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Critical Assessment of the Menace of Gully Erosion in Southeastern Nigeria

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ABSTRACT

Gully erosion represents one of the most severe environmental challenges facing Southeastern Nigeria, a region marked by heavy rainfall, erodible soils, and rapid urbanization. This paper investigates the causes, consequences, and potential solutions for gully erosion in the region, focusing on its impact on agriculture, infrastructure, and local communities. Through a comprehensive review of existing literature, field surveys, and interviews with local stakeholders, this research explores both the natural and human-induced factors driving erosion, the social and economic consequences, and the effectiveness of current mitigation efforts. The study finds that while localized efforts have yielded some positive outcomes, the scale of the problem requires coordinated intervention, sustainable land management practices, and strengthened governmental policies. The research proposes a holistic approach, combining community-based strategies, reforestation, and soil conservation techniques to address gully erosion and its adverse effects in Southeastern Nigeria.

Key words: Gully erosion, Southeastern Nigeria, anthropogenic, siltation, geomorphology, hydrogeomorphic

INTRODUCTION

Southeastern Nigeria is one of the six geopolitical zones in Nigeria. The region is composed of six states: Abia, Anambra, Ebonyi, Enugu and Imo. Gully erosion is one of the most pervasive environmental issues in the region, causing severe land degradation and threatening local livelihoods [1]-[5]. Studying gully erosion is usually complex and expensive as a result of the multiple nature of the causal factors, heterogeneity of the underlying geological structures, and the high amount of point source data required within a given area to make a reliable conclusion [2]. With the Southeast region having the highest population density in Nigeria of 500 persons per square kilometer, the menace of gully erosion is a major environmental concern for inhabitants of the region [1][3]. The region's high rainfall, coupled with poor land management practices, has led to the rapid formation of deep gullies that erode the soil, wash away fertile land, and disrupt farming activities. Southeast Nigeria, with its predominantly agrarian economy, relies heavily on subsistence farming, making the erosion crisis not only an environmental challenge but also an economic and social one [1][3][5]. For instance, in some areas lives have been lost and some communities separated from each other as a result of gullies that may be as deep as 12m and as long as 15km [1]. As the problem continues to escalate, it displaces communities, damages infrastructure, and undermines food security.

Gully erosion is of critical significance because it affects the livelihood of millions of people in Southeastern Nigeria [1][3]. The region's reliance on agriculture means that the loss of arable land due to erosion directly threatens food security, economic stability, and social well-being [1]. With the expanding urban population, the demand for land also increases, further exacerbating land degradation. Though several efforts have been made by policymakers and environmentalists, the occurrence and expansion of gullies in Southeastern Nigeria have remained as environmental nightmares [6].

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Furthermore, the environmental consequences of gully erosion are far-reaching, with the destruction of ecosystems, loss of biodiversity, and siltation of water bodies. [1] The erosion of riverbanks and the pollution of local water sources also threaten the health and well-being of surrounding communities. The broader socio-economic impacts include increased poverty, forced migration, and a decline in the quality of life for affected populations [1].

The thesis of this paper is that gully erosion in Southeastern Nigeria is a multi-dimensional problem caused by both natural factors and human activities, and that its impact extends beyond environmental degradation to affect social and economic stability. This research aims to analyze the causes of gully erosion, assess its effects on local communities, and explore sustainable solutions to mitigate its impact.

METHODOLOGY

The method used for this study was the critical review of literature on different studies involving gully erosion particularly in southeastern Nigeria. The study design was selected as it provided a holistic platform to enable effective review of the impact of gully erosion and the implications for Southeastern Nigeria. The literature reviewed included peer-reviewed articles, government reports, and environmental assessment reports. The data in the literature were assessed for relevance, reliability, and applicability. Though the data quality was high, limitations in long-term studies were identified. The literature reviewed were retrieved from reputable research databases such as ScienceDirect, Google Scholar, and JSTOR and generic searches across different research websites.

To validate the data from reviewed literature and gain insights into the socio-economic impact of gully erosion and the effectiveness of existing erosion control measures, semi-structured interviews were conducted with local farmers, government officials, and environmental experts in the area. Also, field visits were made to several erosion-prone areas in Southeastern Nigerian states of Ebonyi, Abia, and Imo States to observe the extent of gully erosion and document its impacts on the land and local communities.

