Application of Geographic Information System (GIS) Towards Flood Management in Calabar, Nigeria

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Introduction

- Natural disasters such as floods, storms, landslide and tropical cyclones have caused environmental damages and loss of human lives.
- Flood hazard is one of the most frequent phenomena in the world.

- Coastal flooding occurs frequently at many large coastal cities of Nigeria such as Calabar, Port Harcourt, Lagos, etc.
- Several processes such as high tides due to astronomical tidal activity, wave action caused by winds,

high sea levels combining with high river flows, uncontrolled urbanisation leading to development violations, and accelerated sea level rise due to global warming play important roles in coastal flooding.

Study area

- Calabar, the capital of Cross River State in south-south Nigeria is geospatially located between latitudes 5.55oN and 5.58oN and longitudes 8.15oE and 8.22oE. It is a coastal city, barely 60 kilometres from the Atlantic Ocean, encompassed by numerous creeks and rivers that drain the alluvial poorly drained lithology.

Fig. 1.2 Map of Cross River State showing Calabar Municipality

Scale:- 1:1,125,000

- The city is characterised by lowland terrain with the highest point being a little above 200meters above mean sea level, while the lowest point is as low as zero meter above mean sea level. This configuration (figure 2) is highly disposed to seasonal inundation from the ocean due to sea level rise consequent upon the phenomenal global climate change.

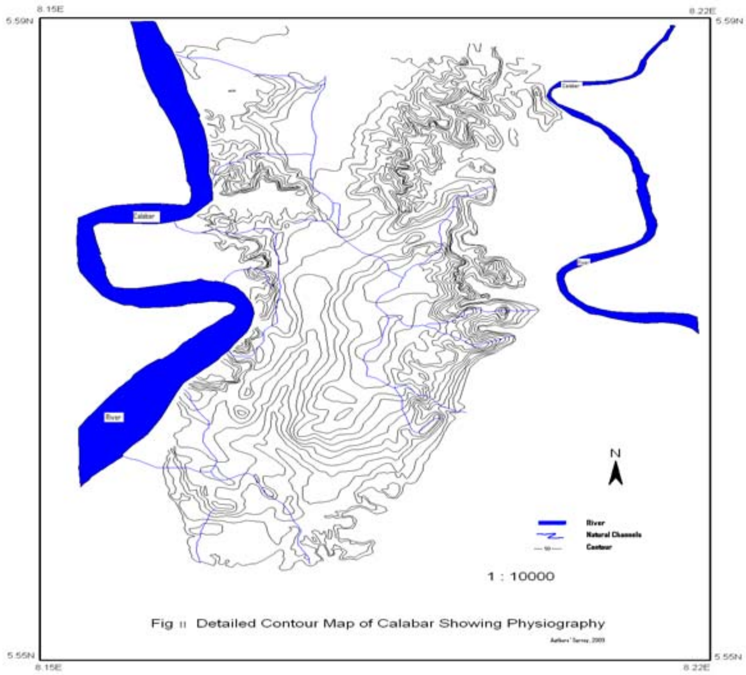


Fig II Detailed Contour Map of Calabar Showing Physiography

Objectives

- To use GIS to identify the causative factors responsible for coastal area flooding
- To facilitate data integration that will enable graphic and holistic appreciation of environmental challenges peculiar to the coastal area urbanisation

- To evolve and streamline decision making mechanism in a clear manner that offers a forceful and convincing solution to complex man induced environmental quagmire.
- To initiate a departure from traditional way of adopting remedial solution rather than prevent hazard occurrence.

Method

- The approach applied in this study is basically a geo-information technique that deployed GIS to acquired secondary data from topomap and added value to the set of data. The generated data were integrated in a digitally geo-referenced framework that enabled better understanding and knowledge for intelligent decision making.

- ILWIS- (Integrated Land and Water Information System), was used to prepare the required geospatial dataset for the GIS operation. Contour and point maps were generated from a toposheet. The toposheet of the study area was scanned, geo-referenced and digitised to produce point map and contour maps, referred to as thematic layers.

- A contour interpolation using nearest neighbour algorithm was applied to allocate height value to every available pixel within the study area (fig 3). A digital elevation model was carried on the interpolated raster to express the configuration of the map. The statistics of the digital elevation showed the relative area of the different landform

- An orthophoto covering the study area was examined and digitised to capture the planned area and poorly planned. These layers were not overlaid or crossed because they had different geo-reference. Consequently they were put side by side and compared

