E-ISSN: 2997-9382

SemantJournals

American Journal of Technology Advancement

https://semantjournals.org/index.php/AJTA

| Research Article

Check for updates

Survey of Some High-Risk Erosion Sites in Kogi State, North-Central Nigeria using Remote Sensing Techniques

Oyibo David [1], Ayegba Abdullahi [2], Gana Joseph [3], Janet Jonathan Ngala [4], Kadir Rasheedat Aderonke [5], Uhumuavbi O. Clement [6] and Lazarus John [7]

[1,3,4,6,7] Geospatial Intelligence and Space Technology, National Space Research and Development Agency, Abuja, Nigeria,

[2] Engineering and Space Systems Department, National Space Research and Development Agency, Abuja, Nigeria,

[5] Policy Planning and Research Department, National Space Research and Development Agency, Abuja, Nigeria

Annotation

Satellite images (Landsat 2001) for four local government areas of Kogi State, including Ankpa, Dekina, Okene, and Kabba-Bunu, were used for the survey of nine (9) high-risk erosion sites. This was done to determine the spread, development, and dynamic of gullies in the areas. Gully borderlines were delineated for the identified gully system in each of the local government areas. Gully parameters such as length, width, and depth were determined. The gully was classified into severe, moderate, and mild. The result shows Ankpa and Dekina with the longest gully length ranging from 300m in Ajobe to 700m in Ogane Aji-Dekina with 7m to 25m width and a depth of about 4m to 7m. Moderate gulling was apparent in Omigbo Kabba water channelization with a gully length of 500m, 15 meters width, and 4 meters depth, followed by Etahi and Agassa in Okene Local Government Area. Mild gullying with a total gully length of about 1.2 meters in Etahi and 1.4 meters in Agassa. The recorded width ranges from 20 to 25 meters with 17 meters depth in Etahi to 4 meters in Agassa.

1.0 Introduction

Agents of erosion play a major role in dislodging particles of soil, removing them, and eventually disposing of them at a new location. Egboka (1993) states that an area is subjected to erosion when certain factors are considered; they include geology, land use practices, geomorphology, climate, soil texture, biodiversity, and land conservation (Goudie 1981, Timothy 1981, Timothy2007). Both natural and anthropogenic factors contributed to the speedy development and expansion of gullies in Kogi State. The study identifies the spatial spread of gully erosion and impacts in Kogi State, North-Central Nigeria.

The nonchalant attitude of man and his actions to the environment contribute heavily to gully development; common actions include laterite and sand extraction, quarrying, wood harvesting for fire, bush burning for farming activities, and infrastructural development like building and road construction, among others. These activities, coupled with annual flooding from excessive

rainfall, cause serious havoc and monumental destruction of properties as gullies develop and expand rapidly. Beijing Times (2002).

2.0 Geology of the Study Area

The geological setting of Kogi State is unique in view of the occurrence of the two (2) major components of Nigerian geology (basement complex and sedimentary basin). Half of the state is covered by crystalline basement complex, while the other half is covered by Cretaceous to recent sediments.

The western part of the state, colored red in Fig. 1, comprises basically the basement complex; they are made up of migmatite and gneisses. The schist belts (metasedimentary and meta-volcanic rocks) KSMSMD (2014). Omali (2014) described the geology of Lokoja to be bounded to the south and the west by the migmatite gneiss complex of the Kabba – Okene area and on the north and the eastern part by the cretaceous sedimentary rocks of the mid–Niger basement, which overlies the basement complex rock. The eastern part of the state is on the alluvial (youngest and most recent sedimentary rocks); these areas lie within the Anambra basin.

