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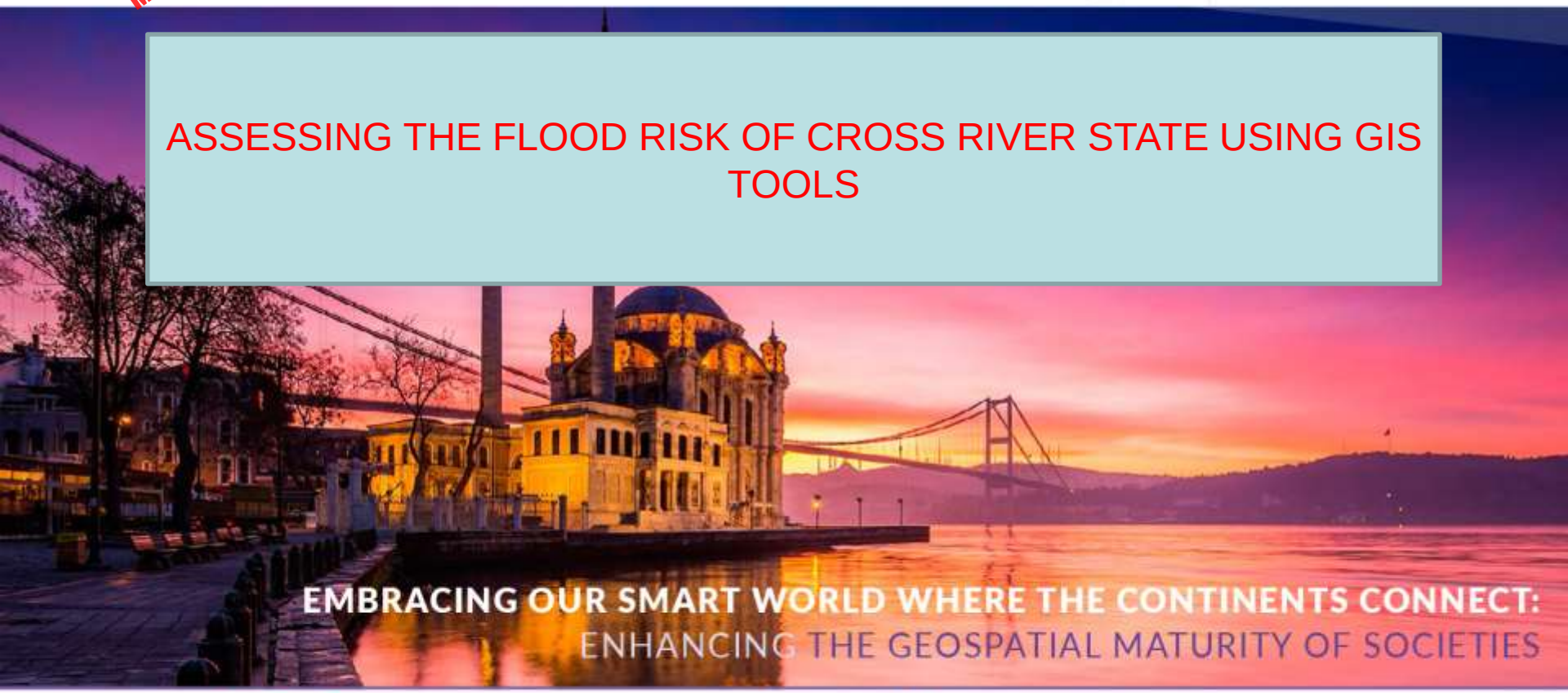
ASSESSING THE FLOOD RISK OF CROSS RIVER STATE USING GIS TOOLS



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ASSESSMENT OF FLOOD RISK OF CROSS RIVER STATE USING GEOGRAPHIC INFORMATION SYSTEM (GIS)

By

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PRESENTATION OVERVIEW

- 1. INTRODUCTION/MOTIVATION
- 2. AIM & OBJECTIVES
- 3. STUDY AREA
- 4. METHODOLOGY
- 5. RESULTS
- 6. FUTURE RESEARCH
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INTRODUCTION & MOTIVATION

- WHAT IS FLOOD: THIS IS AN OVERFLOW OF A LARGE AMOUNT OF WATER BEYOND ITS NORMAL LIMITS, ESPECIALLY OVER WHAT IS NORMALLY DRY LAND. THE EUROPEAN UNION FLOODS DIRECTIVE DEFINES A FLOOD AS A COVERING OF LAND NOT NORMALLY COVERED BY WATER(www.Wikipedia,2018).
- FLOODING IS EXREMELY DANGEROUS AND HAS THE POTENTIAL TO WIPE AWAY AN ENTIRE CITY, COASTLINE OR AREA, AND CAUSE EXTENSIVE DAMAGE TO LIFE AND PROPPERTY.
- IT IS A NATURAL EVENT OR OCCURRENCE WHERE A PIECE OF LAND (OR AREA) THAT IS USUALLY DRY LAND, SUDDENLY GETS SUBMERGEDE UNDER WATER.

