

Use of Geospatial Technologies for Environmental Protection in Ethiopia

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1. Introduction

Background

Ethiopia is a country of great geographic diversity and endowed with natural resources.

- Renewable natural resources**
- Mineral resources**
- Water resources ...**

Background ...

An increase in population, and increasing demands have led to a great portion of the biological resources being used in unsustainable manner.

The Ethiopian rural environment has suffered an accelerating devegetation leading to diminishing soil fertility, soil erosion, increased severity of the impact of drought, and a further reduction in the ability to produce food and other biological resources.

Background ...

It is obvious that sound natural resource management and planning is essential, to tackle the above-mentioned problems and to bring about sustainable development, consequently poverty reduction.

Therefore, environmental and natural resources information should be available at all levels of the public and decision makers to support decision making process and planning.

Background ...

To this end, the use of space technology /remote sensing and geospatial technologies are very crucial and inevitable for environmental monitoring, natural resource mapping, early warning systems and disaster management.

2. Use of Geospatial Technologies for Environmental Protection in Ethiopia

Several studies have been studied in different sectors related to the environment. Major studies conducted by EPA and different sector institutions and their use of geospatial technology are discussed

- 1. Environmental Protection Authority (EPA)**
- 2. National Meteorological Services Agency (NMSA)**
- 3. Ethiopian Mapping Authority (EMA)**
- 4. Woody Biomass Inventory and Strategic Planning Project**

2.1. Environmental Protection Authority (EPA)

Environmental Protection Authority (EPA) is established with the responsibilities to environmental protection, regulation and monitoring for the sustainable use of environmental resources.

Objective of EPA

formulate policies, strategies, laws and standards, which foster social and economic development in a manner that enhances the welfare of humans and the safety of the environment sustainable, and to spearhead in ensuring the effectiveness of the process of their implementation.

Some of the Powers and Duties of the Authority are:

- 1. Establish a system for environmental impact assessment of public and private projects, as well as social and economic development policies, strategies, laws, and programmes;**
- 2. Prepare and avail to the government as well as the public a periodic report on the state of the environment of the country;**
- 3. Coordinate, promote and, as may be appropriate, carry out research on environmental protection;**

The environmental policies with regard to Environmental Information Systems are:

- To adhere to the principle that the right to live in a clean and healthy environment carries with it the right to be informed about environmental issues and to develop an appropriate information system;**
- To ensure that all environmental data collection and analysis as well as information dissemination are coordinated and as far as possible standardized but not centralized;**

The environmental policies ...

- To ensure that there be a central point or agency at which it is possible to have access to widely used information and to ascertain the type and location of any specialized data and information.

EPA as stated in the proclamation, to avail the state of the environment of the country, produced the first State of the Environment Report, in August 2003.

The report indicates the current state of natural resources and the ecosystem

- **Annual Daily Mean Temperature,**
- **Rainfall Regime**

Environmental Information Center

Collects and compiles information from different sources.

The center has developed geospatial database for environmental datasets like Ecological Zones, Annual Rainfall, Annual Daily Mean Temperature, and Protected Areas.

However, use of geospatial technologies is in its infancy.

This is due to lack of appropriate hardware and software.

Possible study areas for environmental protection using space technology

Mapping Protected Areas

Mapping Wetlands

Inventory and delineation

Natural resources inventory and mapping (Wild life, Forest)

Water Pollution

Water Hyacinth

Industrial waste disposed to rivers

Software and hardware used in EPA

Software

Microsoft Access

Arcview GIS 3.2

Windisp

Hardware

Computers

Scanner

Color Printer

2.2 National Meteorological Services Agency (NMSA)

National Meteorological Services Agency is mandated for providing meteorological data.

The installation of Meteosat Receiving stations over Ethiopia has been in the early 90s.

Currently, it is not operational

When the receiver is operational, meteorological data will be made available by NMSA, sharing the data from the MeteoSAT station to EPA and DPPC (Disaster Prevention and Preparedness Commission).

Data Analysis

Vegetation Monitoring Techniques:

- **Field observation**
- **Remote sensing observation /data (NDVI from MeteoSAT satellite Image)**
- **Agroclimatological yield models**

NDVI from AVHRR (NOAA satellite) is also used for vegetation monitoring.

The data analysis is done by Windisp image processing software.

Rainfall estimation

The economies of most countries in Africa are dependent on the rain-fed agriculture.

The variability of rainfall greatly impacts on socio-economic activities. Rainfall monitoring and prediction in space and time are therefore a critical aspect for the sustainable socio-economic development of the region.

Rainfall estimation ...

most of rainfall observations in the region are based on a sparse rain gauge observational network.

Satellite technology provides some real potential for comprehensive rainfall monitoring in space and time.

Satellite rainfall estimation techniques can be used for seasonal forecast for early warning systems.

