

# Causes of Nun River Bank Erosion at Okoloba in Kolokuma-Opokuma Local Government Area, Bayelsa State, Nigeria

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## Abstract

This study is aimed at identifying the causes of the Nun River bank erosion at Okoloba. With respect to the concept of geomorphic and anthropogenic interrelationship, the study employed a direct field contact methodology which led to the application of field measurements, soil sample analysis, and personal observation and interview. Following this, the study discovered that, the Nun River bank erosion at Okoloba is a function of un-consolidated bank materials, sinuous meandering at the Okoloba reach, high stream velocity, presence of underground erosion induced by groundwater flow from the backswamps, steep gradient of the bank, run-off pattern to the river and, effects of such anthropogenic activities as building and cropping near the banks and sand-mining near the banks and along the stream channel. In conclusion, the work recommended a professional and comprehensive assessment of the study area, as well as public enlightenment of the inhabitants as surrogates of mitigation in the area.

**Keywords:** Riverbank, erosion, stream velocity, bank gradient, geomorphic factor and anthropogenic factor

## INTRODUCTION

Land can be explained differently by many persons in accordance to their individual backgrounds. In the social and environmental sciences, land is explained in terms of geographical space capable of occupying both natural and anthropogenic processes, involving the atmosphere, lithosphere and hydrosphere. Land and its availability are very essential factors in the physical and socio-economic growth and development of any geographical area. This assertion appears quite obvious where the geographical area is a wetland.

The diversified importance of land to man is demonstrated from ancient times to date. The regions of Mesopotamia and Nile were famous in those days and thus attracted high population because of the fertile nature of their land and other arable-support factors such as relief, good drainage etc. Although, the entire earth and its surface can be explained as land, only about 20 percent is habitable to man (Areola, Ahmed, Iruoghe, Adeleke and Leong, 2002). For instance, even in Nigeria, nature of land is still very important as determining factor for population distribution. It is against this premise that some parts of Nigeria, such as scarplands of South-Eastern Nigeria and the Niger Delta (comparatively to other parts) are sparsely populated. Moreover, it is important to note that all dimensional resources benefited by man are products of land. In this sense, land has to be jealously guarded.

Amazingly, land which is at limited supply all over the globe, is constantly faced with various hazards that are capable of further limiting its activity space and quality in efficiency. One of these is river bank erosion. River bank erosion is the removal of rock particles making up the banks of streams by fluvial actions. It is the retreat-mechanism of river banks that is a common hazard in riverine environments.

The Niger Delta region of Nigeria is a major wetland of global status. One of its major problems is riverbank erosion. This basic fluvial geomorphic action is constantly devastating (in a large scale) the settlement and cropping credibility of the region. Sadly, Okoloba is located in this area. To put it straight, river bank erosion is a constant occurrence at Okoloba. This occurrence has been in association with diverse problems in the locality but without obvious attempts for solution by government or any other formal agency. The importance of Okoloba community in Kolokuma/Opokuma Local Government Area, and Bayelsa State in particular is such that river bank erosion should be jealously prevented and its effect mitigated. The specific context of this work is to look at the causes of its occurrence. This is on the grounds that solving a problem effectively, must begin with unveiling the process of causes to the problem.

The basic aim of this study is to identify the causes of Nun River bank erosion at Okoloba and the specific objectives include;

- i. To determine the physical causes of Nun River bank erosion at Okoloba,
- ii. To identify anthropogenic factors that are capable of causing riverbank erosion at Okoloba

## THE CONCEPT OF GEOMORPHIC AND ANTHROPOGENIC INTERRELATIONSHIP IN THE CAUSES OF RIVER BANK EROSION

Over the years, several scholars (such as Thornbury 1969, Robinson 1977; Faniran & Jeje, 1983; Schuum, 1971; Raven, Berg and Johnson 1993; Harnberger, Rattersperger, Wilberg & Eshlenan 1998) have shown that river bank erosion is an obvious fluvial geomorphic process caused by natural factors like, river-meander, high stream

velocity, un-consolidated textural materials of the banks, slope saturation from inundation, as well as steepness of channels and bank gradient. However, a few scholars have discovered that some rivers experience bank erosion from both geomorphic and land use factors. The deductions from Salter, Hobbs, Wheeler and Kostbade (2000), Kirkby, (1971) and Dey (2006) have unveiled human actions such as cultivating and building of structures near river banks, dredging of river channels, sand and gravel mining along channels and near or at river banks, and channel diversion among others are the basic human factors that could lead to river bank erosion.

