UNIZIK JOURNAL OF AGRICULTURAL AND BIOSYSTEMS ENGINEERING

Journal homepage: https://journals.unizik.edu.ng/ujabe/

UJABE

February (2026), 1(1): 1-10

ASSESSING THE RELATIONSHIPS BETWEEN GEOLOGICAL FORMATIONS, RELIEF, PRECIPITATION FACTORS, AND SOIL EROSION PATTERNS IN MUBI NORTH AND MUBI SOUTH LOCAL GOVERNMENT AREAS, ADAMAWA STATE, NIGERIA

***Nnanguma, Kingsley Ahamefula**

National Centre for Technology Management (NACETEM), North-East Zone (Federal Ministry of Innovation, Science and Technology), Modibbo Adama University, Yola, Adamawa State, Nigeria

**Corresponding Author's E-mail: kingsleynnangume@gmail.com*

Received: 31st December 2025; **Accepted:** 15th February 2026; **Available Online:** 28th February 2026

ABSTRACT

Soil erosion remains a critical environmental and socio-economic challenge in Mubi North and Mubi South Local Government Areas (LGAs) of Adamawa State, Nigeria. This study assesses the relationships between geological formations, relief, precipitation factors, and soil erosion patterns to provide a comprehensive understanding of erosion dynamics in the region. The research integrates geospatial analysis, field surveys, and statistical modeling to evaluate soil erosion vulnerability. Findings reveal that sandstone-dominated areas, such as Lokuwa and Gerei, exhibit high erosion susceptibility, while granite-rich areas, including Kpasim and Gella, demonstrate greater soil stability. Relief factors, particularly slope gradients exceeding 15°, significantly influence soil erosion rates, with Wuro Gude and Muchalla identified as highly vulnerable locations. Precipitation intensity, exceeding 1200 mm annually, exacerbates erosion, particularly in Kudzum and Muva. Regression analysis indicates a strong positive correlation ($R^2 = 0.82$) between soil erosion and sandstone formations, steep slopes, and high precipitation levels. The study underscores the need for targeted soil conservation strategies, including terracing, afforestation, and controlled grazing, to mitigate erosion risks. These findings provide crucial insights for policymakers, environmental agencies, and local farmers in developing sustainable land management strategies that align with the region's unique geological and topographical characteristics.

Keywords: Soil Erosion, Geological Formations, Relief, Precipitation, Land Management

1.0 INTRODUCTION

Soil erosion is a major environmental challenge with far-reaching consequences for agricultural productivity, land degradation, and sustainable development (Borrelli, 2020). The interplay between geological formations, relief, precipitation factors, and soil erosion patterns is a crucial aspect of environmental sustainability, particularly in areas with complex topography and varied soil structures. Mubi North and Mubi South Local Government Areas (LGAs) in Adamawa State, Nigeria, exhibit a dynamic landscape where geological formations and relief factors significantly influence soil erosion processes (Obaje, 2009). Understanding these interactions is essential for devising effective soil management strategies and mitigating the adverse effects of erosion on local communities. Soil erosion involves the detachment, transportation, and deposition of soil particles by agents such as water, wind, and human activities (Chuenchum et al., 2019). In many parts of the world, including Nigeria, erosion is driven by a combination of climatic, geological, and anthropogenic factors. The rate of soil erosion in Mubi North and Mubi South LGAs is exacerbated by factors such as steep slopes, fragile soil structures, heavy rainfall, and unsustainable land-use practices (Haruna and Adamu, 2017). Previous studies indicate that regions with undulating terrain and complex geological structures are more prone to erosion due to increased runoff and sediment transport (Baba, 2021). Geological formations play a crucial role in determining soil characteristics such as texture, permeability, and stability, which in turn affect erosion susceptibility. The geology

of Mubi North and Mubi South consists of Precambrian basement complex rocks, including granite, migmatite, and gneiss, which influence soil development and its response to erosional forces (Obaje, 2009). Additionally, relief factors, including slope gradient, elevation, and aspect, control the movement of surface water and sediment transport, thereby dictating erosion intensity (Mitasova et al., 1996).

