

Impact of Environmental Degradation and Gully Erosion in Arochukwu On School Infrastructure: Mitigation Strategies for Abia State College of Education (Technical) Arochukwu (ASCETA)

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Abstract- *Environmental degradation and gully erosion remain pressing ecological challenges in Arochukwu, causing severe damage to school infrastructure, disrupting academic activities, and posing safety risks to staff and students. This study examined the extent of gully erosion in Arochukwu communities, its impact on school buildings and learning environments, and the mitigation strategies needed for Abia State College of Education (Technical), Arochukwu (ASCETA). A descriptive survey design was adopted. Data were collected from 110 respondents, including school administrators, lecturers, environmental officers, and community leaders. The study was guided by four research questions and three null hypotheses tested at the 0.05 significance level. Findings revealed that gully erosion in Arochukwu has led to structural cracks, collapse of perimeter fences, classroom flooding, loss of school land, and restricted access routes. Results also showed that low funding, inadequate drainage systems, poor environmental maintenance, and excessive rainfall accelerate degradation around school infrastructures. Hypotheses testing confirmed a significant relationship between erosion intensity and the level of infrastructural damage in ASCETA. Recommended mitigation strategies include reinforced drainage construction, vegetation cover restoration, community-institution collaboration, and engagement of civil engineering experts in erosion control design. The study concludes that proactive and sustainable environmental management practices are essential for safeguarding educational infrastructure and ensuring long-term resilience for ASCETA.*

and weak soil structures lead to land loss. In southeastern Nigeria, gully erosion poses a serious ecological threat, endangering homes, farmland, public facilities, and schools. Arochukwu, a historically important community in Abia State, has faced ongoing environmental decline over the last thirty years, with gully erosion growing deeper, wider, and more intense. This issue affects human settlement, economic growth, and educational stability in the area.

The Abia State College of Education (Technical), Arochukwu (ASCETA), situated in this erosion-prone area, is increasingly at risk as gully erosion approaches access roads, staff housing, classrooms, and utility systems. Seasonal rainfall often makes things worse by causing sudden road collapses, flooding on school grounds, and damage to buildings. As a technical education institution, ASCETA depends on stable infrastructure—such as laboratories, workshops, hostels, and classrooms—to promote effective teaching and learning. When this infrastructure is damaged, the quality of education, student attendance, safety, and overall development of the institution suffer significantly.

Gully erosion in Arochukwu is not just a natural disaster; it results from a mix of environmental abuse, deforestation, poor drainage planning, and geographic weakness. Communities have reported being displaced, losing their livelihoods, and experiencing economic hardships. For schools like ASCETA, this situation brings additional challenges: weakening structures, frequent repairs, difficulties in transporting

I. INTRODUCTION

Environmental damage has become one of the biggest challenges for developing countries, especially in areas where poor land management, heavy rainfall,

students and staff, and disruptions to academic activities. In some cases, erosion threatens the institution's long-term sustainability.

Despite its importance, little research specifically examines how gully erosion impacts school infrastructure in Arochukwu, particularly regarding ASCETA. Most existing studies focus on erosion control in agricultural or residential contexts, leaving a gap in the literature concerning its effects on education. Filling this gap is crucial since education plays a key role in regional development.

This study therefore looks into the scope, nature, and effects of environmental degradation and gully erosion in Arochukwu, concentrating on ASCETA's infrastructure. It also explores practical solutions to help protect the school's environment, ensure academic continuity, and promote sustainable land management. By assessing the impact of erosion through field observations, expert evaluations, and quantitative data, this research provides evidence-based recommendations for policymakers, school leaders, and erosion-control agencies.

Literature Review

Environmental degradation refers to the decline of the natural environment caused by human actions or natural processes that reduce land productivity, disrupt ecological balance, and threaten human settlements (UNEP, 2021). In many developing countries, rapid population growth, ineffective environmental policies, deforestation, and poorly managed urban sprawl increase environmental pressures. In southeastern Nigeria, environmental degradation is evident through erosion, flooding, deforestation, and land instability (Nwankwo et al., 2020). Among these issues, gully erosion is the most damaging because of its rapid growth and its ability to destroy structures, roads, and farmland.

Gully Erosion in Nigeria

Gully erosion occurs when fast-moving runoff water removes topsoil and subsoil, creating large channels or gullies. Researchers like Ezezika & Adesina (2020) note that gully erosion in Nigeria results from intense rainfall, weak soil composition, unchecked deforestation, and poor drainage systems. The

southeastern region, especially Abia, Anambra, and Imo States, is known for having the highest erosion risk in Nigeria due to its sandstone geology and heavy annual rainfall (over 2500 mm).

In Arochukwu, historical records show that major gullies began to form in the 1980s and have continued to expand due to neglected drainage systems, poor road construction, and the lack of sustainable land-use plans (Okoro & Anorue, 2019). The National Erosion and Watershed Management Project (NEWMAP) lists Arochukwu as one of the key areas needing urgent intervention. Gully sites in this area can deepen by 1 to 3 meters and widen by up to 5 meters each year, depending on rainfall patterns (World Bank, 2018).

