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The Influence of Runoff on Landscape Features in the Tropical Area, Southeast Nigeria

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ABSTRACT

This study examined the Influence of Runoff on Landscape features in tropical Region, Enugu-Anambra state, Southeast, Nigeria. The specific objectives are to; Examine the effect of Runoff water Pollution on landscape and determined the extent of runoff change on landscape. Data were drawn from primary and secondary sources. The secondary data involve the use of information already in existence and these were sourced largely through literature review. Primary data used was acquired through field survey, and case study method. The result revealed that Runoff water Pollution has significant effect on the landscape. and it also affect the water quality. Also, runoff erosion action has significant effect on the landscape. It has caused real change on the shape of the landscape because we lack regular maintenance of roads to keep drains and culvert clean in order to prevent flooding in the system. Based on the result, we can conclude that Runoff water Pollution and erosion action has strong negative effect on landscape. We therefore, recommend that, an effective control system should be put in place in other to direct runoff channels from critical areas to areas with little or no risk. There should be regular maintenance of roads to keep drains and culvert clean so as to prevent runoff changing the landscape and also installing diversion at drains and culverts where runoff velocity can cause erosion.

Keywords: *Influence of Runoff; Landscape Features; Tropical Area; Runoff water Pollution*

1. Introduction

Rainfall, mother the nature and it covers the landscape with runoff downhill. Runoff is nothing more than water "running off" the land surface. When rain falls onto the landscape, it does not just sit or wait for sun to rise in order to evaporate or lapped up by the local wildlife. It starts moving immediately due to gravity. Some of it seeps into the ground in order to refresh groundwater, while most of it flows down gradient as surface runoff. Runoff is an intricate part of the natural water cycle. It is the major source of flooding and water pollution to the city dwellers and non-city dwellers globally.

Runoff is extremely important because it keeps lakes and rivers full of water, which is needed by the people, plant and animals living around that geographical area: it also changes the landscape by the action of erosion. Runoff normally occurs during storms, and increase the volume of water that flows in the rivers and lakes. The U.S. Geological Survey (USGS 2016) posit that runoff can occur either through the natural or man-made processes many parts of the regions, due to heavy rainfall more especially in the southern regions, western regions and Middle Belt regions in 2011 to 2012. Runoff can be classified according to speed of appearance after rainfall as direct runoff or base runoff, and according to (USGS 2016) source as surface runoff, storm interflow, or groundwater runoff.

Storm water runoff is the volume of water generated by rainfall event, snowmelt, or other forms of precipitation that falls to the earth's surface and which do infiltrate into the ground. Runoff can be directly correlated with specific land use. Runoff associated with forested landscape will typically be less than runoff from an urbanized landscape. Following rainfall events, runoff flows overland and picks up materials including but not limited to trash, debris, sediments, and pollutants. The runoff can often contain pollutants in quantities that will affect water quality. Runoff can also carry a variety of pollutants that are associated with a specific land use. These materials can remain in solution or attach to sediment and will eventually be deposited in the lowest part of the landscape or discharged to creeks, rivers, lakes, and wetlands.

Runoff that occurs on the ground surface before reaching a channel may get to nonpoint source of pollution, and it may carry man-made contaminants or natural forms of pollution such as death animal or rotting leaves. Man-made contaminants in runoff could be petroleum, fertilizers, pesticides and so on.
The runoff does increases temperatures in streams and harm fish. Also, other organisms are affected.

The Problem and Objective of the work

As rain fall flows over the land surface, it picks up potential pollutants that may include sediment, nutrients (from lawn fertilizers), bacteria (from animal and human waste), pesticides (from lawn and garden chemicals), metals (from rooftops and roadways), and petroleum by-products (from leaking vehicles). Pollution originating over a large land area without a single point of origin and generally carried by stormwater is considered non-point pollution. In contrast, point sources of pollution originate from a single point, such as a municipal or industrial discharge pipe. Polluted stormwater runoff is so harmful to the people living within that geographical area, it is harmful to the plants in that geographical area and to the others animals in that same geographical area also it changes the landscape by the action of erosion.

Objective of the study

The main aim of the study is examined the influence of runoff on landscape features on city Dwellers in the tropical Region, Southeast Nigeria. The objectives are to;

i. Examine the effect of Runoff water Pollution on landscape features in S. E. of NN extent of.
ii. Evaluate the extend runoff erosion action effect change on landscape of city dweller in the tropical area.

