Space Technology for Integrated Water Resources Management of the Lake Chad Basin

The Pilot Project Implementation Plan Lake Chad Basin

By
Mr. Garba Sambo Hassan
Lake Chad Basin Commission
N'Djamena – Chad

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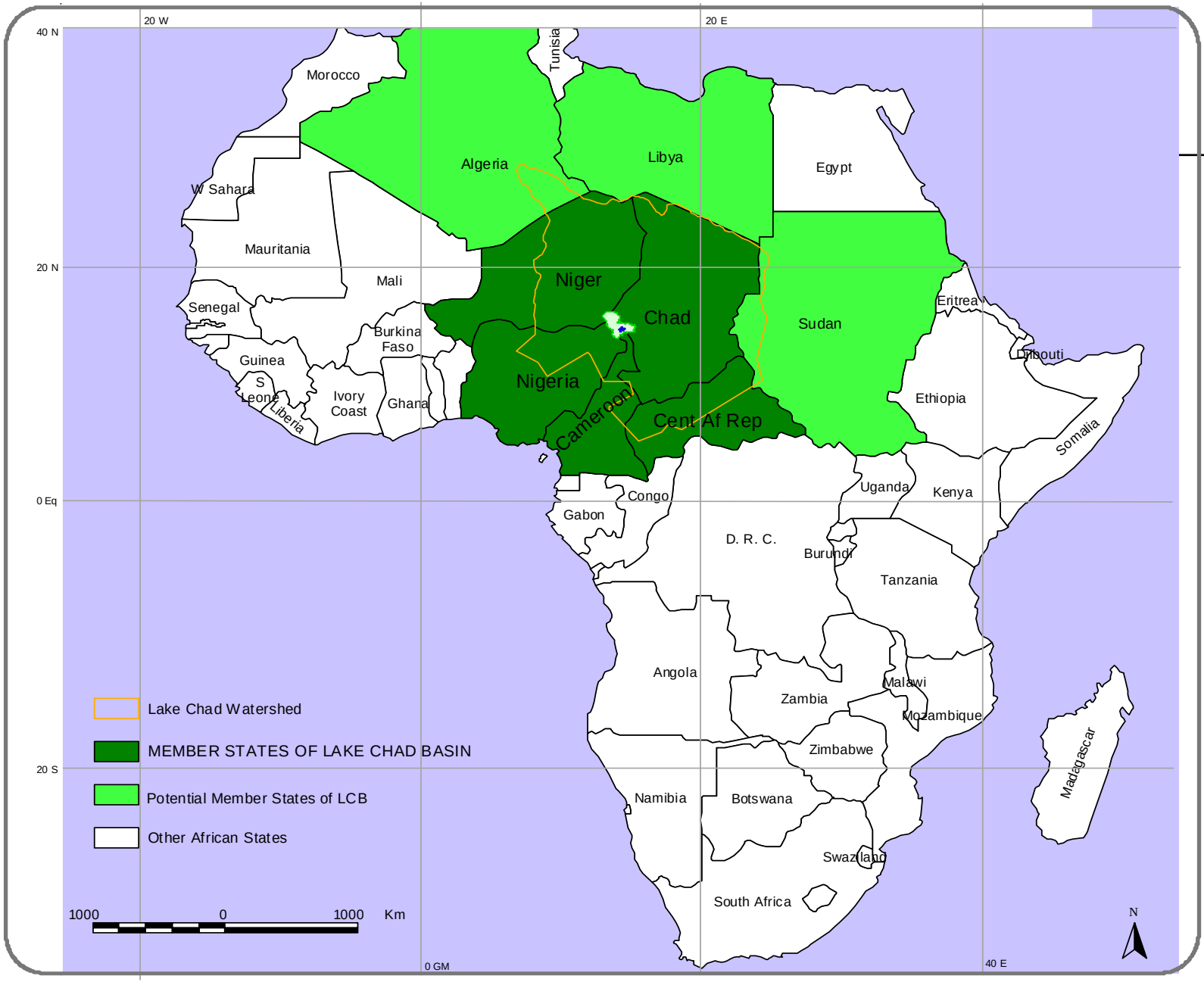
Background 1/2

- The LCBC member States and Basin: The entire basin is shared between Algeria, Libya, Sudan, Chad, C.A.R., Cameroon, Nigeria and Niger.
  - The hydrological basin of Lake Chad covers a surface 4.44million km^2 The fourth largest Lake in Africa.
- LCBC promotes regional economic integration and cooperation, as well as integrated land and shared water resources management in the Basin.
- Reversal of the drying up of Lake Chad through concerted management of resources in the Basin and enhanced collaboration, institutional and capacity building are major issues of discussion in LCBC 52nd Sessions, June 2005;

Member states, watershed

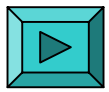


Background 2/2

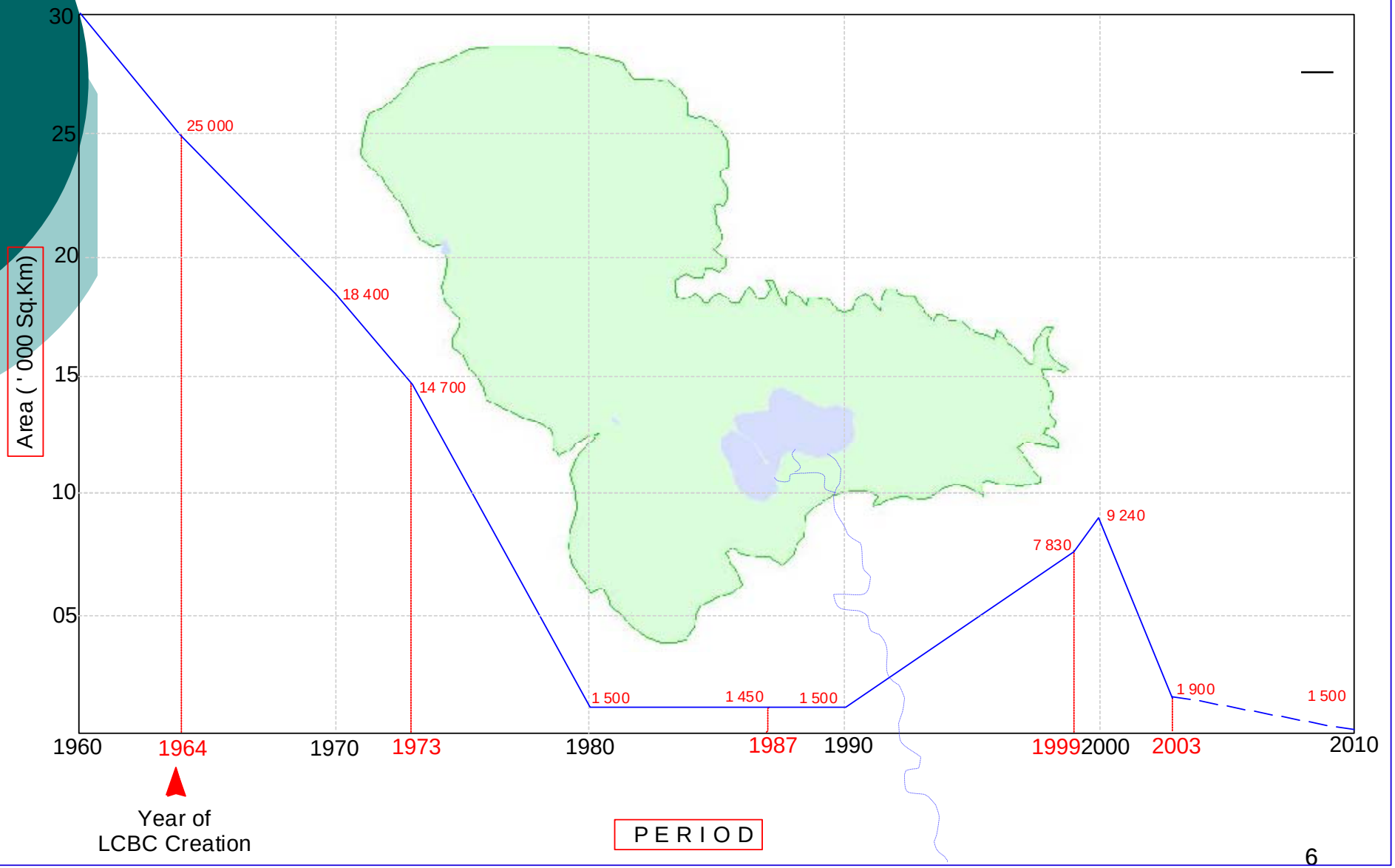
- Considering the scarcity of water to satisfy over 30million inhabitants in the Lake Chad Basin, as is apparent in the physical shrinking of the Lake Chad, threaten by of droughts and desertification;
- In recognition of adoption of Millennium Development Goal and World Summit on Sustainable Development and UN/Austria/ESA conceived Vision – 2004;
- Lake Chad Pilot Project was drafted with the assistance from UN/Austria/ESA in June 2005;
- LCBC presented the Pilot Project to the 52th Session, and unanimously adopted and directed on behalf of member States to send a Letter of commitment to UNOOSA;

Lake Chad Pilot Project Objectives

- To elaborate the use of Space Technology for restoration and management of water resources in LCB;
- To develop standardised and historical image database for monitoring trends and decision making in the Basin;
- To inventorise and compile the existing scattered meteorological data;
- Poverty alleviation in the Basin through appropriate site selections and transfer of information to stakeholders;
- To build the human and Institutional capacity in the Basin;



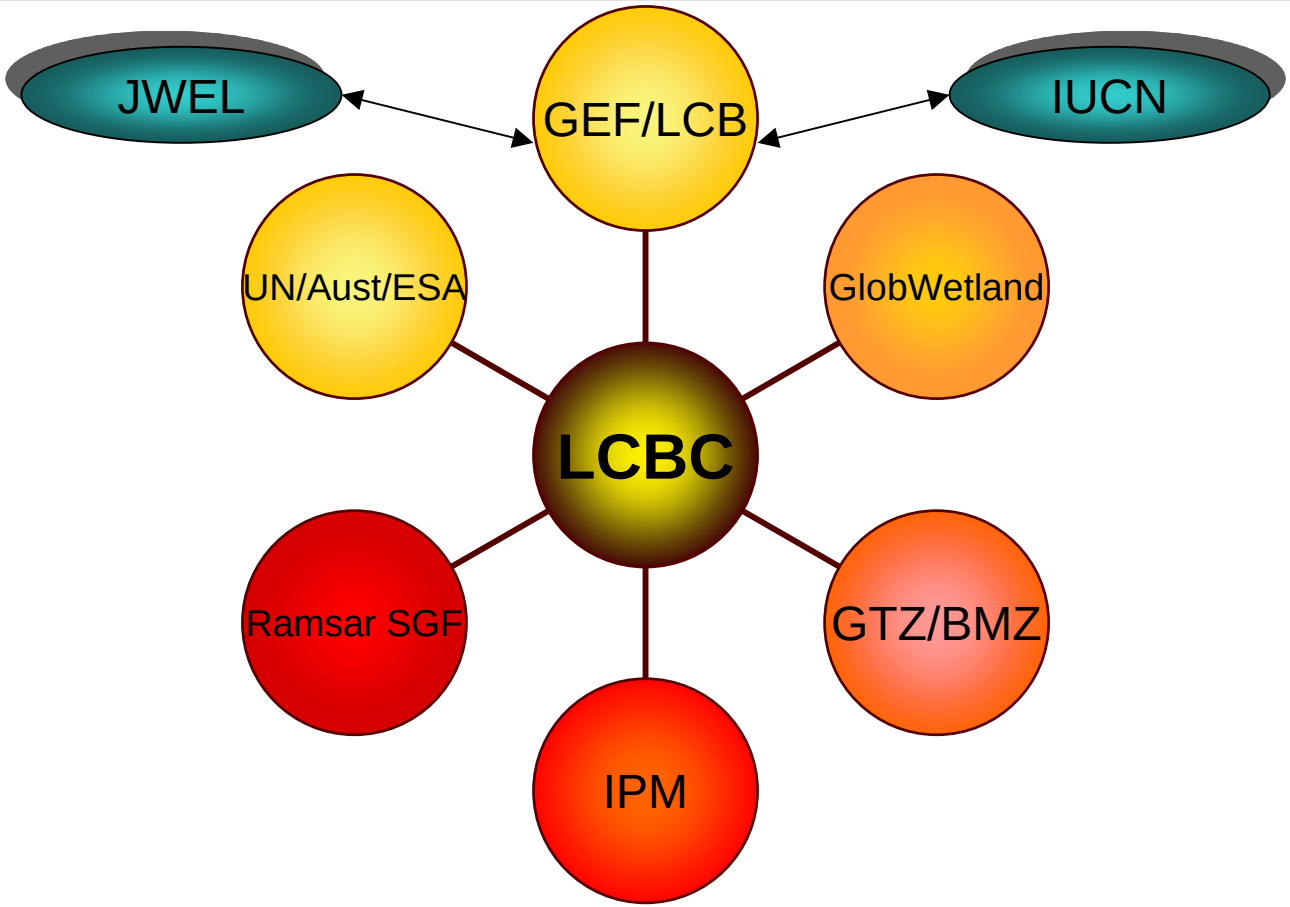
ANNUAL AVERAGE SURFACE AREA OF LAKE CHAD (1960 - 2010)



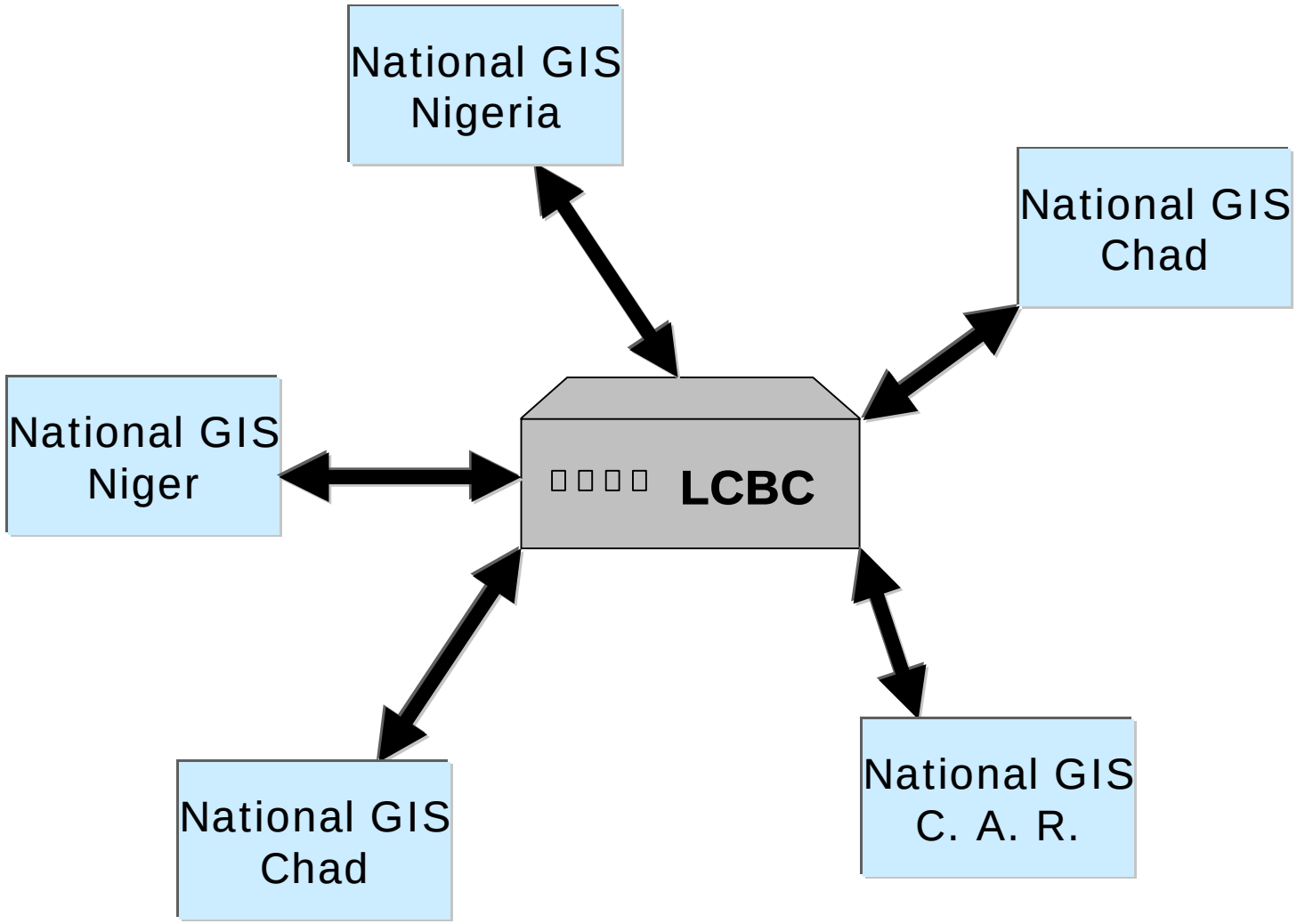
Scope of Activities

- Opportunity to link with some existing projects in the basin to fill the existing wide gabs in data collection
- Opportunity to link with member States;
- Inventory of existing data: (hydrological/ hydrogeological, meteorological, administrative, demographic, socio-economic data, etc);
- Acquisition of data: Crop inventories and forest management, desertification, deforestation, disaster/damage assessment – flooding, forest fires;
- Processing of Digital Elevation Models (DEM/DTM);
- In-situ acquisition of hydrological/hydrogeological data;

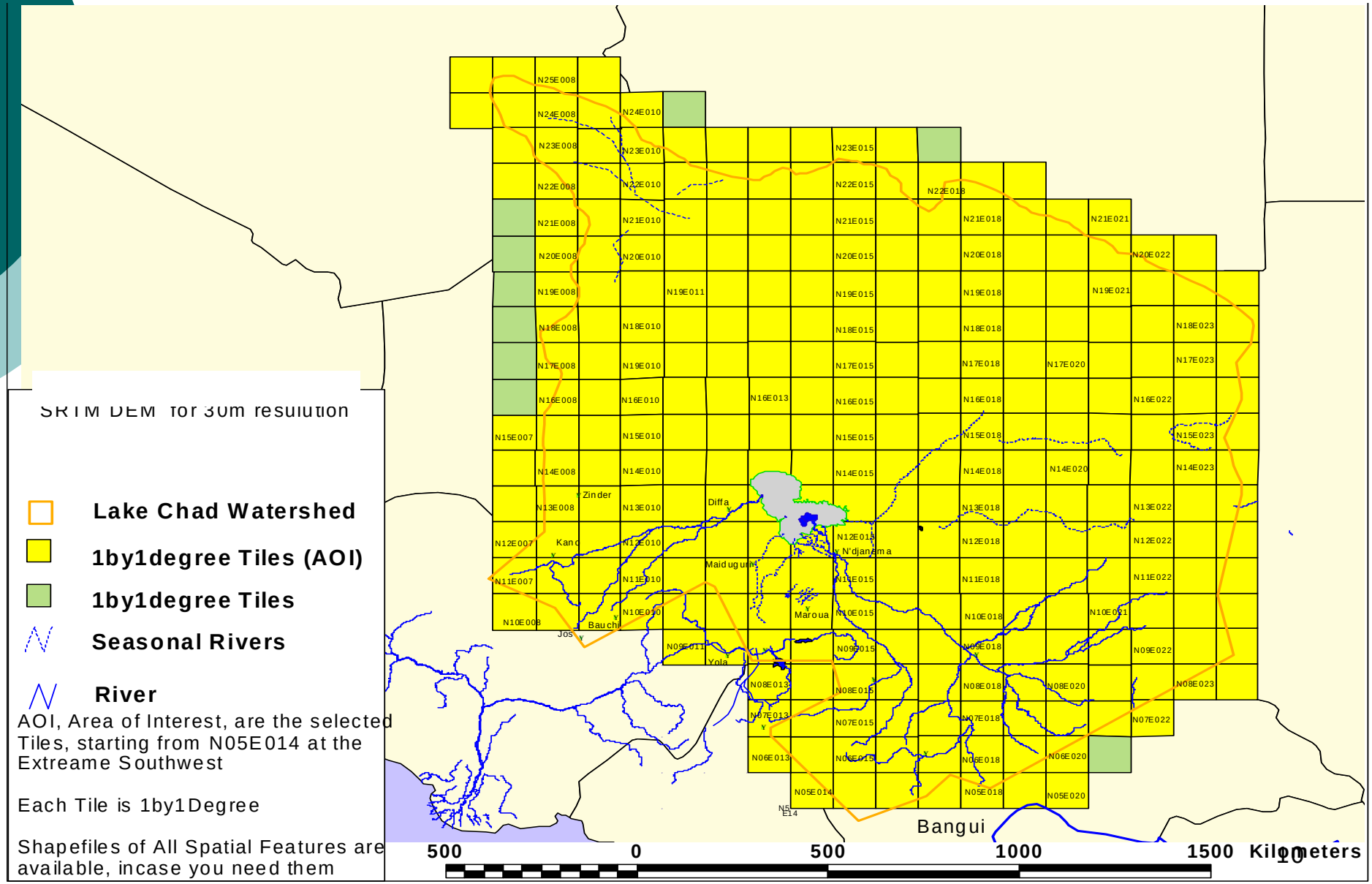
Some Existing Projects and Collaborations in the Basin



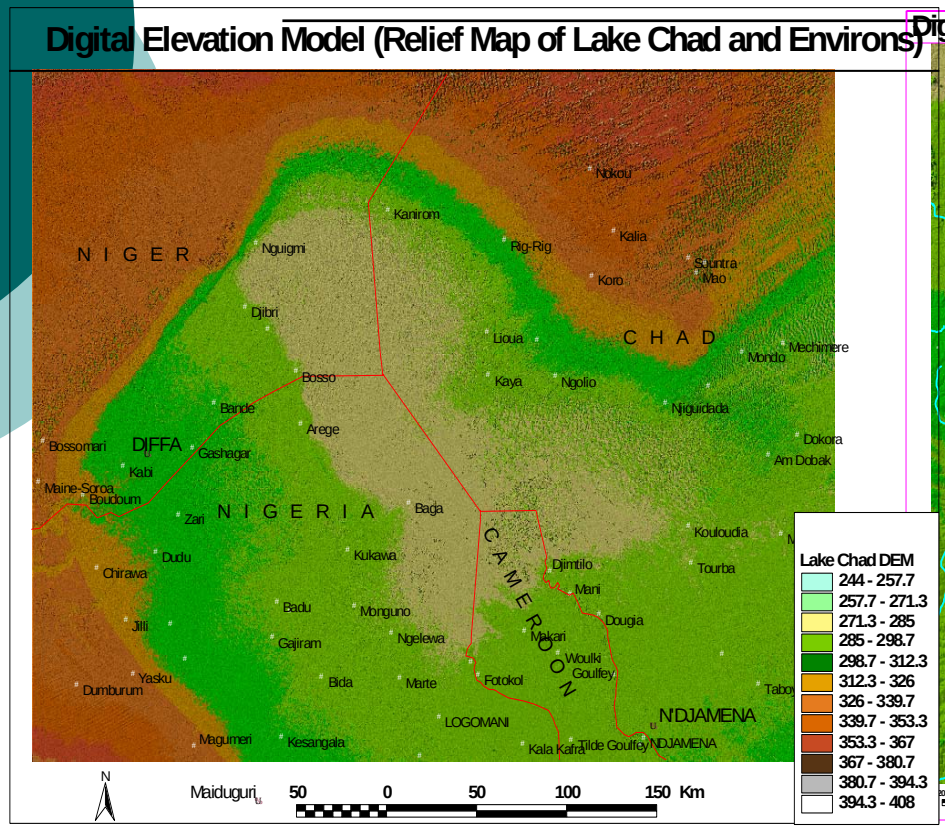
National GIS/Data Collection Centres

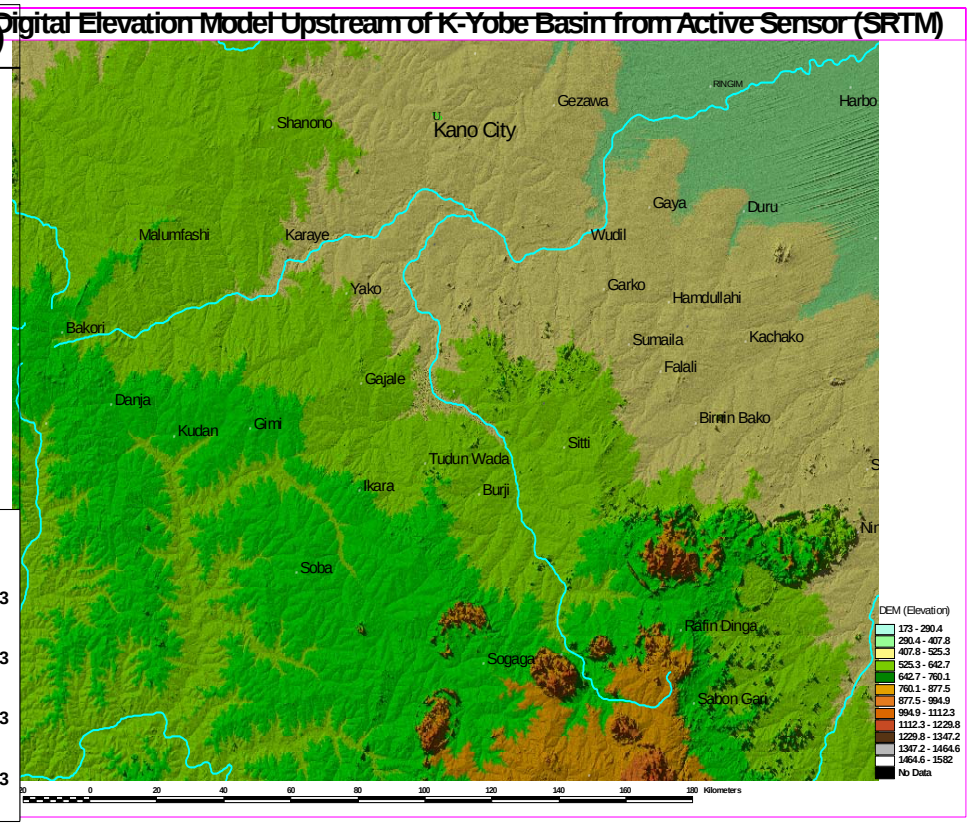


SRTM DEM 3*3 arc sec (90m)



DEM Processing





Project Methodology:

- Input data assessment (hydrometeorological and GIS) – mean monthly records of Climatological data 1970 – 2005: Precipitation, Temperature, Runoff and Evaporation (for each sub-basin);
- Input data from satellite images

- Hydrological Modelling and Applications: Using Image Processing Software packages (Raster and Vector):
  - ILWIS;
  - Erdas IMAGINE (Essential);
  - ArcView 3.2a and Extensions – Spatial Analyst and GeoHEC,
- Analysis of precipitation, evapotranspiration and runoff maps for the whole Lake Chad Basin

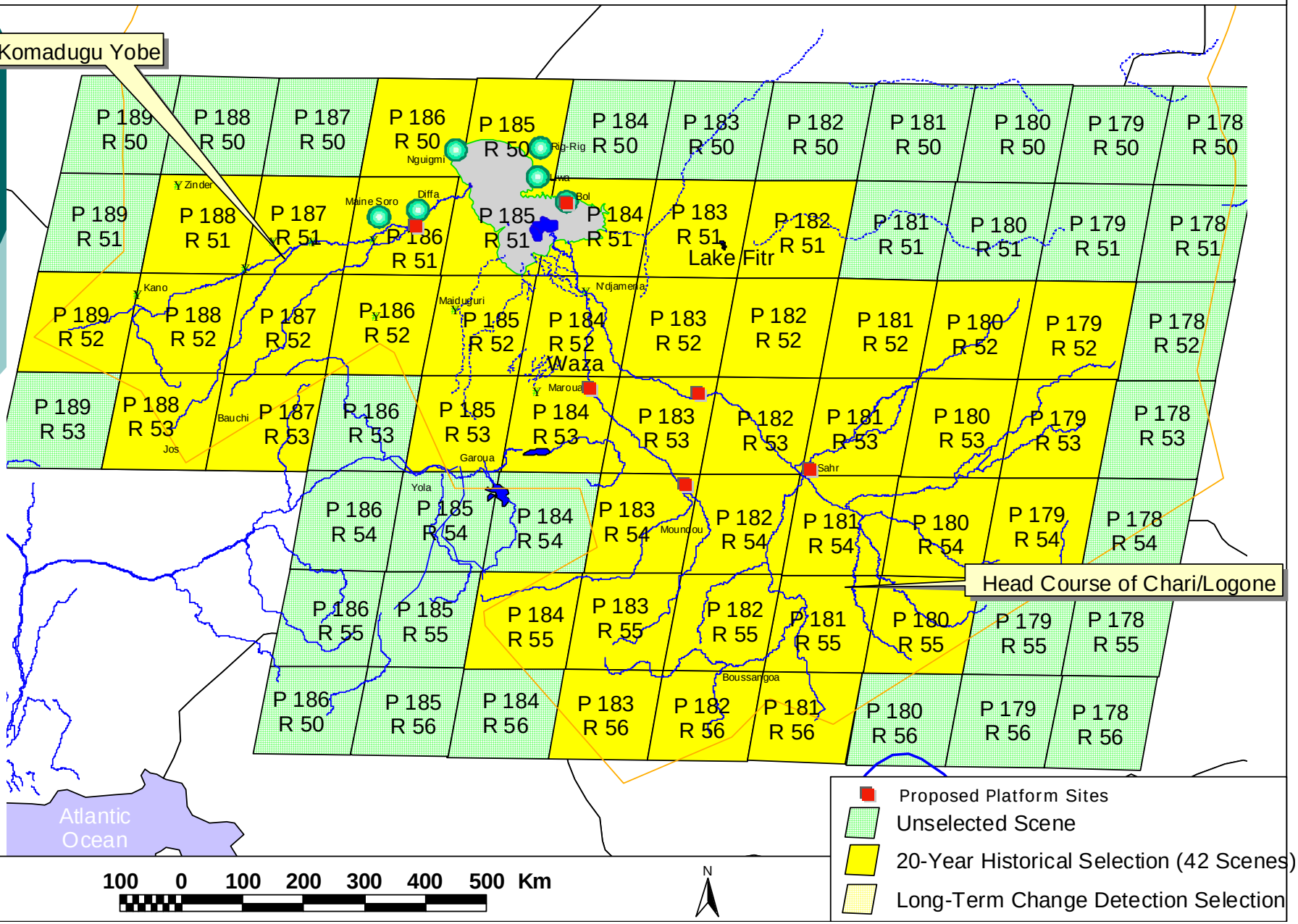
Follow-up of the Pilot Project

- **Data Available / Inventory:**
  - Hydrological data 1970 – 1999 …..
  - Demographic data;
  - Land use/cover few areas;
  - Soil Categorization (with FAO);
  - Satellite Imageries from GEF – 1984 to 2007 
    - Opportunities for ESA to start from 2005 to 2010;
  - Historical Images to be paid by GEF is **$168,024** (1984 – 2004);
  - SRTM DEM 3*3 arc sec for the entire Basin (Donated by Water Resources Dept., ITC-Enschede;
  - Topographic maps (Ordinance Survey);
- **SW and HW Available for the Project:**
  - ILWIS (ITC Product);
  - Erdas IMAGINE (Essential);
  - ArcView GIS 3.2a – with Spatial Analyst and GeoHMS Extensions;
  - ArcGIS 8.3;
  - Two Pentium III, 30Gb HDD;
  - HP Designjeted 1050c large format printer;

Some Identified Problems to be Addressed

- Large gabs in the Hydrological data;
- Fewer area of coverage of satellite images;
- Image Processing Limitations;
- Projection (zones 32 – 34);

Landsat Satellite JK Value Scenes for GEF/LCB Project



Common Projection to Adopt

- Considering the size of the Basin, we resolved to adopt common system:
  - Projection: UTM
  - Ellipsoid: Clarke 1880
  - Datum: Minna (and Zones from 32 – 34; select appropriately)
    - (for Cameroon and C.A.R. data – select CAMEROON)
    - (for Nigeria, Niger and Chad data – select Nigeria)

Capacity and Institutional Development

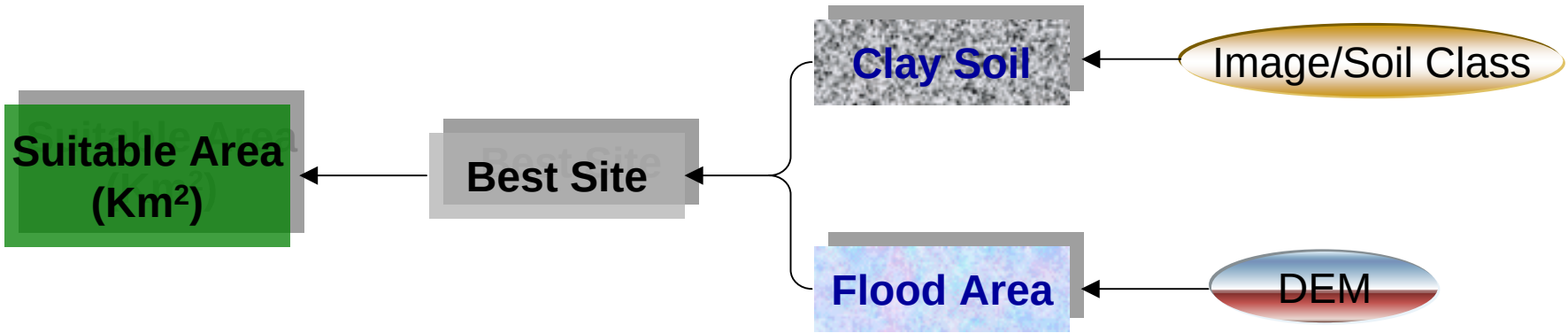
- Institutional Assessment is going on in the Commission – GEF;
- All Stakeholders need will be determined by December;
- Work Plan

Use of RS/GIS in the Project (Poverty Alleviation)

- Problem 1: Decline in Fish Production

adverse effects lead to increase in poverty; Malnutrition; Unemployment.

- Solution: Appropriate Site Selection for Fish Production (mathematical operations on images)
  - Criteria Setting;
  - Cartographic modelling and measuring impact:

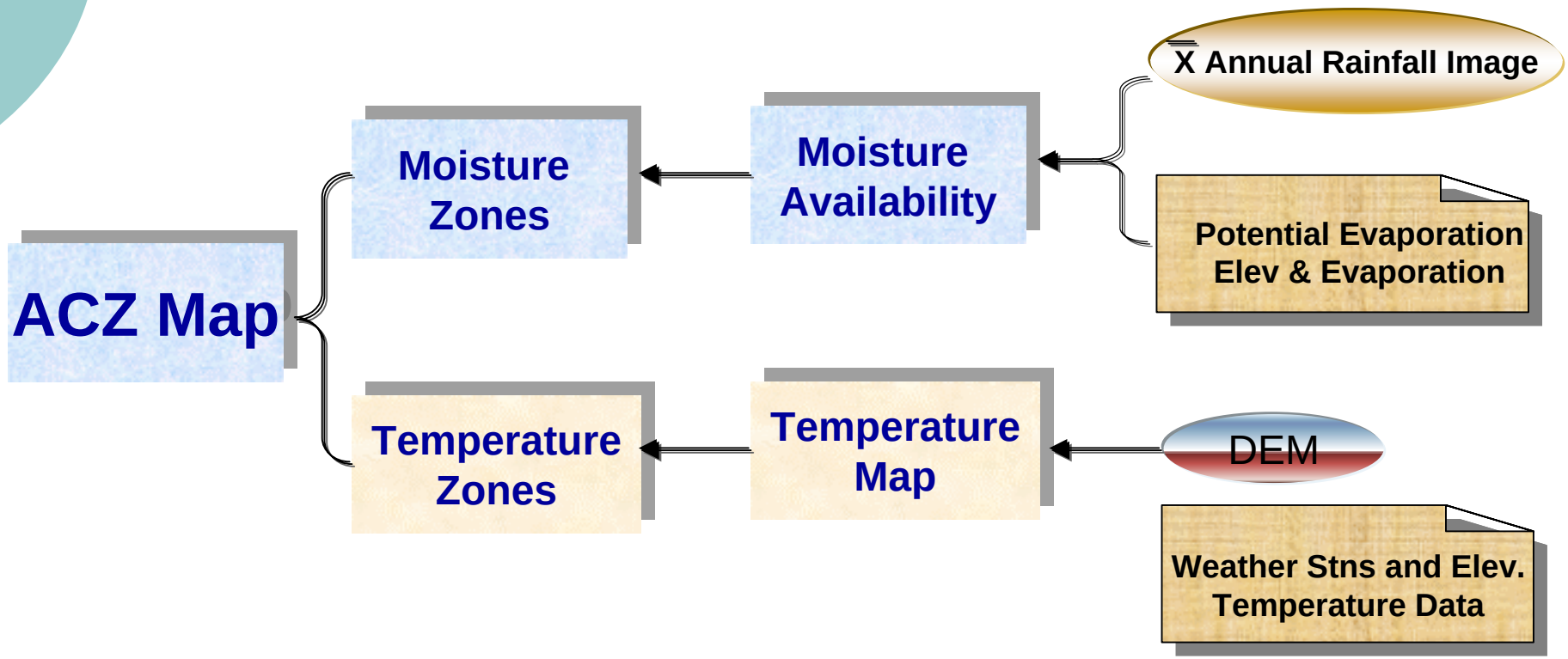


Use of RS/GIS in the Project

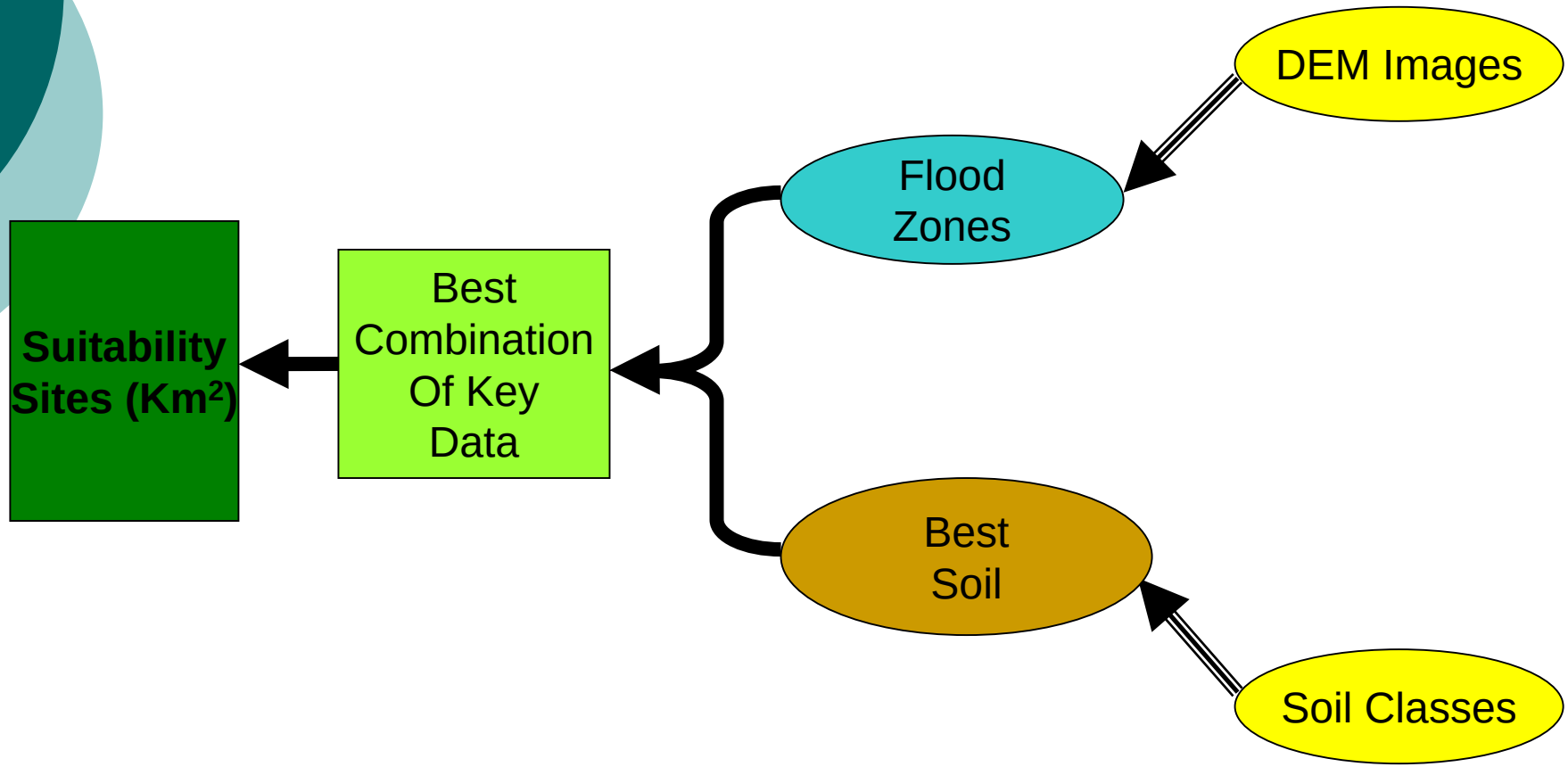
- Problem 2: Decline in Agricultural Produce: Comparative performance of Agro-climatic Zones in the Basin
  - Solutions:
    - Agro-Climatic Zones Map;
    - Recession Agriculture;

Agro-Climatic Zoning (ACZ) of LCB

- GIS Modelling for Comparative Analysis of Agro-Ecosystems in the Basin – Regional Planning Tool



Methodology for Poverty Alleviation from Space to be Adopted



Base Map Produced

- DEM of the whole Basin
- The only better large scale available in the Commission donated by ITC, The Netherlands.
- Resolution: 90x90m
- **To be Extracted:**
  - Estimation of Mean, Minimum and Maximum Elevation;
  - Vertical Gradient of hydrometeorological elements for each sub-basin;
- The two key themes for consideration in DEM processing are:
  a. Topographical (Terrain) Processing
  b. Hydrologic Processing
     - Basin Processing
     - Basin Characteristics

a. **Topographical (Terrain) Processing**: to modify and analyse terrain. Capable of computing datasets as:

- Depressionless/Fill DEM
- Flow Direction
- Flow Accumulation
- Stream Definition
- Stream Segmentation
- Watershed Delineation (sub-basin delineation)
- Stream Segment Processing
- Shadow/Relief maps

EM Processing by PMU

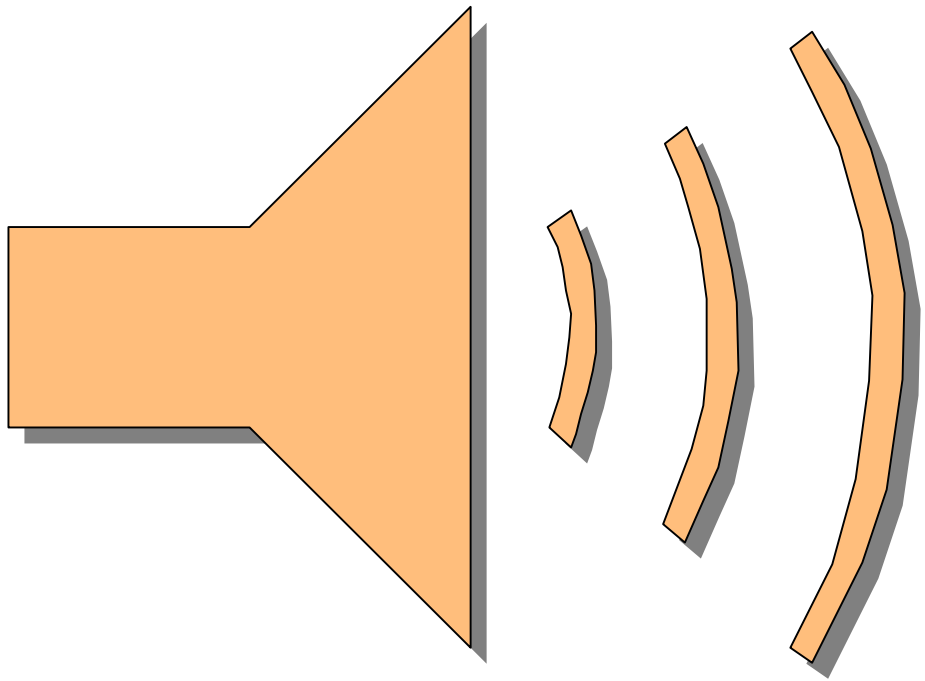
b. **Hydrologic Processing:** After the terrain processing, data is then extracted for HMS model and this allows the Pilot Project to come up with Stream and Watershed Characteristics/Attributes

Stream Attributes	Watershed Attributes
Length	Area
Upstream Elevation	Perimeter
Downstream Elevation	Centroid Location
Slope	Centroid Elevation
Slope Profile	Longest Flow Path/Length
River Cross Section at agreed Intervals	Slope between end points

Map Algebra Output

- Precipitation map; and
- Evapotranspiration;
- Runoff Maps = Precipitation map – Evapotranspiration maps

If this Pilot Project is fully sighted in the Lake Chad Basin, with over 30 million Inhabitants, they would rise and applause as



Thanks for your Concern