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EFFECTS OF GULLY EROSION IN KONTAGORA, NIGER STATE NIGERIA

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ABSTRACT

Environmental degradation is a menace to many developing cities and they are not unconnected with the changes in the weather pattern occasioned by Climate Change. Erosion in a changing Climate is usually very devastating as it causes a lot of losses both to the environment and the economy of places where they occur. Erosion in Niger State is devastating and has caused a lot of human and material losses. In this study the cause's effects of erosion and the coping strategies were studied. The entire study areas were mapped to identify the extent of the erosion. Gully Erosion Classification System which assessed the gully and allocates an erosion class rating was used. The results revealed that natural and anthropogenic factors are responsible for the causes of erosion in the study area. Poor drainage systems (27%), poor road condition (21%), overgrazing, poor construction techniques (19%), dumping of waste along drainage channel, and falling of trees. The effect of gully on property value (2.57) and threat to lives and properties (3.10) is moderate, while the effect of gully erosion on loss of farmland (2.26) is low. The use of sand bags is the most common coping strategy employed by majority (56.8%) of the respondents which could be as a result of the low cost of producing the sand bags.

Introduction

Erosion is a natural process in which rocks or soils are moved from one location to another by wind or water. Material may move through erosion for distances ranging from a few feet to thousands of miles. (Toy *et al.*, 2020). Erosion often is most noticeable along shorelines, but it occurs in a variety of areas throughout the world. Erosion occurs naturally, but human activity has increased the incidence of erosion by 10 to 40 times globally. Excessive erosion affects agriculture and the flow of bodies of water. It affects various ecosystems and can lead to the endangerment or extinction

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of species that lose habitat or food sources (Blanco-Canqui, *et al.*, 2020) (Pierzynski, *et al.* 2015). The condition of soil plays a role in the susceptibility of an area to erosion. When water can easily soak through soil, it is less likely to run off and take soil with it. The amount and condition of plants on the surface of soil also affect how easily erosion occurs. Grasses and other plants help slow water runoff and make it easier for water to permeate the soil. Climate also plays a role in erosion as written by (Toy, *et al.*, 2020), areas with a great deal of rain can experience significant runoff and resulting erosion. Very dry areas may have erosion from dry soils blowing away. Various factors intensify and speed up erosion. Intensive farming, climate change, cutting down trees and construction of roads and buildings all affect erosion. They are different types of erosion depending on the scale of the erosion; ranging in increasing order from sheet to rill to gully erosion (Le Bissonnais, *et al.*, 2020). There are recent reports on the impacts of gully erosion in Nigeria, ranging from devastation of roads within the town and major roads linking from state to states in the south eastern and northern parts of the country. This has attracted both regional and national attention, as they impede the movement of goods, services and persons from one place to another. Erosion have affected hundreds of people directly every year causing them to relocate due to eroded buildings, infrastructures, and loss of large areas of agricultural farm land as a result of destruction of both the land surfaces and farm produce by erosion rendering the land unsuitable for cultivation (Egboka, *et al.*, 2000). These erosive effects are more prominent and severe by recent and rapid increase in population growth and hence the need to understand how to monitor and prevent gully erosion. The aim of this study is to examine the effects of gully erosion in Kontagora area of Niger State with Babban Rami area of Mashegu as a case study. Therefore, the specific objectives of the study are to determine the nature and causes of gully erosion in the area; assess the impact of gully erosion in the study area and assess the coping and mitigation strategies used in the study area.