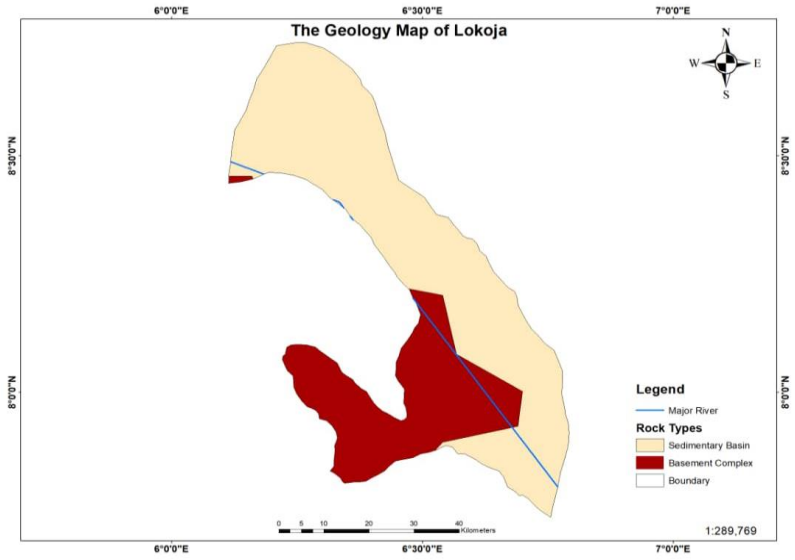

Fig. 1: Geology of Lokoja

2.1 Study Area

The study area is located between latitudes $6^{0}33$'N and $8^{0}44$'N and longitude $5^{0}40$'E and $7^{0}49$'E. The four (4) local government areas, including Ankpa, Dekina, Okene, and Kabba-Bunu, with nine (9) gully sites, were the areas of interest.

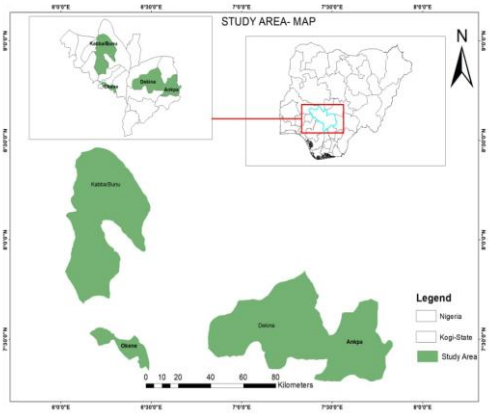

Fig. 2: Study Area Map

Kogi State has a tropical climate that is divided into the dry and wet seasons. The wet season begins around March and ends towards October, while the dry season begins in the month of November and lasts till late February. The average annual rainfall ranges from 850mm to 2,000mm during the rainy season, with the daily mean temperature of about 28°C (KADP, 2011).

3.0 Materials and Methods

Field work was undertaken using the traverse method to access the high-risk erosion area. GPS points of all the gully sites were taken; tape for measuring the width, length, and depth of various gullies with a camera for photography was also employed.

Landsat satellite images of 2020 at scale 30tm for all the four (4) local government areas were obtained from NASRDA; a high-resolution image of the study area from Google Earth and an administrative/local government map of Nigeria at scale 1:15,140,90 was also obtained from NASRDA. These data were geo-referenced to universal transverse Mercator projection word 1984 (UTM). ArcGIS 10.4 and QGIS 3.2 were used to analyze the data for map composition.

4.0 Results / Discussions

4.1 Ankpa Local Government Area

i. Ajobe in Ankpa falls within the humid tropical rain forest belt of Nigeria with an annual rainfall of about 200mm; the vegetation falls within the guinea savannah belt. It consists of lowlands and hills with an average elevation of 900ft. The gully has a dimension of 300m long, 7m wide, and a depth of 4 m, causing massive destruction of houses and properties; these represent the longest gully length within the Ankpa Local Government Area (Plate 1).

