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The Devastating Effect of Gully Erosion Menace on Urban Infrastructures in Calabar Metropolis, Nigeria

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Abstract

Gully erosion is caused by several factors such as heavy rainfall, industrial construction, poor drainage system and deforestation were overtime resulted in loosening the soil structure and expose it to vagaries of agents of erosion. The study was aimed at assessing the effect of gully erosion menace on urban infrastructures in Calabar metropolis. Data for the research were collected using a structured questionnaire, handheld, measuring tape, leveling staff and rope. The coordinates of gully erosion sites and the affected infrastructure were obtained from the field using the Global positioning system (GPS). Findings revealed that the total length and average width of each of the gullies as at 2015 were 385m and 20m for Ikot Anwantim, 1925m and 43m for Ikot Udauk, 3995m and 68m for Ikot Nkebre, 721m and 40 for Etinym Abasi, 1430m and 48m for EdimOtop and 1700m and 28m for Ekeya respectively. Also 18 houses were destroyed at Ekeya gully site. Seventy respondents attributed the impact of gully erosion menace in urban infrastructure to be the collapse of buildings with 35 percent. The researcher recommended that public awareness programme sensitization be undertaken to discourage the inhabitants from developing areas prone to gully erosion.

Index terms— gully, erosion, hazards, degradation and infrastructures.

1 Introduction

he rate of environmental problems that have occurred in recent decades has assumed unprecedented height, especially in human populated areas such as Calabar metropolis and the multi-facet environmental issues that plague the global community includes global warming, pollution escalated desertification, drought, soil and land degradation, deforestation, food shortage, oil spillage, flora and fauna specie extinction, and flooding, which overtime defaced the earths structure, with a dire consequence on urban settlement in both developed and developing countries.

Amidst the different environmental hazard that occur in Nigeria. The most prevalent and threatening in Calabar is erosion, which involves the transportation of soil particles from one geographical space to another by a high flow of water at the peak of heavy down pour or after. Although we have three types of erosion namely; splash, rill and gully erosion, they most prevalent type in Calabar is the gully erosion, and it contributes to the sculpturing of the earth surface.

Infrastructures such as schools, hospitals, roads, houses and telecommunication mass have been greatly destroyed by gully erosion in Calabar. The dramatic increase in population has resulted to the high demand of land for building and over dependence on the available infrastructures. The scenario of rapid population expansion have been playing out in the metropolis over time in diverse measures, leading to urban growth and expanded land use development. There are two major factors responsible for the urban population expansion to out weight the capacities of urban management systems provided, there are the natural growth of the population at an overwhelming rate and the poor urban development control mechanism, which do not act proactively to

pre-erupt urban disorder. Gully erosion menace in Calabar has caused socioeconomic and environmental issues such as; loss of arable lands, lives and properties, creation of bad land and topography, collapse of buildings and culverts, pot holes on roads and destruction of electricity and telecommunication poles. The researcher observed that along areas such as Murtala-Mohammed highway by Bebosco bus stop the road was almost cut off due to gully erosion, also at Ikot Anwatin gully site, but at EdimOtop a large chunk of a nursery school land collapsed and at Etinyin Abasi and Dr. Ekong street, several residential houses wave collapsed.

The effect of gully erosion on urban infrastructure can be assessed, studied, examined and evaluated when the morphometry of gully erosion in the study area is holistically studied. The morphometry of gully erosion is best explained through its variables which include gully, altitude, slope steepness, maximal catchment area as well as maximal, minimal, mean, horizontal, and vertical curvatures of mouth, base, fingers and end points of gullies. Gully morphometry indicators represent methods of describing basin attributes, impact on the development and expansion of ravines in the areas of processes compared to basin characteristics **??**Musa, 2006).

2 II.

3 Study Area

Calabar metropolis lies between 8 0 18 1 00" E to 8 0 24 1 00" and 4 0 54 1 00" N to 5 0 04 1 00"N. it is bounded by Calabar River to the west, Great Kwa River to the East, Odukpani Local Government Area to the north and the Greeks of the Cross River as it empties into the Atlantic ocean in the south. It covers a land area of 406 square kilometers. Under Koppen's climate classification, Calabar metropolis has a tropical monsoon climate with a lengthy wet season spanning eight more months and a short dry season covering the remaining three four months with an average annual rainfall of 270mm. Temperatures are relatively constant throughout the year with average high temperatures ranging from 25 to 28 degrees Celsius. Calabar is an inter-fluvial city that is drained by two major rivers, which are the Cross River and the Great Kwa River. The hydrological pattern influences the conventional rainfall commonly experienced in the city. The drainage pattern which is dendriliz is believed to be the remote factor responsible for gully erosion in the area. Calabar has a low lying gentle and undulating topography that forms the coastal plains of south Eastern Nigeria. The locations in Calabar closer to the coast are low lying with an average altitude of 10m above mean sea level, while the areas further away towards the north of the metropolis have heights of between 40 to 80m above sea level. The undulating nature of the Calabar terrain undoubtedly encourages the speed of gully erosion and agents of devaidation.

