Erosion and Climate Change Challenges: Anambra State, Nigeria Case Study

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Abstract

The study area; Anambra State is located in the south-eastern part of Nigeria. Soil erosion due to climate-induced flooding constitutes the major ecological challenge of the state.

The topography of the area, in addition to the soil type and the incidence of flooding, is a consequence of heavy rainfall and surface water runoff occasioned by climate change according to the Intergovernmental Panel on Climate Change (IPCC, 4AR, 2007)[1] which results in soil transport and severe gully erosion of this area. The state constitutes about 65% of gully erosion incidence in Nigeria.

Anthropological factors also accelerate the development and expansion of these gullies, with the attendant human vulnerability. Over 40% of the total land area in the state is currently severely eroded.

This paper classified the gully erosion in the area according to their severity and socioeconomic impact; it further analyses their consequence in the face of climate change challenges.

Keywords— **gully erosion, human vulnerability, climate change**.

Summary statement:
Soil erosion in the study area arising from increases in precipitation levels and heavy runoff due to climatic variability has led to ecological disasters with its attendant human vulnerability

1.0 INTRODUCTION

Soil erosion is an ecological process in which soil is displaced faster than it can be replenished. In Anambra State and the southeastern zone of Nigeria, the agents of this soil displacement is basically flooding exacerbated by climatic variability. However human activities also accelerate the process of erosion in this area.

Basically, three (3) types of erosion occurs; sheet, rill and gully erosion. Gully erosion is the most prominent in this region. The topography and the soil characteristics enhance the accelerated spread of gullies in this area. The incidence of gully expansion is heightened during the rainy season, with the resultant effect of loss of agricultural land, residential areas and even human lives.

1.1 The Study Area

With a population of 4,182,032 million people, spread over a land mass of 44,116 km^2; Anambra State in the Federal Republic of Nigeria is the most densely populated state in the southeastern part of the country. The state lies between latitude 5˚ 42´ N and 6˚ 47´N and longitude 6˚ 37´ E and 7˚ 23´ E, being made up of 127 communities divided into 22 Local Government Areas.

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The study area lies within the tropical region. The area is influenced by two climatic seasons, the dry and wet seasons. The wet season starts around May and ends in November, with a break in August, and an average annual rainfall is about 1800mm. The dry season lasts for about 4-5 months spanning the period from December to April.

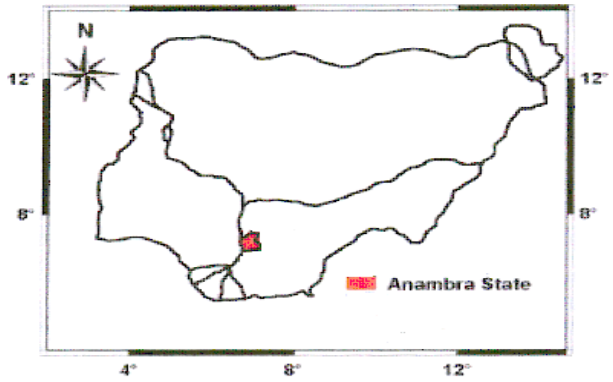


Figure 1: Map of Nigeria Showing the Study Area; Anambra State.

The prevailing winds are the southwesterlies which bring rains during the wet months and the northeasterlies or northwesterlies which occur during the dry months and are known for the hazy harmattan conditions. The wind speeds are low, less than 2 m/s (4 knots or 7.2km/h) throughout the year.

The relative humidity is high all the year round; 80% at night and between 65%-75% during the day. The ambient air temperature varies between 25^0C and 32^0C. The mean daily temperature is 28^0C, while the average annual temperature is 27^0C. However the temperature can go up to 32^0C during the hot periods of the year.

The main drainage system for the state is the Anambra River which empties into River Niger. The natural flow patterns of the river and streams in the area form a kind of drainage pattern in the area. The area is well drained. In general, two types of structures can be identified in the state; namely the uplifts and the basins of sedimentation.

The soil type is deep red, porous and unconsolidated. The land surface is covered with vegetation. The area used to be the rainforest part of Nigeria that has been deforested due to civilization and urbanization. There are various tree species of commercial value found within the area.

Farming (subsistence agriculture), trading and small scale industries are the main source of economy of the state.

