WWW.IJRPR.COM

**International Journal of Research Publication and Reviews**

Journal homepage: www.ijrpr.com ISSN 2582-7421

# Effect of External Geomorphic Process on Ushongo Hills and its Environs, Ushongo Local Government Area of Benue State

***Sunday Asemakaha [a], Dr. Johnson Orfega Mage [a], Achagh Vambe [a] and Solomon Gbaa [a]***

[a] Benue State University, Makurdi, Benue State, Nigeria
DOI: https://doi.org/10.55248/gengpi.5.0324.0861

**ABSTRACT**

The study assessed the effect of external geomorphic processes on Ushongo hills and its environs, Benue state Nigeria. Data were collected through field observation, interaction with land users and direct field measurement. Data was analyzed using both descriptive and inferential statistical techniques. Descriptive statistics such as tables, average, frequencies and percentages were adopted while influential statistics include standard deviation and coefficient of variation were adopted, while descriptive statistic was used to analyze data on geomorphic variables, inferential statistic was used to investigate the effects of geomorphic processes on agricultural activities. A multi-stage sampling technique was adopted where stratified sampling techniques were used to stratify north, south and west side of the study area. Purposive sampling was used to select three gullies, three sites each of landslide and rockfall and also to select 30 persons who engage in farming within the study area. The study revealed that, three major external geomorphic processes currently operate on Ushongo hills, namely; mass movement (rock fall and landslides), weathering and gully erosion. Landslide inhibits farming activities in the portion of land it covers. The study also found that gully erosion has a greater impact on agriculture which is a prominent human activity around the area with the gullies eroding farm lands in the area. The study recommends that contour ridging should be practiced by farmers in the area. This method slows down the rate of soil loss and could be an effective methods of control erosion along the hill slopes of Ushongo hills and its environs.

Keywords: Geomorphic processes, environs, Ushongo hills.

## 1. Introduction

The Earth's surface is constantly changing. These changes mostly occur every minute, which over time accumulate to create the Earth's physical features we observe around us today. Some of these changes take thousands of years (Akintola, 2015). The external forces are known as exogenic forces and the internal forces are known as endogenic forces. The actions of exogenic forces result in wearing down (degradation) of relief/elevations and filling up (aggradation) of basins/ depressions, on the earth's surface. The phenomenon of wearing down of relief variations of the surface of the earth through erosion is known as gradation. The endogenic forces continuously elevate or build up parts of the earth's surface. Hence, the exogenic processes fail to even out the relief variations of the surface of the earth. So, variations remain as long as the opposing actions of exogamic and endogenic forces continue. These forces (external and internal) constitute geomorphic processes.

Geomorphic processes such as mass wasting, soil erosion, and weathering occur in different parts of the world, under all climatic conditions and environments. It is a problem of either increased shear stress on a slope or reduced shear resistance of material covering a slope and its climax is shear failure manifested as slope failure. This kind of situation is a reflection of the destruction of natural slope stability which is as a result of both natural and human-inducing factors (Ramli, Sahrone and Wagiran, 2005). Although slope instability can occur on any inclined surface, the physical conditions as well as human activities in hilly and mountainous areas make them susceptible to rapid mass movements which are often disastrous. This leaves a great imprint on the landscape that can be measured accurately over a given period (Turyabanawe, 2014).

Geomorphic processes are the major natural hazards in which its global concern keeps increasing yearly. In many regions of the world, the impacts of geomorphic processes have been cataclysmic with damages worth several millions of dollars in monetary losses. They are responsible for thousands of deaths and injuries annually. Regularly, they cause long-term economic disruption, population displacement, and negative effects on the natural environment (Ancuţa, Daniel, and Paulică, 2007; Highland and Bobrowsky 2008; Igwe, 2015). For example, a vehicle carrying 11 people struck caused a boulder to tumble down a mountain in the Himalayan State of Himachal Prasesh killing 9 persons and destroying a bridge in India (Reuters 2021). On the 9th of November 2021, a landslide in Sri Lanka killed many persons and destroyed properties worth millions of dollars which happened as the result of heavy rainfall (Aljazeera news, 12/11/2021).