Ankpa (Ajobe) Gully (Plate 1)

i. Ankpa (Olubojo): The gully is located within a residential area along Old A.A. Suite in Ankpa. It has a gully length of 250m, a width of 6 m, and a depth of 1m. The land use affected was a pathway to many private homes.

ii. Okaba: The gully site is located within Okaba town, a suburban town in Ankpa; it has a length of 120m, a width of 5 m, and a depth of 1m. The land use affected was a pathway leading to United Evangelical Church road; the land lacks shrubbery and trees.

Table 1: Gully Erosion site in Ankpa LGA

S/No	Location	Length (m)	Width (m)	Depth (m)	Land use affected
1	Okaba	120	5	1	Pathway
2	Ajobe	300	7	4	Farmland
3	Ankpa	250	6	1	Pathway

4.2 Dekina Local Government Area

i. Ogane Aji (Anyigba): This area is located within Anyigba town, a few meters from CMML Secondary School. During site visitation, the gully site was measured to have a gully length of 700m, a width of 25 m, and a depth of 7m. The site has a slope in front of Idrinana hotels and some residential houses all round the gully. It is the longest and the deepest within the study area.

ii. Atanigoma—This site is located along the Atanigoma area in Anyigba. It has a length of 300m, a width of 2 m, and a depth of 1m; it is suspected to have occurred from uncontrolled run-off along the highway.

iii. Okura – This site is located near the major highway, measuring 110m long, 15m in width, and 2m deep. It has no vegetation cover and therefore allows for detachment of soil and enhances easy run-off.

Okura Gully (Plate 2)

Table 2: Gully site in Dekina LGA

S/No	Location	Length (m)	Width (m)	Depth (m)	Land use
1	Okura	110	15	2	Road/Settlement
2	Atanigoma Anyigba	300	2	1	Residential
3	Ogane Aji (Anyigba)	700	25	7	Residential

4.3 Okene Local Government Area

i. Etahi – This site measures a gully length of 1.2m, a width of 25 m, and a depth of 17 m. Land use affected includes pathways and residential buildings. The erosion was suspected to have occurred from uncontrolled runoff.

ii. Agassa – This site is located in Agassa near GRA and Agassa Secondary School. The site was measured to have a gully length of 1.4m, a width of 20 m, and a depth of 4m. The topography of the area is slightly undulating.

Okene Gully (Plate 3)

Table 3: Gully Site in Okene LGA

S/No	Location	Length (m)	Width (m)	Depth (m)	Land use
1	Etahi	1.2	25	17	Farmland/Residential
2	Agassa	1.4	20	4	School/Residential

4.4 Kabba Local Government Area

Omigbo Water Channelization: This site is located near residential buildings; the gully passes through the entire Kabba town; the gully has a length of 500m, a width of 15 m, and a depth of 4m. It contributes immensely to flooding in Kabba. The land use affected includes residential buildings and pathways.

Table 4: Gully Site in Kabba LGA

S/No.	Location	Length (m)	Width (m)	Depth (m)	Land use
1	Omigbo	500	15	4	Residential

4.5 Discussion

The study examined about nine (9) gully sites within the four (4) local government areas of Kogi State; serious impacts on land use were observed. Landsat images of 2021 from all the LGAs were obtained and geo-referenced to UTM 1984. ArcGIS 10.4 and QGIS 3.2 were used variously in the computation of gully maps of all the study area.

The result indicated a systematic relationship between topographic characteristics (hill slope position and slope steepness) and the loose, unconsolidated soil as key. It was observed that both natural and man-made factors are responsible for causing untold hardships, loss of lives, houses, and other valuables worth millions of naira.

Table: 1,2,3 and 4 represent major gully sites within Ankpa, Dekina, Okene, and Kabba-Bunu Local Government Areas. The inherent characteristics of the local soil to a large extent promote the spread of gully erosion. Anthropogenic factors with regards to land use, afforestation, poor drainage systems, and bad farming practices have all contributed to gully development (Chisci, 1981; Oformata, 1987). From the overall analysis, Ankpa and Dekina Local Government Areas, which form part of the loose unconsolidated soil of the Anambra basin (Murat R.A., 1972), are the most affected by gullies, particularly in terms of magnitude or severity of occurrence in Kogi State. With Omigbo in Kabba, water channelization moderately gullied, and lastly, Okene LGA territory mildly gullied. Figs. 3-6 represent various gully maps of the respective LGAs, with the red colour indicating high-risk gully areas.

