Transdisciplianry Journal of Education and Sustainable Development Studies, *Vol. 2, No. 1,April 2026*
A publication of the Department of Education Geography & Sustainable Development Studies, ISSN: 1595-8051 EISSN: 3092-9571
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Spatial Analysis of Socio-Economic Drivers of Gully Erosion and Their Implications for Tourism Development in Cross River State, Nigeria

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Abstract

This study explores the spatial analysis of socio-economic drivers of gully erosion and their implications for tourism development in Cross River State, Nigeria. The researcher identified and categorize the socio-economic activities contributing to gully erosion in selected LGAs of Cross River State and Map and analyze the spatial extent and intensity of gully erosion using remote sensing and GIS tools. The researcher therefore made use of two research questions and two hypotheses in line with the specific objectives of this study A mixed-methods design was adopted, integrating spatial analysis of erosion-prone areas, surveys of key tourism stakeholders, focus group discussions, interviews with government officials, and econometric modeling to assess the economic implications of erosion on tourism. Out of the 388 questionnaires distributed, 362 were validly retrieved, representing a 93.3% response rate. analyzed using both descriptive and spatial analytical techniques in line with the research objectives. The analysis was carried out using GIS report, descriptive statistics and simple Linear regressionThe findings revealed that socio-economic activities such as deforestation, sand mining, agricultural expansion, urbanization, and infrastructural development are the major drivers of gully erosion in Cross River State. Spatial analysis showed that erosion is both widespread and spatially clustered, with many high-risk zones located close to key tourism destinations. This interaction underscores the strong link between human land-use practices, environmental degradation, and tourism vulnerability. Consequently, gully erosion has led to severe road damage, reduced accessibility, loss of scenic landscape quality, and declining visitor satisfaction, all of which contribute to reduced tourist inflow and weakened tourism performance. The study concluded that weak policy implementation, poor environmental management, inadequate funding, and heavy reliance on land-based livelihoods exacerbate the persistence and severity of erosion. These challenges hinder effective control measures and threaten sustainable tourism development. Sequel to the

DOI: https://doi.org/10.60787/tjesds.vol2no1.82

findings in the study, the researchers recommended among other, the integrated spatial planning and erosion control for tourism sustainability:
By this, GIS-based land-use planning approach should be adopted to guide the location and development of tourism infrastructure away from high-risk erosion zones.
Keywords: Spatial Analysis, Socio-Economic Drivers, Gully Erosion, and Tourism Development.

Introduction

Tourism has become one of the fastest-growing industries in the global economy and plays a crucial role in socio-economic development across many countries. The sector contributes significantly to national income, employment creation, foreign exchange earnings, and infrastructure development. According to the World Tourism Organization, international tourist arrivals have increased significantly over the past decades, demonstrating the growing importance of tourism in global economic development (UNWTO, 2023). Tourism contributes approximately 10% of global Gross Domestic Product and supports millions of jobs worldwide (World Travel & Tourism Council, 2023).

The rapid expansion of tourism has created numerous opportunities for economic development, particularly in developing countries where tourism serves as an alternative source of revenue beyond traditional sectors such as agriculture and manufacturing (Sule, 2023).). Tourism development often stimulates investments in transportation networks, hospitality infrastructure, cultural heritage conservation, and environmental management. These investments contribute not only to economic growth but also to community development and poverty reduction (Hall & Page, 2019).

Despite the economic benefits associated with tourism, the sustainability of tourism destinations is strongly dependent on environmental quality. Natural landscapes, biodiversity, scenic beauty, and ecological resources form the foundation of many tourist attractions worldwide. Consequently, environmental degradation poses a serious threat to tourism development and sustainability (Holden, 2016). Environmental degradation occurs when natural resources are depleted or ecosystems are damaged through human activities such as deforestation, poor land use practices, pollution, and unsustainable agricultural activities.

One of the most severe forms of environmental degradation affecting many developing countries is soil erosion, particularly gully erosion. Soil erosion refers to the detachment and transportation of soil particles by natural forces such as rainfall, runoff, wind, or human activities that disturb the soil surface (Morgan, 2005). When erosion becomes concentrated

DOI: https://doi.org/10.60787/tjesds.vol2no1.82

ISSN: 1595-8051 EISSN: 3092-9571

along drainage channels, it develops into gullies, which can rapidly expand and cause severe environmental damage. Gully erosion has become a major environmental problem in many parts of the world, particularly in tropical regions characterized by intense rainfall and fragile soil structures (Poesen, 2018). The formation of gullies not only destroys agricultural land but also damages infrastructure such as roads, buildings, and drainage systems. Furthermore, erosion alters natural landscapes and reduces the aesthetic value of environments that serve as tourism destinations.

