The Effect of Urbanization on Channel Adjustment and Flood Vulnerability of Woji Basin, River State, Nigeria.

Vincent Ezikornwor Weli[1]. and Ideki, Oye[2].
1. Centre for Disaster Risk Management, University of Port Harcourt.
2. Department of Geography and Environmental Management, University of Port Harcourt.
*E-mail of corresponding author: welivinezi@yahoo.com

Abstract
The impact of urbanization on the hydrology and sediment supply of streams is a major problem causing the flooding of flood plains and its inhabitants. This study examines the impact of urbanization on the channel adjustment of the woji creek and flood vulnerability of the catchment area. The study used both primary and secondary data in its investigation. The primary data were obtained through direct field measurement of the hydro-geomorphic parameters of channel depth, width, discharge, velocity and channel morphology while data for sediment yield and infiltration capacity were obtain through laboratory analysis of samples collected from the stream channel. In the same vein, data for urbanization index was obtained by measuring the distance of urban infrastructure close to the channel. Findings showed that a unit decrease in distance to the channel resulting from an urban infrastructure will consequently lead to a increase of 0.555m/s in the velocity of flow; 0.458cumecs in discharge; 0.520m in width of the channel; 0.489m in depth of the channel; 0.466m in channel morphology and 0.504m/s in infiltration capacity of the Woji River. However, it was only sediment yield that increases at a unit of 0.372ppm for every unit increase in distance of any urban infrastructure which is a function of flood vulnerability. This shows that urbanization influence channel adjustment and exposes the catchment area to flood risk. Policies aimed at integrating flood management, preservation of the stream channel in addition to urban growth control along the Woji creek in Port Harcourt is advocated.

Keyword; sediment load, runoff, urbanization, flood vulnerability, channel adjustment.

1. Introduction

There is a growing interest in the effects of urbanization on hydrological cycles as well as on stream morphology and dynamics (Anderson, 1970). In other words, progressive change in land use and vegetation accompanied by increase in impervious surfaces will result in such phenomena as increase in runoff ratio, the amount of peak discharge and the rate of stream flow. Closely linked with this is the draw down effect of the ground water level. The focus of this paper is the examination of the response of channels to increase in peak flow brought about by urbanization. Previous studies have shown that progressive urbanization of a drainage basin can result in changing channel morphology and hydraulic geometry of stream channels (Knox, 1977; Knight, 1979; Morisawa and Vemure, 1976; Morisawa and Laflure 1979; Ogunkule, et al, 1980; Ebisemiju, 1989). Disturbed watershed will respond by both morphologic and hydraulic variables alterations (Simon, 1992; Church 1992; Pizzuto, 1994; Elliot and Gyetvai, 1999). Notwithstanding the growing literature on the effect of urbanization on stream channel morphology, none of these investigations have examined the implications of these increased flows on channel size and hydraulic geometry response in detail, particularly as it affects flood vulnerability in Nigeria (Odemerho, 1980). Again, despite the importance of these results, there still remains a great shortage in quantitative data on the effects of urbanization on stream system especially within the Niger Delta. The present study is aimed at analyzing the impact of urban development on the woji watersheds and to use the results thereof as guiding principles for watershed management.

2. The problem

The global trends from pure subsistence to industrial and from rural to urban have their attendant environmental problems including urban flood hazards. More important is the fact that every niche of the urban landscape belong to one drainage basin or the other (Teme and Gobo, 2005). Thus, in a bid to meet growing demand for housing and other infrastructural development including industrial and commercial activities, the natural drainage configurations have not been properly analyzed and utilized in the entire layout. These have created severe cases of urban flood hazard of alarming rate within the study area than ever. It has been firmly established by Ologunorisa (2001); Weli (2005); Teme and Gobo (2005) that flooding within the lower Oginigba basin is caused by channel adjustment to processes of urbanization and indiscriminate dumping of refuse on the drainage channel. This observation has also been noted by Umeuduji (2000) that human activities within a drainage basin can trigger off changes in processes that occur in stream channels such as flooding. Development in the drainage basin can take different forms and can be located on different parts of the basin. It can be land phase development (Simon, 1992), e.g. removal of vegetation by logging, deforestation, changes in landuse etc while on the other hand, it can be through channel phase development which takes place for a considerable distance along the river channel e.g. river regulation and channel changes (Pizzuto, 1994). Due to addition to the volume of water in the stream channel, there is the possibility of increased sediment yield. Normally, such may lead to areas down valley being covered with sand. This in turn leads to ditches and canals being clogged with sediments, reservoirs and channels considerably reduced their capacity as a result of siltation thereby resulting into flood hazards.