WHAT CAUSES FLOODING

- FOLLOWING CAUSES ARE IDENTIFIED:
- 1. RAIN:EACH TIME THERE ARE MORE RAINS THAN THE DRAINAGE CAN TAKE
- 2. RIVER FLOW: RIVERS CAN OVERFLOW THEIR BANKS TO CAUSE FLOODING, ESPECIALLY WHEN THERE IS MORE WATER UPSTREAM THAN USUAL.
- 3. STRONG WINDS IN COASTAL AREAS: SEA WATER CAN BE CARRIED BY MASSIVE WINDS AND HURRICANES ONTO DRY COASTAL LANDS AND CAUSE FLOODIND.
- 4.DAM BREAKING: DAMS ARE MAN –MADE BLOCKS MOUNTED TO HOLD WATER FLOWING DOWN FROM A HIGHLAND. THE POWER IN THE WATER USED TO TURN PROPELLERS TO GENERATE ELECTRICITY . SOMETIMES , TOO MUCH WATER HELD UP IN THE DAM CAN CAUSE IT TO BREAK AND OVERFLOW THE AREA. EXCESS WATER CAN ALSO BE INTENTIONALLY RELEASED FROM THE DAM TO PREVENT IT FROM BREAKING AND THAT CAN CAUSE FLOODS..
- 5. ICE AND SNOW-MELTS: THIS IS USUALLY CALLED A SNOW MELT FLOOD.ESPECIALLY IN MOUNTANEOUS REGIONS.

FLOOD TYPES

- 1. FLASH FLOODS: THIS OCCURS WITHIN A VERY SHORT TIME (2-6 HOURS AND SOMETIMES WITHIN MINUTES). THERE IS USUALLY NO WARNING, NO PREPARATION AND THE IMPACT CAN BE VERY SWIFT AND DEVA.SATATING.
- 2.RAPID ON-SET FLOODS:SIMILAR TO FLASH FLLODS, THIS TYPE TAKES SLIGHTLY LONGER TO DEVELOP AND THE FLOOD CAN LAST ADAY OR TWO.
- 3. SLOW ON-SET FLOODS: THIS KIND IS USUALLY AS A RESULT OF WATER BODIES OVER FLOODING THEIR BANKS. THEY TEND TO DEVELOP SLOWLY AND CAN LAST FOR DAYS AND WEEKS. THEY USUALLY SPREAD OVER MANY KILOMETERS AND OCCUR MORE IN FLOOD PLAINS(FIELDS PRONE TO FLOODS IN LOW-LYING AREAS).

INTRODUCTION & MOTIVATION

- **Floods are the major disaster affecting many countries in the world year after year. It is an inevitable natural phenomenon occurring from time to time in all rivers and natural drainage system, which not only damage the lives, natural resources and environment, but also causes the loss of economy and health (Thilagavathi, *et al.*,2011).**

- **The impact of floods has been increased due to a number of factors, with rising sea level and increased development on floodplains. Recurring flood losses has handicapped the economic development of both developed and developing countries .**

INTRODUCTION AND MOTIVATION

- **The potential of Geographic information System (GIS) in flood studies cannot be over emphasized. It allows for a proper integration of physical, socio-economic and demographic data. As data management and map representation tools of GIS helps in exploring new portions.**
- **Its integration with remote sensing, enhance the ability for preparing flood hazard map and forecasting (Thilagavathi, *et al., 2011*).**
- **Besides its constraints like technological Knowledge requirements, hardware and software requirements, hence GIS can be very useful to minimize flood hazard**

AIM & OBJECTIVES

- **AIM**
- **The aim of this research is to apply GIS/RS in flood hazard studies in Cross River State.**
- **OBJECTIVES**
- **To achieve the above mentioned aim, the following objectives shall be considered:**
- **Analyzed and model flood hazard based on certain physical, environmental and climatic parameters favorable to flood menace in Cross River State.**
- **Analyzed and modeled flood vulnerability vis- a-vis socio- economic factors linked with peoples' vulnerability to flooding in Cross River State.**
- **Use GIS and RS technologies to produce flood risk map for used in flood control program in the state**

THE STUDY AREA

- Cross River State is located within the tropical rainforest belt of Nigeria. It lies between latitude 4 28' and 6 55'N north of the equator and longitude 7 50' and 9 28' east of the Greenwich meridian.
- It shares common boundaries with the republic of Cameroon in the East, Benue state in the north, Ebonyi and Abia state in the west, Akwa ibom state in the southwest and the Atlantic Ocean in the south. It has a total landmass of about 23,000km (CRS SEEDS, 2004).
- Arising from its location, the state enjoys a tropical climate with the Obudu plateau at an altitude of 1,595.79m above sea level enjoying a temperate change. The state records heavy rainfall during the wet season (CRS, SEEDS, 2004).