Mass movement is a very common and devastating natural disaster which occurs in almost all mountainous areas of the world (Hong et al., 2016; Hawas, Muhammad and Muhammad (Khan, Mian Bacha, Safeer Shah and Chiara, 2019). It is currently one of the most common natural disasters in the world. The causes and triggers of mass movement have attracted the attention of researchers all over the world. The causes of mass movement are those factors

that render slopes vulnerable to failure, while triggers are factors that initiate the downslope movement or slide. The major triggering factors include both natural and human activities. The natural triggering factors include precipitation and slope instability, slow and steady decrease in rock strength due to fracturing, water infiltration into cracks and pore spaces, weathering while landslides that are entirely due to or aided by human activities such as construction, mining, quarrying and excavations remain on the increase all over the world, (European Geosciences Union, 2018). It is against this backdrop that the researcher investigates the effect of external geomorphic processes on the Ushongo Hills and its environment to identify the dominant external geomorphic processes operating on Ushongo Hills and its environs and describe the dominant land use of Ushongo Hills and its environs.

## 2. Materials and Methods

### *2.1 Study Area*

Ushongo Local Government Area is located on latitude 6° 48' 00" N and 7° 15' 01" N of the Equator and Longitudes 8° 40' 06" and 9° 13' 00"E of the Prime Meridian. The Ushongo Hills are located along Katsina-ala - Ogoja road near Ushongo town in Mbayegh Council Ward of Ushongo Local Government Area of Benue State, Mbayegh Council Ward is bordered to the north, east, west and south by Utange, Ikov, and Mbagwaza Council Wards and Kwande Local Government Area respectively, (Ahile, 2018), (Figure 1.1 and Figure 1.2). Denga (1995) and Ahile (2018) in their separate studies observed that the Ushongo Hills area generally has a rugged or rocky and stony terrain, the prominent geographical feature in the area is the Bwarbwase stream. Much of the land surface in the area is generally about 100m above the mean sea level.

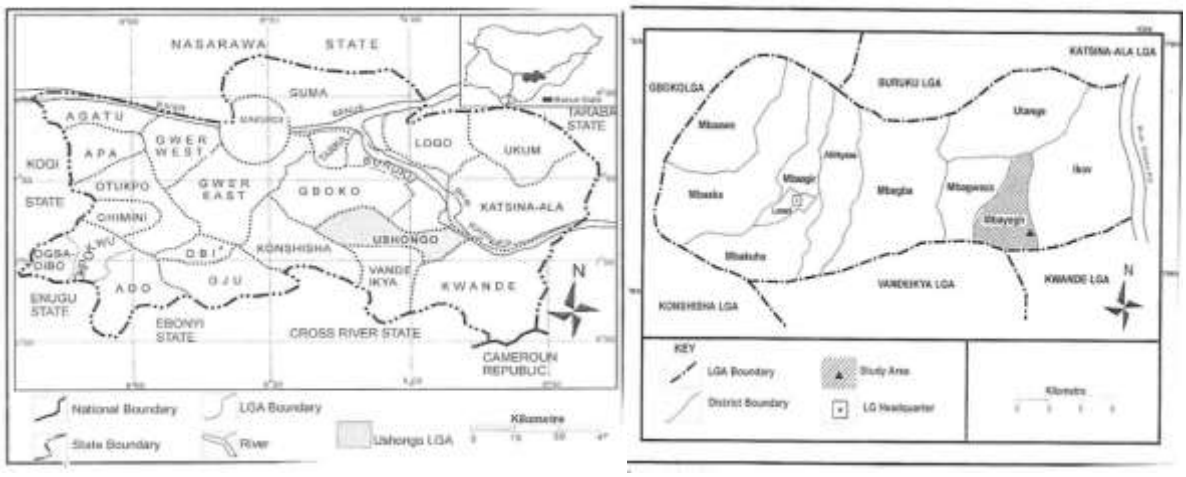


Fig.1 - (a) Benue State ShowingUshongo Local Government Area; (b) Ushongo Local Government ShowingUshongo hills

Source: *Adapted from Benue State Ministry of Lands, Survey and Solid Minerals, Makurdi (2023)*

The main drainage features in the area are the Sohonor and Bwarbwase streams, both of which drain into River Amile U Kiriki, which in turn drain into the river Katsina-Ala, most of the streams that are naturally drained in the study area rise from the hills, flows into different directions forming a radial drainage pattern around the hills. The single maximum regime of stream in the area coincides with the single rainfall peak that generally occurs in September every year. The key relationship between relief and drainage in this area is that most of the streams in the study area take their Waterhead from the hill and flow in different directions (Ahile, 2018).