Flooding has been recognized as a serious environmental challenge in Port Harcourt. The magnitude of urban floods being experienced in the last few years has resulted into several losses of human lives and properties worth over N8 Billion (Arokoyu and Weli, 2008). The immediate causes have been attributed to climate change induced rainfall, uncontrolled urbanization, and floodplain habitation (see Weli and Worlu, 2011). This has forced the Rivers State government to set up inter ministerial committee on flooding and flood management for regular clearing of the drains and urban control.

3. Study area and Methodology

The study was conducted in Woji River basins, Port Harcourt City, Rivers State, Nigeria. The Woji basin drains approximately 520.3km^2. The catchment areas are underlain by oil and gas deeply weathered sedimentary rock that is often referred to as the Agbada formation on top of which is the Benin formation (Okonny, 2010). The topography is undulating with a relative relief of 15 meters (Umeuduji and Aisuebeogun, 1999; Bell-Gam, 2010). Rainfall distribution is fairly uniform and the climate is tropical moist. Tropical rainforest, which has now been removed by industrialization and urbanization, is the natural vegetation of the watersheds. Today the rainforest is nothing more than a gallery of riparian forest bordering stream channels and wet land. The rest of the catchment's areas remain a mosaic of farmlands, fallow bushes at various stages of maturity, and urban uses. Port Harcourt City is an ancient city dating back to the 1913, although modernization and rapid urbanization began in the late 60s. Ever since, the built up area of the city has increased some 15 folds. However, rapid urbanization has been going on without commensurate basic runoff disposal facilities (Arokoyu and Weli, 2008). During storms, large quantities of runoffs flow freely into these rivers. These large inputs of sediments and runoffs are responsible for channel enlargement experienced within the urban reaches of these rivers. Stream response to urbanization was studied adopting the inferred method, which involved the comparison of stream section in basins under different land use stages. The studied channels are headwater tributaries of these major rivers. Channel morphology was measured using tape, level rod and hand leveler to acquire detailed bankful cross-sectional data. Velocity measurements were made using a horizontal axis-ott type current meter mounted on a wading rod. At times, velocity was estimated using float method especially when the water becomes too shallow and velocity too low to adopt the conventional discharge measurements.

The sample size for this study consists of thirty (30) and is based on the assumption/premise that it gives a total representation of the sample population within the study area. Choice of sampling points was based on careful site and point selection that falls along the main channel from Eliozu with distance of 420 metres in length. The sampling point was determined by dividing the channel length by thirty Sampling points. This resulted in a 14 meter interval for each sampling point. Parameters measured include: Discharge, stream velocity, infiltration capacity channel morphology, channel width and channel depth. The following equipments were used for the collection of the necessary data. They include; Stop watch, Ranging pole, Matchet, Field notebook, A 30 meter tape, Meter stick, Hammer and pegs, Sample pegs, Sediment trap, wooden Canoe.

Different relatively straight with fairly uniform channel banks was chosen at each station where all the instruments listed above was used in the manner specified by Dunne and Leopold (1978). In order to obtain data on bankful discharge, the width and average depth of the sampled sites across the river channel were obtained as well as channel velocity. Caution was however taken in delimiting its exact bank-full width to avoid unnecessary introduction of errors into data. The cross-sectional shape was plotted and bank-full defined by reference to floodplain at each sample points. This was achieved by noting the depth at which width-depth ratio increases reflecting over bank flow. Continuity equations show that with increasing discharge, width, depth and mean velocity increased according to simple power functions (Aziegbe, 2006).

$$W = aQb, D = cQf, V = kQm \quad (1)$$

Where: Q is discharge; W, D and V are width, depths and velocity respectively. The values a, c, and k are intercepts of the regression lines and the exponents b, f, and m, are the slopes of the regression lines when the hydraulic parameters are plotted logarithmically.