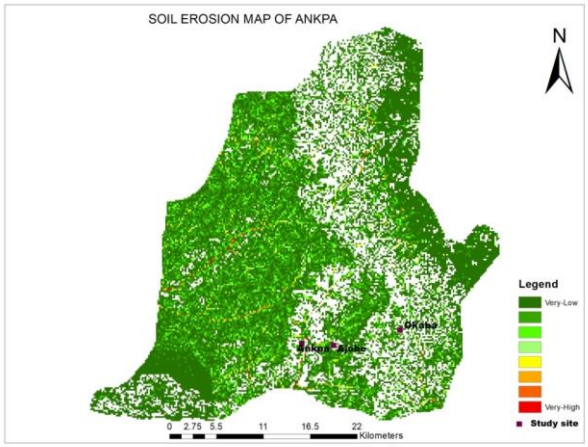

Fig. 3: Soil Erosion Map of Ankpa

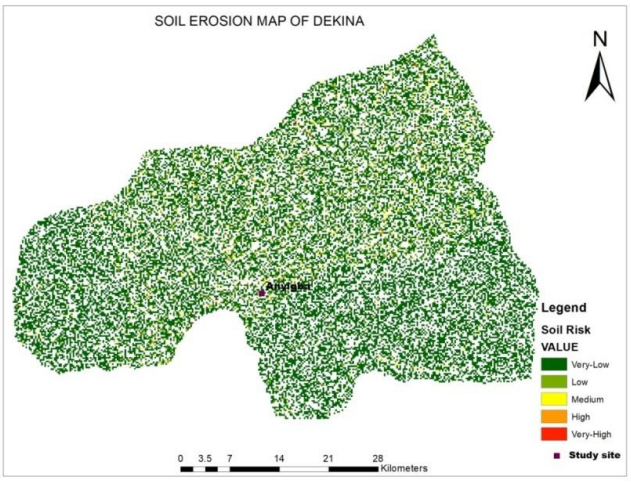

Fig. 4: Soil Erosion Map of Dekina

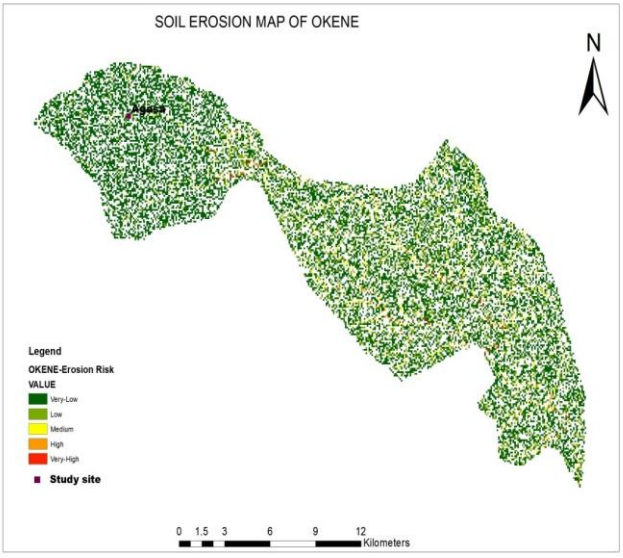

Fig. 5: Soil Erosion map of Okene

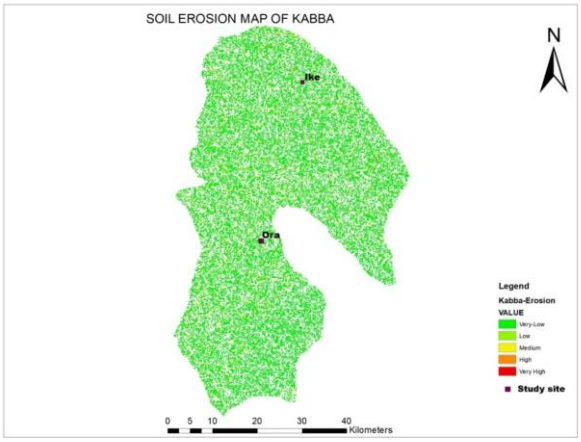

Fig. 6: Soil Erosion map of Kabba

5.0 Conclusion

Remote sensing imagery was used to analyze the gully erosion map of the four (4) areas of interest.

Gully erosion is one of the major environmental problem round the whole world and affects multiple soil and land functions. The development of gullies increases run-off and sediment connectivity in the landscape, hence increasing the risk of flooding and reservoir sedimentation (Verstraeten and Poesen 1999). The high rate of gully erosion in the area has also been attributed to heavy and high rainfall (Aina et al., 1983; Chijioke, 1992).

Some of the conclusions from the study include:

i. Nature of soil: Ankpa and Dekina LGA fall within the sedimentary basin and as such have loose and very porous soil. The soil particles are not consolidated and therefore detach easily when impacted by floodwater. This is what facilitates lengthy, deep, and wide gullies in the eastern part of Kogi State.

ii. Nature of topography—Kogi State consists of lowland and hills; gully developments are pronounced in areas with high undulating terrain, slope, and steepness. In Okene, Agassa, and Etahi, Okene LGA. This inevitable result increases the speed and volume of the overland flow and subsequently the detachment and transportation of soil particles.

iii. Settlement patterns—the nature of housing and infrastructural development contributes to the development of gullies in the west (Kabba); houses are built without consideration to natural flood paths (river channels) and drainage systems. The dense population in the Kabba area is also a factor; as population increases, the need to promote housing and other facilities increases.

