MEASUREMENTS AND DOCUMENTATION FOR FLOOD AND EROSION MONITORING AND CONTROL IN THE NIGER DELTA STATES OF NIGERIA.

BY

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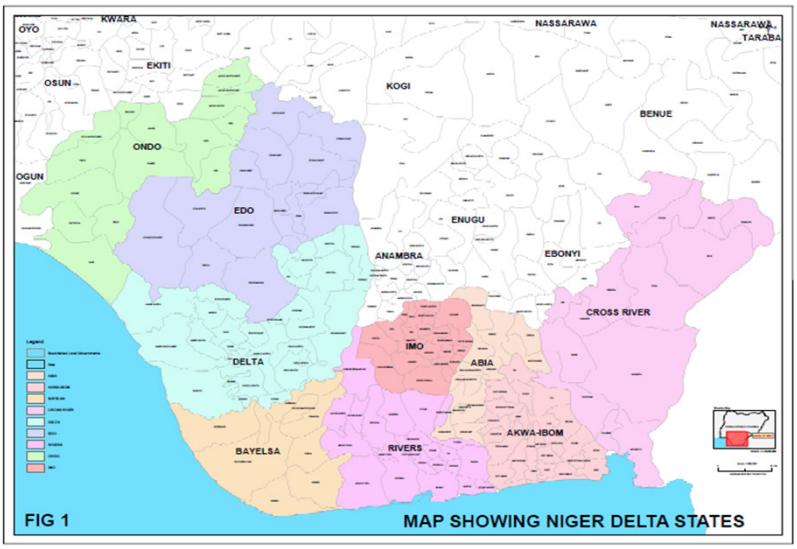
THE STUDY AREA

- The Niger Delta region of Nigeria is situated within the Gulf of Guinea and covers an area of approximately 80,000sq kilometers.
- Nigerian economy depends mainly on oil and gas and the produced within the Niger Delta.

  In this region, flooding and erosion is prevalent mostly as a result of human intervention or a combination of human impact and natural events.
- The activities of the oil companies, unplanned construction activities, stripping of land surfaces has placed the zone as among the most prone to the effect of flooding and erosion in Nigeria.
- In Cross River State alone for instance, it is estimated that there are over 300 active flood and erosion sites in the state (Ehiorobo et al 2010).

  In the urban areas many of the flooding problems are the result of a lack of coordinated land Use planning and control of property development.

FIGURE 1:MAP SHOWING STUDY AREA



- The intensity and amount of rainfall in recent times has resulted in some of the most significant flooding and erosion experienced within the Niger Delta region in the last years.
- Gully erosion is a highly noticeable form of soil erosion and can affect soil productivity and impair roads and water ways.
- Within the Niger Delta region, erosion gullies are formed primarily by surface run-off from high intensity rainfall events on the fine-to coarse grained sand of the Benin formation.
- The gully forming process yield a degraded terrain in which deep and wide gullies are formed within some states such as Edo, Delta and Cross River states.
- Within the region, the gullies originate as rills with a down-slope orientation which undergo progressive widening and deepening with successive rainfall events.

Assessing the soil erosion rate is essential for the development of adequate erosion prevention measures for sustainable management of our scarce land resources.

A flood and erosion management system in general will require :

- a meteorological model to forecast the rainfall,
- a hydrological model to convert rainfall to a run-off,
- a hydraulic model to route the flow through the stream network and to predict timing and severity of the flooding,
- a decision support model to convert results to an early warning system and take necessary action, and socio-economic assessment model to evaluate damage caused by flooding and erosion and take necessary action (Koussen et al 2003, Cesur 2007,Adebe and Price 2005)
- GIS technology is a valuable tool in developing environmental models

- ❖ They include space and time as a common denominator and also possess advanced features for data storage, management analysis and display.
- ❖ Geoinformation technology aside from being used to integrate various models also enable us to acquire information about the environment.
- ❖ Remote sensing technology provide land use and land cover images which when combined with ground survey data by GPS and Total station instrument enable us to model soil erosion and other environmental hazards.
- ❖ The integration of these various Geoinformation technologies do not only enable us to estimate soil loss but they provide the spatial distribution of the flood and erosion sites.
- ❖ Accurate erosion risks and sensitivity index maps can be generated by the system (Ehiorobo et al 2010, Yuksel et al 2008)

METHODS

In order to plan for appropriate flood and erosion control, it is necessary to acquire timely and reliable geospatial information about the flooded areas, water sheds, river and streams configuration prior to, during and after flood events.