In order that too much discrepancy did not set in to alter the result of this study, sample point similarity in terms of relief, gradient and other physical characteristics were selected for use in the analysis. This decision helps to ensure that the hydraulic exponential values reflect the dominant landuse in the woji basin, which make stream channel changes comparable.

A unit regression analysis was performed to determine the at-a-station relation of stream width, depth and velocity to changes in stream discharges associated with dominant land uses in the woji basin. The variables were first transformed to logrimathic units in order to yield linear relationships and increase the precision of correlation and regression analysis. This is in conformity with studies done elsewhere (see Pickup 1975; Aziegbe, 2006) in which it was shown that many geomorphic and hydrologic variables show logarithmic relationships.

The determination of the suspended sediment concentration per unit volume of the urbanizing Woji creek was done in the laboratory. The filtration method was adopted for this study. In the analysis performed, 250ml beaker, funnel, 25ml pipette, filter papers and a stirrer will be used. An oven and desiccators was used in the drying of the resulting filtrate and weighing balance at the physical laboratory of the Department of Geography and Environmental management, university of Port Harcourt. The sample in the sediment trapper was measured and l00ml of samples of Woji river water for the 30 sampled points were thoroughly stirred and filtered with the filter paper which previously its dry weight has been determined. The resulting filtrate was oven dried at a temperature of 100^0C for three hours and then cooled in a desiccator and re-weighted. The resulting weight difference between the initial weight of the filter paper and the filtrate gave the sediment concentration per l00ml of the Woji creek. It was later converted to sediment concentration per unit liter in parts per million (ppm). The infiltration capacity was determined using soil capillary nature which gives an idea of the soil water retention and infiltration capacity.

Urbanization index is another important parameter that was measured in this study to establish the degree of relationship between urbanization and the adjustment processes of the Woji creek. Urbanization index in this study refers to the extent of urban infrastructures close to the channel. It includes houses, commercial buildings, services, bridges and other impervious land surfaces. This was determined from a landuse map of 2005 with a scale of 1:4800 and aerial photograph of 1:25000 of Port Harcourt flown in 2010. The urbanization index was computed by measuring the distance of an urban infrastructure at different sampling points along the Woji creek with the aid of measuring tape and pegs (see, Aziebe, 2006). Other statistical techniques used in this research were; the student “t” test, and the Pearson’s product moment correlation coefficient.

4. Results and Discussion of Findings

From the table 1 below, the variations in depth, width, degree of urbanization (measured in distance of urban infrastructures) and discharge along the creek at different sampling points. The factors responsible for the observed differences are as a result of the fact that some sections of the creek downstream have taken over by dredging and other human activities. Moreso, the increase in depth, width and discharge recorded downstream are caused by high run-off of overland flow from the urbanized impervious surfaces and sewers of the basin. Also, between air force base through 2nd artillery to Mini-Okoro (station 15 and 20), the width became reduced from 9.6m to 9.0m as a result of dual carriage bridge that cut across the channel. These stations are located at the foot of Mini Okoro and Air force Bridge. Also the increased urban growth over the years along the channel downstream has resulted into storm run-off into the channel with corresponding increased discharge, reduced infiltration capacity, greater sediment yield and velocity of flow thereby increasing the vulnerability of the catchment to flooding. This revealed that there is a significant adjustment of the Woji creek hydraulic parameters brought by urbanization.

Table 1: Summary Statistics of depth, width, urbanization index and peak discharge of Woji basin.