In Africa, land degradation and soil erosion remain significant environmental challenges affecting sustainable development. Studies have shown that over 65% of Africa's agricultural land is affected by some form of land degradation, including soil erosion, desertification, and deforestation (FAO, 2020). These environmental problems have serious implications for food security, economic stability, and tourism development across the continent.

Nigeria is among the countries severely affected by soil erosion, particularly in the southeastern region where gully erosion has caused widespread environmental damage. According to research conducted by Egboka and Okpoko (2018), gully erosion in southeastern Nigeria has destroyed thousands of hectares of farmland, damaged infrastructure, and displaced numerous communities. The environmental and socio-economic consequences of erosion are therefore profound and require urgent intervention.

Cross River State is widely recognized as one of Nigeria's major tourism destinations due to its rich biodiversity, scenic landscapes, wildlife reserves, and cultural heritage sites. The state is home to attractions such as the Cross River National Park, the Obudu Mountain Resort, and the globally celebrated Calabar Carnival. These tourism attractions contribute significantly to the state's economy by generating employment opportunities, promoting cultural exchange, and attracting both domestic and international visitors.

However, the sustainability of these tourism resources is threatened by environmental degradation, particularly gully erosion. The formation and expansion of erosion gullies can destroy natural landscapes, reduce environmental aesthetics, and damage tourism infrastructure. Environmental degradation can therefore discourage tourists from visiting affected areas, leading to reduced tourism revenue and economic losses for local communities (Butler, 2017).

Furthermore, socio-economic activities such as urban expansion, road construction, agricultural practices, and deforestation have been identified as major factors contributing to

DOI: https://doi.org/10.60787/tjesds.vol2no1.82

gully erosion in many parts of Nigeria (Ofomata, 2019). These human activities disturb the natural stability of soil structures and increase surface runoff, which accelerates erosion processes. When such environmental degradation occurs within tourism destinations, it can significantly undermine tourism development and environmental sustainability.

Morgan (2005) and Poesen (2018) emphasized that soil erosion is largely accelerated by human interference with natural land surfaces, especially through vegetation removal and poor land management practices. Similarly, Egboka and Okpoko (2018) observed that socio-economic activities such as farming, sand mining, and urban expansion significantly disturb soil structure and increase runoff, thereby intensifying gully formation. The result also supports the findings of Hall and Page (2019) noted that environmental degradation resulting from human activities reduces the quality of natural landscapes that support tourism development. In the context of Cross River State, activities such as deforestation and sand mining not only worsen erosion but also threaten tourism resources by degrading scenic environments and ecological stability. Poesen (2018) observed that gully erosion tends to develop in concentrated zones where surface runoff is high and vegetation cover is weak. Valentin et al. (2005) noted that once gullies are initiated, they expand rapidly and form clustered patterns under conditions of high rainfall and disturbed landscapes. Ofomata (2019), on the other hand reported that southeastern Nigeria, including Cross River State, is highly prone to gully erosion due to its fragile soil structure and intense human activities. The proximity of erosion sites to tourism destinations also confirms impact as emphasised by Jimoh (2011) that environmental degradation near infrastructure zones poses serious risks to economic activities such as tourism. Butler's Tourism Area Life Cycle model (1980) explained also that environmental degradation leads to stagnation or decline in tourism destinations. Egbenta (2015) stated that degraded environments reduce destination attractiveness and discourage repeat visitation. Similarly, UNWTO (2022) reported that environmental degradation significantly reduces tourism revenue and weakens the economic sustainability of destinations globally.

Given the increasing importance of tourism as a tool for economic diversification and sustainable development, it is essential to understand the relationship between socio-economic activities, environmental degradation, and tourism development. Effective environmental management strategies are necessary to protect tourism resources and ensure the long-term sustainability of tourism destinations.

This study therefore seeks to examine the relationship between socio-economic activities, gully erosion, and tourism development within the study area. By investigating how human

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ISSN: 1595-8051 EISSN: 3092-9571

activities contribute to environmental degradation and how such degradation affects tourism potential, the study aims to provide insights that will support sustainable tourism planning and environmental conservation in Cross River State.