Hardware and Software Used in NMSA

Hardware

Computers

Receivers

Rain Gauges

Software

Windisp software for MeteoSAT satellite data analysis (NDVI and RFE)

Arcview for display

2.3. Ethiopian Mapping Authority (EMA)

**Ethiopian Mapping Authority
mandated to undertake mapping at a
national level and to provide geospatial
data.**

EMA conducted different studies in the following areas.

- **Assessment of refugee's Impact on the Environment in Western and Eastern Ethiopia, in coordination with United Nations High Commission for Refugees (UNHCR) and Administration for Refugees and Returnees Affairs (ARRA).**
- **Impact of Resettlement**
- **Impact of Tannery Industry on the rivers**
- **Pollution on the Lakes (Koka, Abijata, Awassa)**

Assessment of refugee's Impact on the Environment in Eastern Ethiopia

to investigate the environmental state pertaining to the long-term presence of refugees in two areas of Eastern Ethiopia, using remote sensing and geoinformation techniques.

The study areas are:

Darwanaji-Teferiber and

Jerer Valley – Kevribeyah-Hartishek camps and their surroundings.

Objective of the study was

- **To undertake Land Use/Cover and environmental change detection studies based on time series satellite data at and around the refugee centers;**
- **To select potential sites for environmental restoration measures;**
- **To produce comprehensive thematic maps for planners, decision makers and environmentalists.**

An aerial photograph of a rural settlement, likely in a developing region. The image shows a cluster of small, rectangular buildings with light-colored roofs, arranged in a somewhat circular pattern around a central, taller structure that appears to be a tower or a church spire. The surrounding landscape is a mix of green fields and brownish soil, with some roads and paths visible. The overall scene suggests a traditional village or a small town in a rural area.

The study include satellite images of pre refugee arrival (1988) and post refugee arrival (1998).

To identify the physical environment before the arrival of refugees and augment the 1988 satellite image analysis, aerial photographs of 1966 were interpreted.

Data analysis

The digital image analysis and interpretative works were divided into three basic groups. Preprocessing, information extraction and presentation of the output.

I.e., in the form of thematic maps, and tables vegetation was taken as an indicator.

With a change in vegetation, the other components of environment, such as soil, climate, surface and groundwater quality and quantity also change.

Data analysis ...

After the necessary geometric corrections on the raw images were done, a Normalized Difference Vegetation Index outputs were produced. The Normalized Difference Vegetation Index outputs of 1988 and 1998 were overlaid so as to see the changes in the vegetation conditions in the study areas.

Hardware and Software used

Hardware

Digitizing tablet for data capture

Scanner for rasterizing analog data

Computers

Plotter and printer for hard copy production

GPS

Stereoscope for aerial photo interpretation

Software

AutoCAD for vector data capture

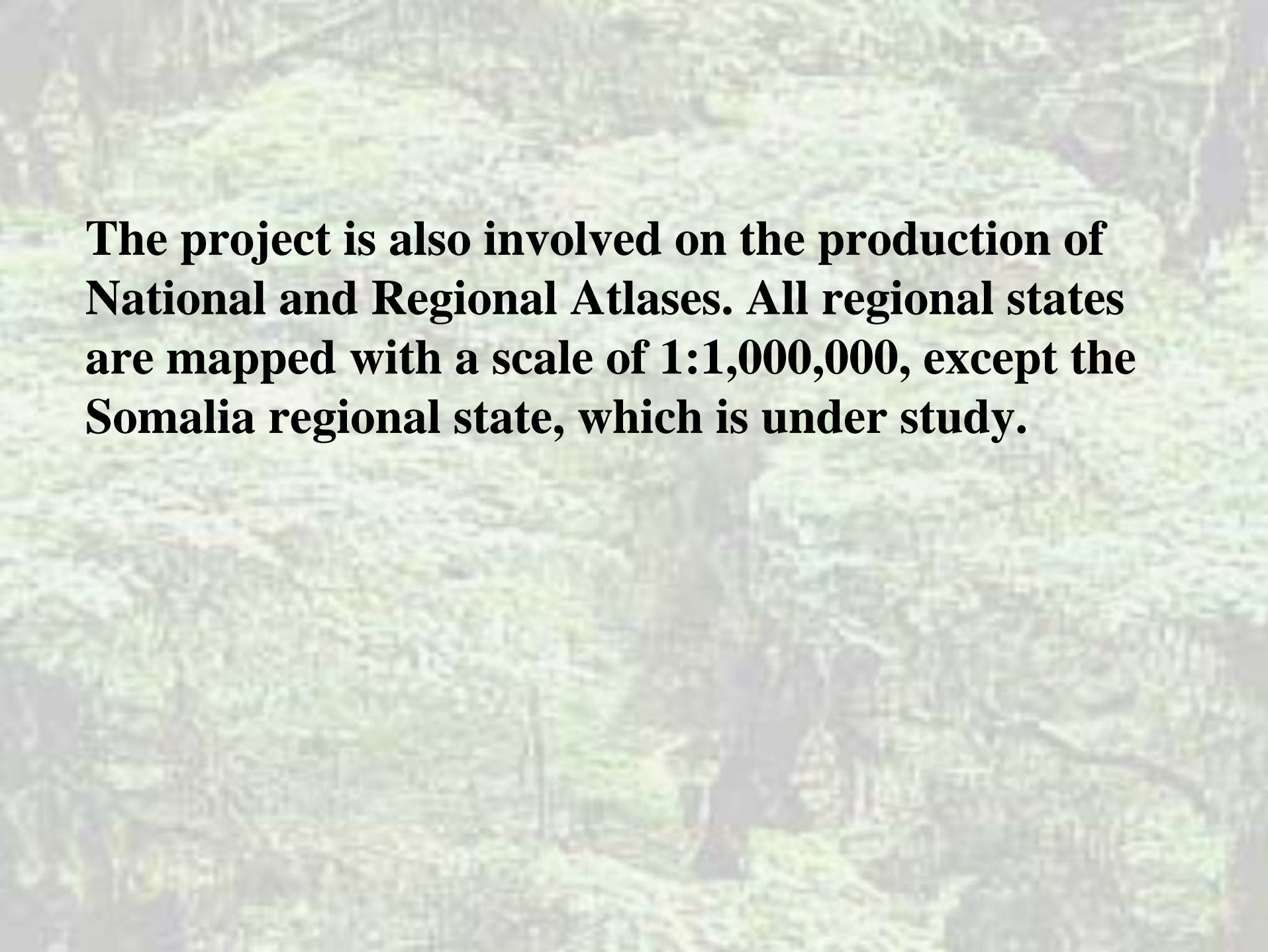
ERDAS Imagine 8.3 for digital image analysis