The Study area

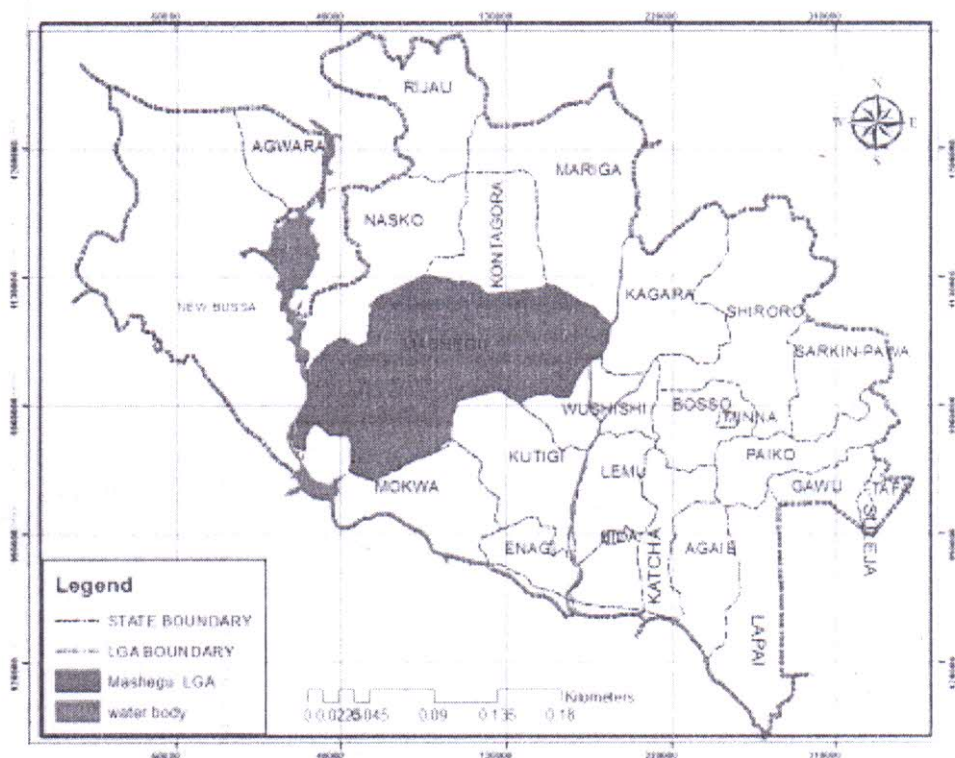
Babban Rami district lies on latitude $10^{\circ} 11^{11} 00^{11}N$ to $10^{\circ} 12^{11} 00^{11}N$ and longitude $5^{\circ} 19^{11} 00^{11}E$ to $5^{\circ} 20^{11} 00^{11}E$, on the boundary between the Nupe sand stones to the south west and the basement complex to the north East. The town also sits on the catchment boundary of three separate river system. The Beri river catchment also lies to the south and east and drains into the Kaduna River about 15kms South of Wushishi. The Kontagora river

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catchment drains to the south west and joins to the river Niger just upstream of kanji dam. Finally, the Malendo river catchment about 10kms to the north of the town drains to the Niger River near Yauri at the northern end of the Kanji reservoir. The town is thus well drained with large developable area along the water shed.



Literature Review

Gully erosion has been studied extensively by many researchers in Nigeria (Akpokodje *et al.*, 1986; Okagbue and Uma 1987; Ofomata, 1988; Uma and Onuoha, 1988; Hudec *et al.*, 2005; Nwajide and Hoque, 1979 Abdulfatai *et al.*, 2014). Once gullies are initiated, the soil properties become responsible for their rapid propagation (Okagbue and Ezechi, 1988). Both natural attributes (rainfall, topography, engineering-geological properties of soils, slope of the land surface) and associated human activities contribute to initiation and propagation of gullies. (Teme, 2001) concluded that impermeable nature of the cohesive top soil assists in initiating the gully process by encouraging overland flows that lead to the formation of rills and eventual gullies. In addition, the soil erodability index is influenced by both

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physical and chemical properties of soil (Osadebe and Akpokodje, 2007). Akpokodje and Akaha (2010) reported that the initiation and development of gullies are facilitated by natural processes such as rainfall, topography, soil properties and organic fill material. Ogboi and Odeh (2012) in their study on erosion problems in Ika environs observed that erosion problems are more common in cultivated farmland, exposed/bare compounds, on poorly constructed road sites and in places of concentrated buildings and that area plagued by soil erosion has the vegetation cover removed either by cultivation or construction works or bush burning.

The causes of gully erosion processes are amply described in the standard literature (Diekau, 1986; Summerfield, 1991; Press and Siever, 1994; Strahler and Strahler, 1995; Ahnert, 1996; Richter, 1998). Intensity of soil erosion is mainly influenced by three factors:

Research Methodology

Determination using natural causes was based on a study of precipitation in area, 10years precipitation record (2008-2018) were obtained from Nigeria Meteorological Agency (NiMET). Drainage pattern was determined from downloaded satellite images for the area. Anthropogenic causes of gully was determined using focus groups discussions and structured questionnaire to address issues of land use pattern including felling of trees used as fuel.

Impact of gully erosions in the area was determined through direct assessment, focus group discussion, structured questionnaire designs to capture previous effect and mitigation strategies that might have been put in place but not obviously effective enough to curb the menace.

The coping strategies used by the inhabitant of the area were identified using focus group discussions based on previous information identifying those that had been affected by erosion while the structured questionnaire targeted the various coping measures that has been put in place in adapting to effect of gully erosion.