Statement of the problem

Tourism is major driver of economic growth in the present Cross River State since their oil derivation was seeded to Akwa Ibom State, but its sustainability depends largely on environmental quality. In Cross River State, one of Nigeria's major tourism destinations, increasing environmental degradation particularly gully erosion has become a serious challenge to tourism development.

The problem is largely driven by socio-economic activities such as deforestation, agricultural expansion, sand mining, urbanization, poor drainage practices, and infrastructural development. These activities disturb land surfaces, increase surface runoff, and accelerate soil erosion processes, leading to the formation and expansion of gully erosion across the state.

Spatially, these erosion processes are increasingly affecting areas close to major tourism destinations such as the Cross River National Park and Obudu Mountain Resort. As gullies expand, they damage roads, tourism facilities, and natural landscapes, thereby reducing accessibility, safety, scenic quality, and overall tourist satisfaction. Consequently, tourism development is negatively affected through reduced visitor inflow, declining destination attractiveness, and weakened economic benefits from tourism activities. Despite this, there is still limited integrated research linking socio-economic drivers of gully erosion with their spatial distribution and direct implications for tourism development in Cross River State.

This creates a knowledge gap that limits effective environmental planning and sustainable tourism management. Therefore, this study examines how socio-economic activities contribute to gully erosion and how the spatial pattern of erosion affects tourism development in Cross River State, Nigeria.

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Objectives of the Study

The main objective of this study is to examine the spatial relationship between socio-economic activities, gully erosion, and tourism development in Cross River State, Nigeria. Specifically, the study seeks to:

1. Identify the major socio-economic activities contributing to gully erosion in Cross River State.

DOI: https://doi.org/10.60787/tjesds.vol2no1.82

2. Examine the spatial distribution and severity of gully erosion across tourism zones in the state

Research Hypotheses

Based on the objectives of the study, the following null hypotheses were formulated:

1. There is no significant relationship between socio-economic activities and gully erosion in Cross River State.
2. There is no significant variation in the spatial distribution and severity of gully erosion across tourism zones in Cross River State.

Methods

This study adopted a survey research design to answer the research questions of this study. To successfully carry out the study, two hypotheses were formulated in line with the objectives of the study. The researcher identified and categorize the socio-economic activities contributing to gully erosion in selected LGAs of Cross River State and Map and analyze the spatial extent and intensity of gully erosion using remote sensing and GIS tools. The researcher therefore made use of two research questions and two hypotheses in line with the specific objectives of this study A mixed-methods design was adopted, integrating spatial analysis of erosion-prone areas, surveys of key tourism stakeholders, focus group discussions, interviews with government officials, and econometric modeling to assess the economic implications of erosion on tourism. Out of the 388 questionnaires distributed, 362 were validly retrieved, representing a 93.3% response rate. analyzed using both descriptive and spatial analytical techniques in line with the research objectives. The responses obtained from the structured questionnaires were coded and analyzed using descriptive statistics such as frequencies, percentages, and mean scores to summarize the socioeconomic activities contributing to gully erosion, its impacts on tourism infrastructure and accessibility, economic implications, and challenges to sustainable tourism development in the study area.

Results

This section presents the results of the statistical analysis used to answer the research questions and test the hypotheses of the study. The analysis was carried out using descriptive statistics (frequencies and percentages), spatial analysis (GIS mapping), and inferential statistics (regression analysis). The interpretation of results was done at 0.05 level of significance. A total of 388 questionnaires were distributed, out of which 362 were correctly filled and returned, representing a 93.3% response rate. This was considered adequate for analysis and generalization of findings.

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ISSN: 1595-8051 EISSN: 3092-9571

HO_1

There is no significant relationship between socio-economic activities and gully erosion in Cross River State.

To test this hypothesis, simple regression analysis was used to determine the extent to which socio-economic activities influence gully erosion. The result shows that socio-economic activities have a significant relationship with gully erosion. The coefficient of determination ($R^2 = 0.545$) indicates that 54.5% of the variation in gully erosion is explained by socio-economic activities such as deforestation, sand mining, agricultural expansion, urbanization, and infrastructural development. The F-statistic was also significant at $p < 0.05$, indicating that the relationship is statistically meaningful. Therefore, the null hypothesis was rejected.

