flooding, filtration and headword erosion. In this regard, attempts must be made to arrest these problems at their incipient stages and people should be discouraged from encroaching the drainage basin influence (Jimoh, 2000).

REFERENCES

Cooke, R.U. and J.C. Dornkamp, 1974. Geomorphology in Environmental Management: An Introduction. Oxford University Press, pp: 1-20.

Jimoh, H.I., 2000. Effects of river erosion on houses: A case study of Asa river catchments in Ilorin Kwara State. Ilorin J. Business Soc. Sci., 7(1, 2): 17-23.

Knighton, A.D., 1981. Local variation of cross sectional form a small gravel bedstream. J. Hydrol., 20: 131-141.

Oyegun, R.O., 1983. Erosion active surface on a pediment shops. J. Trop. Agric., 6(1): 53-55.

Oyegun, R.O., 1995. Ilorin in maps and diagrams. Crystal Press Ilorin.

Richard, K. and C. Greenhalgh, 1984. River Channel Change: Problems of interpretation illustration by the River Derwent, North Yorkshire. Earth surface processes and landforms, 9: 175-180.

Walsh, R.P.D., 1985. The Influence of Climate, Lithology and Time in Drainage Density and Relief Development in the Tropical Volcanic Terrain of the Windward Island, Douglas and Spencer, T. (Eds.), In: Environment.