- ❖ The use of conventional survey methods alone are quite inadequate in providing such information.
- ❖ Geoinformation technology combines space based sensors and ground based earth observation systems to generate spatial models for current and future analysis of flooding and erosion events.

- In this study a preliminary survey was carried out to identify the major flood and erosion sites in the states. This was done using Google imagery along with a base map covering the states.
- The locations were then geo reference with the aid of GPS receivers.

  Using severity rating based on length, depth and width of erosion gullies and area of flood basins, some of the sites were selected for detailed studies.
- Preliminary attribute data acquire included metrological data from Benin airport, river discharge data from Benin-Owenna river basin development authority.

FIGURE 2:Map of Edo State

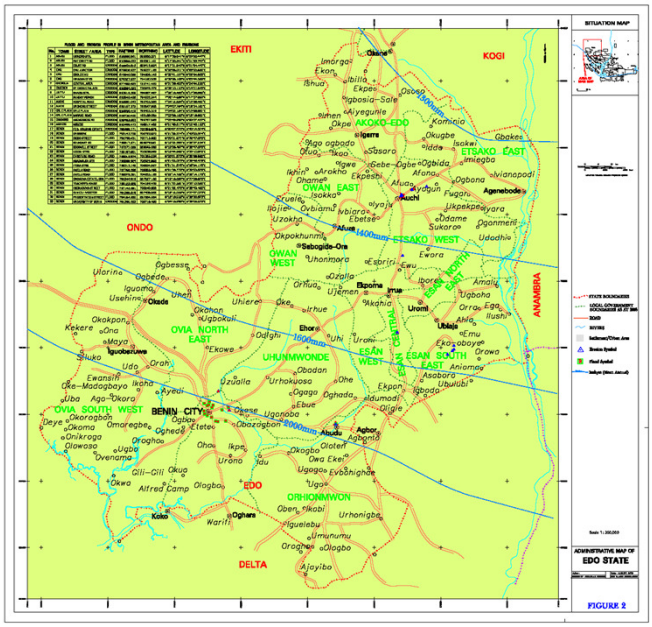


Figure 3(a): University of Benin and Queen Ede Gully sites.

Figure 3(b):Emu and Ibore Erosion Gully sites.

Figure 3(c): Orle Oshiobugie and Ikabigbo Erosion Gully sites

Figure 4: Flooded area by Teachers House in Benin City

- The first phase of field surveys was completed in December 2010. This included
  - Topographical surveys of the erosion gullies using Leica Total station instrument,
  - Location and assessment of spatial coverage of flood basins from Google imagery. XYZ coordinates generated from the total station measurement were stored in Microsoft excel file format.
- They were thereafter imported into the ArcGIS environment using the Add XY menu.
- The project coordinates system were then specified in (Nigeria West Belt) and then exported into personal Geo data base as shape files for each of the erosion sites.
- The shape files containing the elevation data were then added and a Triangulated Irregular Network (TIN) created using the Z coordinates.
- The DEM (Digital Elevation Models) were generated by converting the TIN into Raster.
- Contours lines were generated using the created TIN to interpolate for the contour with the aid of 3D analyst extension.
- ArcScene was then used for the visualization of the 3D model generated from the TIN.

- The Edo state Government recently commission a construction company to develop drainage master plan based on satellite imagery contours. The mapping of the project area by means of Lidar survey is planned.
- The survey is to be flown at a low altitude to counter the cloud cover present over Benin City.
- Control points have been established and referenced by GPS method and these are to be used as reference for the Lidar survey.
- The anticipated accuracy of the Digital Elevation model is expected to be 10-15cm (High-tech Benin City 2010).
- The results from this survey will be used to prepare flood inundation maps which will be used to:
  - Define spatial extent of flood inundation within the city.
  - Identify likely worst flood affected areas during storms.
  - Evaluate impact of flooding on infrastructure and utilities within the city.