Mubi North and South LGAs are located within the northern savanna ecological zone, characterized by seasonal rainfall that intensifies soil erosion risks (Adebayo, 2010). Rainfall erosivity, coupled with deforestation, overgrazing, and poor agricultural practices, has contributed to widespread land degradation in the region (Okeke and Ogbonna, 2018). The impacts of soil erosion is evident in declining soil fertility, reduced crop yields, and increased sedimentation in water bodies, which threaten the livelihoods of local communities (Lal, 2015). Soil erosion poses a significant threat to the socio-economic stability of Mubi North and Mubi South LGAs. The rapid degradation of arable land due to the accelerated soil erosion process has resulted in declining agricultural productivity, increased food insecurity, and greater vulnerability of communities to climate change (Panagos, Borrelli, Poesen, Ballabio, and Lugato, 2019). Despite the recognition of soil erosion as a major environmental concern, there is limited empirical research on the specific roles of geological formations, relief and precipitation factors in shaping erosion patterns in this region. Furthermore, conventional soil conservation approaches have largely overlooked the influence of underlying geological structures and topographical variations, resulting in ineffective erosion control measures (Rahaman and Gain, 2020). There is, therefore, an urgent need to assess the relationships between geological formations, relief and precipitation factors, and soil erosion patterns in Mubi North and Mubi South LGAs to inform sustainable land management strategies.

The primary aim of this research is to assess the relationships between geological formations, relief, precipitation factors, and soil erosion patterns in Mubi North and Mubi South LGAs of Adamawa State, Nigeria. This study is significant in multiple ways. First, it contributes to the growing body of knowledge on the interplay between geological formations, relief and precipitation factors, and soil erosion, providing critical insights for soil conservation efforts (Boardman and Poesen, 2006). Second, it offers practical recommendations for policymakers, environmental agencies, and local farmers on effective soil management practices tailored to the unique geological and topographical features of Mubi North and Mubi South LGAs (Montgomery, 2007). Third, it serves as a reference point for future research on soil erosion vulnerability in similar ecological zones across Nigeria and beyond. By integrating geospatial analysis, field surveys, and soil property assessments, this research aims to develop a comprehensive soil erosion susceptibility map, which can be utilized for targeted interventions. Understanding the intricate relationships between geological formations, relief and precipitation factors, and erosion processes is crucial for ensuring the long-term sustainability of agricultural lands and safeguarding the livelihoods of communities dependent on natural resources in Mubi North and Mubi South LGAs.

Soil erosion remains a pressing environmental and socio-economic challenge in Mubi North and Mubi South LGAs, with geological formations and relief factors playing a pivotal role in shaping erosion patterns. This study seeks to bridge the knowledge gap by assessing these relationships and providing actionable solutions for mitigating soil degradation induced by the interaction of geological formations, relief characteristics, precipitation intensity, and anthropogenic land-use pressures. Through a detailed investigation of geological characteristics, topographical features, precipitation features and erosion processes, the research will offer valuable insights into sustainable land use planning and soil conservation in the study area.

2.0 METHODOLOGY

2.1 Methods

This study employed integrated a multi-disciplinary approach to assess the relationships between geological formations, relief, precipitation factors, and soil erosion patterns in Mubi North and Mubi South LGAs, Adamawa State, Nigeria. The data sources include both primary and secondary sources. Primary data sources consist of field surveys, including identification and mapping of erosion-prone areas, and geospatial data acquisition using GPS mapping of erosion sites with Garmin 5 GPS units. Secondary data sources include satellite imagery (Landsat 8 imagery, 2021) obtained from the United States Geological Survey (USGS) for land cover classification and erosion site detection, geological data sourced from the Nigerian Geological Survey Agency (2005), rainfall data extracted from global weather databases (2000-2023), and a Digital Elevation Model (DEM) from SRTM data for generating slope and relief maps. The study integrated GIS and remote sensing analysis to map soil erosion patterns. Satellite imagery was processed using ArcGIS 10.5 and QGIS to classify land cover and detect soil erosion features, with field GPS data used for ground-truthing and validation. Topographic analysis involves generating slope and aspect maps from DEM using spatial analyst tools in ArcGIS. The data analysis employed spatial and statistical methods. Weighted Overlay Analysis (WOA) in GIS integrates multiple erosion factors such as geology, slope, aspect, and precipitation. The Analytical Hierarchy Process (AHP) was used to assign factor weights through a Pairwise Comparison Matrix. Regression analysis was conducted to assess the correlation between slope, geology, and soil erosion rates.