2. Concept of Runoff and Review of Related Literature

Runoff Timing and Volume

According to Butler and Davies (2000), the effects of urbanization on runoff will modify the relative amounts of water that infiltrates, evaporates, flows as subterranean flow, and is delivered as surface stormwater. Not just evaporation, but also changes in the convective cycle and increases in precipitation, as well as interbasin, alter the magnitudes in particular urban areas. Pipe exfiltration, septic discharges, car washes, and sprinklers are examples of drinking water transfers released within the developed area through services and irrigation (Lerner, 2002).

Calder (1993) presents a set of interception and evaporation equations for predicting the hydrologic consequences of land-use change, with a focus on afforestation and deforestation. However, the review does not address the replacement of natural systems with suburban or urban infrastructure. Urbanization increases the volume of direct runoff and amplitude of peak discharge, decreases the time to peak discharge, and decreases the volume of subsurface runoff and baseflow, according to studies dating back to the 1960s (Lazaro, 1979; Bedient and Huber, 2002). Stormwater runoff assessment before and after development has been reported for a small number of watersheds.

Natural Runoff and Man-made Drainage

Natural runoff and Man-made drainage systems are the total combination of natural runoff and man-made runoff called urban hydrologic cycle. The urban hydrologic cycle appearances are totally different from that of nature (plate 1). Important in the water balance of a natural situation are the fluxes of infiltration followed by further percolation into the ground water, the resulting ground water flow, and the transpiration flux from the vegetation. After urbanization, several components of the water balance may change, or even completely disappear. Research about this started around 1970, for example Landsberg (1970), states that the increasing imperviousness due to urbanization causes more rapid runoff. Over the last twenty years, research on this topic has been extended much further.

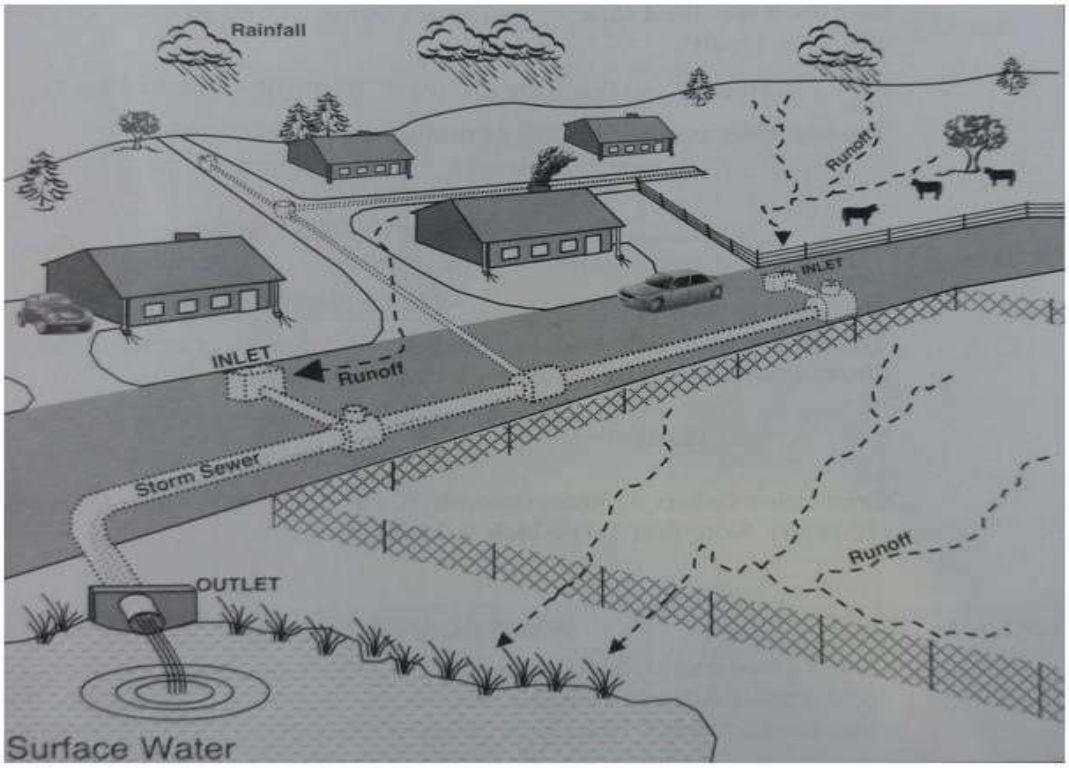

Plate 1. Urban hydrologic cycle. A combination of runoff from natural surroundings and man-made drainage systems, these runoffs come together at a single outlet.
Source: Bedient et al, (2012).