Table 1: Regression Analysis of Socio-Economic Activities and Gully Erosion

Source of Variation	SS	df	MS	F	Sig.
Regression	246.510	1	246.510	52.418	.000
Residual	205.430	360	0.571		
Total	451.940	361			

Significant at 0.05 level; R = .738; R^2 = .545

HO_2

There is no significant variation in the spatial distribution and severity of gully erosion across tourism zones in Cross River State.

To test this hypothesis, spatial analysis using GIS tools and descriptive statistics was applied to assess the distribution pattern and severity of gully erosion across tourism zones.

The results reveal that gully erosion is unevenly distributed and spatially clustered across the study area. High severity erosion zones were found to be concentrated in areas such as Akamkpa, Ikom, and parts of Calabar axis, which also coincide with key tourism corridors. The spatial analysis further showed that erosion intensity varies significantly across zones, with some tourism areas experiencing high gully depth, width expansion, and rapid land degradation, while others recorded moderate or low levels of erosion. Since the spatial variation was statistically and geographically significant, the null hypothesis was rejected (see table 2)

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Table 2: Spatial Distribution and Severity Indicators of Gully Erosion in Cross River State (N = 400)

S/N	Spatial Indicator of Gully Erosion	Frequency	Percentage (%)
1	Number of active gully sites observed	52	13.00
2	High gully depth severity	42	10.50
3	High gully width expansion	40	10.00
4	Longitudinal gully length extension	38	9.50
5	Rapid rate of gully expansion	36	9.00
6	Proximity of gullies to tourism sites	34	8.50
7	Total land area affected by erosion	32	8.00
8	High soil vulnerability zones	30	7.50
9	High rainfall intensity influence	36	9.00
10	Steep slope gradient influence	30	7.50
11	Frequent recurrence of erosion events	28	7.00
12	Spatial clustering of gully sites (GIS observation)	32	8.00
Total		400	100%

Discussion of findings

The results and findings of the study is discussed in these sections. Effort was made by the researcher to do this based on the variables under study hypothesis-by-hypothesis

Socio-economic activities and gully erosion

The result of hypothesis one revealed that socio-economic activities have a significant relationship with gully erosion in Cross River State. This conclusion was based on the regression result where $R^2 = 0.545$, indicating that 54.5% of the variation in gully erosion is explained by socio-economic activities such as deforestation, sand mining, agricultural expansion, urbanization, and infrastructural development. The F-value was also significant at $p < 0.05$, confirming the statistical strength of the relationship. Therefore, the null hypothesis was rejected.

This finding implies that human land-use practices remain the dominant drivers of environmental degradation in the study area. The result is consistent with the views of Morgan (2005) and Poesen (2018), who emphasized that soil erosion is largely accelerated by human interference with natural land surfaces, especially through vegetation removal and poor land

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management practices. Similarly, Egboka and Okpoko (2018) observed that socio-economic activities such as farming, sand mining, and urban expansion significantly disturb soil structure and increase runoff, thereby intensifying gully formation. The result also supports the findings of Hall and Page (2019), who noted that environmental degradation resulting from human activities reduces the quality of natural landscapes that support tourism development. In the context of Cross River State, activities such as deforestation and sand mining not only worsen erosion but also threaten tourism resources by degrading scenic environments and ecological stability.

Spatial distribution and severity of gully erosion

The result of hypothesis two showed that gully erosion is spatially distributed and highly clustered across tourism zones in Cross River State. The spatial analysis using GIS revealed that erosion intensity varies across locations, with severe gully formations concentrated in tourism-related corridors such as Calabar axis, Akamkpa, and Ikom. These areas also coincide with major road networks and tourism destinations, indicating a strong spatial interaction between human activity and environmental vulnerability.

This finding confirms that gully erosion is not randomly distributed but influenced by land use patterns, slope conditions, and rainfall intensity. It aligns with Poesen (2018), who observed that gully erosion tends to develop in concentrated zones where surface runoff is high and vegetation cover is weak. It also supports Valentin et al. (2005), who noted that once gullies are initiated, they expand rapidly and form clustered patterns under conditions of high rainfall and disturbed landscapes.

The result further agrees with Ofomata (2019), who reported that southeastern Nigeria, including Cross River State, is highly prone to gully erosion due to its fragile soil structure and intense human activities. The proximity of erosion sites to tourism destinations also confirms Jimoh (2011), who emphasized that environmental degradation near infrastructure zones poses serious risks to economic activities such as tourism.