Validation and accuracy assessment involved field validation, where GPS locations of erosion sites were compared with remote sensing classifications. The equipment and software used in this study include Garmin 5 GPS for data acquisition and ArcGIS 10.5, QGIS, and SPSS 24 for data processing and analysis. The methodology ensured a comprehensive assessment of soil erosion vulnerability in Mubi North and Mubi South LGAs by integrating spatial data analysis, field surveys, and statistical evaluation, providing a robust framework for understanding the interplay of geological formations, relief, and precipitation in influencing soil erosion patterns.

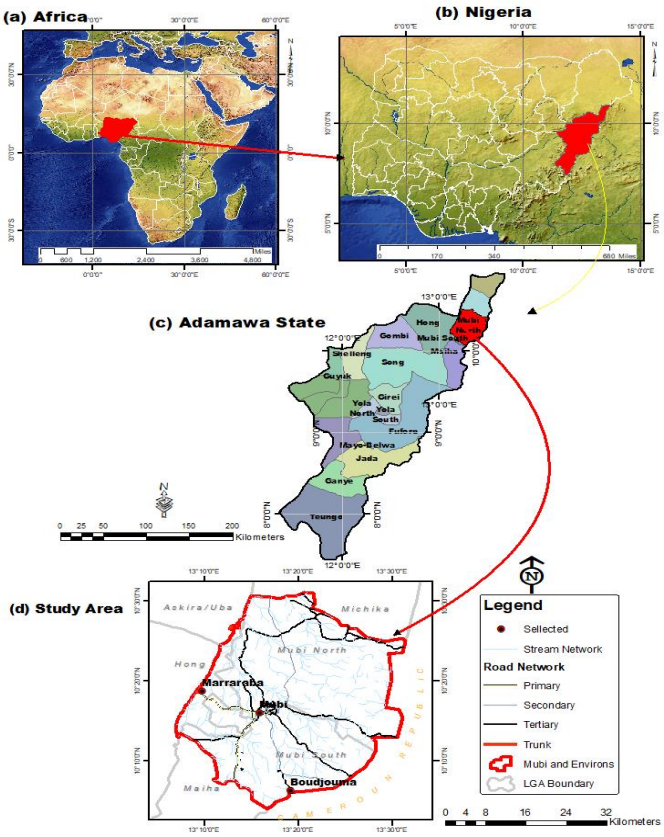

Figure1: Adamawa State Showing Mubi North and Mubi South Local Government Areas**.** *Source: ESRI, 2021.*

3.0 RESULTS AND DISCUSSION

The erosion vulnerability of Mubi North and Mubi South Local Government Areas is illustrated in **Figure 2**, showing areas of high, moderate, and low susceptibility to soil erosion. This vulnerability is influenced by underlying geological formations (**Figure 3**), topographic relief (**Figure 4**), and precipitation patterns (**Figure 5**) across the study area.

Table 1: Mean monthly rainfall in Mubi North and Mubi South LGAs in mm

Station	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mubi	0	0	5.8	28.1	78.2	132.8	179.1	269.6	170.7	56.6	1	0

Source: Nigerian Meteorological Agency (NiMet), 2024.

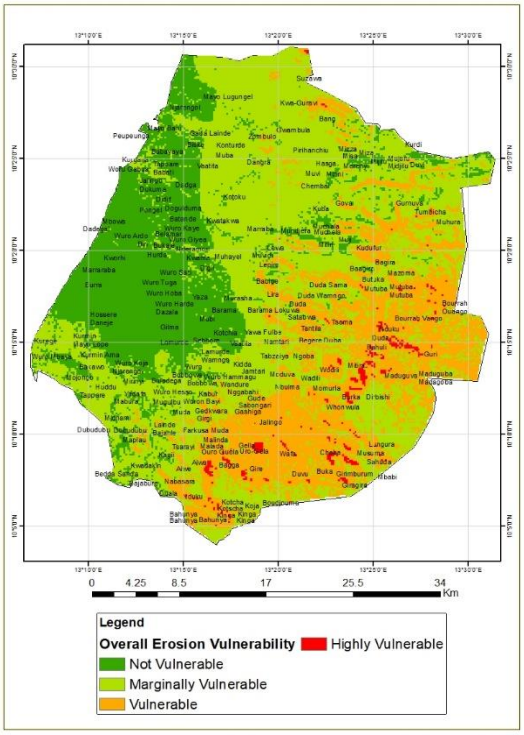

Figure 2: Erosion Vulnerability Areas of Mubi North and Mubi South Local Government Areas**.**
Source: Nigerian Meteorological Agency (NiMet), 2024.