The study area experiences the tropical seasonally wet and dry (Aw) climate according to Koopen's classification scheme characterized by two distinct seasons of dry and wet. The wet season generally lasts between April and October, with a dry spell in August and a single maximum rainfall region in September every year. The mean annual rainfall in the area is about 1,235mm (Ahile 2018), and it is normally convectional rainfall. Temperature is generally uniformly high throughout the years being higher during the daytime than during the night hours, particularly in March and April. The mean diurnal temperature range is high and is between 23oC and 33oC. A hot season is normally experienced between February and March and May to June yearly, with March generally being the warmest month (about 30.3oC) of the year. The area has a mean annual temperature of about 27.4oC (Ahile, 2018).

The dry season generally lasts between November and March, the driest months of the year being December and January. A short cool season is normally experienced between December and January and is usually characterized by harmattan wind with December being the coldest month (25.8oC) of the year. The amount of rainfall in the area is slightly increased by the orographic effects of the hills, (Ahile, 2018).

Relative humidity (RH) of the air generally ranges from 50% to 80% as is dependent on seasons being the greatest in the rainy season and lowest in the dry season. In September, the mean diurnal RH is around 87% to 90%, (Tarhemba, 2019).

## 3. Data Gathering Methods

The study adopted a field observation design and data was collected from direct field measurement using survey tools and geographic information system (GIS). The study involved a field survey and direct measurement of mass movement (rock fall and landslide), gully erosion parameters and dominant land use. Multiple sampling techniques were adopted. the stratified faces were used to select, north, west, and south of the hills. A purposive sampling technique was used to select three pronounced gullies, rock falls as well and landslide sites in the study area and also to select 30 farmers that cultivate within the study area for an interview to determine the level of land use as well as the effects of external geomorphic processes on agricultural activities on Ushongo hills and its environs. Data collected was analysed using descriptive and influential statistics. Descriptive statistics such as tables, averages, frequencies, and percentages and influential statistics such as standard deviation and coefficient of variation were used.

## 4. Results

The information obtained from the dominant external geomorphic activities operating in the area revealed that mass wasting processes like rock falls and landslides, weathering as well as erosion were common geomorphic processes observed in the area. The observations made from these geomorphic processes were captured with the use of the camera. The numbers of common external geomorphic processes operating in Ushongo hills were collated and the data is presented in Table 1.

**Table 1: Number of External Geomorphic Processes operating on Ushongo Hills**

| Geomorphic process | Location | Number of sites observed |
|---|---|---|
| Rock fall | North | 2 |
| | South | 4 |
| | West | 3 |
| Land slides | North | 2 |
| | South | 1 |
| | West | 2 |
| Gully erosion | North | 3 |
| | South | 3 |
| | West | 4 |
| Weathering | North | 0 |
| | South | 1 |
| | West | 1 |

Source: Author's Fieldwork, 2023

The data presented in Table 1 revealed that four major external geomorphic processes currently operate on Ushongo hills namely; rock fall, landslides, weathering and erosion. However, as can be inferred from the result, the dominant geomorphic process operating in the area is gully erosion with ten (10) sites counted (4 each from north and west and 2 from south).

Apart from gully erosion, rock fall is another noticeable external geomorphic process operating in the area accounting for nine (9) sites with 3 sites observed from the west, 2 in the north and 4 in the south. The landslide was another geomorphic process observed in the area. Five (5) landslide sites were recorded in the area with 2 sites each from the north and west and 1 site in the south. The domination of gully erosion in the area might be attributed to the nature of the slope (steep-slope) associated with the hills and the nature of soils (ferruginous soil) in some locations along the hills or even some anthropogenic activities (farming, mining and deforestation) along the hills. Observations made from the field concerning the major geomorphic processes operating in the area are presented in Plate 1-2.