1.2 The Issue of Climate Change and Gully Erosion Problem in Anambra State.

By the Intergovernmental Panel on Climate Change (IPCC) usage, climate change means any change in climate overtime, whether due to natural variability or as a result of intense human activities. Climate change refers to a change in climate that is attributable directly or indirectly to human activities, that alters the atmospheric composition of the earth which leads to global warming. Global warming produces increase in global temperature which brings about rising sea levels, changes in climate patterns, change in the amount and pattern of precipitation, and more severe weather including stronger tropical storms, droughts, and heat waves, likely including an expanse of

the subtropical desert regions. Africa is one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity[2]. Nigeria have experienced major climate-change-induced natural disasters, evidenced through high precipitations leading to flooding and soil erosion in Anambra State, in the south-eastern region.

The issue of gully erosion is a common phenomenon in the southeastern part of the country. Anambra State has the highest concentration of gully sites in this zone and the country at large. Every community in the state has their own story of woes to tell of the ever-expanding gully erosion and the attendant consequences.

1.2.1 Gully Erosion Trigger Factors.

The causative agents of gully erosion in Anambra State are both geologic and anthropogenic. Natural erosion occurs primarily due to geologic timescale[3]. Anthropogenic forces (human activities) include; deforestation, unsustainable farming practice, laterite mining, poorly constructed drainage systems, and path and road construction as well as economic and population growth. Soil erodibility depends to an extent on; soil texture, soil structure, soil permeability and the amount of organic matter. The geologic and anthropogenic factors contributing to erosion are discussed below;

Soil Type

The soil type of the study area is porous, with the soil particles being loose and are not compacted, thus making them easily detachable. The nature of the soil accelerates the process of erosion when exposed to external forces such as flooding and human disturbances.

Topography

The topographic features of the area distinctly influence erosion potential. The region has most areas with pronounced rolling highly terrain as shown in Figure 2. These areas have long steep slopes that enhance runoff velocity which gather momentum to produce force that speedily detach and transport soil particles, which results in gullies. This ~~(~~once~~)~~ lush, green land is now turning into an arid badland that's ~~[~~unsuitable~~]~~ for cultivation, dangerous for human habitation and well on the way of becoming a parcel of useless land.

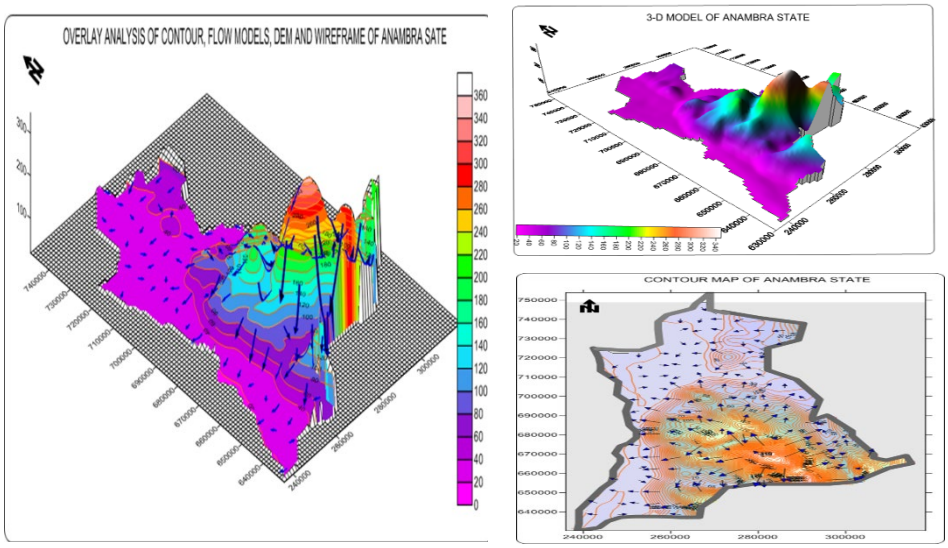


Figure 2: Topography of Anambra State

Agricultural Practices

The farming methodology practiced in the area is unsustainable. During farming, large portions of the land is cleared or burned exposing the fragile topsoil to erosion. Removal of groundcover increases the susceptibility of the soil to erosion. Disturbed land may have an erosion rate 1,000 times greater than normal[3].

Settlement Pattern, Urban and Infrastructural Development

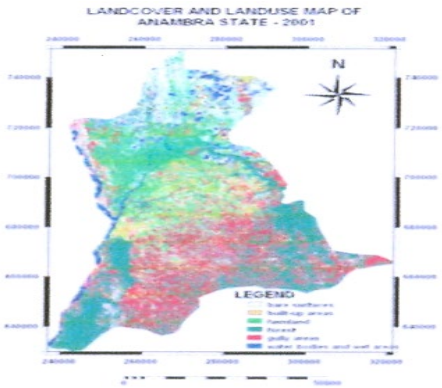
The state is densely populated, with a lot of developmental activities, a critical factor in erosion potential. Population density, is high for the state, about 798 persons/km$^{2(4)}$. Anambra State has probably the highest population density in the whole of sub-Saharan Africa[5]. It then follows that the issue of erosion will result in pressure on the human development potential of the state; such as water supply, housing, education, and waste management etc.