RESULTS AND THEIR DISCUSSION

- In Edo state, thirty five flood and erosion sites were identified from Spot imageries and site visit of the 35 sites identified in the state, six erosion gully sites and four flood sites were selected for detailed studies based on severity ratings. The selected sites are presented in Table I.
- The table gives the location, area affected by flooding and gully erosion size of gullies, as obtained from the satellite imageries and general ground surveys
- In order to understand the phenomenon giving rise to the above environmental hazards site analysis was carried out using a combination of satellite imageries obtained from SPOT and field survey data. (Fig 6a and b) show the location maps for the university of Benin and Queen Ede erosion sites.
- the spot height and contoured maps of the sites are shown in figure 7 and 8 respectively. fig. 9 gives a triangulation Irregular Network (TIN) model for the sites

TABLE I: Selected Flooding and Erosion Sites for Detailed studies

S/N	Description of location	Type of problem	coordinates		Area Flooded (hec)	Gully length (km)	Remark
			X	Y			
1	University of Benin	Erosion	266062.513	356179.253	300	1.8	
2	Queen Ede area Benin City	Erosion	259469.751	361342.934	250	2.4	
3	Use/Siluko Road	Flood	261545.004	350900.371	150	-	
4	Ighomo/Ahile/Uwasota Benin City	Flood	263486.004	352214.607	180	-	
5	Uwelu Road area	Flood	261041.608	352530.164	150	-	
6	Emu town	Erosion	281724.328	444692.147	280	-	
7	Ibore	Erosion	307927.000	430839.000	450	4.5	
8	Oshiobugie	Erosion	339475.810	424947.464	480	1.5	
9	Ikabigbo	Erosion	342794.065	434407.197	130	1.3	
10	Ilushi	Flood	318137.428	464109.870	350	-	