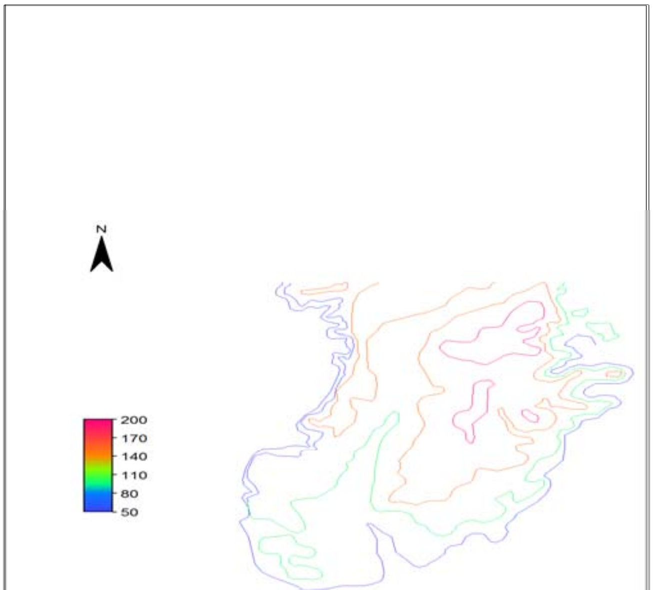


Fig. 1.2 Contour Map of the Study Area

Results

- The outcome of the digital elevation model showed well graphically distributed landform and terrain. See figure 1.3. The statistic of the DTM showed more than 60% of the entire study area to be low land (flood plain), (50 to 80m), while about 20% is occupied by medium height of about 85 m to 160. See figures 1.3 and 1.4.

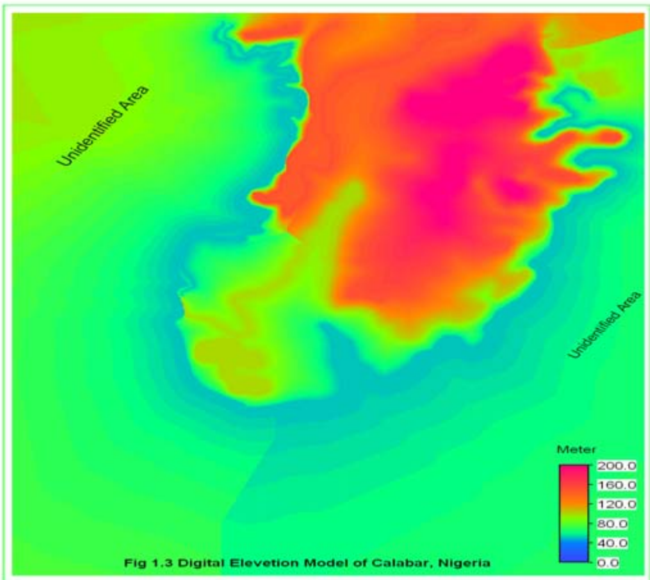
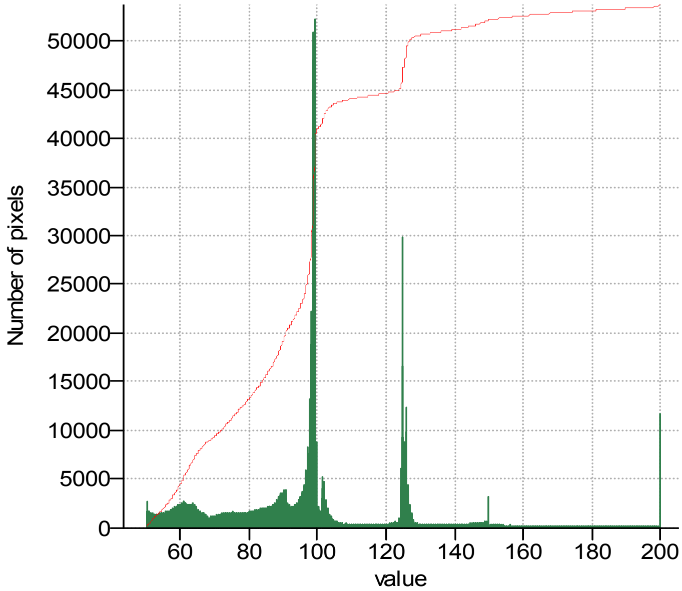


Fig 1.3 Digital Elevetion Model of Calabar, Nigeria

Fig 1.4 The Spectrograph of the DEM



Discussion

- The results of the analysis showed the graphical representation of the terrain and proportional distribution of study area configuration. It was dominantly lowland, occupying more than 60% of the entire study area. The low areas are relatively very low and considering the proximity of 60km to the ocean and being as low as 0 meter, it is liable to flooding, coastal erosion and other coastal related environmental challenges. This study shows from the DTM, that the study area is highly vulnerable to flooding and there is urgent need to manage the problem by identifying suitable water drainage channels and sites, particularly floodplain that is a not suitable for locating structures and buildings

This information is indispensable for planners and managers of environmental resources to ensure sustainable development.

Conclusion

- The nature and characteristics of the terrain of the study could be appreciated through this study. Apart from easy identification of landscape, natural water drainages could be identified and flood plains were visible yet houses were found on these flood prone areas, which disturbs natural stream flow, perturbs the hydrologic cycle and tendency for flooding.

- It was discovered from this study that even though nature contributes to hazards significantly, man should be much more accountable for flood. To this end therefore, flood management in the study area requires the prudent utilization of resources and reducing the rate of land cover/use change.

Thank you.