

**APPLICATION OF SPACE TECHNOLOGY TO
ASSESS REFUGEES IMPACT
ON THE NATURAL ENVIRONMENT
OF WESTERN AND SOUTHERN ETHIOPIA**

**Ethiopian Mapping Authority
&
UNHCR-RLO**

I. GENERAL BACKGROUND

- ◆ The study area is located in western and Southern Ethiopia
- ◆ Topography ranges from plains to undulating ridges.
- ◆ The region extends from Blue Nile to Lake Rudolf (at the border of Kenya)
- ◆ Drainage system is known for large number of steams, rivers and ponds.
- ◆ Western Ethiopia is mostly covered by Tropical Rain Forest (TRF)
 - The remaining 2.5 % Forest coverage of the country is mainly found in this region
 - In addition to high forests, vegetation type includes woodland, grassland, drainage system, and associated biodiversity.
 - National parks and game reserves are habitats for diversified wildlife such as elephants, lions, giraffes, buffaloes, birds, amphibians and etc.
- ◆ Human population density is lower in comparison to the central high lands due to environmental factors.
- ◆ Since the 1980's large number of refugee from the Sudan and few from Uganda have got an asylum in the region.
 - At the very beginning the refugee population population was estimated to be more than 200000
 - Recently the number is lowered to 70000
- ◆ Concerning their background:
 - Most of them are agrarian, pastoralists, and hunters or use supplementary.
 - Some of them have large number of livestock, that requires sufficient grazing area.

II. OBJECTIVES OF THE STUDY

- ◆ **To assess, investigate and appraise environmental issues caused by long time presence of refugees**
- ◆ **To analyse the extent of impact on the physical environment using remote sensing and GIS in practical and quantitative approach.**
- ◆ **To provide with appropriate and quantitative information for decision-makers and planners concerning the current environmental impacts and related related.**

III. METHODS AND MATERIALS

3.1 METHODS

- ◆ **Collection of appropriate remotely sensed data (especially satellite images) and related geo-information such as topographic and thematic maps and other attribute data /information**
- ◆ **Collection of time series data since 1998**
- ◆ **Analysing environmental condition of the study area using old time aerial photographs**
- ◆ **Capturing of the data /information through digital techniques such as:**
 - **Importing of image and other files**
 - **Digitising**
 - **Scanning**
- ◆ **Digital Image processing of multi-temporal remotely sensed data using appropriate techniques and relevant software**
- ◆ **Ground truthing**
 - **Field data collection and verification**
 - **Accuracy assessment**

- ◆ **Identifying major and most sensitive environmental impact indicators such as:**
 - **Vegetation**
 - **Climate**
 - **Soil**
 - **Land use /cover**
- ◆ **Integrating multiple-source data with the aid of Geoinformation /GIS techniques**
- ◆ **Analysing the extent of refugee and related environmental impacts**
- ◆ **Recommendations and suggestion based on the output of Remote Sensing and GIS**
- ◆ **Preparation of technical report, and out put maps.**

3.2. Materials

3.2.1. Data

- ◆ **Satellite images**
 - **Landsat TM Images of 1988 and 1998**
- ◆ **Topographic Maps**
 - **1:50,000**
 - **1:250,000**
- ◆ **Thematic maps**
 - **Soil, land suitability, Vegetation distribution, Land use with the scale of 1:200000 on land use /suitability**
- ◆ **Aerial Photographs of the 1960s**
- ◆ **Attribute data**
 - **Population /Human**
 - **Livestock**
 - **Soil**
 - **Vegetation**

3.2.2. Software Applied

- ◆ ERDAS Imagine Ver. 8.3
- ◆ ARC Info Ver. 7.0
- ◆ Auto CAD 14

3.2.3. Equipment

- ◆ Digital Image Processing systems
 - Scanners
 - Digitizers
 - Computers
 - Plotters
 - GPS
 - All relevant facilities from different departments of the Ethiopian Mapping Authority (EMA)

IV. GEO-INFORMATION PROCESSING AND Information EXTRACTION TECHNIQUES

- ◆ Time series data analysis
- ◆ Supervised Classification of the two years images
- ◆ NDVI analysis of the two years images
- ◆ Topographic and infrastructure analysis Information
- ◆ Change detection by comparing
 - Pre -Refugee settlement
 - Post-Refugee Settlement

V. REFUGEE RELATED ENVIRONMENTAL IMPACTS

- ◆ Deforestation because of :
 - Site selection
 - Expansion of arable land
 - Shifting cultivation practice
 - Traditional hunting especially using fire
 - Search of fuel Wood
 - Infrastructure development
- ◆ Over grazing and non-systematic traditional pastoral farming
- ◆ Hunting and eradication of wildlife
- ◆ Water pollution especially because and dumping of solid and liquid wastes into the main rivers.
- ◆ Soil erosion-by wind and run off water
- ◆ Air pollution because of smokes which comes form forest burning charcoal making cultivation, traditional honey harvesting etc
- ◆ Overall impact on the eco-system and biodiversity.
- ◆ Micro- climatic change (Needs further analysis)
- ◆ Change on Land use/cover system : For example conversion
 - from natural forest, wood land and or grass land to:
 - ➔ open area
 - ➔ grazing area
 - ➔ settlement /camps
- ◆ Interest of locals (indigenous) people to exploit natural vegetation to supply some demands of the refugees such as: : Charcoal , Fuel-wood, Fish and etc.