Impact of Erosion on Infrastructure

Numerous studies confirm that gully erosion weakens public infrastructure, including roads, electricity networks, pipelines, and institutional buildings (Okechukwu & Igwe, 2021). Roads are especially at risk; gullies often cross transportation routes, making access difficult, isolating communities, and hindering economic activities. For schools, erosion can damage foundations, disrupt drainage systems, cause recurring flooding, and make buildings unsafe.

An evaluation of school facilities in erosion-prone areas of Anambra State by Eze & Ugwuanyi (2020) found that 63% of affected schools had cracked walls, collapsed fences, or inaccessible pathways. Similar issues have been observed across Abia State, where educational institutions near erosion channels face ongoing infrastructure problems.

Consequences on Educational Delivery

Educational infrastructure significantly impacts learning outcomes. UNESCO (2022) highlights that safe, functional school facilities improve student attendance, teacher performance, and overall academic success. When infrastructure is compromised or unsafe:

- a) students may skip classes due to safety worries,
- b) teachers may struggle to teach effectively,
- c) practical and laboratory sessions may be disrupted,
- d) hostels may not be suitable for students,
- e) access to school may become difficult during heavy rains.

In communities facing erosion, these challenges worsen. Research by Ajufo (2021) shows that students in erosion-prone regions of Nigeria often experience more school closures and academic interruptions, resulting in less learning time and lower school efficiency.

Gully Erosion and Higher Institutions

While many studies have looked into erosion in secondary schools, fewer have explored its impact on higher education institutions, which often house specialized labs and workshops that need stable buildings. Technical schools like ASCETA are especially vulnerable because their facilities—mechanical workshops, electrical labs, agricultural fields—rely heavily on land stability and safe routes for access (Nnadi & Ezenwa, 2023).

Gully erosion near tertiary institutions can cause:

- a) damage to laboratory equipment from moisture or flooding,
- b) collapse of retaining walls and fences,
- c) changes in natural drainage patterns on campus,
- d) migration of staff and students due to unsafe living conditions,
- e) higher maintenance and operational costs.

Mitigation Strategies in Literature

Researchers have suggested a variety of ways to control erosion, including:

- a) Engineering Methods – such as concrete drainage channels, culverts, retaining walls, check dams, and gabion structures (Igbokwe et al., 2019).
- b) Biological Methods – including planting grass, reforestation, and using soil-binding plants like vetiver grass (Ahaneku, 2019).
- c) Policy and Institutional Controls – which involve stricter land regulations, environmental monitoring, and community education (Ekong & Udoh, 2020).
- d) Integrated Approaches – that combine engineering and ecological solutions for long-term sustainability.
- e) Studies by NEWMAP stress that community involvement is crucial for success since gully erosion often stems from local land-use practices.

Gap in the Literature

While there is a wealth of research on erosion control and environmental degradation in southeastern Nigeria, very few studies focus specifically on the effects of gully erosion on school infrastructure in Arochukwu or its direct impact on ASCETA. This study addresses a significant gap by providing evidence, visual documentation, and practical strategies tailored to the local context.

II. STATEMENT OF THE PROBLEM

ASCETA and surrounding schools in Arochukwu continue to experience progressive damage from environmental degradation. Gully erosion has created deep channels near school boundaries, undermined building foundations, and destroyed access pathways. Seasonal rainfall exacerbates the situation, creating flooding, landslides, and sediment deposition in school compounds. Despite these threats, mitigation efforts remain limited, insufficiently funded, or poorly coordinated. Without evidence-based interventions, the deterioration may escalate, resulting in total building collapse, displacement of staff and students, and disruption of academic operations. This study therefore investigates the extent of gully erosion in Arochukwu and identifies feasible strategies that ASCETA can adopt to safeguard its infrastructure.

Purpose of study

The purpose of this study is to assess the impact of environmental degradation and gully erosion on school infrastructure in Arochukwu and to propose effective mitigation strategies for ASCETA.

III. RESEARCH QUESTIONS

The study was guided by the following research questions:

RQ1: What is the current extent of environmental degradation and gully erosion affecting school infrastructure in Arochukwu?

RQ2: How has gully erosion impacted buildings, access roads, and learning environments in ASCETA?

RQ3: What environmental and human factors contribute to gully erosion around school premises in Arochukwu?

RQ4: What mitigation strategies can ASCETA adopt to control and reduce the impact of environmental degradation?

IV. RESEARCH HYPOTHESES

The following null hypotheses were tested at the 0.05 significance level:

H₀₁: There is no significant relationship between the extent of gully erosion and the level of damage to school infrastructure in ASCETA.

H₀₂: Environmental factors (e.g., rainfall, soil type) do not significantly influence the spread of erosion in Arochukwu school environments.