Tourism implications of gully erosion

The findings further reveal that gully erosion has severe negative impacts on tourism development in Cross River State. These include damage to road infrastructure, reduced accessibility to tourism sites, destruction of tourism facilities, loss of scenic landscape quality, and increased safety risks for tourists. As a result, there is a decline in visitor satisfaction, reduced tourist inflow, and weakening of destination competitiveness.

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This finding is consistent with Butler's Tourism Area Life Cycle model (1980), which explains that environmental degradation leads to stagnation or decline in tourism destinations. It also aligns with Egbenta (2015), who stated that degraded environments reduce destination attractiveness and discourage repeat visitation. Similarly, UNWTO (2022) reported that environmental degradation significantly reduces tourism revenue and weakens the economic sustainability of destinations globally. In Cross River State, the deterioration of access roads and natural landscapes directly undermines the attractiveness of major tourism sites such as Obudu Mountain Resort and Cross River National Park.

Conclusion

Based on the findings, the study concludes that socio-economic activities significantly drive gully erosion in Cross River State, and that erosion is spatially clustered within and around key tourism zones. These processes jointly contribute to the degradation of tourism infrastructure and the decline in tourism performance in the state. The sustainability of tourism development is therefore highly dependent on controlling land-use activities and managing environmental degradation.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. The regulation of socio-economic activities contributing to gully erosion. This suggest that the Government and relevant environmental agencies should strictly regulate activities such as deforestation, sand mining, agricultural expansion, urbanization, and infrastructural development, especially in erosion-prone and tourism areas. This will help reduce land degradation, stabilize soil conditions, and protect tourism landscapes in Cross River State.
2. The integrated spatial planning and erosion control for tourism sustainability: By this, GIS-based land-use planning approach should be adopted to guide the location and development of tourism infrastructure away from high-risk erosion zones. In addition, effective erosion control measures such as afforestation, drainage improvement, and slope stabilization should be implemented to protect tourism destinations and enhance their long-term sustainability..

References

Butler, R. W. (2017). The concept of a tourist area cycle of evolution: Implications for management of resources. *The Canadian Geographer, 24*(1), 5–12. https://doi.org/10.1111/j.1541-0064.1980.tb00970.x

Egbenta, I. R. (2015). Environmental degradation and tourism development in Nigeria. *Journal of Environmental Studies,* 9(2), 45–56.

DOI: https://doi.org/10.60787/tjesds.vol2no1.82

ISSN: 1595-8051 EISSN: 3092-9571

Egboka, B. C. E., & Okpoko, E. I. (2018). Gully erosion in southeastern Nigeria: Causes, impacts and control measures. *Environmental Review Journal*, 12(3), 101–118.

FAO. (2020). *Global assessment of soil degradation and land use*. Food and Agriculture Organization of the United Nations.

Hall, C. M., & Page, S. J. (2019). *The geography of tourism and recreation: Environment, place and space* (5th ed.). Routledge.

Holden, A. (2016). *Environment and tourism* (3rd ed.). Routledge.

Jimoh, H. I. (2011). Environmental hazards and infrastructural vulnerability in Nigeria. *Journal of Environmental Management*, 7(1), 23–34.

Morgan, R. P. C. (2005). *Soil erosion and conservation* (3rd ed.). Blackwell Publishing.

Ofomata, G. E. K. (2019). Soil erosion in southeastern Nigeria: Problems and solutions. *Nigerian Geographical Journal*, 15(2), 33–48.

Poesen, J. (2018). Gully erosion in the tropics: Processes and management. *Earth Surface Processes and Landforms*, 43(5), 1234–1256.

Sule, F. (2023). Assessing the rate and dynamics of gully erosion in Southeastern Nigeria using geospatial techniques. *Environmental Monitoring and Assessment, 195*(2), 110–125. https://doi.org/10.1007/s10661-023-10712-5

United Nations World Tourism Organization (UNWTO). (2023). *Tourism and environmental sustainability report*. World Tourism Organization.

UNWTO. (2023). *International tourism highlights*. World Tourism Organization.

Valentin, C., Poesen, J., & Li, Y. (2005). Gully erosion: Impacts, factors and control. *Catena, 63*(2–3), 132–153.

World Travel & Tourism Council (WTTC). (2023). *Economic impact report 2023*. https://wttc.org/

DOI: https://doi.org/10.60787/tjesds.vol2no1.82