ASSESSMENT OF THE GULLY EROSION AND DISASTER RISK IN RAFINGORA AREA OF KONTAGORA, NIGER STATE, NIGERIA

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ABSTRACT

In Nigeria, gully erosion is mostly associated with the south-eastern part of the country. There is dearth of data on gully erosion activities especially around Rafingora in Kontagora Local Government Areas of Niger State due to the popular believe and focus on desert encroachment and flooding that are common to the north. Soil erosion constitutes one of the most significant global environmental problems due to the severity of its ecological effects, and the scale of occurrences. This study aimed at examining the effect of gully erosion in Rafingora and Baba-rami area of Kontagora with the hope of determining the level of vulnerability of the inhabitant and the socioeconomic implication of the erosion on the community. The study adopted visual observation of the soil profile and land uses, physical measurement of houses proximity to gully erosion hazards. Garmin 78GPS was used to determine the coordinates of key reference points while oral interview and focus group discussions were carried out to ascertain the level of disruption to life and property. The slope analysis reveals that the settlement is located within a valley with rivulets whose main tributary has been experiencing backwash erosion for the past 20 years. The soil is of podzol-sandy soil that catalyzed the creation a gully of about 10 meter deep and 500 meters long from the bridge of the traversing Mokwa-Kontagora road. The study also finds out that poverty is the bane of the ecological degradation in the area. It is therefore recommended that building material mining in the area should be prohibit while the ecological fund in the state should be directed to the re-stabilization of the entire area and strengthening the coping capacity of the community.

Keywords: *Erosion hazards, Ecological degradation, Gully Erosion, Poverty, Vulnerability.*

INTRODUCTION

Soil erosion is the displacement of the upper layer of soil as a form of soil degradation. Over the years, tremendous contributions were recorded in understanding the operations of gully erosion and its controlling factors by many scholars using different criteria. Poesen (2011) observed that Gullies are among the morphological indication of long periods of soil erosion revealing the effects of atmospheric adjustment, example is heavy

rain fall and land use practices. Both natural and anthropogenic activities have been reported to trigger the extent at which this gully erosion occurred. Among the natural factors are; climate, soil structure and composition, vegetation cover and topography. While the anthropogenic factors includes; agricultural practices, deforestation, roads and urbanization and as well as climate change.

Water and wind erosion combined are responsible for 84% of degraded acreage (Blanco *et al.*, 2010); and each year, about 75 billion tons of soil is eroded from the land—a rate that is about 13–40 times as fast as the natural rate of erosion (Zuazo *et al.*, 2009). Approximately 40% of the world's agricultural land is seriously degraded (Sample, 2007). According to the United Nations, sizeable parts of Ukraine fertile soil are lost every year because of drought, deforestation and climate change. In Africa, if current trends of soil degradation continues, the continent might be able to feed just 25% of its population by 2025, according to UNU's Ghana-based Institute for Natural Resources in Africa.

In Nigeria, the prevalent of gully erosion are mostly recognized in the south eastern part of the country especially in Anambra State (Agulu-Nanka) and the Auchi gully erosion in Edo State where government is focusing much ecological fund to combat the severity with the foreign aid. In the northern part of the country where the Rafingora is located, much have not been done on erosion control due to the popular believe of regional peculiarity of land degradation problems the country. Desert encroachment and flooding are common to the north while flooding and gully erosion are more significant in the southern part of the country.

Soil erosion constitutes one of the most significant global environmental problems today due to the severity of its ecological effects, and the scale on which it is occurring (Wang *et. al.*, 2014). Soil loss and water ensuing has become one of the central cause limiting local economic growth and diminishing farmland areas. The socioeconomic activities in this area cum torrential rail downpour eventually triggered the highly devastating gully erosion that led to the death of ten (10) persons and about 60 houses destroyed, (This Day 2018). However, critical assessment has not been carried out to identify the factors that predisposed the area to gully erosion, and the level of vulnerability of the community. Hence, the need for this study to provide mitigating measures that will aid environmental policy makers in sustainable development.

AIM AND OBJECTIVES OF THE STUDY

This study aimed at examining the effect of gully erosion in Rafingora area of Kontagora with the hope of determining the level of vulnerability of the inhabitant and the socioeconomic implication of the erosion on the community. This is to be achieved through the following objectives:

i. Examine the local activities that are aggravating gully erosion in the area,
ii. Determine the level of vulnerability of the inhabitant to the gully erosion;
iii. Examine the socioeconomic impact of erosion activities on the micro and macro human environment, and proffer possible mitigation measures.