The concept of geomorphic and anthropogenic interrelationship in the causes of riverbank erosion (although, the idea had been there over the years) is a concept deduced from Dey (2006) in his study on natural resources and water, supported by Queensland Government expressing that, most rivers erode their banks massively (especially at the reaches where settlement and human activities are associated) by accelerating influences from both physical and human factors as follows:

**(A) Accelerating Physical Factors:**

- (i) Stream-bed lowering
- (ii) Inundation of bank soils, followed by rapid drops in flow after flooding
- (iii) Saturation of banks from off-stream sources
- (iv) Bank soil characteristics such as poor drainage or seams of readily erodible materials within the bank profile
- (v) Wave action generated by wind
- (vi) Intense rainfall events.

**(B) Accelerating Human Factors:**

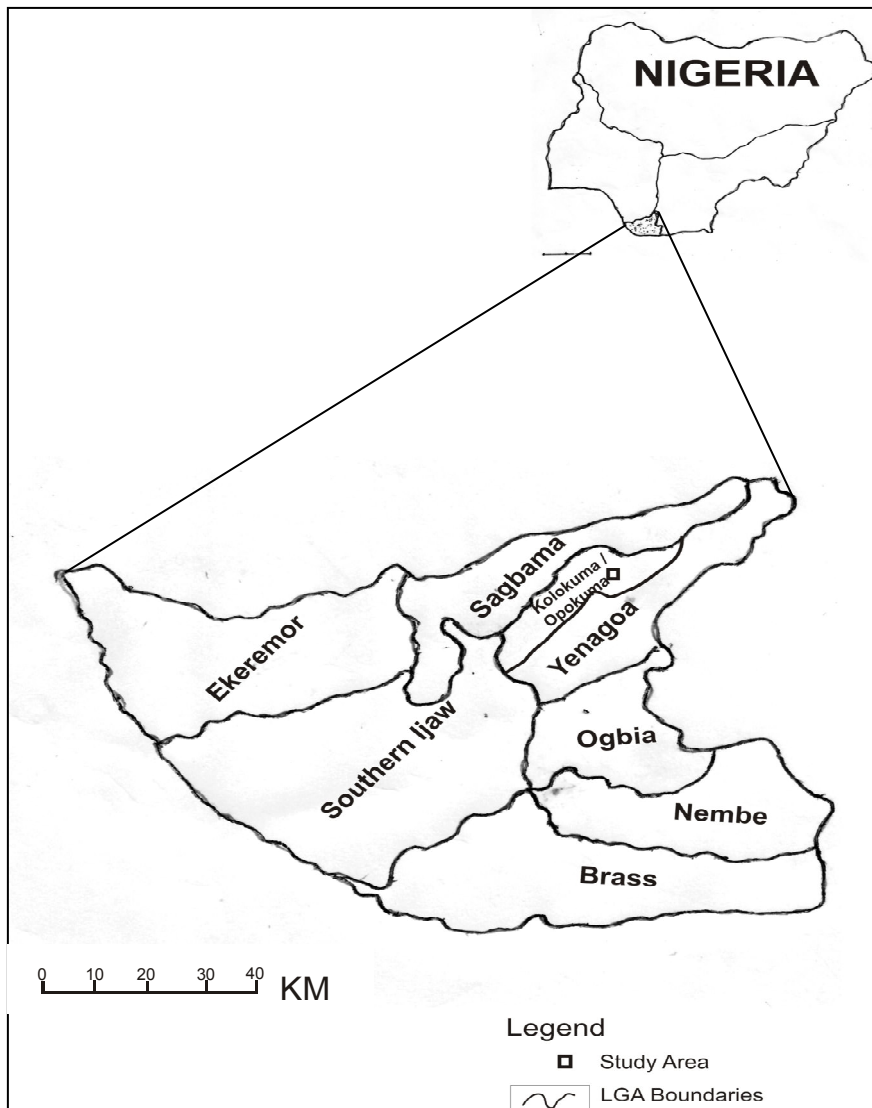
- (i) Stream-bed lowering or in-fill
- (ii) Saturation of banks from off-stream sources
- (iii) Redirection and acceleration of flow of the stream channel
- (iv) Removal or disturbance of protective vegetation from stream bank as a result of trees falling from banks or through poorly managed stock grazing, clearing or fire
- (v) Wave action generated by boats
- (vi) Excessive or inappropriate sand and gravel extraction.