The Effect of Runoff Water Pollution on City Dwellers

Runoff contamination has tremendous and long-term consequences. Runoff pollution has an influence on drinking water, marine life health, and is actually changing the landscape of the watershed by:

a) Reshaping the Watershed: Strong currents of runoff erode stream banks, disrupting the natural shapes of streams and even changing their depths.
b) Affecting Water Quality: Runoff contaminates drinking water sources and transport bacteria, increase the cost of treatment and use of such water
c) Enabling Aquatic Life: Eroded earth from runoff prevents sunlight from reaching underwater grasses, suffocating oysters and other aquatic life. Fish and other species that rely on grasses and marine life are jeopardized as they die. The runoff also delivers nutrients that generate algal blooms, which lead to low oxygen

levels and the death of fish. Stormwater pollution puts not just wildlife in jeopardy, but also residents in the watershed region.

d) Contaminating Recreation Areas: Residents in Virginia and Maryland are advised not to swim in streams for 48 hours following a big rain, as bacteria-laden runoff has caused serious infections.
e) Increasing Water Damage: Local streets and basements frequently flood in urban and suburban regions where ground surfaces have hardened and filthy water has nowhere to go, causing recurring and costly damage to houses and businesses.

One of the most destructive sources of pollution to the Bay and its waters is polluted runoff. And much of it begins in urban and suburban areas.

Rainwater gathers up pet waste, pesticides, fertilizer, oil, and other toxins as it flows off our streets, parking lots, lawns, and other surfaces. This dirty runoff is rarely purified in the same manner that wastewater is at a sewage treatment plant. If the draining water does not evaporate or soak into the ground, it flows directly into local streams, rivers, and the Chesapeake Bay, lowering water quality and threatening aquatic life.

Urban and suburban stormwater runoff erodes streams, kills fish, pollutes swimming beaches, floods homes, and causes many other problems. Stormwater runoff collects a mix or toxic pollutants including:

1. Trash
2. Soil and sediment
3. Faecal bacteria
4. Nitrogen and phosphorus
5. Oil and other petroleum products
6. Pesticides and herbicides
7. Road salt
8. Toxic metals including copper, lead, and zinc

The Effect of Runoff Action Erosion on Landscape.

Landscape is described in different perspectives regarding on the area of interest of the researchers. Olatunde, (2005), described landscape as the portion of land that the somebody can eye and perceive in a single view including all its objects. Landscape can be the combination of many mineral geomorphology with surface mantle consisting of over burden, fauna, topsoil and flora. Landscape deals with the beautification and management of the environment by the society of space with appropriate cognizance of the rudimentary principle of design (Ajayi, et al., 2016). Igwe, et al. (2018) hinted, an effective landscape design may become an integral part of a good municipal environment. A well-structure landscape space can improve the quality of living of the people in a particular area. Landscape design is the science and art of shaping man's natural environment to fit his needs better. Also, to restructure man made environment in order to transport it into closer harmony with nature (Olatunde, 2005). The rudimentary consideration in the design of landscape rest on user's requirement; aesthetic consideration; climatic, environmental consideration and construction and management cost. Ayeni, (2012), declares that landscapes composed of rudiments of different nature which interacts to create a non-random organization in masses and design. The design material is basically divided into two major classes based on the application and the way they appear. These are soft landscape elements such as the plants i.e. flowers, shrubs, grass, trees, water and earth modeling relate with ecosystem and thus easily available among the elements of landscape (Olatunde,2005; Ayeni, 2012).

Landscape directly express the value of the residential area and the lifestyle of the people and how it reflects their personality and attitudes towards the environment. The quest for a qualitative, well landscaped environment, adequate use of land and its resources are very vital issues for every residential development (Ajayi, et al, 2016).