S/NO	Sampling points	Depth (m)	Width(m)	Distance of urban infrastructures to the channel (meters m^2)	Discharge (in cumecs)
1	Eliogu junction	2	6.1	10	2.44
2	ABC transport	3	6.5	15	2.25
3	East-West road	3.2	6.9	25	3.15
4	Depper life	3.4	7.1	100	4.82
5	Adamac	3.5	8.1	120	2.83
6	Eliohani 1	3.7	9.3	90	3.12
7	Eliohani 2	3.8	8.5	85	2.69
8	Elimgbu 1	3.9	8.7	80	2.61
9	Elimgbu 2	4	9.5	70	2.53
10	Rumuodara 1	4.1	10	75	3.42
11	Rumuodara 2	4.3	10.1	71	3.34
12	Cocaine village 1	4.5	10.6	30	3.18
13	Cocaine village 2	4.0	10.8	25	2.7
14	Cocaine village 3	4.3	9.0	20	2.35
15	Air force base	4.6	9.0	10	3.01
16	2nd Artillery junction	5	11.5	60	3.38
17	Rumuogba layout	5.5	11.7	10	3,72
18	Mini okoro 1	5.7	9.6	7	3.92
19	Mini okoro 2	6	12.1	5	4.08
20	Mobil filling st	6.5	15	5	5.42
21	Mini okoro banacks	6.8	20	3	7.22
22	Rumuobiakani 1	6.9	22	5	8.03
23	Rumuobiakani 2	7.1	25.1	30	9.28
24	Ogingba 1	8	25.5	15	10.2
25	Oginba 2	10	26	10	12.86
26	Glass factory	12	27	8	15.91
27	Post 111	13	28.5	10	17.13
28	Slumberger	15	29	10	15.2
29	Slaughter market	16	29.5	5	7.3
30	Zoo	18	30.5	5	7.4

Source: Authors field work, 2013.

Findings showed that the largest depth and width was recorded around Oginigba axis (station 24 to 30) where a lot of dredging and multinational companies operations are carried out. This has resulted in width enlargement of the channel from 26m to 30.5m. Discharge was particularly observed to be swelling the velocity of flow of the channel. This trend has serious implications to flooding in view of the global climate change and rainfall patterns. The study revealed that velocity and sediment yield of the channel was also adjusted due to urbanization effect. Field investigation reveals a reduction in infiltration capacity of the basin due to increase in impervious surfaces as a result of urbanization. The result of the infiltration capacity analyzed from different sampled points along the Woji basin is a pointer that increased urban growth within a drainage basin will increase overland flow and in turn render the surrounding landscape vulnerable to flooding.

Similarly, adjustment processes as a direct response to urbanization shows that the increment in discharge and sediment yield of the woji creek emanates mainly from storm sewers and run-off. The above findings corroborates with the works of Miller (1971); Odemerho, (1984) and Aziebe (2006) that stream channel will naturally adjust in response to urbanization. In addition, effluents and other domestic waste discharge into the stream from urban activities have the potential to pollute the water and reduce its value for the urban dwellers that depend on it.

The correlation coefficient of distance of urban infrastructure to the river channel which is a function of flood vulnerability varies inversely to velocity of flow, discharge, depth of channel, channel morphology, infiltration capacity and sediment yield which represent adjustment processes of the Woji basin. Specifically, the zero-order correlation matrix of the hydraulic parameters and vulnerability to flood shows that velocity (-0.555), discharge (-0.458) width (-0.520), depth (-0.489), channel morphology (-0.466), infiltration (-0.504) varies inversely to distance of an urban infrastructure which defines urbanization and by extension urban channel adjustment in this study. This means that for a unit change in distance to the channel resulting from an urban infrastructure will consequently lead to a decrease of 0.555m/s in the velocity of flow of the Woji River, a decrease of 0.458cumecs in discharge of the River; a decrease in 0.520m in width of the channel; a decrease of 0.489m in depth of the channel; a decrease of 0.466m in channel morphology and a decrease of 0.504m/s in infiltration capacity. However it was only sediment yield that increases at a unit of 0.372ppm for every unit increase in distance of any urban infrastructure which is a function of flood vulnerability.

The regression statistics shows that velocity of flow of channel resulting from the channel adjustment is the only hydraulic variable that determines the vulnerability of the channel to flooding. The hydraulic variables generally were significant at 95% confidence level with an F- calculated value of 12.447 which is greater than the F-critical value of 4.20. This result suggests that there is a significant relationship between urbanization and channel adjustment at Woji basin.