Application of the geomorphic and anthropogenic interrelationship factor in the causes of river bank erosion is very appropriate in this work. The application of the concept here, is a confirmatory approach where the aforementioned factors were observed and examined to note their occurrence and relationship with the occurrence of Nun River bank erosion at Okoloba, a rural riverine environment in the Niger Delta region of Nigeria

### THE STUDY AREA

Okoloba is Izon speaking community of Opokuma Clan in Kolokuma /Opokuma Local Government Area of Bayelsa State of Nigeria. It has a point location of Latitude  $5^{\circ}2'33''$  North and Longitude  $6^{\circ}14'32''$  East. By this location, it is obvious that Okoloba is in the equatorial region. It is important to note here that, Okoloba is closely linked with Sabagreia community (also Izon speaking). While, Okoloba occupies the concave part of the bank, Sabagreia occupies the convex part. Being located in the equatorial region, Okoloba climate and vegetation are equatorial in nature. The average temperature is hot, which leads to high relative humidity and high Mean Annual Rainfall (MAR) of about 3000mm. The vegetation which is also equatorial, has a mix of forest trees and animals. There are hardwood, softwood and palms, (raffia and oil palms) as well as associated mammals, reptiles and amphibians.

The study area is mainly drained by River Nun running North - South (a first order stream of the Niger Delta, sharing equal status with River Forcados). A few in-lets and some surface run-offs during rainfall drain into the Nun River at Okoloba reach. Furthermore, the study area has some socio-economic activities such as cropping, fishing, trading, transportation, local craft and apprenticeship. The area is showing a relatively fast physical development expansion.



**Figure 1. Bayelsa State showing the Study Area**

**Source:** Cartography Unit, Department of Geography & Environmental Management, Niger Delta University, Bayelsa State

## **MATERIALS AND METHODS**

### **A) MATERIALS**

The following materials were taken to the field in-order to have an appropriate study of the causes of Nun River bank erosion at Okoloba;

- i. One 50-metre measuring tape for accurate measurement of distances
- ii. Two local boats (i.e canoes)
- iii. One stop-watch, two ranging poles and one floating-cork for stream velocity measurement
- iv. One Global positioning system (GPS) device
- v. One soil auger for collection of soil samples
- vi. Three black polythene bags for storage of collected soil samples
- vii. One clinometer for riverbank gradient measurement
- viii. One field metre-rule and one field square-rule (in association with the clinometers) for bank angle measurement
- ix. One roll of white string
- x. One field-book and pen
- xi. One field camera

### **B) METHODS**

With regards to the geomorphic and anthropogenic interrelationship factor, the basic methods applied were:

- i. Direct field observation and measurements as well as laboratory analysis.

ii. Personal Interview

These were carried out, following the stated perspective in order to properly ascertain the causes of Nun River bank erosion at Okoloba

- (i) Soil Textural Analysis: The collected soil samples at a depth of 0cm –river water surface were taken to the laboratory for textural analysis
- (ii) Trace and observation of meandering nature of the course: The meandering nature of the Nun River at Okoloba reach was carefully traced and observed in the field.
- (iii) Gradient Analysis of the Banks: The gradient of the banks of the Nun River at Okoloba was measured and calculated,
- (iv) Drainage Pattern Analysis: The run –off structure of the study area was closely observed, especially in terms of direction.
- (v) Evaluation of the anthropogenic activities of the area along the banks and river channel

**RESULTS AND DISCUSSIONS**

**CAUSES OF NUN RIVER BANK EROSION AT OKOLOBA**

The discovered causes of Nun River bank erosion at Okoloba are summarized below:

- (1) Banks of the Nun River at Okoloba reach are composed of un- consolidated sandy soils
- (2) Excessive Meandering nature of the Nun River at Okoloba
- (3) High stream velocity:
- (4) Groundwater –induced erosion:
- (5) Steep riverbank gradient
- (6) Unfavourable run –off structure
- (7) Anthropogenic activities of the area

Details of the stated causes are as follows:

(1) **Unconsolidated Bank Material:**

Soil samples were collected along the banks ranging from top to the river water surface in the dry season. The samples were taken to the laboratory for analysis and the results obtained are as follows:

**TABLE 1: SOIL TEXTURE ANALYSIS OF NUN RIVER BANK AT OKOLOBA**

| S/N   | SOIL TYPE | PERCENTAGE % | POROSITY % |
|-------|-----------|--------------|------------|
| 1     | CLAY      | 5.63         | 68         |
| 2     | SILT      | 4.76         |            |
| 3     | SAND      | 89.6         |            |
| TOTAL |           | 100          |            |

Source: Authors’ Field Survey

This shows that the banks are more of sand which are un –consolidated. This characteristic makes the bank particles to be easily eroded by the running water which further makes the banks weakened and eventually leads to collapse or slumping or subsidence.

(2) **Sinuuous Meandering Nature of the Nun River at Okoloba:**

Okoloba lies along a space of great meander along the Nun River. This meander, leads to the development of riffles and pools along the system, further making the concave slope to be so effective, and thereby enhancing erosion of the concave slope.

A practical tracing mechanism by direct contact through superficial observation with the help of boats, ranging poles and strings was conducted. This procedure, revealed that Okoloba is lying on a great concave side of the Nun River, and with the development of riffles and pools along the system, under cutting is easy at the concave banks. This finding was further strengthened by the researchers’ observation of up welling of water along the concave side. See figure 2

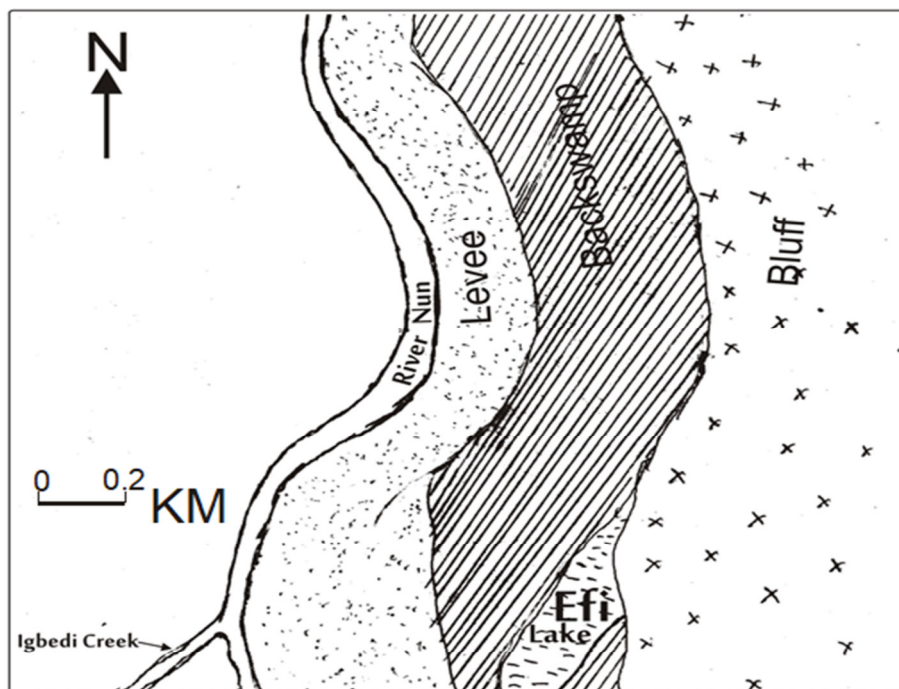


Figure 2: Meander of The River Nun at Okoloba Reach.  
 Source: Authors' Field Survey.