THE STUDY AREA

Rafingora is a remote area in Kontagora Local Government Area of Niger State that lie within latitude of 10°.16̊ N to 10°.23̊ N and longitude 5°.23̊ E to 5°.26E. The village is of a linear settlement pattern along Kontagora-Mokwa road and the inhabitants are mostly Hausa speaking people and other minor settlers, see fig. 1. The field survey estimated the population figure to be about 10 to 15 thousand inhabitants whose major occupation is subsistence farming growing rice, millet and corn. The presence of termites mound indicated that, geologically, the area is situated in sedimentary basin of Nigeria that is quite rear in basement complex. This is likely the extension of lower portion of Bida sedimentary basin where it share contact with the Nigeria Basement complex.

Figure 1: The study area.
Source: Adapted from Google.com

Methodology

A recognizance survey was carried out to on the entire community with the aid of an informant to in order to be acquitted with the trend of the phenomena and as well identify the salient areas where the erosion is quite active with the aid of Garmin 78GPS and handheld camera. The village head was also educated on the need for the study which galvanized the free access to information and security of field workers.

The physical spatial assessment was carried out by trailing the drainage channels within the village and the patterns of gully erosion were studied; including the severity of the

eroded channels using transect measuring approach. Soil profiles of the area were sampled and studied using grain size chart to determine the aggregate sizes of the soil. This help in determining the permeability of the soil. The vulnerability of the inhabitants was determined through proximate analysis of the building to the eroded channels and soil stability. The coping capacities adopted by the people were assessed through oral interview and physical inspection.

3.0 RESULTS AND DISCUSSION

3.1 Activities that aggravate Gully Erosion in the area

A critical field study of the area reveals that the poor soil condition, topographical setting, building material mining and the land use pattern are the major four factors aggravating gully erosion in Rafingora environment.

Analysis of the sampled soil profile from the field study through hands filing reveals a fine aggregate loose sandy soil with grain size ranging between 0.5mm to 2mm. According to Mirsal (2008), soils containing more clay tend to be more resistant to erosion than those with sand or silt, because the clay helps bind soil particles together. Assessment of depth water-table from the 3 hand dug wells investigated in the village revealed that the top sandy soil is underlay by less porous clay soil at average depth of about 20m down. This enhances high percolation of surfaces drain and base flow that enhances sliding of the top sandy soil.

3.1.1 Terrain analysis of the area

The topography of Rafingora and Babarami is of a gentle slope from all the directions toward the central part of the village. The nature of the soil surface enhances the development of rivulets and tributaries that are filled with sand flow from the northeastern and northwestern parts of the village up hills. These elevated areas of about 300m above sea level are highly degraded due to overgrazing and farming activities. The entire village is well drained with evidences of dry valleys as illustrated in Fig. 2 This is in consonant with the works of Michaelides et al (2012) and Turnbull et al (2011) that long slopes (especially those without adequate vegetal cover) are more susceptible to very high rates of erosion during heavy down pour than shorter, less steep slopes. Steeper terrain is also more prone to mudslides, landslides, and other forms of gravitational erosion processes.

The field observation further reveals the pattern and the rate at which the erosion activities are changing the morphology of the entire area. For instance, the eroded channels from the hills at the northwestern part of the village were less severe to an average breadth and debt of about 2.6m and 1.6m respectively. These channels toward the built up areas were later widely distributed forming a network of various channels with breath and height of about 4.0 to 1.8m within the village. At the eastern part of the village, the erosion activities were so prominent and severe, and this was where lives and houses were lost to flash flood in July, 2018.

Figure 2. slope analysis of Rafingora village.

3.1.2 Land Use Pattern of the Area

The inhabitant of Rafingora majorly lives in mud houses. The physical examination and oral interview of the people revealed that the walling materials of their buildings were excavated from the major stream valley within the village. In other scenario, sand stone were also excavated from the stream valley to buttress their building foundations to mitigating the impact of gully erosion as revealed in Fig. 3. The only consolidated sand stone available in the area is been excavated by the villagers and this has made the entire area more vulnerable to gully erosion. The farming system is dictated by the short duration of the raining season of about three months effectively. Amidst of this, the villagers still depend on fuel-wood for their domestic energy supply. Apart from mango trees and other trees like lime, the entire area is covered with patches of grasses. There is therefore no cover crop after rain-fed harvest to checkmate erosion activities.

Figure 3. Gully erosion and sandstone used as foundation embankments in Rafingora.