LateriteMining

In this area laterite mining is a booming business due to the level of infrastructure development that requires the use of laterite. The issue of concern here is that the excavation is carried out for commercial purposes indiscriminately without any regards to the environmental consequences. The government of the day seems not to have done enough to check the ugly situation, thereby giving the culprits a field day.

1.2.2 Landuse & and Landcover Mapping Scenarios of the State.

The available landuse and landcover imagery data of the state as captured with Landsat EMT+ (2001), is shown in Figure 3 below.



(a) Anambra State Landuse and Landcover from Landsat EMT+

Figure 3: Landuse and Landcover Maps of Anambra State- (Landsat EMT+)

The data obtained are summarized in Table 1 below.

Table 1: Result of Landuse and Landcover of Anambra State as depicted by Landsat EMT+.

S/N	Landuse & Landcover Type	Area (Km^2)
		Landsat ETM+
1.	Bare and Exposed Surfaces	822.94
2.	Built-up Areas	243.74

3.	Farmlands	782.72
4.	Forest/Vegetation	1814.06
5.	Gully Areas	906.16
6.	Water Bodies/Wet Areas	166.16

2.0 GULLY EROSION SURVEY.

The imagery classification of gully erosion in the state shows that 1769.52 km^2 of the total land area of the state is severely gullied. The map of the classification is as shown in Figure 4 below.

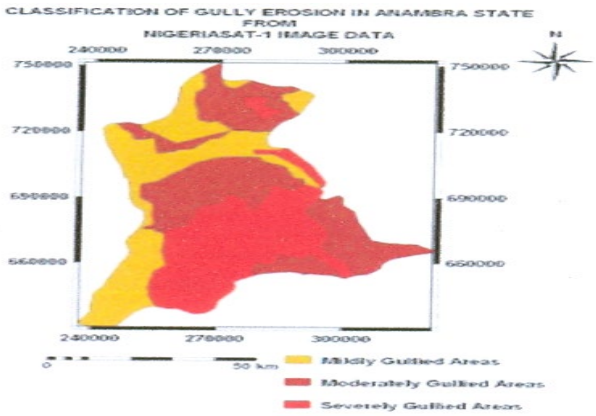


Figure 4: Image Classification of Gully erosion severity in Anambra State.

There are over 750 gully erosion sites in Anambra State. The state accounts for 65% of all gully erosion incidence of the whole nation. Available data showed that 1769.52 km^2 of the land area of the state or 40.1% are severely gullied, 1316.58 km^2 or 27.8% are moderately gullied and 1416.12 km^2 or 32.1% are mildly gullied. Figure 5 shows the picture of some of the gully sites in the state.

(a) A section of Agulu gully site (b) Umuchiana-Ekwuluobia gully site. (c) Gully site at Obosi

Figure 5: Some of the gully erosion sites in the state.

3.0 HUMAN VULNERABILITY OF GULLY EROSION IN ANAMBRA STATE.

The consequences of gully erosion in Anambra State are enormous and include;

- Displacement of communities

- Loss of lives
- Loss of farmland
- Destruction of Houses
- Destruction of Highways, link roads and infrastructural development

4.0 CONCLUSION.

Our survey showed that the people are using local wisdom to combat gully erosion havoc they have to face and live with. They use sandbags, erect barriers, dig shallow containment wells, divert floods to control the gully problem but all these efforts are not enough to check the gully erosion in the state.

We therefore recommend that a scientific and well-articulated measure; "sensitivity index mapping" be put in place to provide a solution to the problem. These measures shall not only serve as an early warning signal but help to check the menace.

We also call for capacity building through the establishment of a "Geomatics Information Station" that will provide data on the area gullied or prone to gully erosion. A special fund either by the Federal or International Funding Agency shall be made available to assist the state and the citizenry as gully erosion control is an expensive venture. The local people that are victims of this problem shall be properly educated on their practices and lifestyle that enhance gully erosion havoc and shall be better equipped with methodologies of handling.

We also recommend advocacy on the mitigation and amelioration of the effects of gully erosion in Anambra State in particular, other southeastern states (that face similar gully erosion problem) and Nigeria in general.

Reference:

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