Study Area

The study area is located within latitudes 4° 47' 35‟N and 7° 7' 44‟N, and longitudes 7° 54‟ 26‟E and 8° 27‟ 10‟E as represented in (Figure 1). We have tropical rain forest zone in Nigeria. We have mean maximum temperature of about 27 °C and the sum total the yearly rainfall is exceeding 2500mm (Ezemonye and Emeribe, 2012). We normally experience early rainfall between January and February. The rainy season fully commence in March/April and stop between October/November each year. While the dry season begins November and lasts for about four to five months. The highest rainfall is recorded from June/July to October with little break in August generally known as "August break". The area comprises the geographical location of the following States: Anambra and Enugu. The relative location is bounded in the north west by Kogi and Benue States, in the northeast by Cross River State, in the South by Akwa Ibom and Rivers States and finally in the West by Delta State, as shown on Figure 1 below. The area is well drained. The notable streams, lakes and rivers that are found draining the area in this zone include Nike Lake, Oguta Lake, River Niger, Anambra, Idemili, Njaba, Nkisi, Ezu, Oji etc.

Geomorphic location features and geology of study area

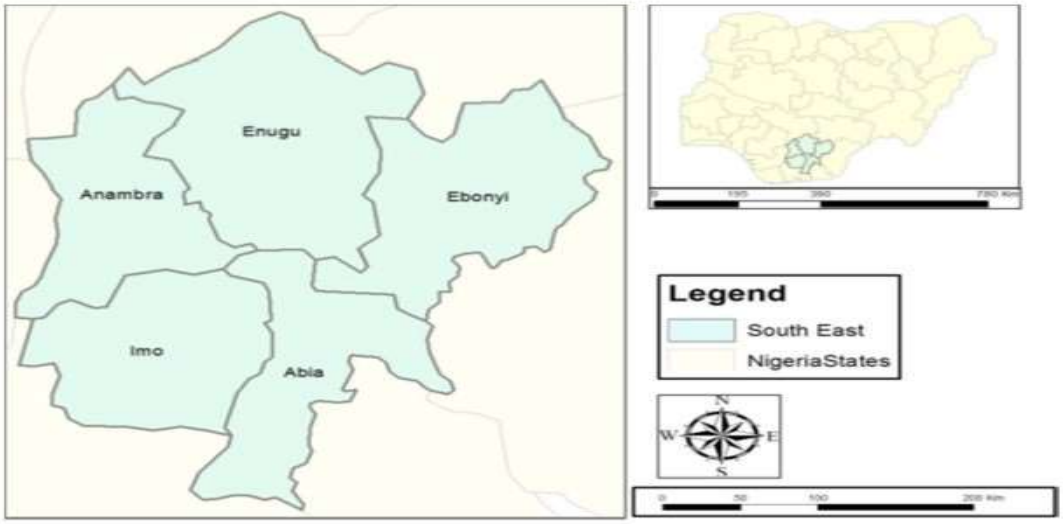

Plate 1
Figure: Map of the south east region of Nigeria showing the five component states.
Source: Map of Nigeria is inset Anejionu O.C.D, Nwilo P.C, Ebinne E.S (2013).

3. Materials and Methodology

Data was drawn from primary and secondary sources. The secondary data involves the use of information already in existence and this was sourced largely through literature review. Primary data used were acquired through field survey, and case study method.

The environment in which people live and how it is arranged has significant societal and individual implications. As a result, there is a need to concentrate on harm to the natural environment that affects not only current and historical landscapes, but also future landscapes.

The change of runoff action erosion on Landscape show in the plate below.

Stormwater Generation, Collection and Drainage

Plate 2
Source: field work.

Runoff gains energy as it flows over a gully head into a plunge pool, causing various gully expansion processes to occur. A gully, like a stream out of balance, attempts to reach a new balance as it goes through processes that may

change its length, depth and width. (Soil conservation guidelines for Queensland, 2015). Mining activities can create steep spoil heaps with exposed dispersive subsoil. Such sites are also prone to serious gully erosion.

Plate 3 A Site at Nach-Agbalaenyi, Enugu State

Source: Boniface C.E Egboka, Akudo Ernest Orji and Hycienth O. Nwankwoala (2019)

The site is undulating and has its drainage in different directions according to the land form (topography), with the greater part of the runoff flowing to the lowest part of the site; most of this runoff is channeled by existing water path on the site.