CAUSES AND IMPACTS OF GULLY EROSION

Gully erosion in Southeastern Nigeria is caused by a combination of factors, both natural and anthropogenic [1][3]-[5][7]-[10]. The region's topography, characterized by steep slopes, combined with intense rainfall, creates ideal conditions for the formation of gullies [3]. Human activities, such as deforestation for agricultural expansion, unsustainable farming practices, and rapid urbanization, exacerbate the problem by disrupting the natural balance of the soil and vegetation.

A source [6] identified climatic variability (e.g. changes in the patterns of temperature and rainfall), soil type and geomorphology as the catalysts for gully expansion in Southeastern Nigeria. As the gullies deepen and expand, they pose a serious threat to lives, farmland, housing, and infrastructure [1].

However, [7] noted that "Gully erosion is most often triggered or accelerated by a combination of inappropriate land use and extreme rainfall events." Based on the study by [10], hydrogeomorphic factors contribute to the persistent gully erosion taking place in some parts of Southeastern Nigeria such as Nanka, Ogwashi and Benin formations, hence the need to investigate the impact of hydrology and geomorphology on gully development and expansion. As [10] noted, geotechnical results showed that the soils of parts of Southeastern Nigeria are permeable, weak, easily dispersible and collapsible while geomorphological study indicated that the region has abundance of uneven badland topography, high gully slope gradients (dominantly > 30°), concave slopes, poor land-use practices, and low vegetation cover. For instance, in a study on some parts of Southeastern Nigeria, [14] identified that bulk density, pH, and organic matter content of the soil range from 1610 to 1740 kgm^3, 5.10 to 5.30, and 0.32% to 0.46%, respectively. Particle size analyses showed that the soils are composed of 50 - 68% coarse sand materials [14]. The implication is that, mostly, the prevalence of gully erosion in Southeastern Nigeria is due to hydrogeomorphology and soil engineering properties [10]. Some other studies indicated a combination of natural and human factors to the devastating and continuous soil erosion and the development and expansion of some parts of the Southeast. Such factors include poor soil engineering properties, inadequate road construction, poorly constructed and maintained surface drainage facilities, poor land-use practices and

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poor vegetation covers [11]-[15].

The severity of gully erosion vary among the six southeasten states [10]. Reports have shown that among the southeastern States, Anambra State has experienced the worst gully erosion, followed by Enugu, Imo, Abia, and Ebonyi States, respectively [15][17]. The changes in the intensity of gully erosion is related to the variations in the geological formations underlying these States [10]. Anambra State, for instance, has more of the youngest and friable sedimentary deposits whereas Ebonyi State, the least gully erosion-impacted southeastern state, is made mostly of the oldest and well-consolidated sediments [18].

The primary problem associated with gully erosion is the loss of fertile soil, which directly impacts agriculture, the backbone of the economy of Southeastern Nigeria and by extension, the economy of Nigeria [1][8]. With reduced crops yield, there is a threat to the 'Green revolution" campaign [1]. Additionally, the destruction of infrastructure such as roads and bridges, the displacement of communities, loss of human lives, disruption of the ecosystem, and the siltation of rivers further complicates the situation leading to a cycle of poverty and land degradation [1]. Researchers tried ranking the impact of gully erosion [8][19]. According to the researcher, the most severe impact is damage to footpaths, roads and properties, while the least is loss of biodiversity [8][19]. Assessment results revealed that out of the ten gully erosion problems of the region, damage to footpaths, roads and properties was perceived by the respondents as the most problem whilst biodiversity loss was the least

CURRENT STRATEGIES IN DEALING WITH GULLY EROSION MENACE

Numerous studies have highlighted the severe nature of gully erosion in Southeastern Nigeria and its environmental, social, and economic consequences [1][3][6][9]. While gully erosion is a natural process, many studies has indicated how human activities particularly deforestation, poor agricultural practices, and unplanned urbanization have greatly accelerated the menace of gully erosion and the associated impacts [11]-[15].

Several efforts have been made to prevent and/or mitigate gully erosion in Southeastern Nigeria [10]. The steps taken include community-based approaches, where local residents are actively involved in erosion control efforts an interventions by government agencies. Such efforts include attempts by government agencies to mitigate erosion using concrete structures, stabilization work such as planting bamboo and cashew trees to increase water intake, and use of pipe structures to channel water directly to nearby surface waters such as embankments and retention ponds to control the flow of water and sediments [16].