THE STUDY AREA

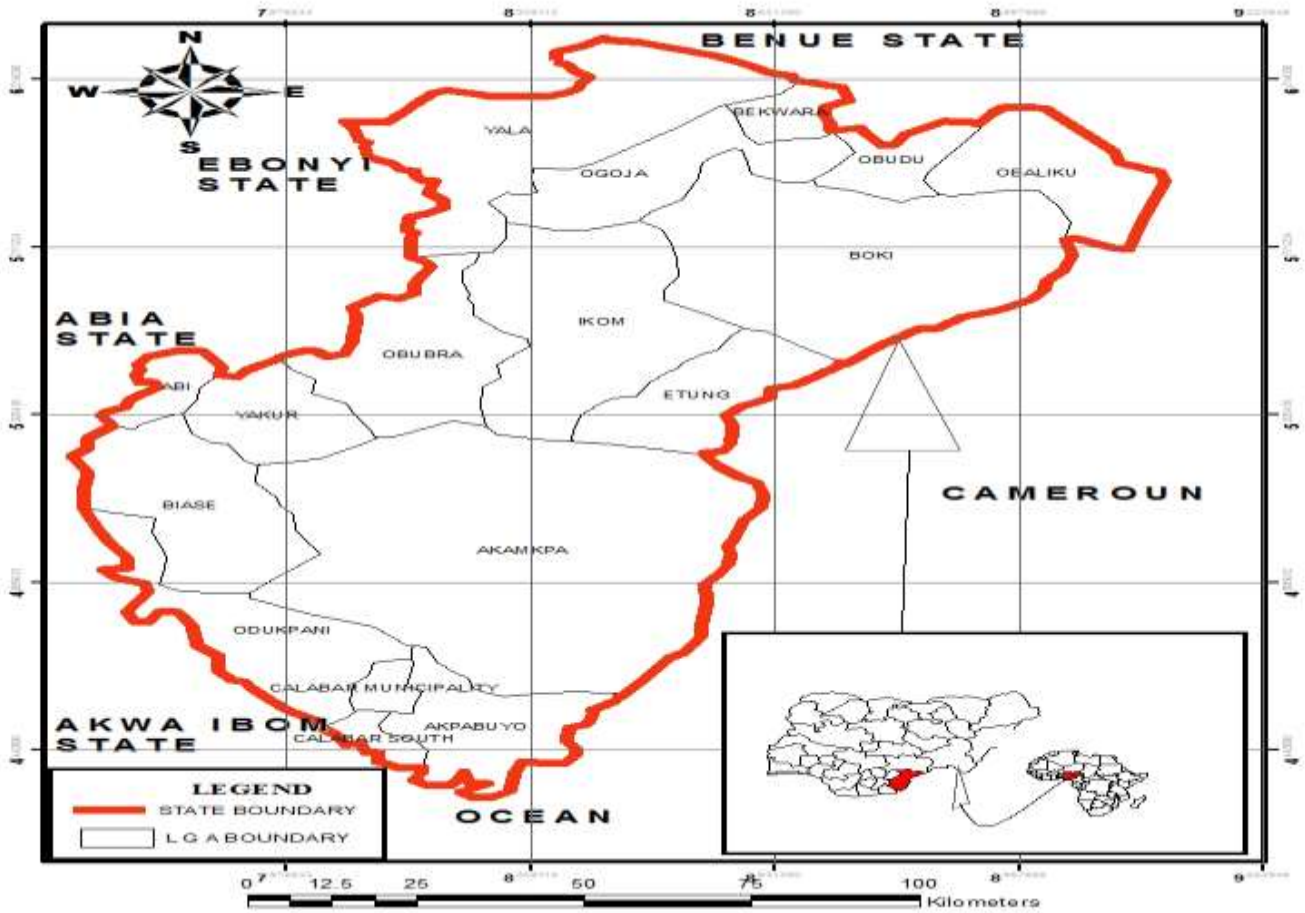
- **At least five distinct ecological zones are represented in the state ranging from mangrove and swamp forest towards the coast, tropical rain forest further inland,, and savannah woodlands in the northern parts of the state. The highlands of the Obudu plateau offer montane type of vegetation.**
- **Up the Obudu plateau, the climate is essentially temperate. This coupled with the favourable climate of tropical, humid, dry and wet season give rise to rich agricultural lands thus encouraging both perennial and annual crop cultivation (CRS SEEDS, 2004).**