In the case of urbanization and flood vulnerability, the data on distance of an urban infrastructure was used as an index of urbanization and data on velocity of flow of the river as a measure of flood vulnerability. Findings showed that the model summary of the regression statistics had R and R^2 values of 0.555 and 0.308 respectively. The coefficient of determination shows that velocity accounted for 30.8% of the variation in the incidence of flood in the Woji river catchment area, at 95% confidence level. The relationship between urbanization and flood vulnerability is captured in a regression equation stated below;

$$Y = 88.197 - 0.555X_1 + 16.149 \quad (2)$$

With a T-calculated value of 3.528 which is greater than the critical T-values of 2.76, this shows that there is a significant relationship between urbanization and flood vulnerability at the Woji river catchment area at 95% confidence level. In terms of the relationship between channel depth and stream velocity, the Students' T-test analysis showed that the t-calculated value of 8.50 was greater than the t-critical value of 2.76. This result means that there is a significant relationship between channel depth and velocity of flow in Woji basin. Figure 1 below, gives a graphic illustration of the impact of urbanization on velocity of flow plotted against discharge of the urbanize Woji creek. The channel velocity of flow is represented in the vertical section as against discharge on the horizontal axis. The graph shows progressive increase in velocity in the downstream section of the creek. The reasons been that the downstream sections of the creek are areas were rapid urbanization have taken place. The increase in velocity corresponds to run off intensities which represent a long term adjustment of the stream to changing hydrologic regimes. The increase velocity therefore impact on the channel morphological character. Findings showed that depth; width and discharge increases in direct response to the urbanization rate experience in the channel (see fig. 2 and 3). The size of the channel also results in increased peak discharges which promotes vulnerability to flooding. The increasing discharge into the channel causes an adjustment to the width of the channel to be enlarged particularly in the downstream. The first form of adjustment is associated with stream stations whose immediate upstream areas are under rapid urban development. A geomorphic threshold appears operational in the relationship of impervious areas versus channel adjustment ratio or ratio of mean flood, such that above a certain impervious cover or degree of development, a radical increase in the effects of flood magnitudes and channel enlargement results. This finding is in agreement with that of Kowal (1970), Laflure (1978), Simon (1992) and Aziegbe (2006), and noted in their studies that the effect of channel slope, nature of channel material, bed load, the local lithology, flow regime and amount of water flowing within the channel also contribute to the values of the exponents.

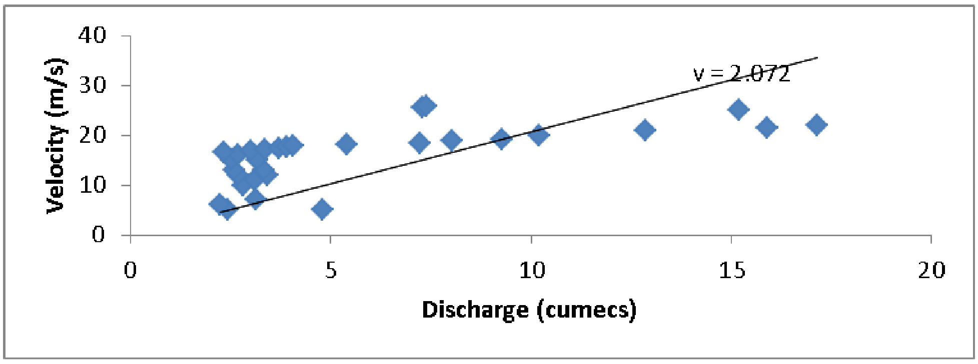

Fig. 1: Velocity adjustment to discharge in Woji River.