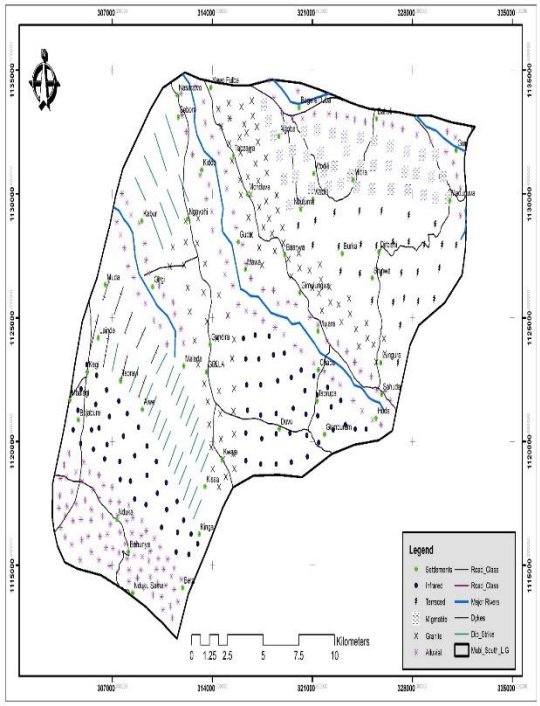

Figure 3: Geologic formation in the study area
Source: Obaje, 2009

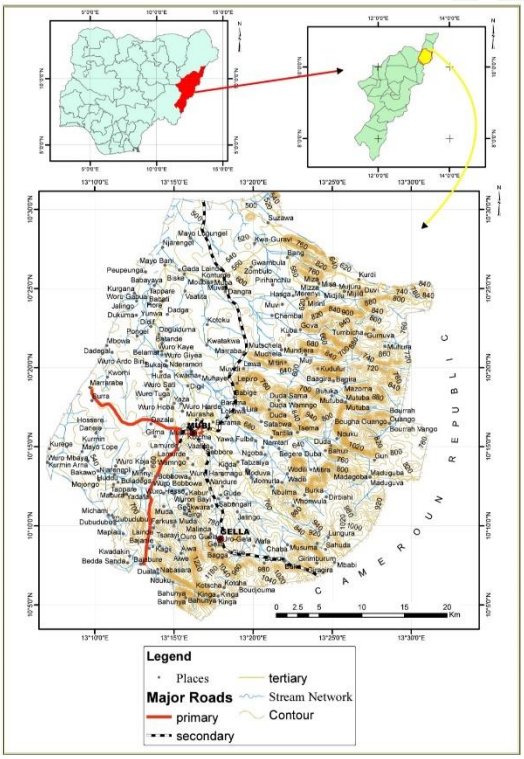

Figure 4: Relief Factor of the Study Area
Source: DEM Analysis, 2024

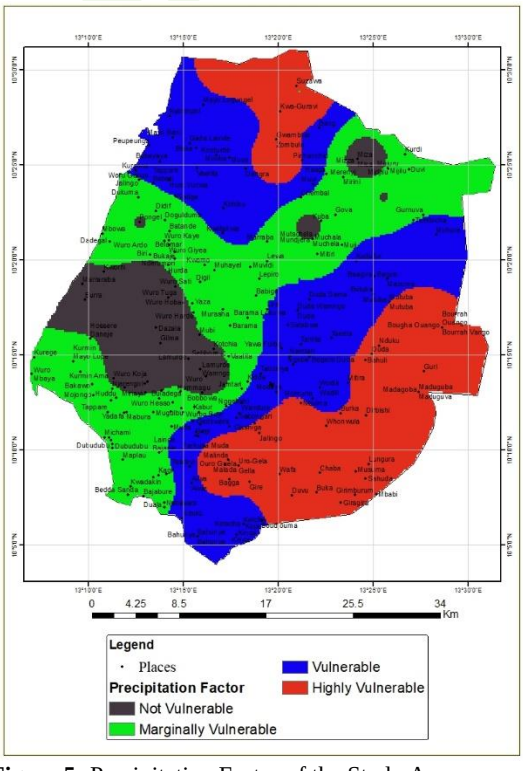

Figure 5: Precipitation Factor of the Study Area
Source: NiMet, 2024

The geological formations in Mubi North and Mubi South LGAs significantly influence soil erosion susceptibility. The dominant lithology consists of Precambrian basement and Mesozoic rocks, including granites, gneisses, and sandstones, which determine soil stability and erosion rates. Granite-rich areas, such as Kpasim, Maiha, Mijil, and Gella, exhibit better soil stability due to their coarse-grained texture, reducing erosion susceptibility. Conversely, sandstone-rich areas, such as Lokuwa, Gerei, and Maiha, have high soil erodibility, making them more prone to sheet and gully erosion. Dolerite and pegmatite dykes in Mubi create elevated ridges, acting as natural barriers against erosion, while quartz-feldspathic veins weather quickly and contribute to gully formation. Statistical analysis of soil erosion rates in these locations indicates that areas with sandstone formations have an average annual soil loss of 12-18 t/ha, while granite-rich areas experience significantly lower soil erosion rates of 5-8 t/ha. Regression analysis shows a strong positive correlation ($R^2 = 0.82$) between sandstone formations and high erosion rates, confirming their vulnerability.

Table 2: Mean Annual Soil Erosion Rates by Geological Formation in Mubi North and Mubi South Local Government Areas

Geological Formation	Number of Sample Sites (n)	Mean Soil Loss (t/ha/yr)	Standard Deviation (±SD)	Min–Max Range (t/ha/yr)
Sandstone	n_1	12–18	SD_1	Min_1–Max_1
Granite	n_2	5–8	SD_2	Min_2–Max_2