THE STUDY AREA

- **The state with its underlying crystalline basement rocks is rich in oil in its coastal regions and other identified mineral resources such as limestone, quartz, natural gas, clay, salt, tin, granite, basalt, etc. some of which are yet to be exploited.**
- **Cross River State has a total population of 3.0million based on an average growth rate of 3.0% (Ottong, *et al,2010).***
- ***40%* of the estimated population constitute an active population that is 'engage in various economic activities ranging from subsistence agriculture to urban commerce and transport business.**
-

THE STUDY AREA

- **It is often referred to as a miniature Nigeria because of its diversity in ethnic composition as well as its natural heritage both of which have the potential of greatly enhancing the tourism industry in the state and country at large. The people are noted for the warmth and hospitality which arguably is rated unequalled in Nigeria.**
- **In spite of the numerous dialectical groups that exist in the state, there are three dominant languages groups. These are Efik, Bekwarra, Ejagham. Nevertheless, all the language groups have a common linguistic root that is traceable to one ancestry (CRS SEEDS, 2004).**



MAP OF NIGERIA SHOWING THE STUDYN AREA

CONCEPTUAL FRAMEWORK

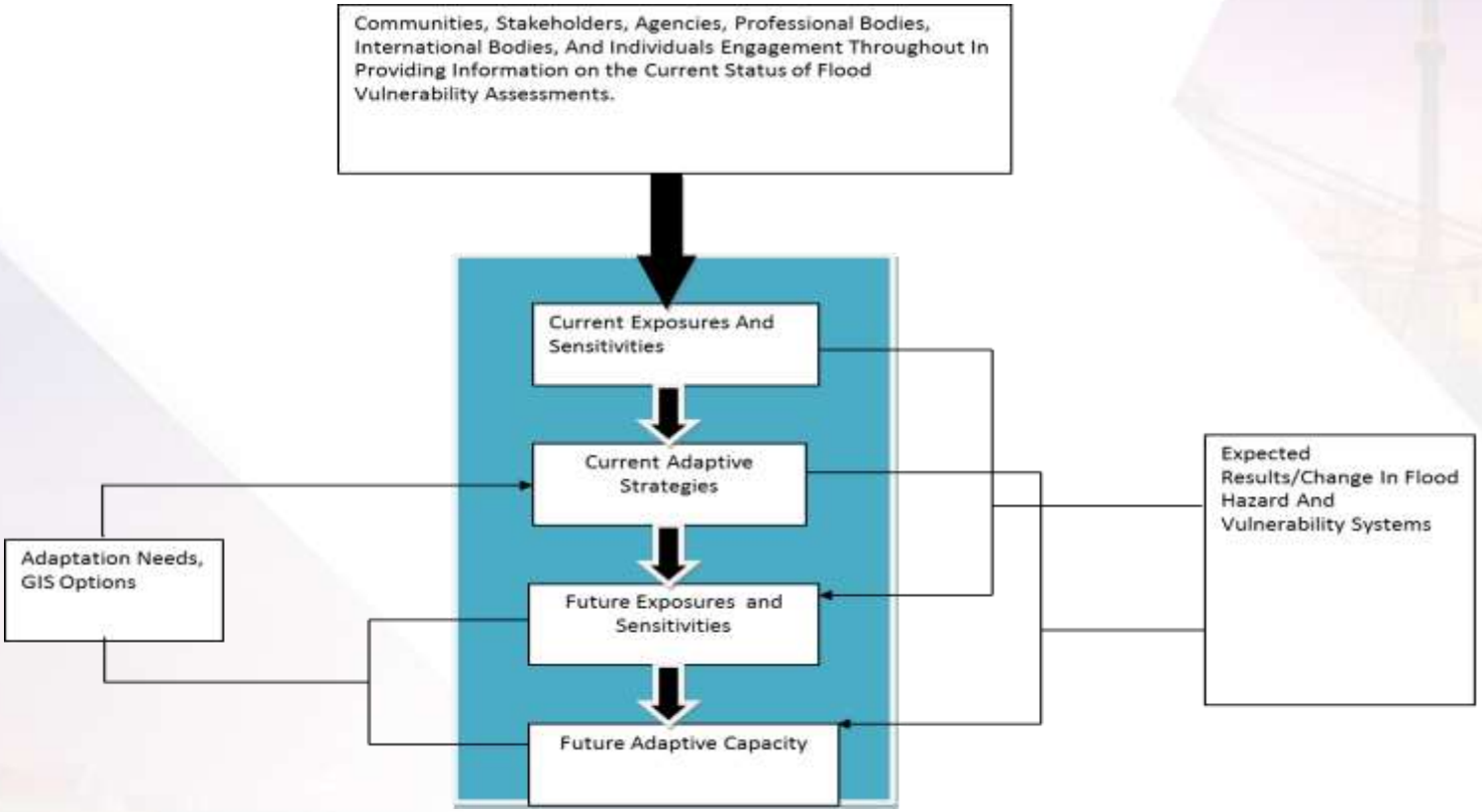


Figure 2: Modified illustration of Participatory GIS Based Sustainable Flood Vulnerability Assessment/Management Model. Adapted after Anyanwu, 2015.

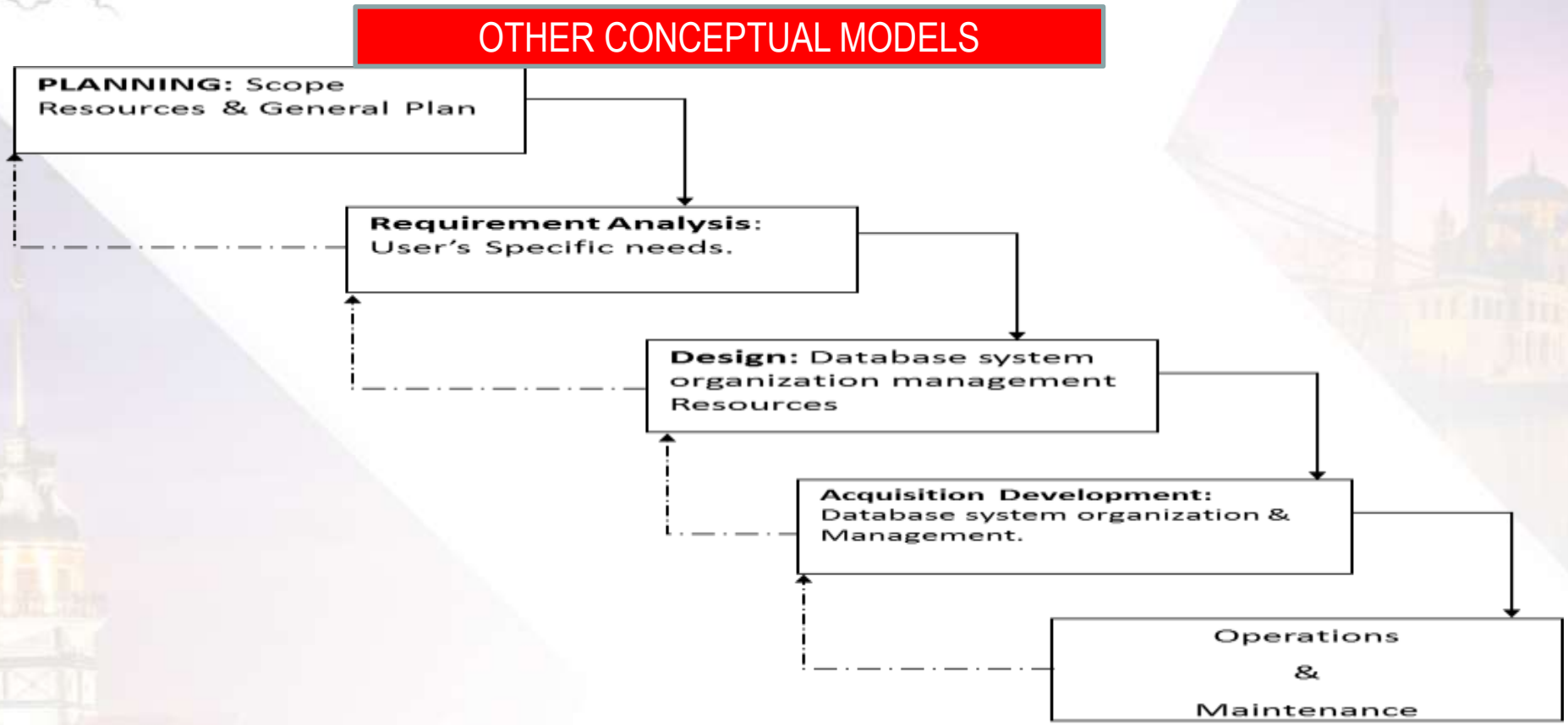


Figure 3: GIS implementation process for assessment of flood risk. Adapted after Somers, R.M

METHODOLOGY

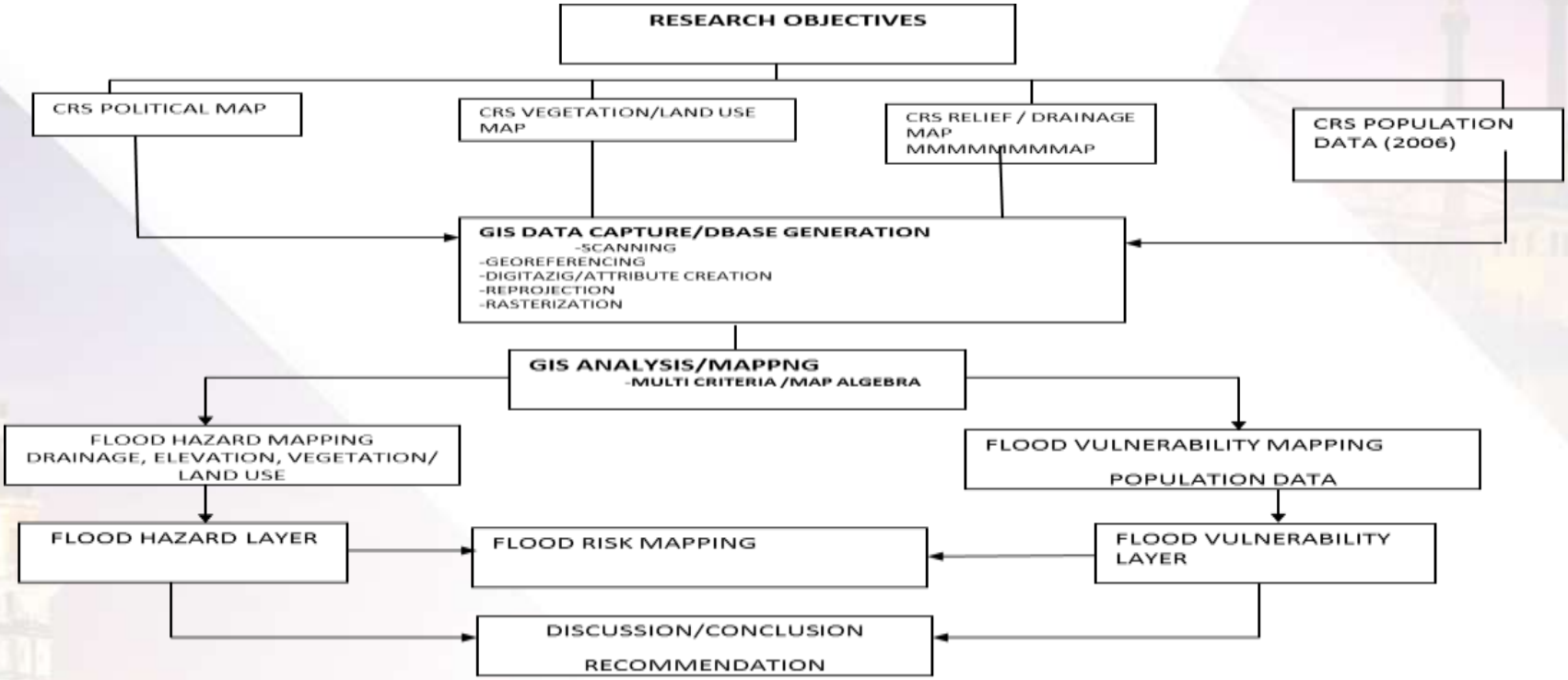


Figure 4: The Research Schematic diagram for Assessment of Flood Risk in Cross River State

Data Types, Sources and Methods of Collection

- Geo-referenced digital data sets used for this research were generated from existing analogue base maps and thematic data. These are summarized in Table 3.1 and they provide their sources from where the various datasets for the study were obtained.

Table 3.1 Data Types and Sources

S/N	Data type	Identification	Scale & Date	Format	Source
1	State& L.G.A. Boundaries	Administrative Map Of Cross River State	1:50,000 (1992)	Analogue	Ministry of Lands And Town Planning Authority
2	Land use And Vegetation Map	Cross River State Land use& Vegetation Map	1:50,000(1982)	Analogue	Cross River Basin Development Authority
3	Population Data	Cross River State 2006 Population Census	2005 To 2017 Projection	Tabular	National Population Commission 2006
4	Relief And Drainage Data	Relief And Drainage Map Of Cross River State	2009	Analogue	Encarta Map In Microsoft Document.

GIS Policy Implementation and Assessment for Flood Risk

- A phased approach to implementation allows the necessary time to gather first- hand information about the assessment of flood Risk characteristics of (Cross River State) of the study area, personnel and cultural norms so that the delivered solution be tailored appropriately. Therefore, for phases of implementation were considered as shown in table.

Table 4: Flood Risk Assessment Implementation

S/N	PHASE	IMPLEMENTATION
1	Initiation	The goal of this phase is to successfully mobilize the organization, remedy any current at-risk activities and set the stage for the level. Here, flood Risk Assessment methodology is introduced and software training is conducted
2	Installation	This utilizes information gathered from pilot Assessments in the Initial phase to roll-out structured project planning and control possession. Establishing the office of the organization with necessary infrastructure.
3	Enterprise-level installation	This involves Flood Risk Assessment Status, Project Scheduling based on available resources and entire tools implementation
4	Maintenance	This involves providing the enterprise-level information and analysis required by management in Assessing Flood Risk. It is a transitory phase with well trained staff.

GIS Analysis of Flood Risk Assessment

- **Assessment of Flood Risk was conceptualized in a GIS environment, using Arc map 9.2 version software, for data manipulation.**
- **Flood Hazard Mapping:**
- **Weights were assigned to the rasterized data layers and using map Algebra in the spatial Analyst tool to run a multi-criteria Analysis. That is Flood hazard map was generated combining drainage, elevation and vegetation rasterized datasets as shown on the sub-schema in figure 5.**
- **Drainage layer Elevation layer and vegetation layer**
- **Multi criteria Technique**
- **Zones vulnerable to flood hazard.**

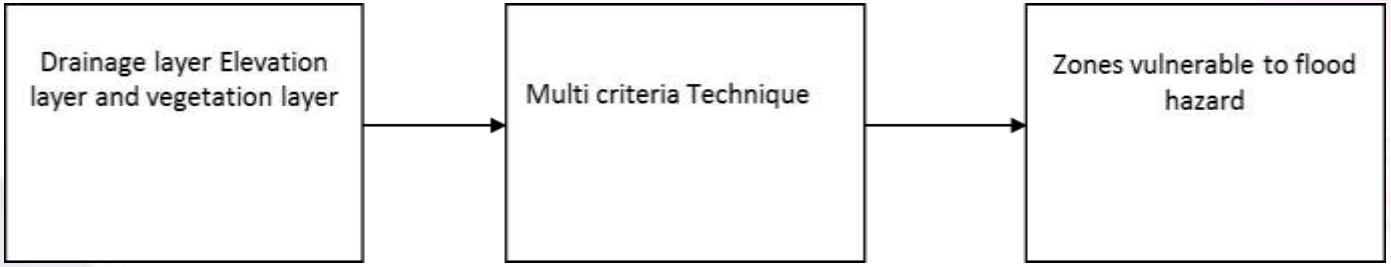


Figure 5: Sub-schema Flood Hazards Mapping Analysis

Flood Vulnerability Mapping:
This was generated by the combination of the flood hazard layer and population map using the spatial Analyst Tool of the Arc map 9.2 as shown on the sub-schema in figure 6

Figure6. Subschema Flood vulnerability mapping Analysis

RESULTS

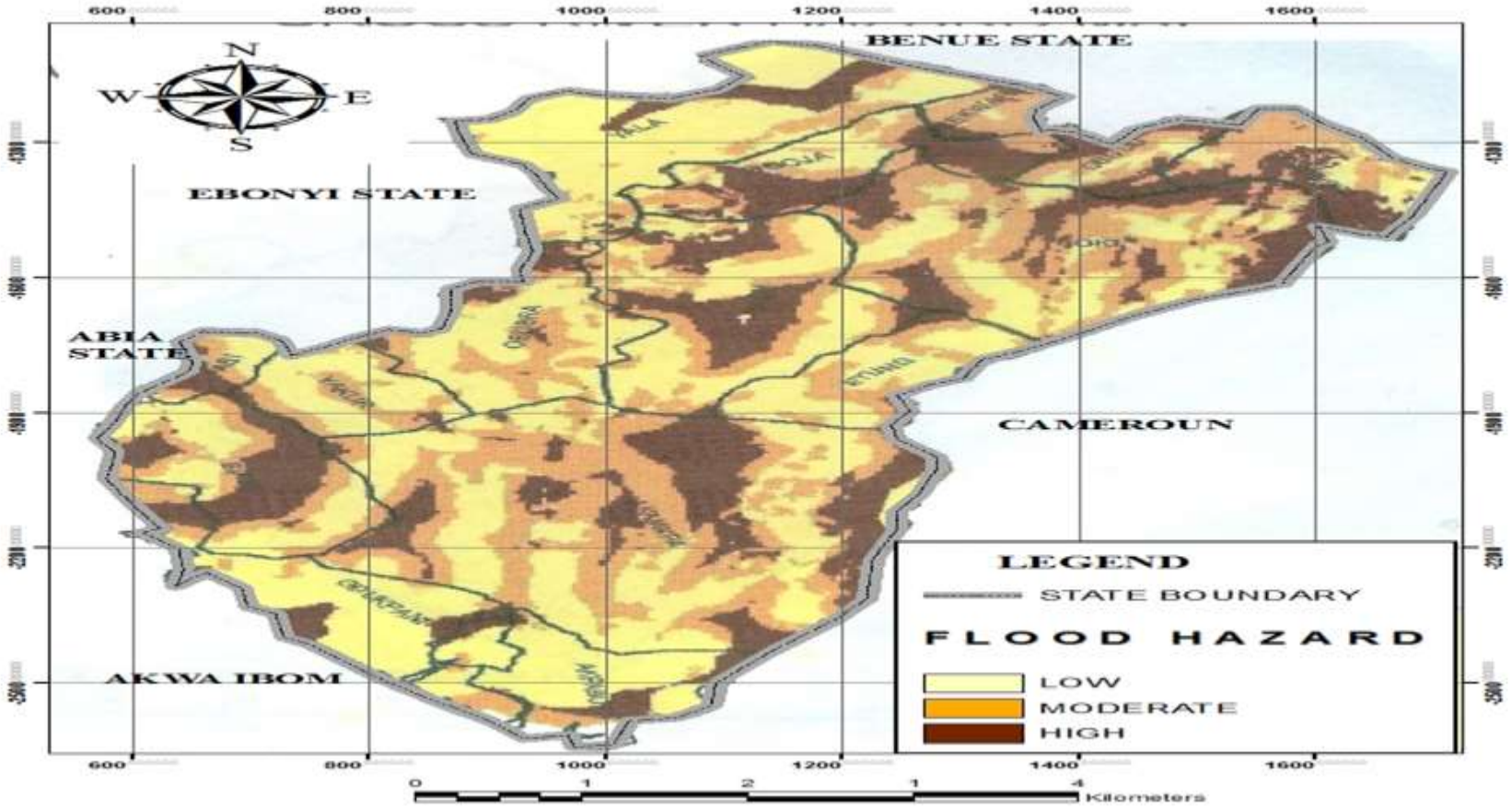


Figure 8: Flood Hazard Map of Cross River State

Flood Vulnerability Presentation Analysis:

The two (2) flood vulnerability surface layers in the study area was generated and illustrated using, Flood hazard layer and population layer

S.N	Data layers	%	Decimal Weightage
1	Flood hazard layer	60	0.6
2	Population payer	40	0.4
	Total	100	1.0

The two (2) layers were weighted as presented above in table 4.2 and analyzed in a GIS environment

Flood Risk Presentation Analysis:

The two Flood Risk surface layers in the study area was generated and illustrated using Hazard layer and Vulnerability layer

S/N	DATA LAYER	%	DECIMAL WEIGHTAGE
1	Hazard Layer	50	0.5
2	Vulnerability Layer	50	0.5
	TOTAL	100	1.0

The two layers were weighted as presented above in table 4.3 and analyzed in a GIS environment.
The flood risk map like the hazard and vulnerability maps also has 3 classes, namely Low, Moderate and high Flood risk areas respectively as shown in figure 10.

- **Flood Risk Assessment and Cross River State Environment:**

- **Based on the map-based GIS analysis, this study has shown that Cross River State Environment is prone to Flood risk. This is due to extreme intensity of rainfall events, wide spread of severe poverty and threatened by urbanization (Ekpenyong, 2010). Besides, basic adaptation needs/resolutions remained low or not available.**

- **Summary of Findings:**

- **Flood are one of the most common and widely distributed natural hazards to life and property worldwide. This research represents an attempt to understand the dynamics of GIS/RS technology.**

- **The findings demonstrated that flood hazard and vulnerability maps are used for improved communication about risk and what it threatens. It shows that it is possible to monitor and control urban growth /expansion, deforestation and loss of biodiversity that always lead to flooding**

CONCLUSION AND RECOMMENDATIONS

- **CONCLUSSION**

1. GIS technology can be employed as an effective and efficient tool for flood management as seen from this study .

2. The study has proved GIS/RS integrated technologies can be deployed in the pre- and post flood assessment study and development of mitigation measures and sustainable remedial solutions to flooding menace in cross-river state in particular and other vulnerable areas in Nigeria.

- **RECOMMENDATIONS**
- **A GIS implementation strategy will help in effective and efficient flood control measure in the state to target areas of high flood risk.**
- **Map-based flood risk assessment provides information that leads to disaster reduction.**
- **Other flood control measure can be integrated into field enterprise with GIS technology. E.g. financing, Emergency Response measure and Government and legislature**

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