Plate 1: *Gully Erosion in Ushongo Hills and Environs*

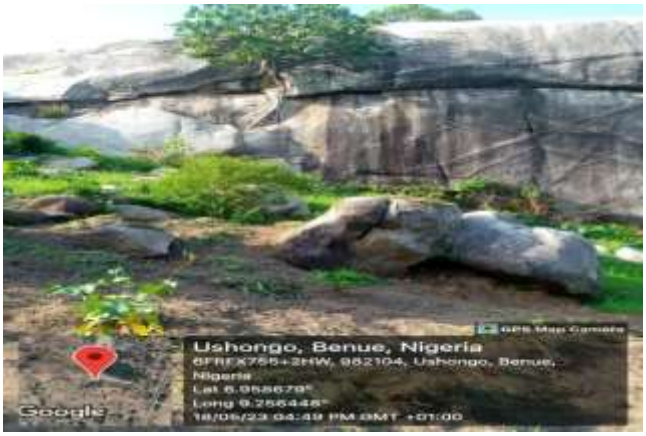


Plate 2: *Rockfall Sites in Ushongo Hills and its Environs*

Source: Field Survey, 2023

Plate 3: *Landslide Sites in Ushongo Hills and Environs*

Source: Field survey, 2024

Another external geomorphic process observed on Ushongo hills and its environs is weathering, field observations showed that physical disintegration of rocks occurred where cracks were noticed on rock outcrops and scarp faces. Those cracks developed on rocks with cross joints, and they were noted to have with time resulted in rock fragments of different shapes and sizes ranging from blocks of boulders to small debris that gradually collapses freely down the slope under the influence of gravity. Interviews with the land users of the study area reviewed that, chemical weathering took place on the hills in the year 2006 when PW company of road construction were using chemicals to disintegrate rocks (plate 4.6). Root wedging (biological weathering) and solution where rainwater attacks and dissolves rocks minerals thereby widening the rock's cracks. It was observed that the process of root wedging helps to break down rocks into situ paving the way for other exogenic geomorphic processes identified in the area. This is commonly seen in the areas with plant roots interacting with the exposed rocks as can be seen in Plate 4.

Plate 4.: *Root Wedging Sites in Ushongo Hills and Environs*

Source: Field survey, 2023

The findings of this study are in line with studies conducted by Clague and Robert (2012; Icheen (2021) that the most common and catastrophic geomorphic processes along the hills are landslides, rock fall and gully erosion. Similarly, Ayodeji (2021) in his study emphasized that landslides are responsible for hundreds of millions of naira worth of damage and, on average, most farmlands around the world. Although most common in mountainous areas, landslides can occur anywhere with enough local relief to generate gravitational stresses capable of causing rock or soil to fail.

## 5. Conclusion

The study findings revealed that major external geomorphic processes currently operate on Ushongo hills namely; rock fall, landslides, weathering and gully erosion. However, the findings identified the dominant geomorphic process operating in the area as gully erosion with ten gully sites. Mass wasting such as rock fall landslides and erosion harms agricultural activities in the study area. There is a need to undertake a detailed quantitative study of the factors responsible for the operation of the identified geomorphic processes in the area.

**References**

Adewole, M.G., Moyosoluw, O.A.,Hakeem, O.A.,Adedayo A. B. (2021).Geotechnical and geomorphological investigation of rainfall induced shallow landslide at Okeigbo, Ondo State, southwestern Nigeria. Journal of African Earth Sciences Volume 178, June 2021, 104163

Ahile, O.J. (2018) Assessment of soil physical characteristic for crop production around Ushongo hills in Benue State,Nigeria. Journal of Geography and Development 8(1):881-891.

Ancuţa, R., O. Daniel, and R. Paulică. 2007. Analysis of the landslide movements.International Journal of Geology 1 (3): 70–79.

Denga D I (Ed) Benue State, the land of great potentials; A compendium (1st edn.). calabar, Nigeria; Rapaid Education Publishers LTD.

Faniran, A and Ajaegbu H (1971) Land slope and farm size in part of Jos Plateau State, Nigeria. Geography, j. 14(2).

Favis-Mortlock, D. T, Guerra, A. J.T. (1999) the implications of general circulation model estimate of rainfall for future erosion: a case study from Brazil. Catena. 37: 329-354.

Fell, R., Stapledon, D, McGregor, P. (2012). Landslides and geologic environments. In Clague J,

Fullen, M.A. (1985). Compaction, hydrological processes and soil erosion on loamy sands in east Shropshire, England.Soil & Tillage Research. 6: 17-29.

Fullen, M. A. (1992.) Erosion rates on bare loamy sand soils in East Shropshire, UK. Soil Use and Management. 8:157-162.