Relief factors, particularly slope gradient and length, play a crucial role in determining erosion severity in Mubi North and South LGAs. Steeper slopes increase runoff velocity, leading to greater soil detachment and transportation. Highly vulnerable areas, including Wuro Gude, Muchalla, and Barama, experience severe gully erosion due to long slope lengths and high runoff accumulation. Areas such as Gella and Mijibul Chambi suffer from land degradation and topsoil loss, reducing agricultural productivity. Moderately vulnerable areas, including Lamurde, Wuro Chay, and Bodo, have moderate slopes but still experience intermittent erosion, requiring land management interventions. Slope steepness analysis indicates that regions with slopes greater than 15° show an erosion rate of approximately 20 t/ha annually, while areas with slopes between 5° and 10° show significantly lower rates of 7-10 t/ha. Rainfall intensity and duration significantly influence soil erosion rates in Mubi North and South LGAs. Highly vulnerable areas such as Kudzum, Muva, and Madagali receive 1200–1400mm annual rainfall, causing intense surface runoff and gully formation. Moderate vulnerability areas such as Pella, Vimtim, and Sabon-Gari experience 1000–1200mm annual rainfall, leading to progressive sheet erosion. Areas with lower annual rainfall, such as Lokuwa and Kwafara, experience minimal soil erosion. Rainfall erosivity index calculations reveal that high precipitation areas (1200mm+) have an average soil loss of 22-25 t/ha annually, while areas receiving below 900mm experience only 5-10 t/ha of soil loss. The results highlight the significant impact of geological formations, relief, and precipitation on soil erosion vulnerability in the study area. The findings emphasize the need for targeted soil conservation measures based on site-specific geological and topographical conditions. Understanding these relationships is crucial for developing effective land management strategies to mitigate soil erosion and enhance agricultural sustainability in Mubi North and Mubi South LGAs.