H₀₃: Human activities (e.g., improper waste disposal, poor drainage) have no significant effect on the rate of environmental degradation affecting ASCETA.

V. METHODOLOGY

Research Design

A descriptive survey design was used to obtain data from respondents on erosion impacts and mitigation strategies.

Population and Sample

The target population included ASCETA staff, school administrators, environmental officers, and community leaders. A sample size of 110 respondents was selected using purposive and simple random sampling.

Instrument for Data Collection

A structured questionnaire titled Environmental Impact on School Infrastructure Questionnaire (EISIQ) was designed with four sections:

- extent of erosion
- impact on infrastructure
- contributing factors
- mitigation strategies

The instrument used a 4-point Likert scale.

Validity and Reliability

Experts in environmental management validated the instrument. A reliability coefficient of 0.82 was obtained using Cronbach's alpha.

Data Analysis

Mean, standard deviation, and t-test statistics were used to analyze data and test hypotheses.

VI. RESULTS

Table 1: Extent of Gully Erosion Affecting Schools in Arochukwu

Item	Mean	Standard Deviation	Decision
Presence of deep gullies near school boundaries	3.62	0.51	Agree
Erosion threatens foundations of school buildings	3.55	0.57	Agree
Seasonal flooding worsens gully expansion	3.71	0.49	Agree
Heavy rainfall accelerates soil loss	3.68	0.53	Agree

Interpretation: Respondents confirmed that erosion is extensive and actively threatening school structures.

Table 2: Impact on ASCETA Infrastructure

Impact Variable	Mean	Standard Deviation	Decision
Cracks in classroom and office buildings	3.59	0.55	Agree
Collapse of perimeter fence	3.42	0.61	Agree
Blocked access roads and walkways	3.63	0.52	Agree
Flooding of learning areas	3.58	0.58	Agree

Hypothesis Testing Summary

Hypothesis	t-value	p-value	Decision
H ₀₁	8.72	0.000	Rejected
H ₀₂	6.41	0.000	Rejected
H ₀₃	5.97	0.001	Rejected

All hypotheses were rejected, indicating significant relationships between erosion, environmental factors, human practices, and infrastructural damage.

VII. DISCUSSION OF FINDINGS

- a) The study revealed that gully erosion in Arochukwu is severe, widespread, and rapidly expanding toward school environments. The high mean ratings confirm that respondents perceive erosion as a major threat to ASCETA's built structures. This aligns with previous studies reporting southeastern Nigeria as a hotspot for soil degradation due to climatic and geological factors.
- b) The damage to school infrastructure—such as cracked buildings, collapsed fences, and blocked access routes—demonstrates that erosion directly disrupts teaching activities. This finding corroborates earlier research showing that environmental instability compromises educational continuity, safety, and operational efficiency.
- c) Human-induced factors such as improper waste disposal, poor drainage design, and deforestation were identified as major contributors. The rejected hypotheses reinforce this relationship, proving that erosion spread in Arochukwu is both environmentally and anthropogenically driven.
- d) Mitigation requires a multi-layered approach combining engineering controls (e.g., drainage channels, gabion walls) with community participation and environmental education. Respondents strongly supported afforestation, soil stabilization, and collaboration with local government agencies as viable strategies.

VIII. CONCLUSION

The study concludes that environmental degradation and gully erosion pose significant threats to the structural integrity and functional capacity of school infrastructure in Arochukwu, particularly at ASCETA. The severity of gully expansion requires urgent intervention to safeguard lives, protect investments, and maintain educational standards.

IX. RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

1. Engineering and Structural Interventions
 - Build well designed retaining walls, gabions and check-dams around schools threatened by active erosion.
 - Install standard drainage systems to direct runoff water away from school areas.
 - Strengthen school foundations using soil stabilization methods like compaction, geotextiles and cement-treated earth.
2. Government and Institutional Support
 - The Abia State Government should include Arochukwu erosion sites on the Nigeria Erosion and Watershed Management Project (NEWMAP) priority list.
 - Increase budget allocations for school repair, rehabilitation and erosion control.
3. ASCETA-Led Community Outreach
 - ASCETA should work with local chiefs, youth groups and NGOs to start community erosion monitoring programs.
 - Students in the Engineering and Environmental Technology departments should take part in service-learning projects focusing on gully mapping and drainage design.
4. Geographic Information System (GIS) Mapping
 - Schools should team up with environmental agencies to create detailed GIS maps of erosion hotspots for better forecasting and planning.
5. Greening and Afforestation Programs
 - Schools should plant deep-rooted trees such as Gmelina, Bamboo and Cassia to stabilize soil around classrooms and boundaries.
6. Establishment of a Rapid Response Erosion Taskforce
 - A dedicated team within ASCETA and affected schools should carry out seasonal assessments to ensure that warning signs of erosion are addressed before they worsen.

7. Public Awareness and Education: Organize seminars and local awareness campaigns focusing on:

- Proper waste disposal
- The importance of vegetation cover
- Reporting early signs of soil collapse

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