Plate 4 A site in Umuchu Anambra State

The amount, intensity, and frequency of rainfall; soil type (infiltration rate, organic matter content, etc.); soil surface roughness; slope length and steepness; and ground cover (vegetated or unvegetated) are other factors that can have a significant impact on the amount of pollutants discharged to surface waters and ground water. In addition, the location of the construction site in relation to the receiving waters can have an overall impact on water quality.

Finding

Runoff water has a considerable negative effect on the landscape, according to the findings. Because the system is out of control, it is wreaking havoc on the landscape. The erosion caused by runoff has had a profound impact on the terrain. It has resulted in significant changes in the landscape due to a lack of regular road maintenance to maintain drains and culverts clean in order to prevent floods in the system.

Conclusion

Based on the findings, we can conclude that runoff water pollution has a significant detrimental impact on city dwellers' landscapes and also has an impact on water quality, creating substantial landscape damage due to a lack of control in the system. In addition, how runoff erosion has a significant detrimental impact on the terrain. It has resulted in significant changes in the landscape due to a lack of regular road maintenance to maintain drains and culverts clean in order to prevent floods in the system.

Recommendation

i. An effective control system should put in place in other to direct runoff channels from critical areas to areas with little or no risk as well as construction of concrete culverts to channel the runoff water in city dwellers.
ii. There should be regular maintenance of roads to keep drains and culvert clean so as to prevent runoff changing the land shape and also installing diversion at drains and culverts where runoff velocity can cause erosion.

Reference

Ajayi, M.; Adegbie, M. & Omole, F. (2016). Landscaping and Sustainable Housing Development in Akure, Nigeria.

Ebohon, O. J., Ayeni, D. A, Egbu, C. O, and Omole, F. K. Procs. of the Joint International Conference (JIC) on 21st Century Human Habitat: Issues, Sustainability and Development, 21-24 March 2016, Akure, Nigeria, pp 958-964

Ayeni, D. A. (2012). Emphasizing Landscape Elements as Important Components of a Sustainable Built Environment in Nigeria. Developing Country Studies 2(8), pp.33-42

Anejionu OCD, Nwilo PC, Ebinne ES (2013) Long Term Assessment and Mapping of Erosion Hotspots in South East Nigeria. FIG Working Week 2013, Environment for Sustainability Abuja, Nigeria, pp. 1-19.

Bedient P.B. and Huber W.C. (2002) Hydrology and Floodplain Analysis, Third Edition, Prentice Hall: Upper Sadle River, p. 763

Boniface CE E, Akudo E. O. and Hycienth O. N. (2019), Gully Erosion and Landslides in Southeastern Nigeria: Causes, Consequences and Control Measures. *Global Journal of Engineering Sciences*, 2 (4).

Calder I.R. (1993) Hydrologic effects of land use change. In Handbook of Hydrology, Maidment D.R. (Ed.), McGraw Hill: New York, p. 50.

Emmamoge O. M, Chijioke O. and Ogenyi R. A. (2019), A Suitable Landscape Design for Areas Affected by Gully Erosion in Jos, Plateau State, Nigeria. *International Journal of Innovative Research & Development* Doi No: 10.24940/ijird/2019/v8/i7/JUL19060

Ezemonye MN, Emeribe CN (2012) Rainfall Erosivity in Southeastern Nigeria*. Ethiopian Journal of Environmental Studies and Management (EJESM)* 5 (2): 112-122.

Igwe C. A. (2018), Gully Erosion in Southeastern Nigeria: Role of Soil Properties and Environmental Factor.

Igwe P.U., Chinedu O.C., Nlem E.U., Nwezi C.C., &Ezekwu J.C., P. (2018). A Review of Landscape Design as a Means of Controlling Gully Erosion*. International Journal of Environment, Agriculture and Biotechnology (IJEAB)* 3(1), 103-111

Lazaro T.R. (1979) Urban Hydrology: A Multidisciplinary Perspective, Ann Arbor Science Publishers: Ann Arbor, p. 249.

Lerner D.N. (2002) Identifying and quantifying urban recharge: a review. Hydrogeology Journal, 10(1), 143 – 152.

Obuka E. N; Chukwu, E. N and Okwu D. V. (2018), Effects of land use land cover runoff surface water quality in Enugu Urban Area, Enugu state, Nigeria*. Journal of Environment and earth science* 8(12) 66-74.

Olatunde, O. (2005). Basic Principles of Site Selection and Planning. Penthouse Publications (Nig)