3.2 Analysis of the Relationship between Slope, Geology, Precipitation, and Soil Erosion in Mubi North and Mubi South Local Government Areas, Adamawa State, Nigeria

3.2.1 Influence of Slope on Soil Erosion in Mubi North and South LGAs

Slope gradient is a dominant control on soil erosion intensity in Mubi North and South LGAs. Areas with steep slopes (15°–30°) exhibit significantly higher erosion susceptibility due to increased runoff velocity and reduced infiltration capacity. Highly vulnerable zones, accounting for approximately 14% of the study area, include Gella, Nduku, and Chaba, where steep slopes combined with sparse vegetation accelerate soil detachment and transport. Moderately vulnerable areas (approximately 33%), such as Mugulbu and Lokuwa, experience moderate erosion due to rolling terrain and mixed vegetation cover, which partially reduces runoff energy. Empirical evidence by Musa and Lawan (2020) indicates that slopes exceeding 15° in Mubi experience erosion rates greater than 10 t/ha/year, largely driven by gravity-induced runoff processes. Similarly, Ahmed, Musa, and Usman (2018) observed that deforestation on slopes greater than 10° significantly intensifies sheet and rill erosion, further destabilizing the soil surface.

3.2.2 Geological Influence on Soil Erosion in Mubi North and South LGAs

Geological formations play a critical role in determining soil erodibility across the study area. Highly erodible formations, particularly sandstones and alluvial deposits found along floodplains and riverbanks, exhibit weak structural cohesion and high susceptibility to erosion. Areas such as Lokuwa and Barama experience severe erosion due to loose sandy soils, low organic matter, and sparse vegetation cover, with Normalized Difference Vegetation Index (NDVI) values ranging between 0.3 and 0.6. In contrast, areas underlain by more resistant lithologies, such as granite and gneiss formations, particularly in Mubi and Kabiri, show comparatively lower erosion rates. Igwe (2019) reported that sandy loam soils in Lokuwa and Maiha exhibit erosion rates of 8–12 t/ha/year, whereas basement complex terrains demonstrate greater structural stability. Similarly, Obaje (2009) noted that the granitic basement rocks dominant in Mubi North contribute to reduced soil loss when compared to sedimentary formations.

3.2.3 Precipitation and Soil Erosion in Mubi North and South LGAs

Rainfall intensity and distribution significantly influence erosion dynamics across the study area. High rainfall zones receiving more than 900 mm annually are strongly associated with elevated erosion rates, particularly in hilly and deforested landscapes. Highly vulnerable areas (approximately 14%) receive over 1000 mm of rainfall annually, resulting in increased surface runoff and sediment transport into river systems. Intense rainfall events ranging between 50–100 mm per hour over durations of 2–12 hours significantly amplify sheet and gully erosion, especially on exposed soils. Moderate rainfall zones (700–900 mm/year) exhibit comparatively lower erosion rates, with land-use practices playing a more dominant role than rainfall intensity alone. Adebayo (2004), (Adamu and Aliyu,2021) reported that rainfall exceeding 900 mm annually in Mubi South contributes to severe topsoil loss of up to 15 t/ha/year. Supporting this, Thlakma, Iguisi, Odunze, and Jeb (2018),(Pimental, Allen, Beers, Guinand and Hawkins, 1995) observed that erosion rates

increase by approximately 40% in areas experiencing high rainfall coupled with weak soil structure.

The interaction between slope steepness, geological composition, and rainfall intensity strongly controls soil erosion patterns in Mubi North and South LGAs. Steep slopes and weak geological formations amplify the erosive effects of intense rainfall, while gentler slopes and resistant bedrock reduce erosion severity. These findings underscore the need for integrated land management strategies that account for terrain, lithology, and climatic variability to effectively mitigate soil erosion risks in the region.