Fullen, M. A. (2003). Soil erosion and conservation in Northern Europe. Progress in Physical Geography 27(3): 331-358.

Hong, H, S.A Naghibi, H.R Pourghasemi, and B Pradhan. (2016. )"GIS-based landslide spatial modeling in GanzhouCity,China." Arab. J. Geosci 9, 112

Hong, H., S.A. Naghibi, H.R. Pourghasemi, and B Pradhan (2016) "GIS-based landslide spatial modeling in Ganzhou City, China." Arab. J. Geosci 9, 112.

Hungr Oldrich (2014). The Varnes classification of landslide types, an update. 10.1007/s10346-013-0436.

Igwe, O. 2015. The geotechnical characteristics of landslides on the sedimentary and metamorphic terrains of Southeast Nigeria, West Africa. Geoenvironmental Disasters 2 (1): 1–14.

Iorkua, S.A., Aper, J .A., Iortyer, C. T. (2018) Runoff induced gully erosion ,estimated soil loss and effects on land use in katisna ala Town Benue State, Nigeria. Journal of Geography and Development 8(1): 892-907.

Khan, Hawas, Muhammad Shafiqueb, Muhammad A. Khan, Mian A. Bacha, Safeer U. Shah, and Chiara Calligaris (2019)"Landslide susceptibility assessment using Frequency Ratio, a case study of northern Pakistan." The Egyptian Journal of Remote Sensing and Space Science Vol 22. 11-24.doi: https://doi.org/10.1016/j.ejrs.2018.03.004.

Ramli A.T., S. Sahrone, H. Wagiran, (2005). Terrestrial gamma radiation dose study to determine the baseline for environmental radiological health practices in Melaka state, Malaysia Journal of Radiological Protection, 25 (4) (2005),

Tchindjang M. (2003) L'homme et l'érosion en milieu montagnard Camerounais. Université de Yaoundé I.

Thornbury, D W. (2002) principle of geomorphology 2nd edition. New edition, Satish kumar bain for c13 publishing and distribution.

Thornes, J.B. (1990). The interaction of erosional and vegetational dynamics in land degradation: spatial outcomes. In Thornes, J. B. (ed.) Vegetation and Erosion, Processes and Environments.Wiley, Chichester. pp. 41-53.

Tricart, J. (1962) The landform of humid tropics, forest and savannah. Longman London.

Turyabanawe, l.G. (2014). Effects of geomorphic processes and land use activities on slope stability in Mount Elgon region, eastern Uganda. A thesis submitted in fulfilment of the Degree of Doctor of Philosophy in the School of Humanity and Social Sciences of Kenyatta University.

Valentin, C., Poesen, J., Yong, L. (2005) Gully erosion: impacts, factors and control. Catena. 63:132-153.

Vanmaercke M, Poesen J, Mele B V, Demuzere M, Bruynseels A, Golosov V, Bezerra J F R., Varnes, D.J. (1978.) Slope movements: types and processes. In Schuster R L, Krizek R J. (eds.) Landslide Analysis and Control.Transportation Research Board Special Report, National Academy of Sciences, Washington DC. 176: 11-33

Varnes, D. J. (1978). Slope Movement Types and processes, In Schuster, R.L and Krizer, R.J, (eds), Landslide Analysis and control, Transportation Research Board, Special Report 176 (National Academy of Sciences, Washington DC): pp. 11-33.

Vente, J., Verduyn, R., Verstraeten, G., Vanmaercke, M., Poesen, J. (2011.) Factors controlling sediment yield at the catchment scale in NW Mediterranean geoecosystems.Journal Soils Sediments.11: 690-707.

Wild, A. (1993) Soils and the Environment – An Introduction. Cambridge University Press, Cambridge.287pp.

Williams M.A.J(1973) The efficiency of creep and slope wash in tropical and temperate Australia aust. Geog.studies.11, 62-78.

Wolfgang, R. (May 8th 2013). Environmental Change and Geomorphic Response in Humid Tropical Mountains, Environmental Change and Sustainability, Steven Silvern and Stephen Young, Intech Open, DOI: 10.5772/53395. Available from: https://www.intechopen.com/chapters/44256 World Population Clock: http://www.worldometers.info/world-population/ [accessed 12/02/2016].