Figure 6: Layout of University of Benin and Queen Ede Gully Erosion Sites

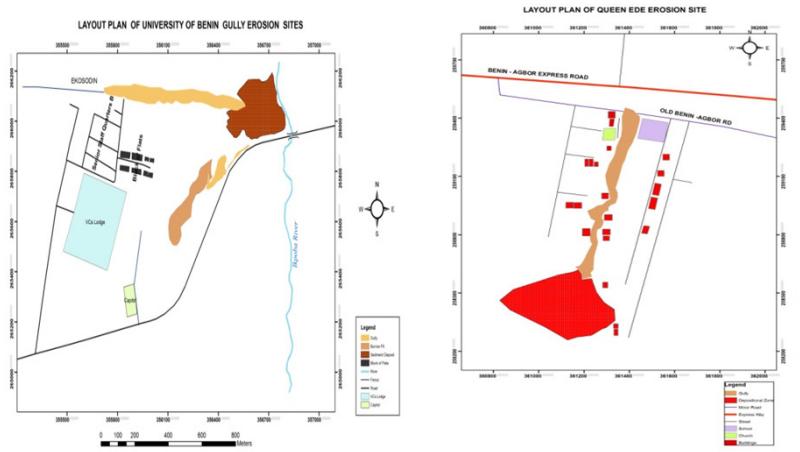


FIGURE 7: SPOT HEIGHT PLAN OF UNIVERSITY OF BENIN AND QUEEN EDE GULLY EROSION SITES

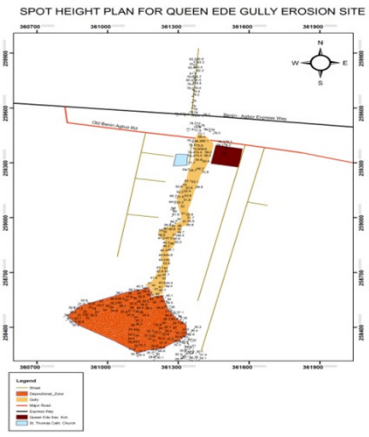
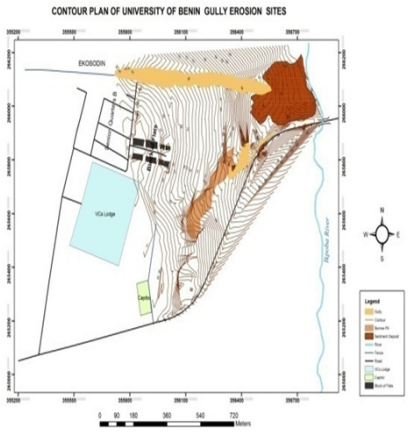


Figure 8: CONTOUR PLAN OF UNIVERSITY OF BENIN GULLY AND QUEEN EDE EROSION SITES



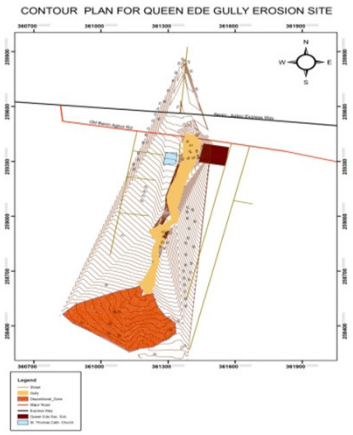
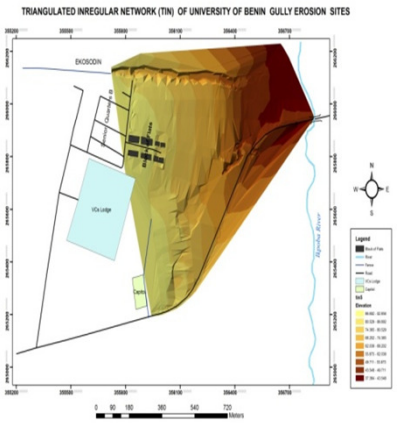


FIGURE 9: TRIANGULATED IRREGULAR NETWORK (TIN) OF UNIVERSITY OF BENIN AND QUEEN EDE GULLY



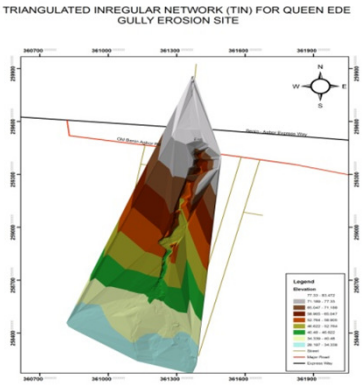


Table I present details of the six erosion gully sites and four flood basins being studied. flooding is more prevalent in Benin City, the state capital.

- This has been found to be as a result of inappropriate land use and as the landscape of Benin is relatively flat, pluvial flooding is common.

Of the six gully sites,

- Oshiobugie has the highest flood basin occupying an area of about 480 Hectares.
- This is follow by Ibore with 450 hectares and then the university of Benin-gully site 300 Hectares.
- The largest flood basin is at Ilushi. This is accounted for by the fact that Ilushi is located by the bank of the river Niger.
- During peak discharge, the river overflows its bank and most of the low-lying land around Ilushi is flooded.

CONCLUSION

- In this study Remote sensing, GPS and total station survey along with GIS, were used for generating the geospatial information needed for flood and erosion modeling and assessment.
- With GIS, spatial data can be stored in a data base that can be querried and graphically displayed for analysis by overlaying different geographic layers. Flood prone areas can be identified and targeted for mitigation and management.
- The DTM were valuable for analyzing the terrain in term of the extent of gullying.
- It is anticipated that with extensive use of remote sensing and GIS a long term database will be created for flood and erosion monitoring, risk assessment and mitigation management within the Niger delta region of Nigeria.
- Integration of remote sensing data, ground survey and GIS will serve as an interface for hydrologic modeling of flood and erosion events

THANKS YOU FOR LISTENING