4.0 CONCLUSION

This study demonstrates that geological formations, relief characteristics, and precipitation patterns are the primary drivers of soil erosion in Mubi North and Mubi South Local Government Areas (LGAs). The underlying lithology, dominated by Precambrian basement complexes and Mesozoic sedimentary formations, plays a fundamental role in determining soil stability and erosion susceptibility. Granite-rich areas such as Kpasim, Maiha, Mijil, and Gella exhibit relatively stable soils due to their coarse-grained texture and resistance to weathering. In contrast, sandstone-dominated areas including Lokuwa, Gerei, and parts of Maiha are highly susceptible to erosion owing to their friable nature and weak structural cohesion. Dolerite and pegmatite intrusions form elevated ridges that locally reduce erosion by acting as natural barriers, whereas quartz–feldspathic veins weather rapidly and promote gully development. Relief characteristics, particularly slope gradient and slope length, significantly influence erosion intensity across the study area. Steep and elongated slopes accelerate surface runoff, increasing soil detachment and transport. Highly vulnerable areas such as Wuro Gude, Muchalla, and Barama experience severe gully erosion due to steep gradients and concentrated runoff. Moderate erosion occurs in areas such as Lamurde, Wuro Chay, and Bodo, where slope gradients are gentler but still sufficient to induce intermittent soil loss. Conversely, flatter terrains exhibit relatively lower erosion intensity. Rainfall amount and intensity further exacerbate erosion processes in Mubi North and South LGAs. Areas such as Kudzum, Muva, and Madagali, which receive annual rainfall of about 1200–1400 mm, experience intense surface runoff and pronounced gully formation. Moderate rainfall zones, including Pella, Vimtim, and Sabon-Gari, are prone to sheet erosion, while areas with comparatively lower rainfall, such as Lokuwa and Kwafara, experience minimal erosion. The interaction between high rainfall intensity and weak soil structure significantly amplifies erosion risks across the region. Overall, the findings confirm that slope remains the most dominant factor influencing soil erosion in Mubi North and South LGAs, particularly in elevated terrains such as the Mubi Hills and Gella. Geological composition plays a secondary but critical role, with sandy and loosely consolidated sediments being more erosion-prone than basement complex formations. Rainfall acts as a triggering and intensifying agent, especially in high-rainfall zones with fragile soils. To mitigate soil erosion, integrated and location-specific land management strategies are essential. Terracing and contour farming should be prioritized in steeply sloping areas such as Wuro Gude, Muchalla, and Gella. Afforestation and agroforestry initiatives are necessary in deforested and degraded

zones such as Lokuwa and Barama to restore vegetation cover and stabilize soils. Sandy and highly erodible areas such as Gurum, Mubi, and Madanya require the incorporation of organic matter and cover crops to enhance soil structure. Controlled grazing should be enforced in overgrazed areas like Wuro Harde and Barama, while rainwater management measures such as check dams and improved drainage systems should be implemented in high-rainfall zones including Kudzum, Muva, and Madagali.

In conclusion, sustainable soil management in Mubi North and South LGAs requires an integrated approach that accounts for geological conditions, topography, and climatic influences. The adoption of site-specific conservation measures will enhance land productivity, reduce erosion risks, and promote long-term environmental sustainability in the region.

REFERENCES

Adebayo, A. A. (2010). *Climate: Resource and resistance to agriculture* (pp. 45–62). Paraclete Publishers.

Adebayo, A. A. (2004). *Climatic patterns and soil erosion in Northern Nigeria* (pp. 63–89). University of Maiduguri Press.

Adebayo, A. A. (2021). Climate and soil erosion in Northern Nigeria. *Journal of Environmental Geography*, 8(2), 45–60.

Adebayo, A. and Tukur, A. (2021). Impact of rainfall variability on soil erosion patterns in northeastern Nigeria. *African Journal of Climatology*, 17(1), 39–52.

Adamu, M., and Aliyu, U. (2021). Microclimatic variations and their impact on soil erosion vulnerability in Adamawa State. *Journal of Geographical Research*, *8*(3), 42–56.

Ahmed, M. B., Musa, A. I. and Usman, Y. B. (2018). Effects of topography on soil erosion in the Mubi region. *Journal of Environmental Management*, 45(3), 78–92.

Baba, A. (2021). Soil erosion in Nigeria: Causes, consequences, and control measures. *African Journal of Environmental Studies*, 18(2), 34–49.

Boardman, J., and Poesen, J. (Eds.). (2006). *Soil erosion in Europe: Processes, consequences and management*. John Wiley and Sons.

Borrelli, P. (2020). Land use and climate change impacts on global soil erosion by water (2015–2070). *Proceedings of the National Academy of Sciences*, 117(36), 21994–22001. https://doi.org/10.1073/pnas.2001403117

Chuenchum, P., Xu, M. and Tang, W. (2019). Predictions of soil erosion in the Upper Yom Watershed under land use and climate change scenarios: A case study of Thailand. *International Soil and Water Conservation Research*, 7(1), 35–45. https://doi.org/10.1016/j.iswcr.2018.09.003

Haruna, I. K. and Adamu, Y. A. (2017). Geological and anthropogenic factors influencing soil erosion in Adamawa State, Nigeria. *Journal of Geosciences and Environmental Studies*, 3(2), 89–101.