(3) **High Stream Velocity:**

The Nun River at Okoloba experiences high velocity especially along the concave slope where Okoloba is located. This high velocity increases in the flood periods which aggravates erosion occurrence.

The stream velocity measurement taken at two different periods of the year (i.e non flood and flood periods) in 3 years; 2015, 2016 and 2017 revealed that the stream at Okoloba reach in summary runs at a speed of 50 metres per 35 seconds in the non flood periods and 50 metres per 18 seconds in the flood periods. This shows further that the velocity is so exceptionally high at the Okoloba reach, leading to incessant riverbank erosion. See Table 2.

**TABLE 2: NUN STREAM VELOCITY AT OKOLOBA (Summary of 2015, 2016 and 2017)**

| S/N     | PERIOD OF THE YEAR | VELOCITY  |
|---------|--------------------|-----------|
| 1       | NON-FLOOD          | 50m/35s   |
| 2       | FLOOD              | 50m/18s   |
| SUMMARY |                    | 50m/26.5s |

Source: Authors' Field Survey

- (4) **Groundwater –Induced Erosion:** This was discovered as water was seen seeping from the banks of exposed concave slope at the period immediately after the floods. It was also discovered that the backswamps equally accelerate this as the levees form a dyke between the backswamps and the channel. Therefore, at the recession of the floods, the embanked backswamp water will through the pores move underground into the main Nun channel. It is this periodic soaking, underground erosion and drying that cause pores which later lead to cracks and eventually subsidence, collapse and slumping of the banks.
- (5) **Steep Riverbank Gradient-** With the use of a Clinometer, the gradient angle of the concave bank at Okoloba was determined. It was discovered that the gradient is the sharp- steep type. At most points it is as sharp as 90 degrees (ie at right angle). All these suggest that riverbank erosion will continue to be very effective in the study area if something drastic is not done.
- (6) **Unfavourable Run- Off Structure-** A close observation during rainfalls shows that the run-offs are in two directions. One part is directing to the backswamps, while the other is directing to the Nun River channel. It was further discovered that the run –offs toward the Nun River channel are of higher velocity and more in number. This further accelerates the riverbank erosion in the study area. During each rainfall, most of the run –offs are directed toward the Nun River as their main drainage attraction point. These run offs also erode the banks, weakening them for onward erosion.
- (7) **Anthropogenic Activities of the Area-** Most of the anthropogenic activities in the area that are capable of causing riverbank erosion are carried out on the banks and along the channel. These are



cropping and building on banks and sand mining along channel and on banks. Moreover, the study discovered a major sand – mining site, having three main sand dunes of great heights in the study area. These high hips of sand, are of great weight and therefore, exert pressure on the banks.

## CONCLUSIONS

Studies in the field through direct contact with the inhabitants of Okoloba community revealed that a group of the people believes that certain spiritual forces are responsible for the occurrence of the Nun River bank erosion at Okoloba. On the contrary, this study has been able to prove that a combination of geomorphic and anthropogenic factors, are responsible. This assertion is in line with the concept of geomorphic and anthropogenic interrelationship deduced from Dey (2006).

In the basis of this, the study has been able to discover the following as causes of Nun River bank erosion at Okoloba;

- (i) The presence of sandy soil texture which is un-consolidated forming the bank material at Okoloba reach.
- (ii) Okoloba community is unfortunately located at the concave side of the great meandering reach of the River Nun.
- (iii) High velocity of the stream at the Okoloba reach
- (iv) Presence of underground erosion induced by groundwater flow from the backswamps.
- (v) Steep gradient of the banks at Okoloba reach. The strength of this factor is such that, the steeper the bank gradient, the more frequent and efficient the riverbank erosion occurrence.
- (vi) Un-favourable run-off structure which is highly directed to the Nun River.
- (vii) Most of the anthropogenic activities of the area grossly encourage riverbank erosion. These are sand-mining along the channel and on levees as well as cropping and building very close to the banks.

On the basis of these findings, the work is recommending for embarking on a formal professional and comprehensive assessment of the study area. Equally, the work is recommending for public enlightenment of the inhabitants to exhibit the right attitude towards the stream bank and channel in their socio-economic activities.

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