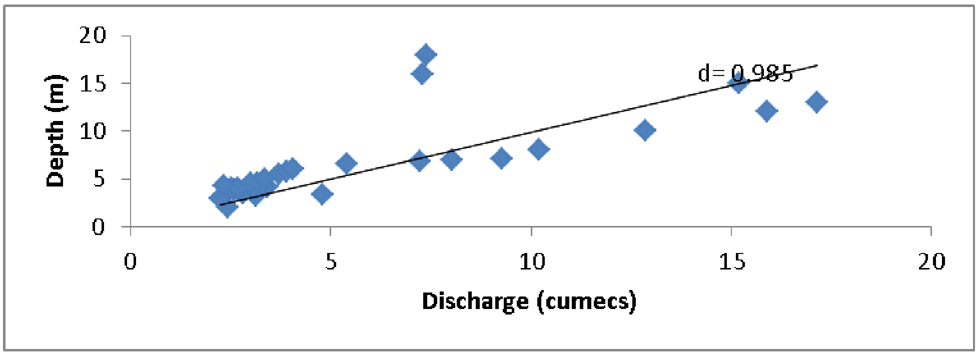

Fig. 2: Depth adjustment to discharge in Woji River

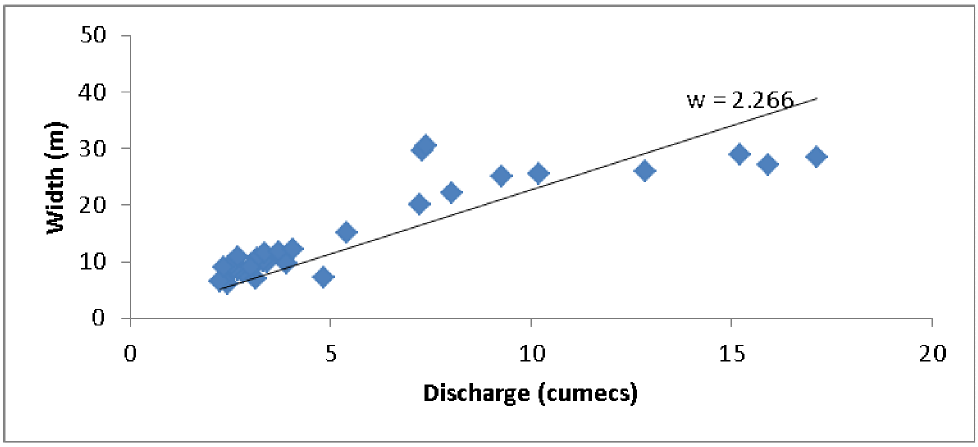

Fig. 3: Width adjustment to discharge in Woji River

5. Conclusion

Studies in channel response to urbanization have shown that changes in urbanization growth have cause corresponding changes in discharge regime of the channel. The foremost effect of urbanization is increased runoff. Changes in any of the individual parameters of the channel do not produce an immediate result, but it does initiate a change that may extend over a long period of time. However, velocity of flow was particularly noted to correlate positively with the other hydraulic parameters. To this end, velocity of flow in a measure factor that determines the environmental challenge posed by flooding due to storm surges exacerbated by urban development. The vulnerability of the urban landscape to flooding has not been fully taken into consideration in urban planning and development. There is therefore, need to integrate natural drainage channel dynamics, and vulnerability of urban dwellers to flooding in Rivers state urban development policies. Enforcement of building guidelines along the water ways is also particularly important.

6. Acknowlegement

We appreciate Dr. J.E. Umeuduji, for supervising the M.Sc thesis from where this paper was extracted. Prof S.B. Arokoyu of the Centre for Disaster Risk management and Development studies and Dr. P. Aifesehi of Department of Geography and Environmental Management, all of University of Port Harcourt, Nigeria who reviewed this paper.

References

Anderson, D. G. (1970): Effects of Urban Development of Floods in Northern Virginia: *U.S. Geological Survey. Water-Supply paper* 2001-c, 22p

Arokoyu, S.B. and Weli, V.E. (2008): Urban flood prediction in a Sub-Humid Tropical city: Implications for urban land use planning in Port Harcourt, Nigeria. *Tropical Focus*. Vol.9 No 2. Pacificam. Douala.

Aziegbe, F. I. (1991). Stream Channel Response to Urbanization: the case of Ikpoba River, Benin city. Nigeria. Unpublished M.Sc. Thesis submitted to the Department of Geography and Regional Planning, University of Benin, Nigeria

Aziegbe, F.I. (2003).: Fluvio-Geomorphic Characteristics of Ikpoba River System. PhD Thesis Submitted to the Department of Geography, University of Benin, Benin City

Aziegbe F.I. (2006): Channel and morphological response of two watersheds to urbanization in Benin City Edo state. Nigeria. *Journal of Human Ecology* 20 (3); 177-182.

Bell-Gam, W.I. (2010) Relief and Drainage in Alagoa E.J. and Derefaka, A.A. (eds). The land and people of River state. Eastern Niger Delta. Onyema Research Publications. Port Harcourt.