4 III.

5 Research Methodology a) Population and Sample

This study adopted descriptive survey research design. The types of data used were, measurements of gully morphometric properties (length, width, perimeter, depth, bed, shoulder width and slope), attribute data of the affected urban infrastructures (type of infrastructure, nature of damage, extent of damage, number of persons displaced), response of residents and population of the area.

6 b) Data and Sources of Data

The primary data were obtained from questionnaire field observation and measurement. Equipments such as the measuring tape, leveling staff and rope were used to obtained direct measurements such as the depth, bed width and slope of the gully. The coordinates of gully erosion sites and affected infrastructures were obtained by using the geographic positioning system (GPS). The residents were also interviewed at each gully site to have first hand information on the impact of gully erosion on the population and infrastructures within the study area.

A purposive sampling technique was used to select locations ravaged by the scourge of gully erosion. During the reconnaissance the researchers identified seven gully erosion sites within the area and the served as sampling scope for the study. Furthermore, systematic sampling technique was used to select buildings to be sampled in the area. The buildings encompasses different land uses from residential to commercial and public land uses. This was done to ensure effective coverage of the aim of study. The research reveals that the remediation work at each of this gully site was not comprehensive and even abandoned at some point due to pavcity of funds from government. At Etinyim Abasi, Ikot Nkebre, Ikot Uduak and Ekeya gully points it was observed that government intervention was not pronounced enough to reduce the threat posed by gully erosion to infrastructures such as buildings, electric poles and access roads, which were seen to be degraded.

7 IV.

8 Results and Discussion

9 a) Results of Descriptive Statistics of the study variables

10 Loss of lives Colapse of buildings

11 Collapse of health centres

12 Destruction of access roads

The table and figure revealed that 70 respondents agreed that the collapse of buildings was the major problem associated with gully erosion menace with 35 percent. But loss of livelihood, destruction of farmlands and collapse of communication installation were least affected with 2.5 percent.

From the study it was deduced that gully erosion distribution pattern cut across different wards within the study area, with each gully sites having unique features in terms of its morphometry properties. Also, it's was seen that the difference in magnitude of gully erosion sites is dependent on the morphometric characteristics. We can say that the morphometric parameters of any gully route do not only show the gully morphology, but also the rate of the gully development. Moreso, the study revealed that build up areas have encroached into the gully and green areas, thereby subjecting the gully route to pressure which results in expansion and ultimately effects the urban infrastructures. This finding is in line with Jimoh (2008), and Lonita(2006) findings on gully erosion research. Despite the intervention effort of government agencies towards ameliorating gully menace, some threatening gully sites in the study area are still expanding due to erosional processes, supported by agents of deviation. The researcher recommends that public awareness be created on the danger posed by gully and residents within these areas be encouraged to adhere strictly to turn planning regulations regarding the types of infrastructures to be created close to gully sites. [1]

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S/N	Gully erosion site	Coordinates	Total length @ 2006(m)	Total length @ 2018	Depth @ 2018	Average width @ 2005(m)	Average width 2018 (m)
1	Ikot Anwan-tim	8 20 02 1 .86”E 5 00 08 1 .87”N	260	385	42	41	20
2	Ikot Udauk	8 20 51 1 .42”E 4 59 56 1 .88”N	1350	1925	29	25	43
3	Ikot Nkebre	8 21 32 1 .10”E 5 03 32 1 .40”N	2690	3915	41	23	68
4	Etinyin Abasi	8 20 12 1 .6”E 4 56 14 1 .82”N	345	721	16	32	40
5	EdimOtop	8 21 18 1 .58”E 4 57 46 1 .55”N	1250	1430	29	52	48
6	Ekeya	8 19 37 1 .24”E 4 55 35 1 .29”N	652	1700	25	19	28

Figure 1: Table 4 . 1 :

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Gully site	Urban infrastructures						
	Access roads	Houses	Electric pole	Schools	Communication installations	Water pipes	Health centres
Ikot Nkebre	10	15	4	3	1	4	1
Ekeya	13	18	5	4	3	19	3
Ikot Uduak	5	8	2	1	1	15	2
Etinyin Abasi	9	14	3	2	2	18	2

Figure 2: Table 4 . 2 :

4

Figure 3: Table 4 .

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Effects of gully on urban infrastructures	Frequency	Percentage
Loss of source of livelihood	5	2.5
Loss of lives	10	5
Collapse of buildings	70	35
Collapse of health centres	30	15
Destruction of access roads	40	20
Collapse of electric poles	35	17.5
Collapse of communication installation	5	2.5
Destruction of farm lands	5	2.5
Total	200	100

Figure 4: Table 4 . 3 :

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