4. HAZARD VULNERABILITY OF THE INHABITANTS TO GULLY EROSION

One of the major challenges in the built environment where gully erosion is prevalent is landslide and soil creep that often threaten housing structures and other infrastructural facilities. The sporadic expansion of the major stream valley in the village has claimed lives and buildings, and still continues to threaten the livability of the existing ones. More than forty (40) houses are less than one meter (1m) away from the brim of the stream gully. Although, within the community there are areas with less severity of erosion, but the eastern part of the village where land sliding is more active, all houses situated close to the erosion channels are highly vulnerable as revealed in Fig. 4.

Figure 4. Parts of those houses that are more vulnerable to severe gully erosion.

5. SOCIOECONOMIC EFFECTS OF THE EROSION ACTIVITIES IN THE AREA.

The impacts of the erosion activities in Rafingora and its environ is o major concern both to the environmentalist and political office holders as it threaten both lives and economic mainstay of the region. At the micro, the loss of soil fertility due to high porosity of the top soil and erosion runoff affect their agricultural yield per hectare and income. There is general socio disorder as families were displaced after loosen their houses and properties. There is economic disequilibrium as host relations and friends have to share their meager resources with the displaced families. It was also discovered that some domestic animals and house birds were lost into the ditches continuously thereby affecting their family income. Health wise, most of the hand dug wells in community have totally or partially collapsed due to their proximity to the stream brim.

At the macro level, the collapsed bridge of the motorable road that links the village to Kontagora and Mokwa with other parts of the state hampered the economic flow of goods and services in the region as revealed in Fig. 5. Also the eroded materials will end up forming depositional features downstream thereby silting up other land uses kilometers away, (Pan et al, 2016). The commercial motorists that have to find alternative

rout where available will incur additional cost that has multiplier effect on the region and the state at large.

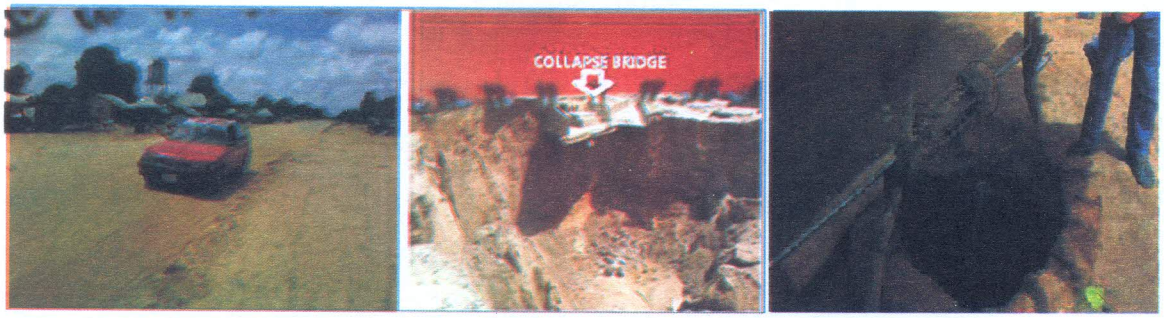

Figure 5. Eroded road and bridge with collapse well at Rafingora village.

CONCLUSIONS

Generally, all erosion activities including gully are directly or indirectly induced and the fact remains that they not boundary restricted. It is a function of the drainage line, soil type and characteristic, anthropogenic activities and of cause climate change of late. When erosion activities metamorphose into gully formation, the multiplier effect is always colossal and thereby requiring collective effort to mitigate. There is no doubt therefore that Rafingora communities have seriously contributed to the degradation of the entire area that is tending toward badland formation. Lives and properties are already been lost in the village, socioeconomic activities are been disrupted as witnessed by authorities concern. The original morphology of the area is gradually being loss, hence the need for urgent intervention at all governmental levels including NGOs and CBOs if the crusade for food security and sustainable development will not be a mirage in Niger State and the country at large. This is in consonant with the views of researchers like Hewett et al (2018) in their work on participatory approach to erosion associated risk. If measures are not immediately taken to curb the problem, all the linear settlement along the road and the road itself would be destroyed just as observed with the collapsing of the bridge

RECOMMENDATIONS

Based on the field data collected and the discussion so far, the following recommendations are being made:

i. The people residing in the eastern part of Rafingora should be evacuated to a more stable land so as to avoid the next unforeseen disaster associated with landslide
ii. Mining of building material and excavation of sand stone from the drainage channels should be totally discouraged as more erosion problems are being created by so doing.
iii. Retention walls and effective artificial drainage system should be constructed within the village to reduce the impact of runoff, while advocating for special tree planting.

iv. Government should give recognition to erosion activities in Northern part of the country as more erosion site is been discovered on daily basis.

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