Results and Discussion

The results of the analyses revealed that human induced causes of gully erosion in the area include poor drainage systems, poor road condition, overgrazing, poor construction techniques, dumping of waste along drainage

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channel, and falling of trees. The table revealed that 27% of the respondents identified poor drainage network as the primary cause of human induce gully erosion, poor condition of roads accounted for 21%, while dumping of waste along drainage channel accounted for 19%. Overgrazing and poor construction technique was reported by 12% of the respondents respectively. Only 8% of the respondents identified deforestation as a primary human induced cause of gully erosion.

The study further went ahead to show the extent of the induced causes. Table 1 showed that poor drainage facility and felling of trees are the highest contributors to gully erosion, while other factors considered had a moderate effect on gully erosion in the study Area.

Table 1: Extent of the anthropogenic causes of Gully erosion

Human Induced-Causes	Weighted Sum	Mean Value	Ran k	Rema rk
Poor Drainage facility	1535	4.05	1 st	High
Poor condition of Road	1271	3.35	3 rd	Fair
Overgrazing	1233	3.25	5 th	Fair
Poor construction technique	1217	3.21	6 th	Fair
Dumping of waste on drainage channels	1249	3.30	4 th	Fair
Felling of Trees	1400	3.69	2 nd	High
Aggregate	1318	3.48		Fair

Heavy rainfall, surface runoff, relief of the area, exposed topsoil and loose soil texture were identified as the primary causes of gully erosion. 34% of the respondents identified heavy rainfall, 26% of the respondents identified surface runoff as a cause of gully erosion, while 17% identified the exposure of the topsoil as one of the primary natural causes of gully erosion in the study area. Those who identified loose soil texture and relief as one of the causes of gully erosion in the study area accounted for 9% and 13% respectively.

The study further revealed that Babban Rami community of Kontagora Local Government of Niger State currently has seven (7) active gullies which are located in Haji a, Haji b, Haji c, Bajobari, Aliyu Madaki, Central

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Mosque, and Central primary school area. The gully erosion is dispersed across the community and is of different length, width and height. The average length of gullies identified in Babban Rami is 289.8 feet; the minimum is 50 feet while the maximum is 582 feet. The longest gully is located in Haji b while the shortest gully is located in central primary school area of the community. The width of the gullies identified in the study area ranges from 16.3m to 57m. The study revealed that on the average, the width of gullies in Babban Rami is about 27.6ft. Haji a area of the community had the gully with the maximum width of 57ft, while Aliyu Madaki area had the gully with the minimum width of 16.3ft. Going by the standard deviation of 13.9ft recorded, it was deduced that most of the gullies had a width of 13.7 – 41.5 ft. The depth of the gullies in the Babban Rami community is between 7ft to 20fts. The study established that depth of gullies in Babban Rami community is averagely 11.8fts. Similarly, Haji a area of Babban Rami community had the gully with the maximum depth of 20fts, while, Central mosque area and Central primary school area had the gully with the minimum depth of 7fts respectively.

The notable effect of gully erosion in Babban Rami community includes; the destruction of roads, loss of farmland, reduction of property value, increase surface runoff, and threat to lives and properties. The study revealed that gully erosion plays a very significant role in the destruction of roads (4.29) and increases surface runoff (4.20) in Babban Rami community compared to other effects reported. The effect of gully on property value (2.57) and threat to lives and properties (3.10) is moderate, while the effect of gully erosion on loss of farmland (2.26) is low. The use of sand bags is the most common coping strategy employed by majority (56.8%) of the respondents which could be as a result of the low cost of producing the sand bags.

Conclusion

The study concluded that the built-up areas are more affected by lack of drainage systems, dumping of refuse on drainage channel, and poor road condition. Secondly, the agricultural areas are more affected by indiscriminate felling of trees, over grazing, loose topsoil and heavy rainfall. Therefore, gully erosion in the study area is as a result of the interplay between human activities and natural elements. The study therefore

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concluded that gully erosion is one of the primary destructive agents for roads in Babban Rami communities including surface runoff which leads to flash floods in some instances. The increase in gully erosion menace in the study area also affected the value of properties, especially those within close distance to the erosion sites, while posing threat to the lives and properties of the inhabitant of the community.

Recommendations

The study recommends that the construction of drainage systems by in the area should be taking as a matter of urgency, while all building codes and regulations must be enforced. Before the beginning of any raining season, all efforts must be made by all concerned to make sure that the drainages are cleared of all kludges. Awareness must be created on proper land use in the study area.

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