The extensive gully development in Kogi State has led to the loss of farmland and the collapse of buildings and infrastructure such as roads and power lines. Regime concentration and run-off from steep land trigger off and exacerbate soil loss and erosion phenomena.

References:

1. Aina et al, (1983) Chijoke (1992), Inventory of some gully erosion sites in Central Cross River State. Pp 153.
2. Benjin times (2002), Qualitative study of gully erosion
3. Chisci (1981, Oformata 87). Empirical studies of soil erosion and conservation.
4. Egboka BCE (2010). Types and causes of erosion, paper presented at the workshop on soil erosion; Nigerians Society of Engineers, Enugu, Imo State.

5. FORMECU (1995). Vegetation Map of Ankpa
6. GOUDIE, A. (1981). The Human Impact; Maris Role in Environmental Change (Oxford: Basil Black well publisher limited) 316 pages.
7. IGBOKWE et al, 2008). Classification of gully erosion in Anambra State.
8. KADP (2011) Kogi State ADP Annual Report, Lokoja, Planning Monitoring and Evaluation Dept. pp. 15.
9. KSMSMD (2014), Kogi State Ministry of Solid Mineral Development: Guide to Investment opportunities in the Solid Minerals sector of Kogi State 26 P.
10. Murat R.A. (1972), stratgraphy and Paleogeography of the cretaceous and lower tertiary in Southern Nigeria Unit of Ibadan Press Pp. 251 – 266.
11. NASRDA (1984) Land use, Administrative/ infrastructural Map of Nigeria.
12. NASRDA (2020) Landsat Image of Ankpa
13. Omali, (2014). Application of remote sensing techniques in the study of ground water zonation of the rocks in Lokoja metropolis central – Nigeria.
14. Verstraeten G. Poesen J. (1999). The Nature of Small Scale Flooding, Muddy Floods and Retention Pound Sedimentation in Central Belgium. Geomorphology 29; 275 – 292.