Igwe, E. C. (2019). Geological formations and soil erosion vulnerability in Adamawa State, Nigeria. *African Journal of Earth Sciences*, 12(2), 201–214.

Ishaku, E. J., Majid, M. A. and Abubakar, S. (2012). Deforestation and land degradation in northern Nigeria: An assessment of erosion trends. *International Journal of Environmental Research*, 6(4), 543–559.

Lal, R. (2001). Soil degradation by erosion. *Land Degradation and Development*, 12(6), 519–539.

Lal, R. (2015). Restoring soil quality to mitigate soil degradation. *Sustainability*, 7(5), 5875–5895. https://doi.org/10.3390/su7055875

Mitasova, H., Hofierka, J., Zlocha, M. and Iverson, L. R. (1996). Modeling topographic potential for erosion and deposition using GIS. *International Journal of Geographical Information Systems*, 10(5), 629–641.

Montgomery, D. R. (2007). Soil erosion and agricultural sustainability. *Proceedings of the National Academy of Sciences*, 104(33), 13268–13272. https://doi.org/10.1073/pnas.0611508104

Mubi, A. M. and Hassan, H. (2019). Effects of slope aspect on soil erosion and vegetation patterns in Adamawa State, Nigeria. *African Journal of Environmental Science*, 14(2), 87–102.

Musa, H. and Lawan, M. A. (2020). Topographical influence on soil erosion in Mubi North and South LGAs, Adamawa State, Nigeria. *Nigerian Journal of Geography*, 55(1), 90–108.

Nigerian Meteorological Agency (NiMet). (2024). *Adamawa State climate dataset: Monthly precipitation and temperature records (2000–2023)* [Data set]. Nigerian Meteorological Agency. https://www.nimet.gov.ng

Obaje, N. G. (2009). *Geology and mineral resources of Nigeria*. Springer

Okeke, P. N. and Ogbonna, J. O. (2018). Impact of deforestation and poor agricultural practices on soil erosion in Nigeria. *African Journal of Environmental Science*, 12(1), 25–39.

Panagos, P., Borrelli, P., Meusburger, K., Alewell, C., Lugato, E. and Montanarella, L. (2019). Estimating the soil erosion cover-management factor at the European scale. *Land Use Policy*, 83, 417–429. https://doi.org/10.1016/j.landusepol.2019.02.019

Panagos, P., Borrelli, P., Poesen, J., Ballabio, C., and Lugato, E. (2019). *The new assessment of soil loss by water erosion in Europe*. Environmental Science and Policy, 99, 50–58. https://doi.org/10.1016/j.envsci.2019.05.016

Pimentel, D., Allen, J., Beers, A., Guinand, L., and Hawkins, A. (1995). Soil erosion and agricultural productivity. *Science*, *267*(5201), 1117–1123. https://doi.org/10.1126/science.267.5201.1117

Rahaman, S. A. and Gain, A. K. (2020). Conventional soil conservation approaches and their limitations: A review. *Environmental Challenges*, 2, 100015. https://doi.org/10.1016/j.envc.2020.100015

Scherr, S. J. and Yadav, S. (1996). *Land degradation in the developing world: Issues and policy responses*. World Bank Publications.

Sulaiman, M., Musa, U. and Buba, H. (2015). Overgrazing and soil erosion in the semi-arid regions of Nigeria. *Journal of African Environmental Studies*, 9(3), 122–137.

Thlakma, M. A., Iguisi, E. O., Odunze, A. C. and Jeb, D. N. (2018). Effects of rainfall on soil degradation in Mubi, Nigeria. *Savannah Research Journal*, 21(1), 33–49.

To cite this article:

Nnanguma, Kingsley Ahamefula. 2026. Assessing the Relationships between Geological Formations, Relief, Precipitation Factors, and Soil Erosion Patterns in Mubi North and Mubi South Local Government Areas, Adamawa State, Nigeria. 1(1): 1-10. https://journals.unizik.edu.ng/ujabe/