Church, M. (1992).: Channel morphology and topology. Pp.126-143, In: *The River Handbook*, Vol.1.P. Carlow and G. E. Petts . (Eds.). Blackwell, Oxford

Dune, T. and Leopold, L. B. (1978). Water in Environmental Planning. W. H. Freeman, San Francisco

Ebisemiju, F. S. (1989). The response of headwater stream channels to urbanization in the humid tropics. *Hydrological. Processes*, 3(2): 37-53

Eliot, J.G.and Gyrtvai, S. (1997): Channel pattern adjustment and geomorphic characteristics of Ekhead Creek, Calorado, 1939-.U.S. *Geological Survey Water Resources Investigations*, *Report 99-4098*. U.S.

Knight, C. (1979): Urbanization and natural stream channel. *Annals Association of American Geographers* 67(3): 323-342

Knox, J. C. (1977): Human impacts on Wisconsin stream channels. *Annals o Association of AmericanGeographers*, 67(3): 324-42

Kowal, J. (1970).: The hydrology of a small catchment basin at Dumsru, Nigeria: Assessment of soil erosion under varied land management and vegetation cover. *Nigeria Agricultural Journal*, 7(2): 134-47

Laflure, S. J. (1978): Hydrologic impacts of urbanization and some proposed solutions. Abstracts with Programs, Northeast. *Sec. Geol. Soc. of American,* 10(2): 72

Miller, R. A. Troxell, J. and Leopold, L. B. (1971): Hydrology of two small river basins in Pennsylvania before urbanization: *U. S. Geol. Survey Prof. Paper* 701-a, 57p

Morisawa, M. E. and Vemuri, R. (1984). Multi-objective Planning and Environmental Evaluation of Water Resources Systems*:* Final Report, Project C-6065, U.S department of the Interior, OWRT, p 1- 99

Odemerho, F. O. (1984): The effects of shifting cultivation on stream channel size and hydraulic geometry in small headwater basins of South Western Nigeria. *Geografiska Annaler*, 66: 327-40

Odemerho, F. O. (1992): Limited downstream response of stream channel size to urbanization in a humid tropical basin. *Professional Geographer*, 44(3): 322-339

Ogunkunle, A. O., Omoti, U Ataga, D. O. and Esiche, A. (1980): Field Tours, *8th Annual Conference. The National Soil Correlation Committee and the Soil Science Society of Nigeria, Benin City* 27th Nov. 3rd Dec. 1980

Okony, I.P. (2010): Geology in Alogoa E.J. and Derefaka, A.A. (eds). The land and people of River State. Eastern Niger Delta. Onyema Research publications. Port Harcourt.

Ologunorisa, E. T. (2001): An assessment of flood risk in the Niger Delta, Nigeria. Unpublished P.hD Thesis, Department of Geography, University of Port Harcourt, Nigeria

Pickup, G. (1975): Downstream Variations in Morphology, Flow Conditions and Sediment Transport in an Eroding Channel. *Z. Geomorph*, *N. F.*, 194: 443-59

Pizzuto, J.E. (1994): Channel adjustment to changing discharges, Powder River, Montana. *Geological Survey of America Bulletin*, 106: 1494-1501

Simon, A. (1992). Energy, time, and channel evolution in catastrophically disturbed fluvial systems. In: *Geomorphology*, M. E. Morisawa (Ed.). Elsevier Science Publishers, Amsterdam.

Teme, S.C. and Gobo, A.E. (2005): Urban flood hazard: issues, monitoring process and guideline. African Journal of pollution and health.

Umeuduji, J.E. Aisubeogun, A. (1999): Relief and Drainage in Oyegun, C.U. and Adeyemo, A. (eds) Port Harcourt Region. Paragraphics

Weli, V.E. (2005): Urban flood prediction in Port Harcourt. Unpublished M.Sc Thesis, Department of Geography and Environmental Management. University of Port Harcourt, Nigeria.

Weli, V.E. and Worlu, S.O. (2011): Recent rainstorm dynamics and its implications for flood frequency in Sub Humid Tropical City of Port Harcourt. Journal of Geographic thought. Dept. of Geography and Environmental Management, University of Port Harcourt, Nigeria.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Recent conferences: http://www.iiste.org/conference/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar