RS & GIS for decision support system

Model for determining preference sites for water harvest

Eastern Nile locality - Sudan

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Introduction

Water is used for several purposes such as drinking, agriculture, power generation, and industries. Due to the importance of these purposes, it is necessary to introduce new technology that assists in setting suitable strategies for water management and development

Cont. Introduction

- Water harvesting is defined as: “the process of concentrating rainwater through flowing and storing in order to use it in useful manner” (Owais, *et al.*/2002)

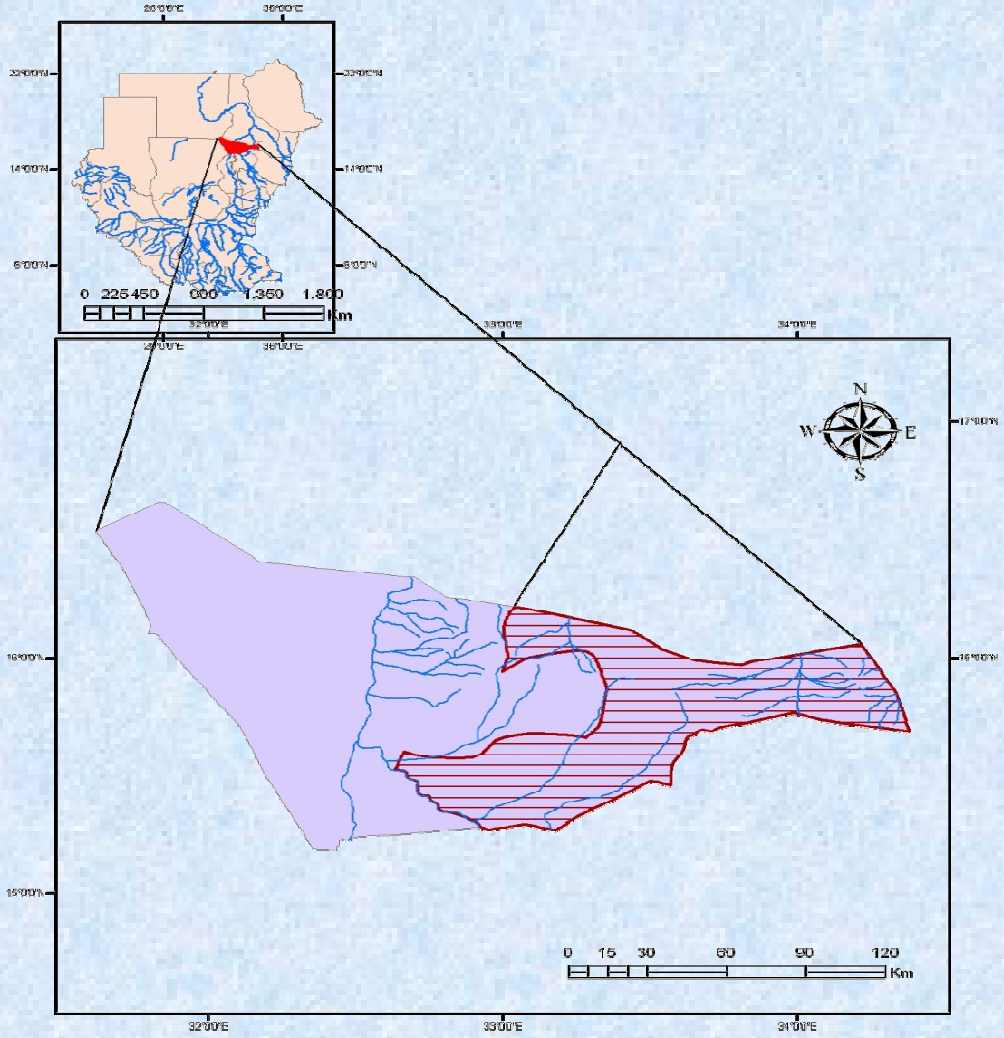
- Recurrent drought in the arid and semi-arid zones is caused by fluctuation of rainfall intensity which also causes floods.

- In the semi-arid drought-prone areas water harvesting is a directly productive form of soil and water conservation.

- Instead of runoff being left to cause floods and erosion , it is harvested and utilized.

Study area

- Eastern Nile locality is situated in Khartoum State within the marginal rainfall area of the semi-arid zone.



Research Problem

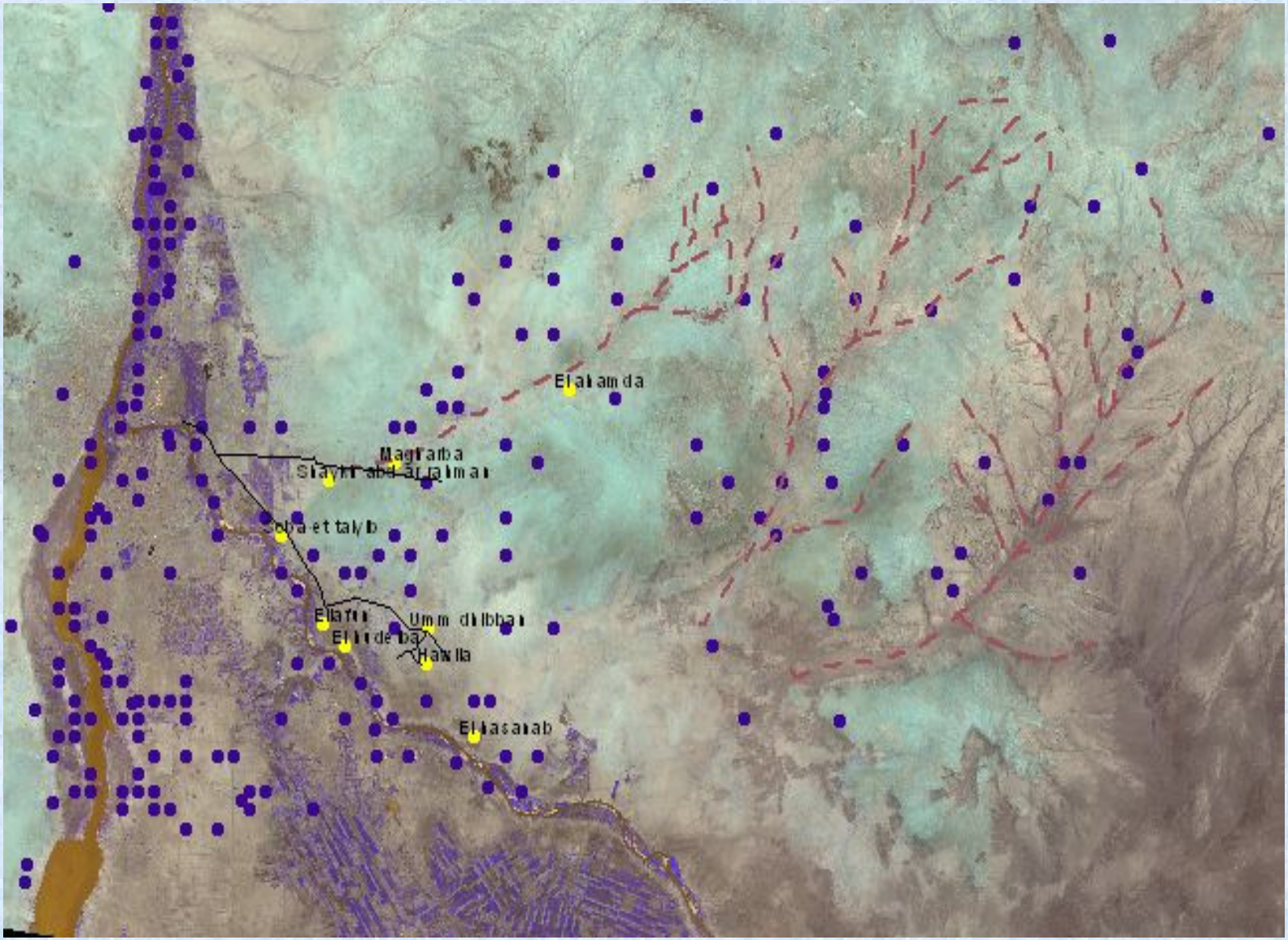
•The study area suffered from drought and flood.

• Rural communities in many villages in the study area have faced waves of drought and extreme flood events since the 1970s.

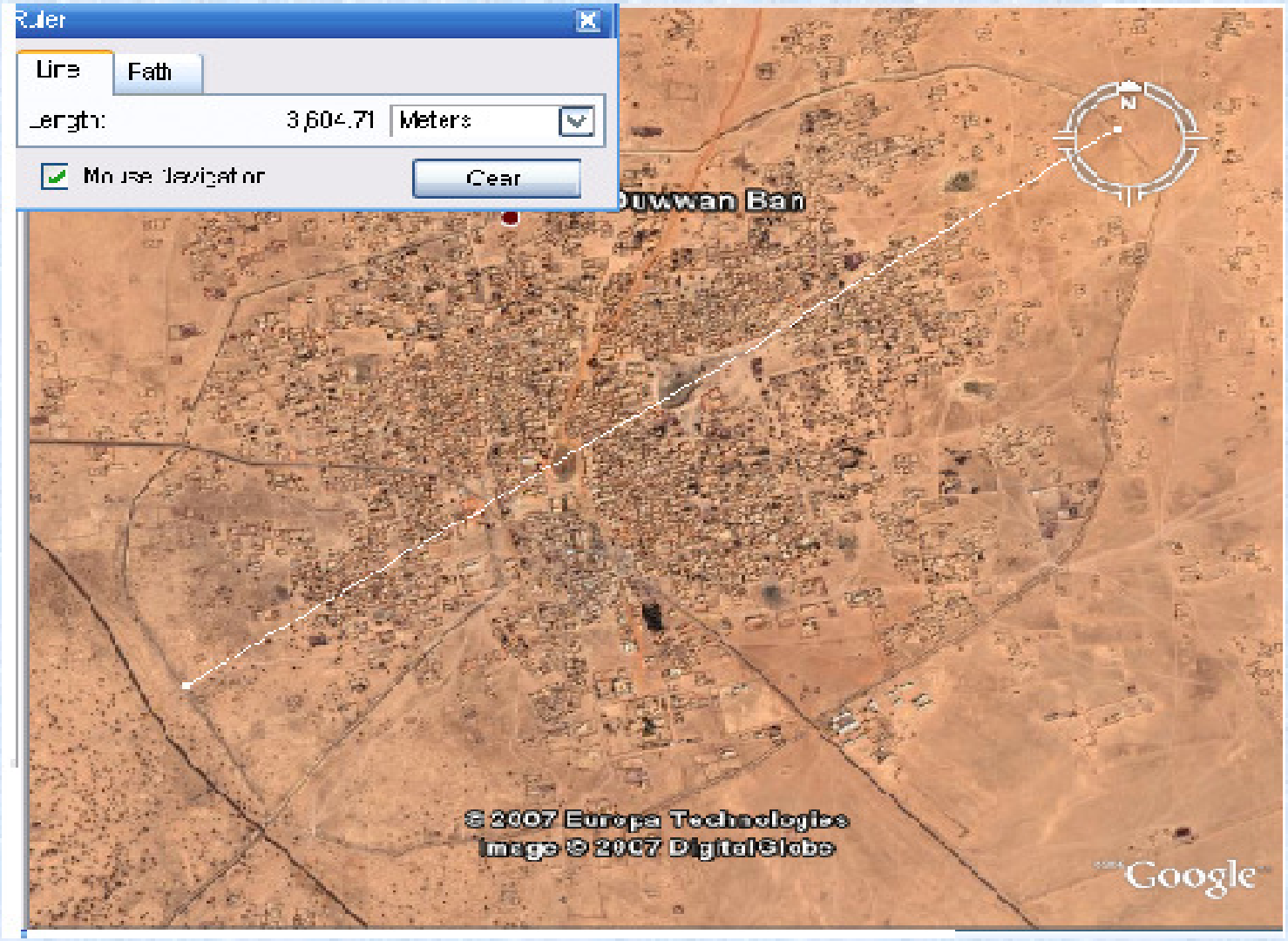
• To manage those problems a comprehensive information collecting and analysis should be implemented.

Events	No. of event	Killed	Injured	Affected
Drought	11	150,000	0	25,500,000
Earthquake	2	34	15	10,000
Epidemic	22	5451	0	47,957
Famine	1	0	0	2,600,000
Flood	17	383	18,556	6,614,962
Insect infes.	5	0	0	0
Wild Fire	1	47	0	0
Wind Storm	1	33	0	0

summary of natural disasters in Sudan (1965 - 2004)


Ellahamda
Magharba
Shaykh abd ar rahman
Soba et talyib
Ellafun
Umm dhibban
El hudeiba
Hawila
El hasanab

The Levee or Terrace Built for the protection of the villages floods



selected site showing the impact of 2007 floods

GIS & RS as tools

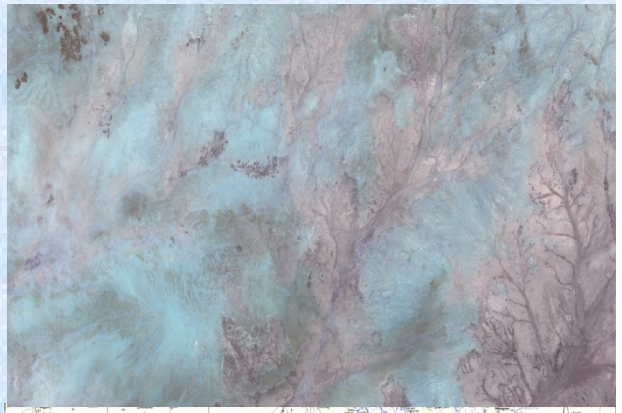
- remote sensing satellites offer synoptic view of water resources that facilitates surveying, and mapping of such resources.
- On the other hand, GIS enables storing data and information in digital format which facilitates their exchange and sharing between users. Likewise, GIS makes possible the integration and analysis of multi-source data so as to obtain additional information.

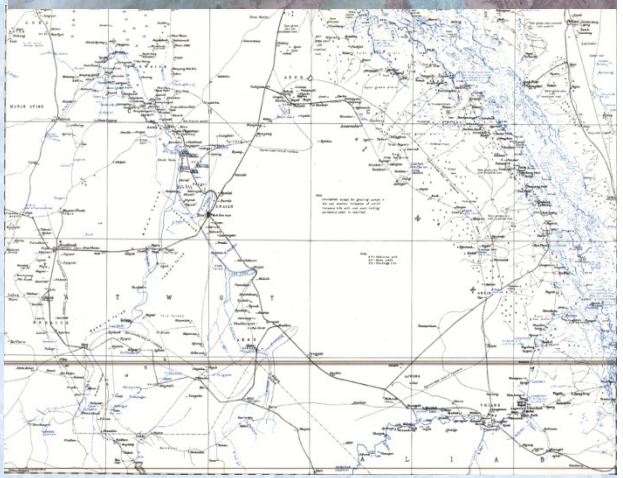
Research objectives

- Preparation of a digital map showing rivers, streams, and valleys.
- Demarcation of contributing areas (catchments) of rivers, streams, and valleys.
- Demarcation of preferred water harvest sites in the study area.

Materials

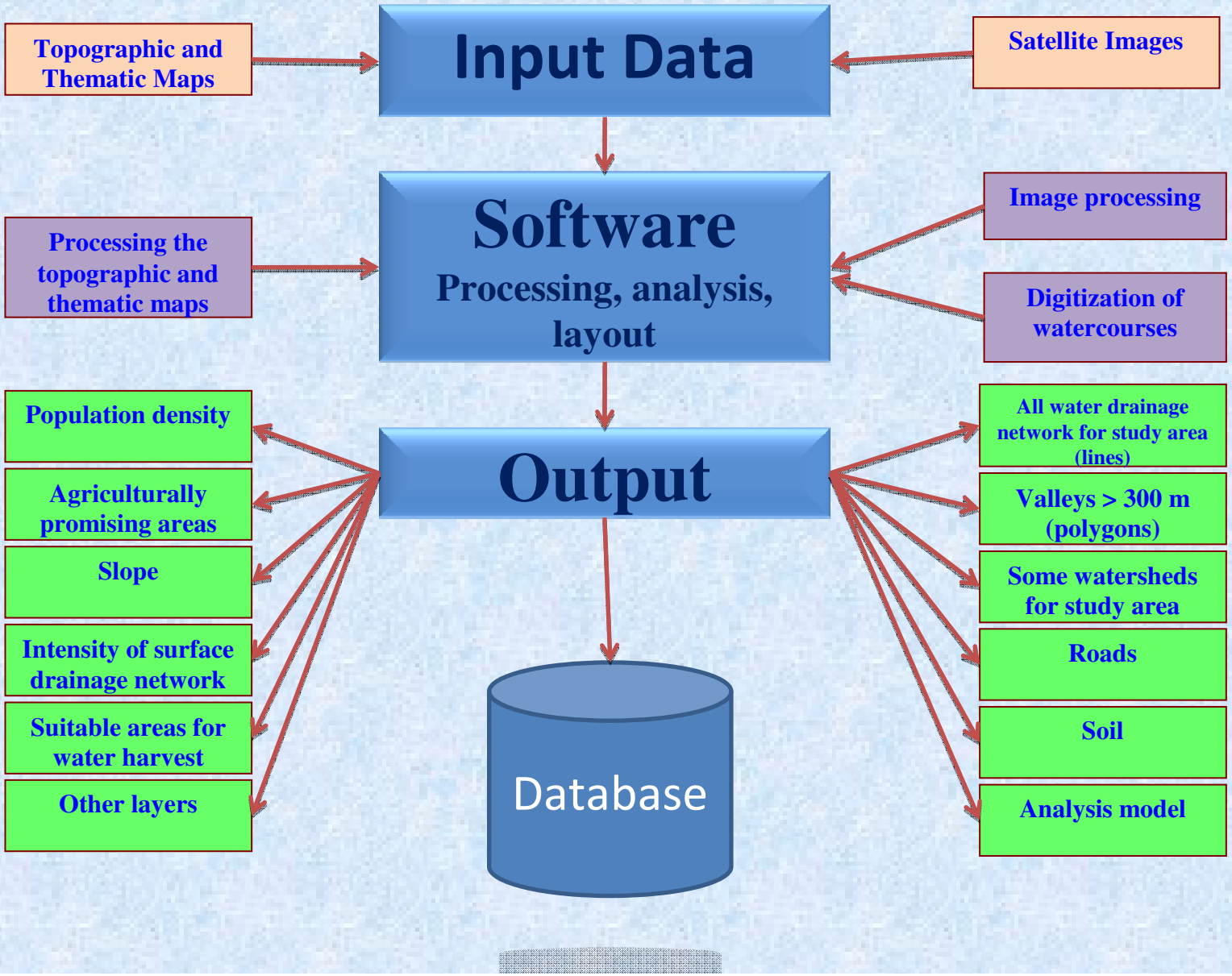
- Satellite images acquired by: Landsat 7 in 2000.
- 1:100,000 scale topographic maps (hardcopy).
- 1:250,000 scale topographic maps.
- Information taken from Google Earth.
- ASTER Global DEM 30m.
- Maps depicting other natural resources such as vegetation, soil, and geomorphology.
- Land use maps.





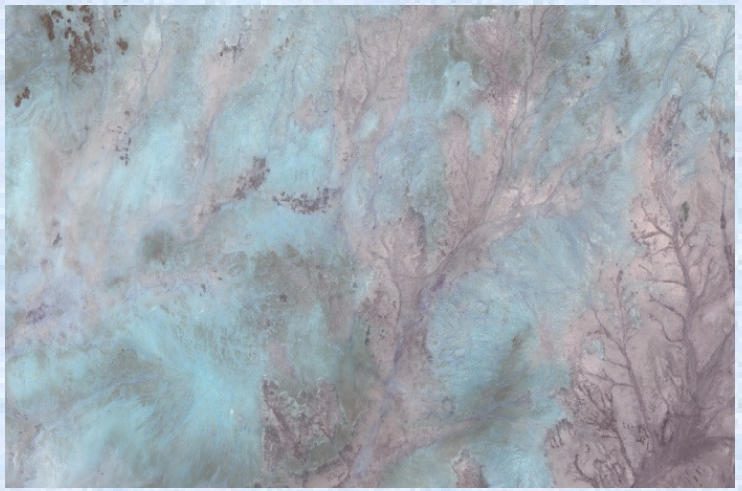
Methodologies

Flowchart

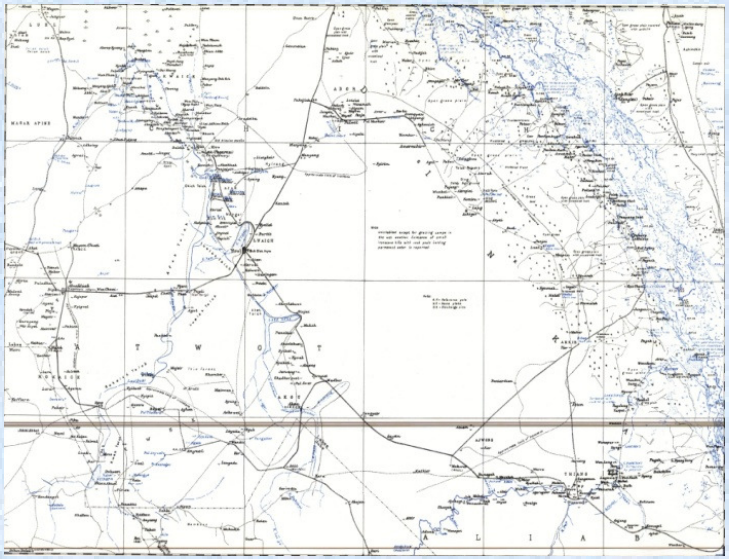

Topographic and Thematic Maps
Input Data
Satellite Images
Processing the topographic and thematic maps
Software
Processing, analysis, layout
Image processing
Digitization of watercourses
Population density
Agriculturally promising areas
Slope
Intensity of surface drainage network
Suitable areas for water harvest
Other layers
Output
Database
All water drainage network for study area (lines)
Valleys > 300 m (polygons)
Some watersheds for study area
Roads
Soil
Analysis model

Input Data

- Satellite imagery.



- Topographic map



Analysis

- This model was based on three main factors:
  - the natural and environmental factor including vegetation, soil, slope and drainage density;
  - the social factor which focuses on the human and animal presence represented in cities, villages, and settlements;
  - and the economic factor represented in the suitability of the location for agricultural production.

To achieve the study objectives database was built including surface watercourses layer in addition to the following:

1- Basins contributing to valleys: the digital elevation model was used to demarcate basins contributing to some valleys and streams in the study area.

3- Slope map: the digital elevation model was used to produce a slope map for the study area.

4- Climatic zones: Sudan climatic zones map was processed to get knowledge of the climatic zones of the study are.

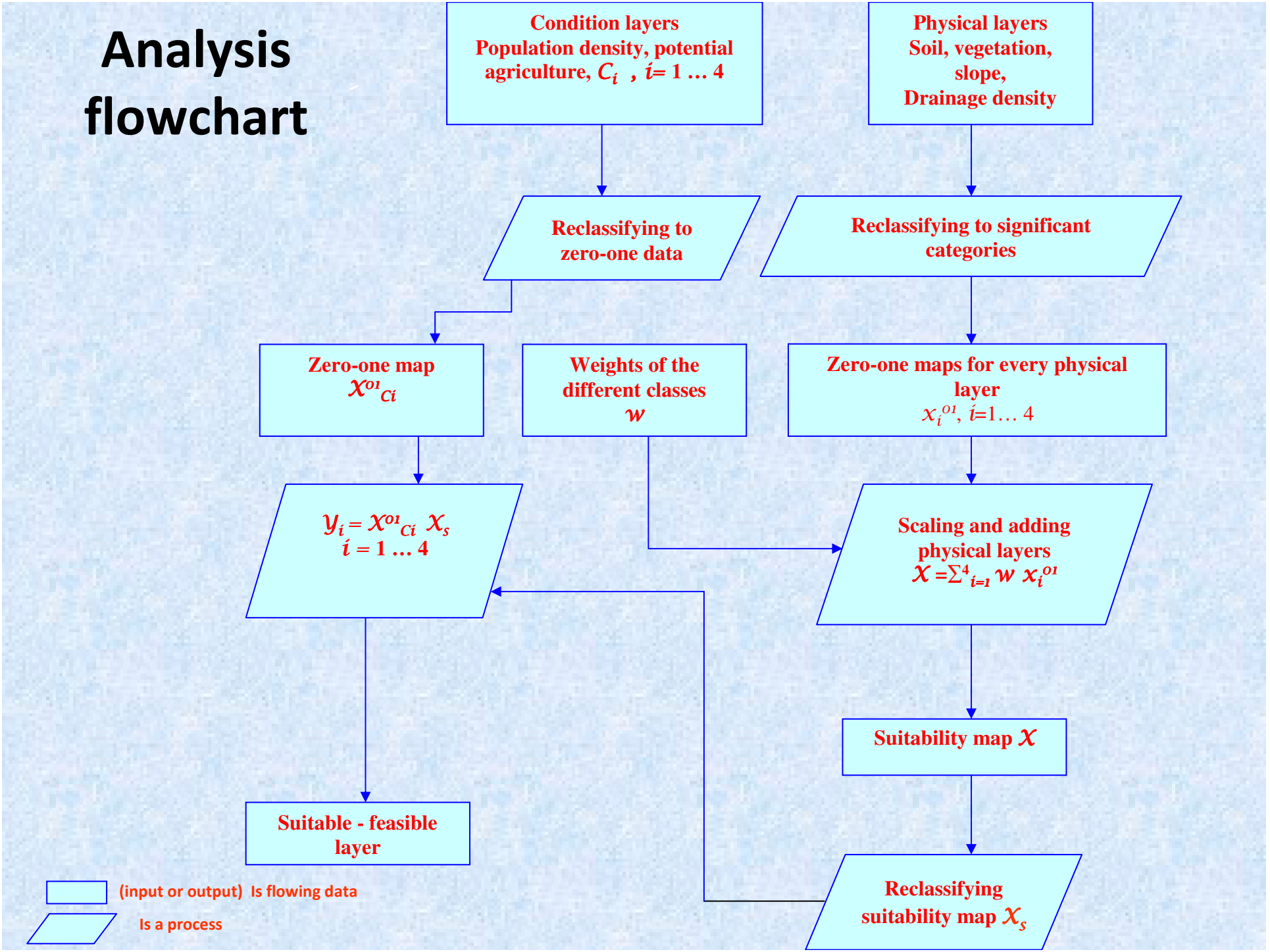
5- Land use map: Africover map 2003 was used to get information about land use in the study area, focusing on land use regarding rain fed agriculture, irrigated agriculture, forests, and pastures.

6- Potential agricultural lands map: A hardcopy map was converted to digital format, georeferenced, processed and linked to the spatial database.

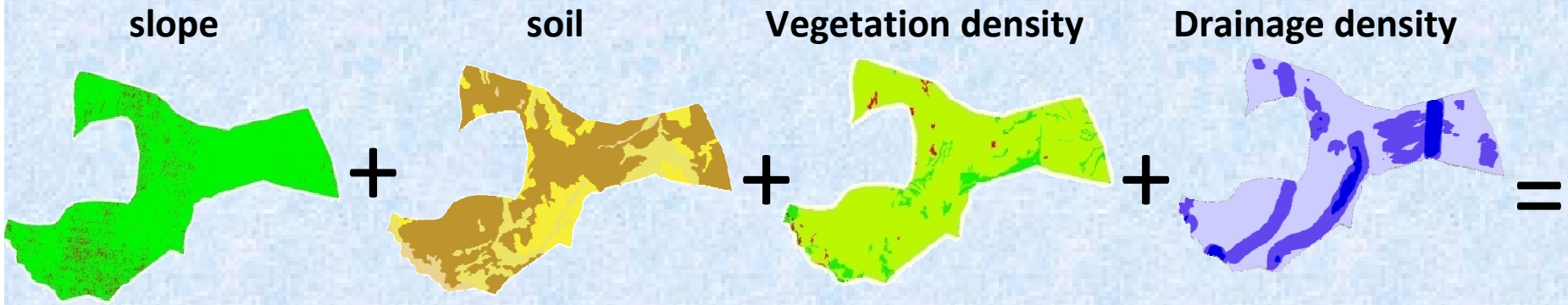
7- Cities, villages, and settlements map: This map was processed and added as a layer using the same geometric projection.

8- Roads map: main roads layer for the study area was created.

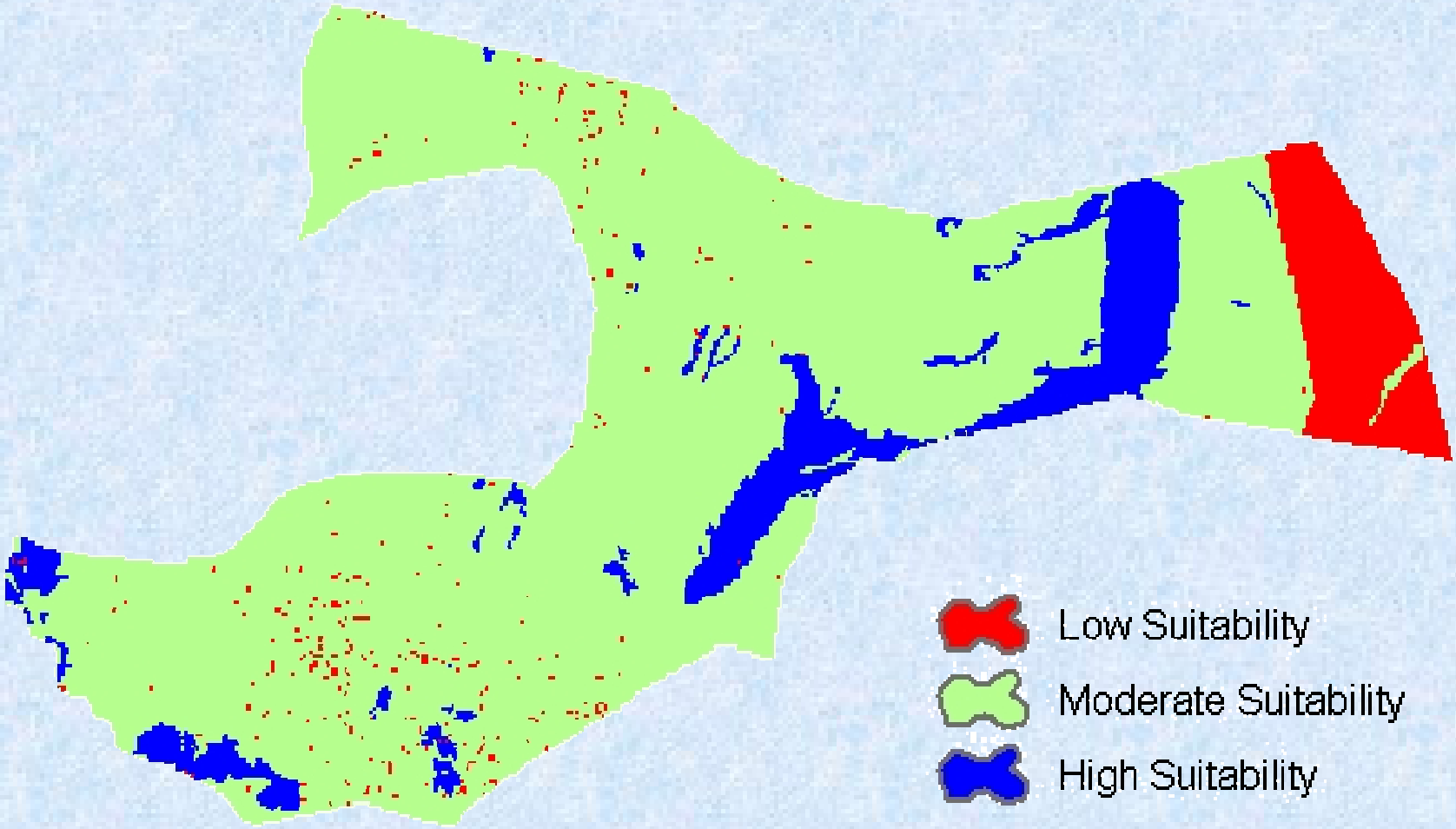
Analysis flowchart



Natural Layers

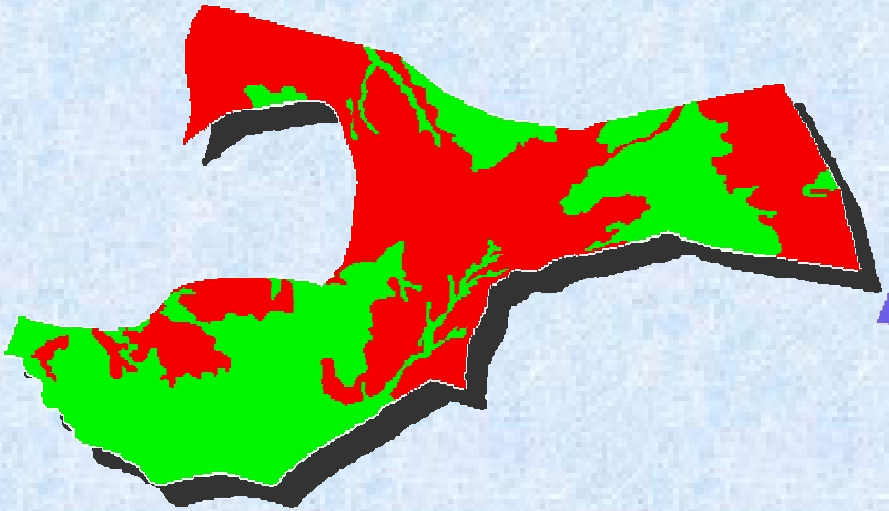


Suitable areas for water harvesting

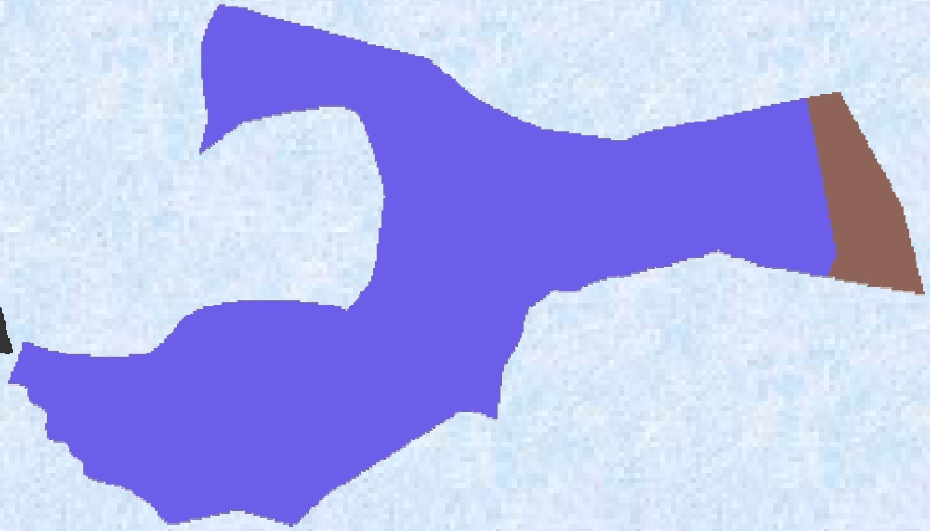


Condition Layers

Potential agriculture

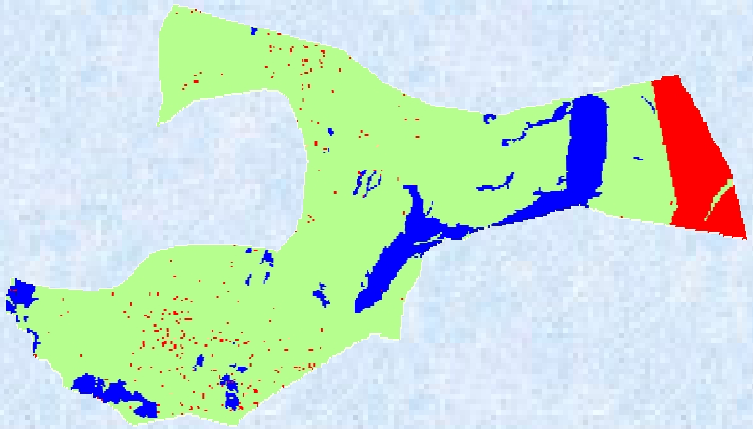


Population density



Feasibility According to Population Density

Harvesting suitability



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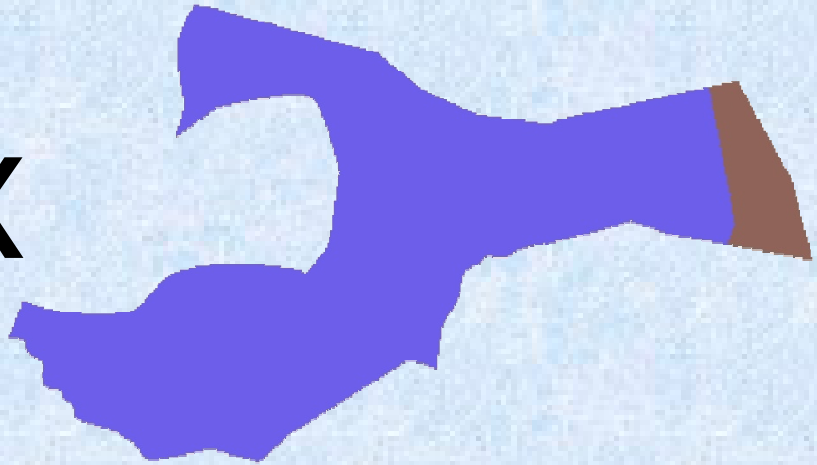
Population density



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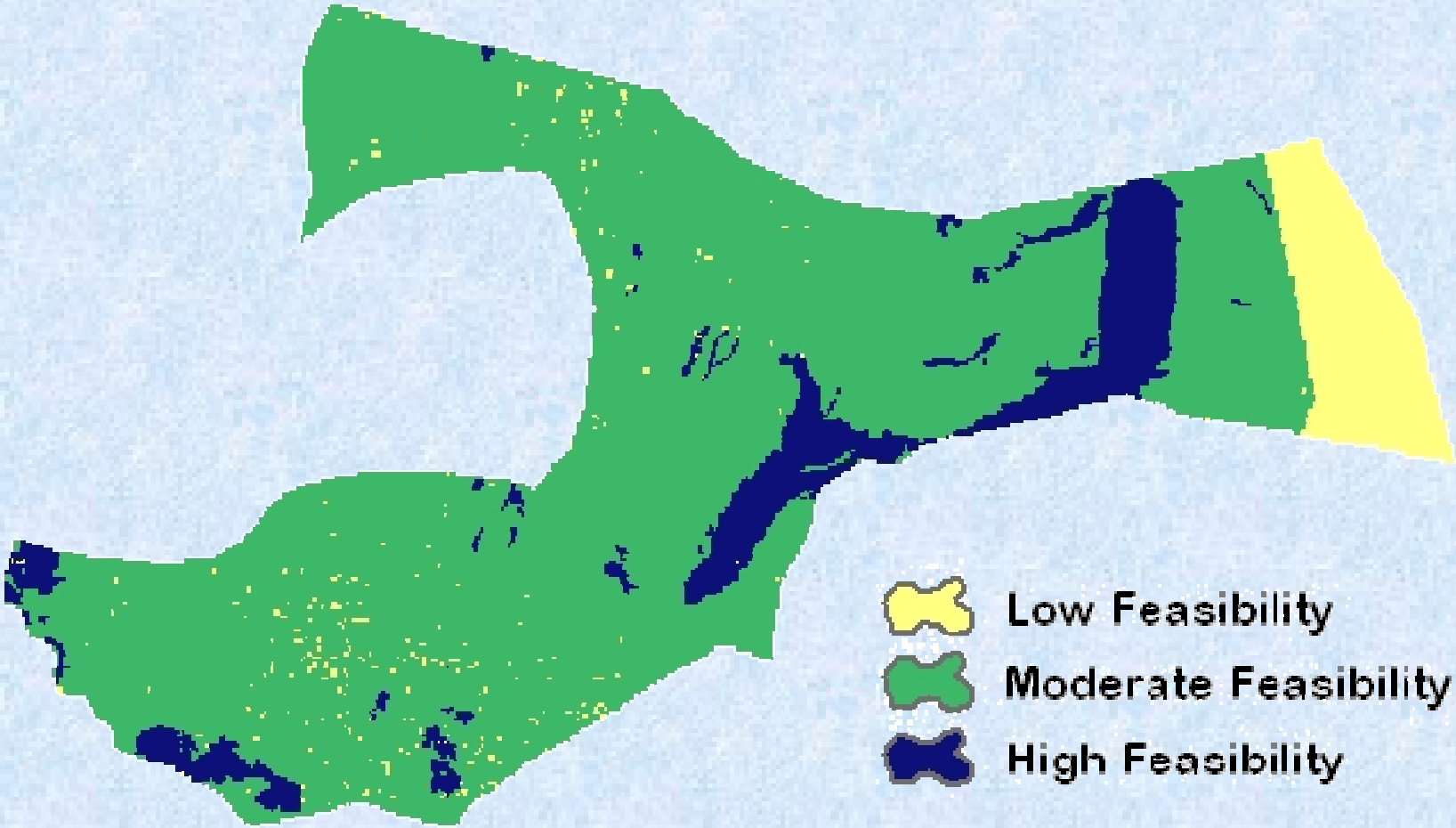
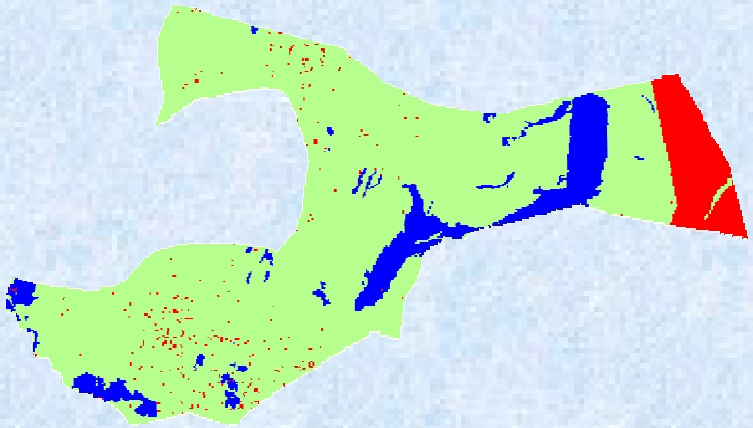
Feasibility according to population density layer



Feasibility according to potential agricultural areas

Harvesting suitability



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Potential agriculture

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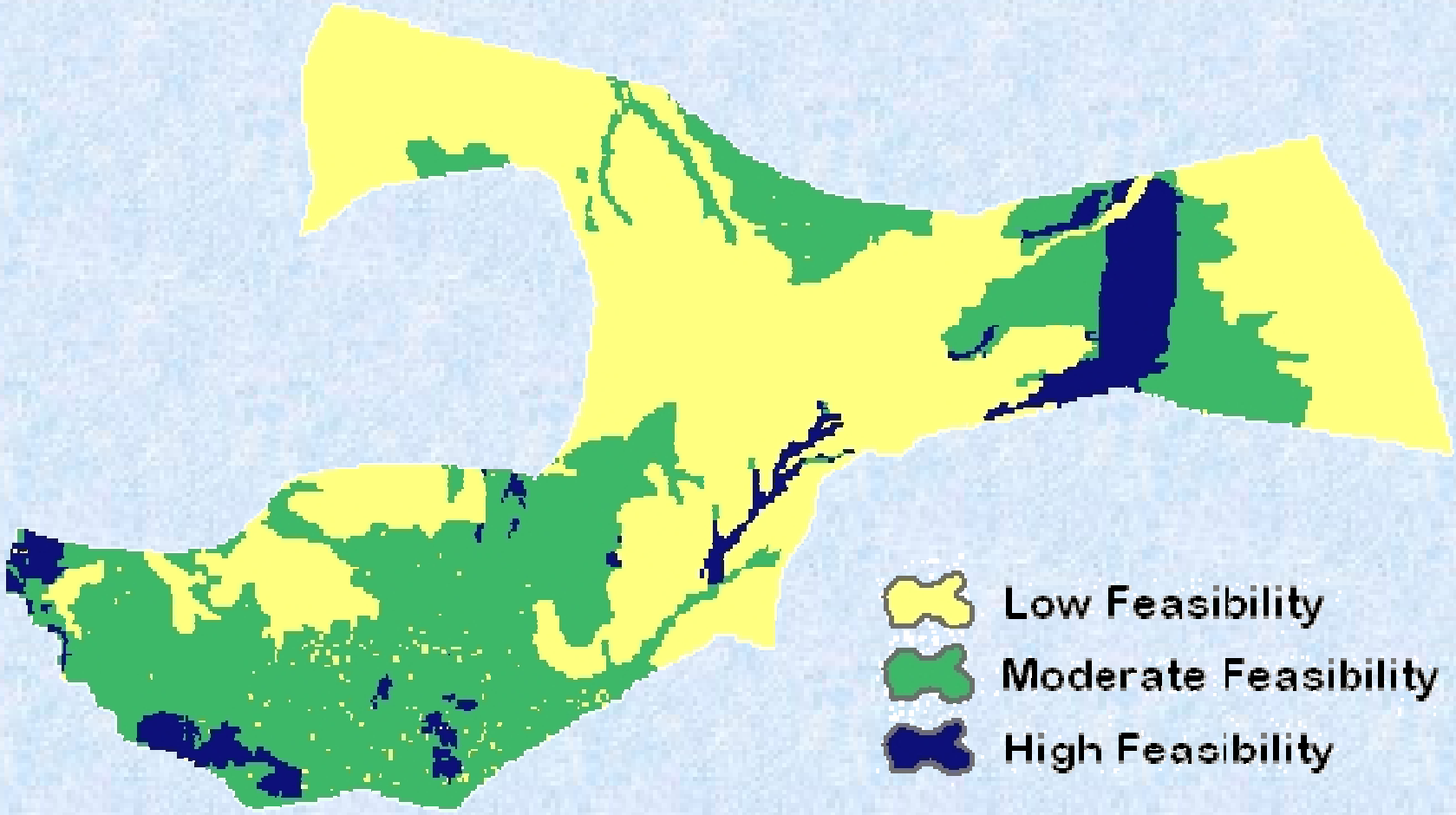
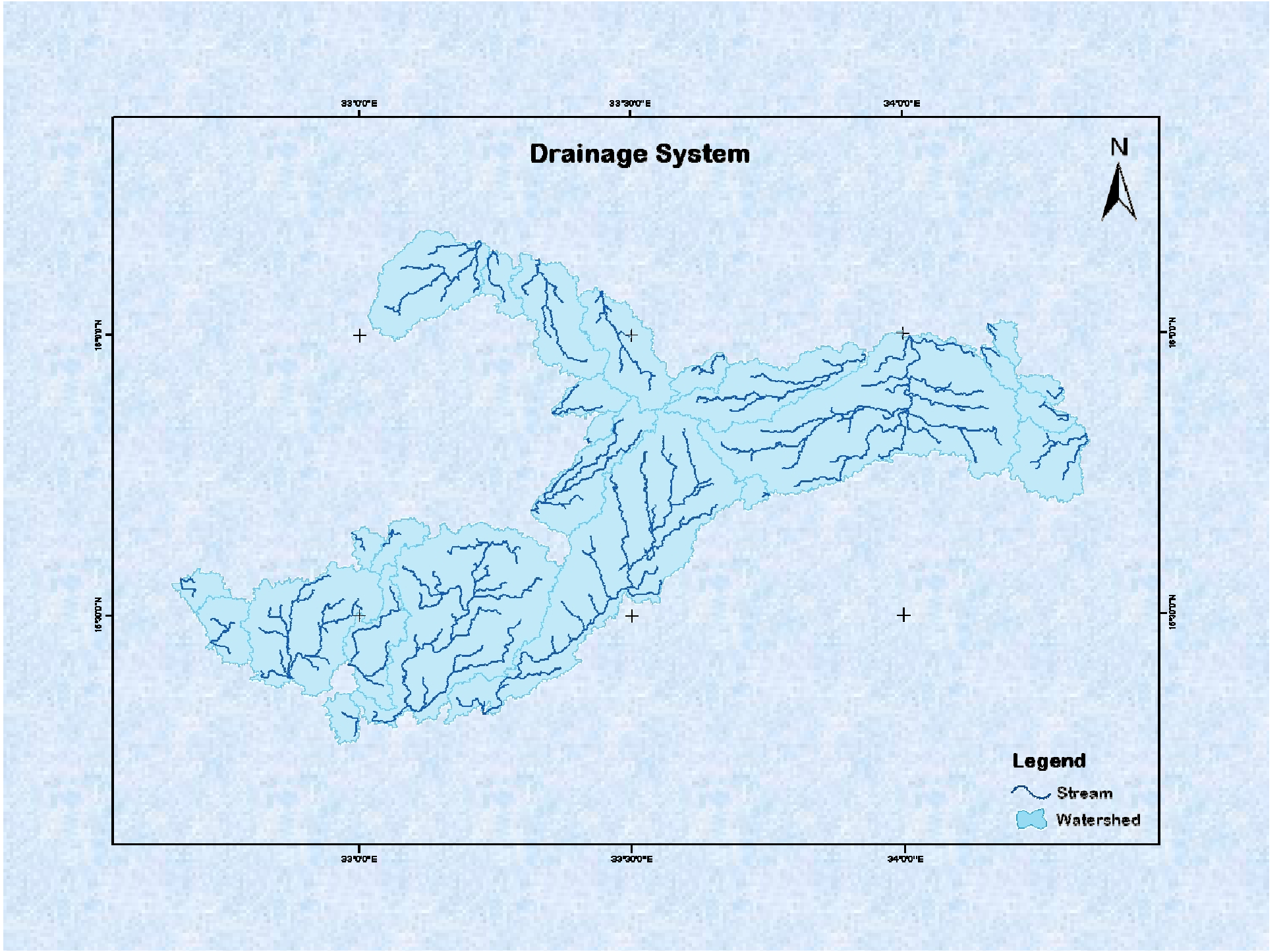
Feasibility according to potential agriculture layer

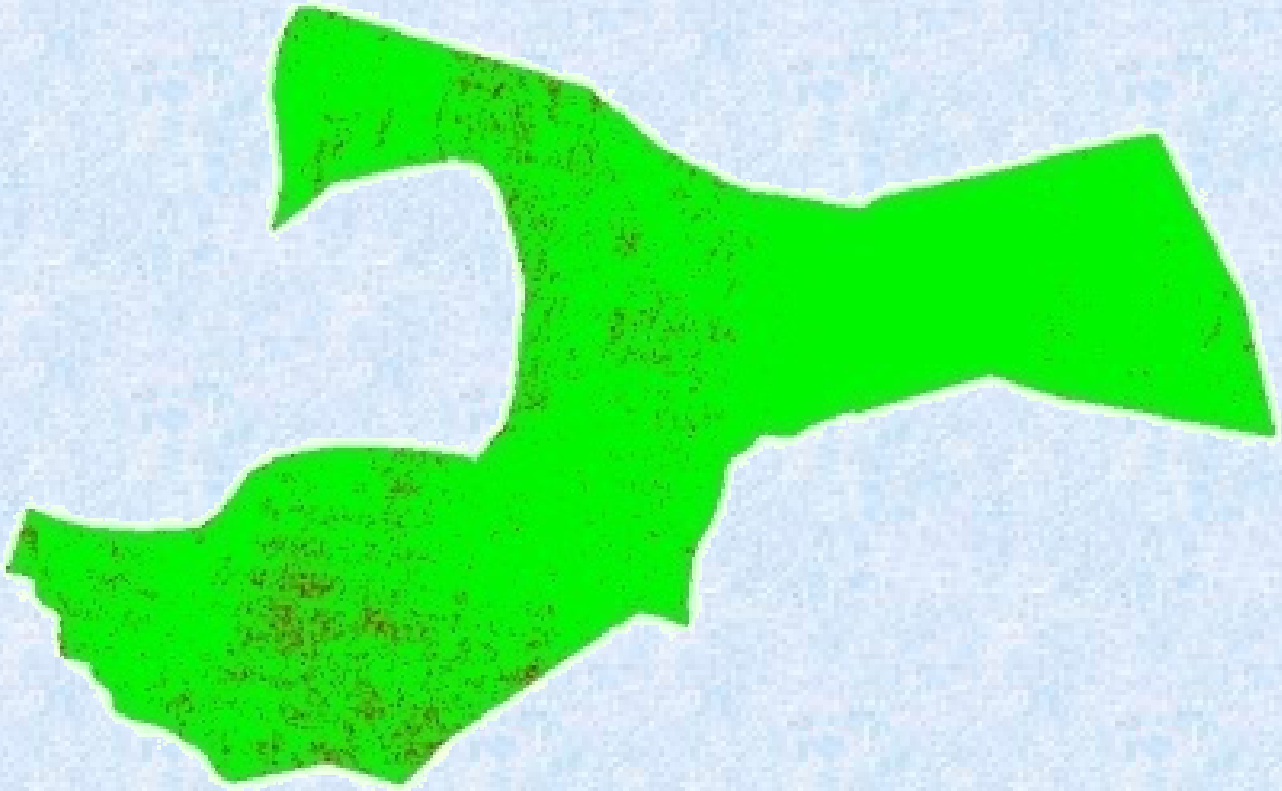


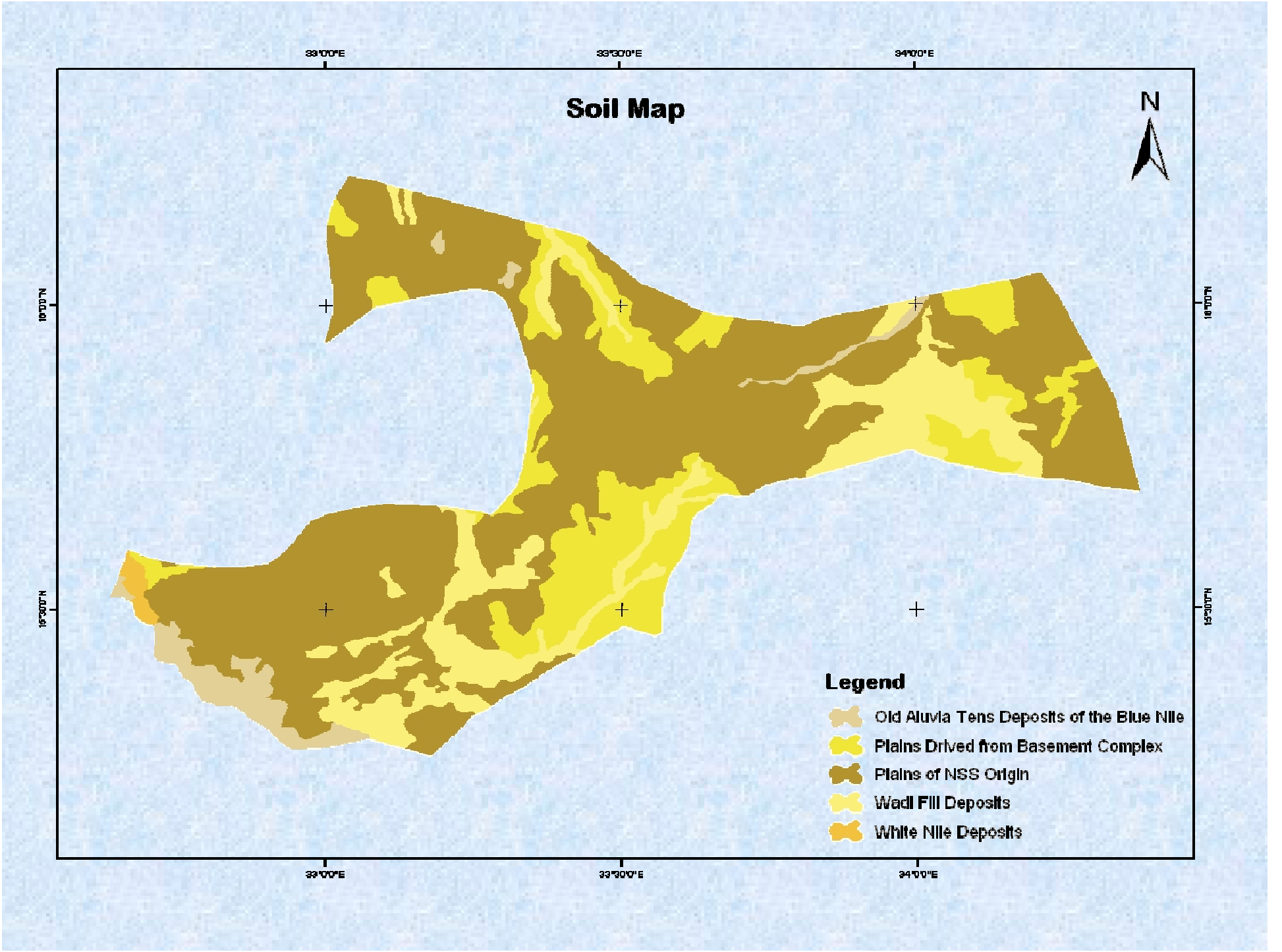
Outputs


Drainage System
N
33°0'0"E
33°30'0"E
34°0'0"E
Legend
Stream
Watershed

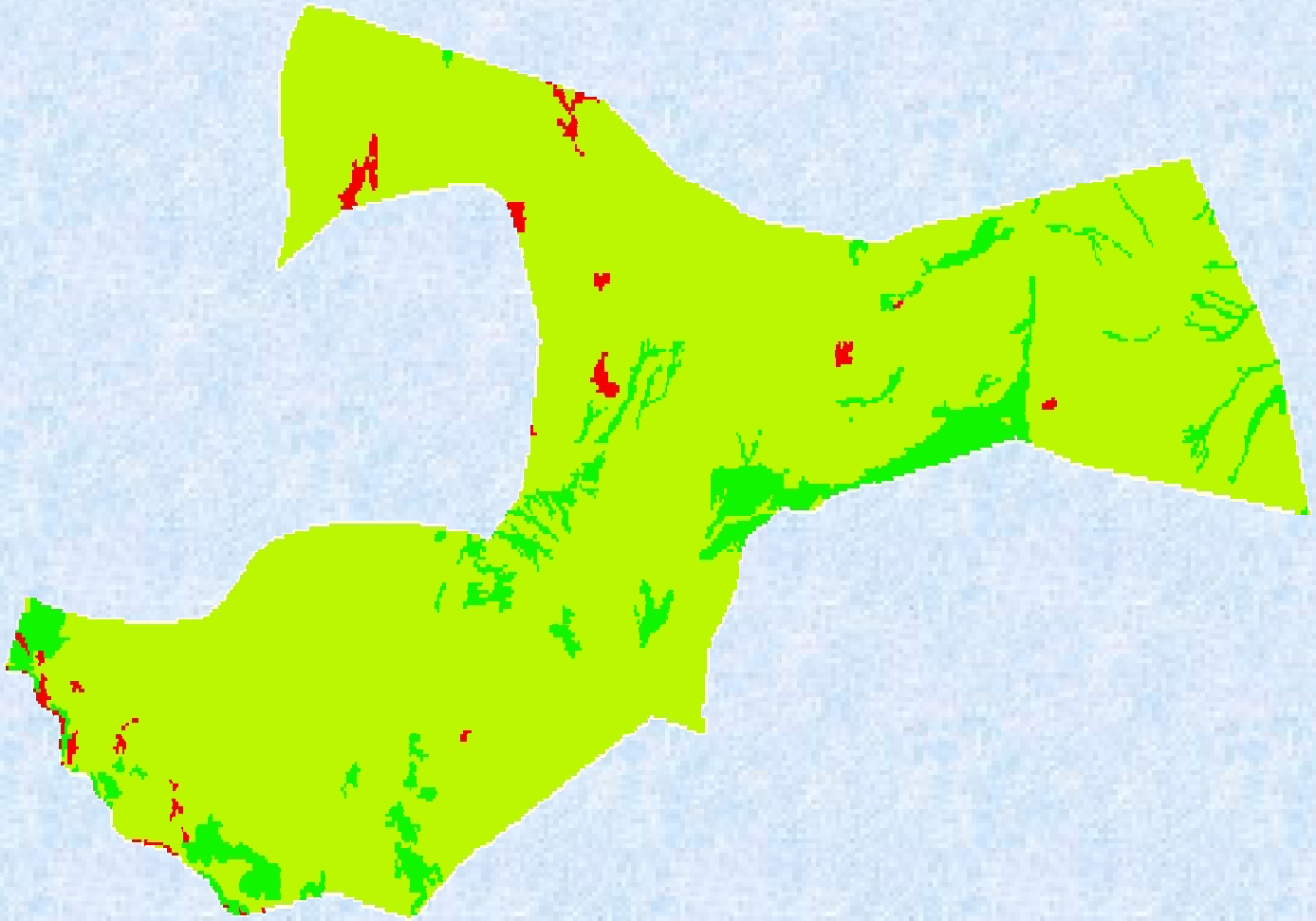
Thematic Maps

- Slope map

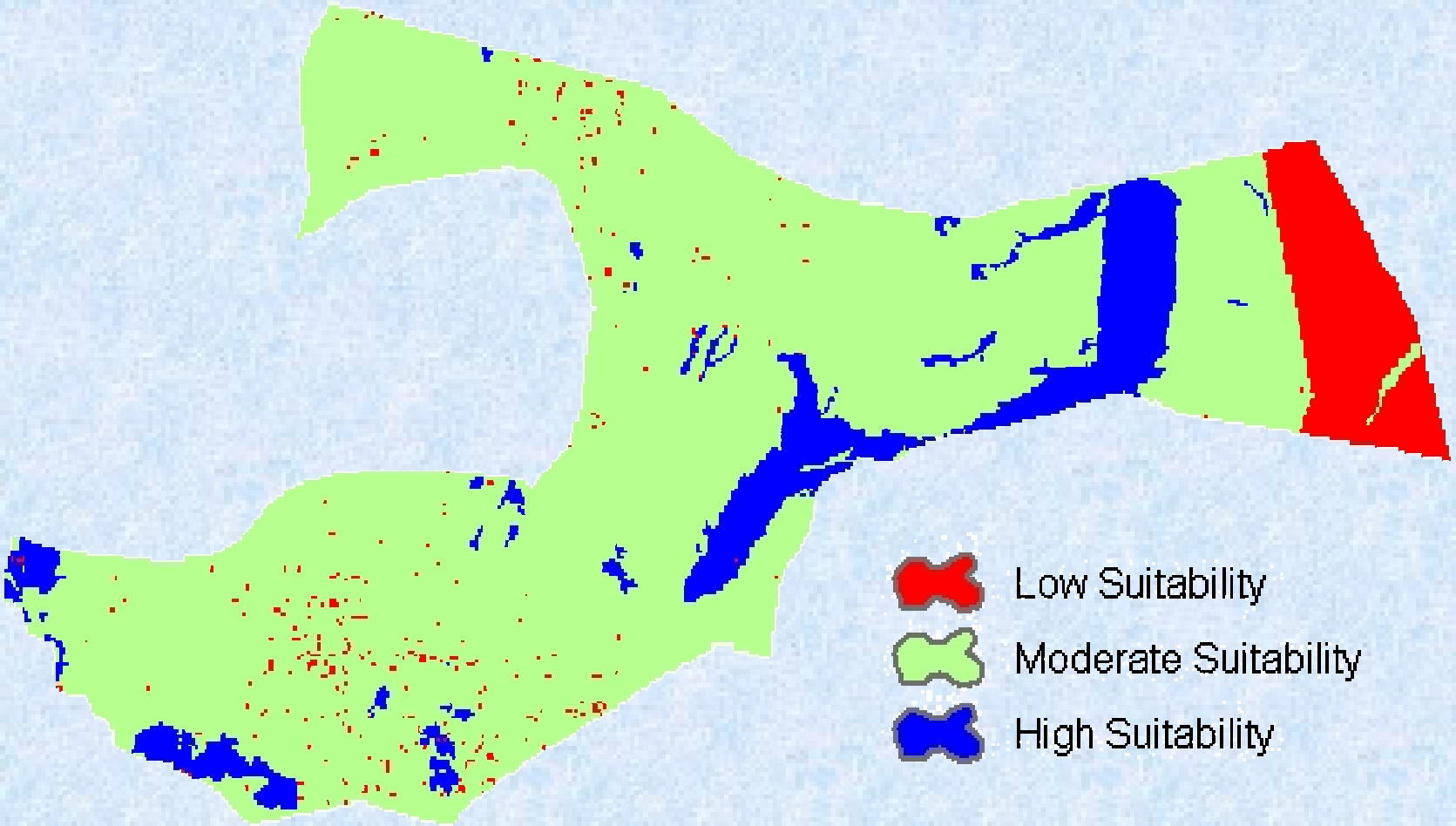



Soil Map
N
33°00'E
33°30'E
34°00'E
16°00'N
15°30'N
Legend
Old Aluvia Tens Deposits of the Blue Nile
Plains Drived from Basement Complex
Plains of NSS Origin
Wadi Fill Deposits
White Nile Deposits

- Vegetation Map



- Suitable Areas for Water Harvesting



Thanks