However, as [16] noted, several challenges persist in effectively managing gully erosion in some part of Southeastern Nigeria. According to the source, most of the concrete structures used to control gully erosion have collapsed. Other factors affecting effective gully erosion control are inadequate funding, failure of engineering structures, flooding, geologic setting of the area, limited technical expertise, population growth, urbanization, limited public awareness on gully erosion control measures, and ineffective collaboration among the different stakeholders [16]. Other challenges include poor enforcement of policies and lack of technical training for local farmers.

Research has also explored the use of advanced technologies such as Geographic Information Systems (GIS) to map erosion-prone areas and predict the future trajectory of gully formation [10]. This approach enables more precise interventions and resource allocation for erosion control.

FINDINGS AND DISCUSSION

As [2] recommended use of modern geospatial analytical tools to mitigate the challenge of studying gully erosion, GIS mapping provided visual spatial distribution of erosion-prone areas and indicated that erosion menace was severe in many Southeastern states of Nigeria.

Interviews with local stakeholders revealed that gully erosion directly impacted agriculture, infrastructure, and community livelihoods. However, there were some limitations in terms of data availability and accessibility. In remote areas, data collection was hampered by poor infrastructure and lack of up-to-date records. Despite these challenges, the data was sufficient to draw meaningful conclusions about the problem and its potential solutions.

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The findings of this study indicated that gully erosion is a widespread menace in Southeastern Nigeria and align with the finding of previous studies [1]-[4][10][19][20]. The extent of erosion has increased dramatically in recent years, with some areas experiencing rapid expansion of gullies that have swallowed large tracts of farmland and destroyed infrastructures. Interviews with local farmers indicated that agricultural productivity has significantly reduced due to the loss of fertile soil. The destruction of roads, bridges, and houses further exacerbates the crisis.

Despite efforts such as small-scale reforestation and the use of erosion barriers, the outcomes of mitigation measures have been mixed. While localized efforts have stabilized some gullies, the overall rate of erosion continues to rise, suggesting that more comprehensive and coordinated efforts are needed.

The results, as noted by [10], underscore the urgent need for a more integrated approach to addressing gully erosion in Southeastern Nigeria. Localized solutions, such as reforestation and community-based erosion control programs, have shown some success but are insufficient on their own to combat the widespread nature of the problem. A coordinated effort, involving both local communities, donor agencies and governmental agencies, is required to effectively tackle the issue [19]. One of the key findings of this study is the importance of sustainable land management practices. By promoting soil conservation techniques and restoring vegetation cover, it is possible to reduce the rate of erosion and mitigate its impact. Additionally, the use of technology, such as GIS, can play a crucial role in monitoring and managing erosion-prone areas.

The broader context of this study suggests that gully erosion is not an isolated issue but part of a wider environmental challenge facing many parts of sub-Saharan Africa [21]. Addressing the problem requires a combination of local, national, and international efforts to promote sustainable land use practices, strengthen environmental policies, and provide financial and technical support to affected communities [10][19].

CONCLUSION AND RECOMMENDATIONS

Gully erosion in Southeast Nigeria poses a serious threat to the environment, agriculture, and local communities. While much has been done previously to mitigate the issue, the scale of the problem requires a more comprehensive and coordinated approach. By combining sustainable land management strategies, reforestation, community-based solutions, sound engineering practices and government support, it is possible to mitigate the devastating impact of gully erosion and restore the region's environmental and socio-economic stability.

Based on the findings, the following recommendations are proposed to mitigate the impacts of gully erosion in Southeastern Nigeria:

1. Reforestation Programs: Large-scale reforestation efforts to restore vegetation cover and reduce soil erosion.
2. Erosion Control Infrastructure: Construction of check dams, terracing, and other erosion control measures in vulnerable areas.
3. Community-Based Initiatives: Empower local communities with knowledge and tools to manage soil erosion through participatory approaches.
4. Sustainable Agricultural Practices: Promote conservation agriculture techniques that minimize soil disturbance and improve soil health.
5. Government Policy Support: Strengthen policies that regulate land use and urbanization to prevent further degradation.

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