Arcview for the display of raster/vector data

ArcINFO for editing features

2.3. Woody Biomass Inventory and Strategic Planning Project

The Woody Biomass Inventory and Strategic Planning Project is mainly working on traditional energy sources such as fuel wood, dung and crop residuals. It conducts the demand and supply study on a household survey basis for traditional energy consumption.



The project is also involved on the production of National and Regional Atlases. All regional states are mapped with a scale of 1:1,000,000, except the Somalia regional state, which is under study.

The main products included in the Atlas are:

1. Wood fuel consumption
2. Sustainable yield of Woody Biomass
3. Mean Annual Rainfall
4. Temperature zone
5. Traditional Ecology
6. Farming and Pastoral Systems
7. Soil (Soil classification adopted from FAO)
8. Land Use/Land Cover –LandSat TM images of 1986-1989
9. Forest Areas and Cover
10. Natural Pasture

Hardware and software used

Software

Arcview 3.2

ArcINFO

PAMAP GIS 5.2B (Canadian software) for digitizing features, editing and analysis

Geomatica 9.1 for image analysis

Recently ArcGIS 8.3 is used

ArcIMS for web mapping – the digital data will be made available on the internet after completing this project.

Hardware

Plotters

Digitizers

Computers

Scanners

3. Initiatives for Environmental Information Exchange

Environmental data are created by different bodies, and may not be interoperable to be shared and used at a national and regional level.

Africa Environmental Information Network (AEIN) is addressing the issue of Environmental information exchange in the region.

The overall goal of AEIN is to strengthen the capacity of African countries to use good quality information on environmental assets to make informed investment choices at national and sub-national levels, and manage these assets on a sustainable basis.

3. Initiatives for Environmental Information Exchange ...

Therefore, EPA has taken the initiative to put in place Environmental Information Management System, which can be achieved through networking sector organizations that have potential for generating Environmental Information.

To effect the initiative, it is believed that there is a need to assess existing environmental information management status and develop a comprehensive Environmental Information Management strategic plan.

Accordingly a National Technical Committee is established which contains experts of high-level information management professionals drawn from different federal institutions to undertake this activity

3. Initiatives for Environmental Information Exchange ...

The committee will provide assistance in establishing an appropriate national networking mechanism to support the implementation of the environmental management information system.

The network for exchange of environmental information, reduce duplication of efforts and wastage of resources in environmental information management in particular and in the areas of environment management and protection activities in general.

3. Conclusion

To bring about development by utilizing the natural resources sustainably, environmental and natural resources information should be available at all levels of the public and decision makers.

Therefore, the use of space technology /remote sensing and geospatial technologies are very crucial for environmental monitoring, natural resource mapping, early warning systems and disaster management.

4. Recommendation

Environmental Information Center of EPA has to be strengthened. This could be:

Capacity Building:

- ☞ Training in the use of space technology and geospatial technologies.**
- ☞ Providing high-resolution satellite imageries.**
- ☞ Providing Powerful Image Analysis / Remote Sensing Software, GIS software.**
- ☞ Providing the necessary equipments and hardware.**

Creating a mechanism to exchange data with in the different institutions concerned with the environment.

☞ National Environmental Information Network.

☞ National Spatial Data Infrastructure (NSDI).



Thank you!