VI. IDENTIFICATION OF MAJOR PROBLEM AREAS AND PRIORITY SETTING

- ◆ Areas very near to the camps are found to be badly affected and environmentally degraded.
- ◆ Expansion of degraded area and change of physical environment continuous until the refugee return to their homeland or alternative solution is found.
- ◆ Some types of species of fauna and flora are found to be more exposed to the extent of extinction

Example-

- Trees useful for timber, canon making, domestic materials production, medicinal plants and etc.
- Wildlife like elephant, buffalo, gazelle, ostrich, and etc.
- Uncontrolled fishing from fresh water (ex. Lake Tata, Baro rivers) has been affecting fish population as a whole and specific species.

VII. BENEFITS GAINED FROM THE SPACE TECHNOLOGY MULTI-SPECTRAL IMAGES LIKE LANDSAT TM AND SPOT-XS)

- ◆ Different types of Feature identification with high radiometric resolution (8 bit data)
- ◆ Regional overviews : From a single scene of Landsat TM image three camps of Sherkole, Bonga, and Pugnido can be studied
- ◆ Multi-temporal data analysis
- ◆ shorter time for image processing and accomplishing of the whole project
- ◆ possibility of integration of multiple source environmental data /information and so on.
- ◆ Least cost in many aspects and so on.

VIII. CHALLENGES FROM THE REMOTELY SENSED DATA POINT OF VIEW

- ◆ shortage of time series data of the same date and or season/may be because of demand
- ◆ spectral value similarity of different features:
 - Example:
 - Riparian vegetation -VS-grass
 - Deciduous forest VS exposed soil settlement
 - Degraded area -VS- Trees with Shaded leaves
 - Dry Grass -VS- Bamboo forest in the dry seasons and so on
- ◆ Difference in spectral value of identical features due to
 - topography
 - age
 - height of the vegetation and etc.
- ◆ Limitation of digital image processing software/ i.e. dependency only on the tone /texture, spectral value.
- ◆ Problems from the suppliers point of view.
- ◆ That created problem on both, digital image classification and visual interpretation

Table 3: Comparison of Land Use Cover features Pre and Post Refugee

| Bonga | | | | Dimma | | | | Pugenido | | | | Sherkole | | | |
|---------------------------|------------------|------------------|----------------|------------------------|------------------|------------------|----------------|--------------------------|------------------|-------------------|----------------|-----------------------------|------------------|-------------------|-----------------|
| Class Name | Area(ha) in 1990 | Area(ha) in 1997 | Area Diff.(ha) | Class Name | Area(ha) in 1989 | Area(ha) in 1997 | Area Diff.(ha) | Class Name | Area(ha) in 1988 | Area (ha) in 1997 | Area Diff.(ha) | Class Name | Area(ha) in 1995 | Area (ha) in 1997 | Area Diff. (ha) |
| Wood land | 25547.1 | 19475.4 | -6071.7 | Scattered trees | 21466.2 | 17915.9 | -3550.3 | Wood land | 9901.9 | 5615.6 | -4286.3 | Cropland | 10792.4 | 10331.5 | -460.9 |
| Scattered trees | 15523.8 | 22008.4 | +6484.6 | Wood land | 5939.3 | 4027.3 | -1912.0 | Forest | 6704.0 | 1381.9 | -5322.1 | Bamboo | 25979.8 | 19600.7 | -6379.1 |
| Riverine trees/vegetation | 906.9 | 866.6 | -40.3 | Bare area / settlement | 3413.0 | 4999.0 | +1586.0 | Bush / Scrub land | 26769.4 | 29384.9 | 2615.5 | Wood land | 8905.7 | 5966.6 | -6939.1 |
| Forest | 14838.7 | 12518.8 | -2319.9 | Bush / Scrub land | 12483.7 | 16351.7 | +3868.0 | Burned Bush / Scrub land | 53151.5 | 1176.3 | -51975.2 | Riverine trees / Vegetation | 2165.7 | 5544.1 | +3378.4 |
| Bare land | 6378.08 | 4176.2 | 2201.8 | Forest | 21.6 | - | -21.6 | Bare area / settlement | 4091.5 | 5553.6 | 1462.1 | Burned area | 9278.3 | 13601.2 | +4322.9 |
| Water | 153.2 | 155.6 | 2.4 | Cloud / Shadow | 25.0 | 75.2 | +50. | Grass/ Swamp | 3734.37 | 2104.2 | -1630.17 | Scattered trees | 14462.2 | 18575.2 | +4113.0 |
| Cloud Shadow | - | 3987.1 | - | | | | | Water | 194.3 | 431.5 | +237.2 | Bush / Scrub land | 5203.6 | 8220.2 | +3016.6 |
| | | | | | | | | Cloud / Shadow | - | 524.5 | | | | | |

Table 4 Priority areas, based on problems , effects, possible solutions and measures to be taken.

| Study Area | Priority area of consideration | Type of problems | Effects | Possible Solution and measure to be taken |
|------------|---|---|---|--|
| Bonga | Pa-1 (Area in the settlement and surrounding) | deforestation (vegetation clearing, settlement, farming, construction, fuel wood, etc) | - erosion (gully) | - reforestation - erosion protection |
| | Pa-2 (the vicinity area is East. south and West directions from the camp) | Deforestation for farming fuel wood, construction, burning etc.) | - gully erosion, escaping of wildlife | - reforestation - erosion protection |
| | Pa-3 (area in the West and South west of the camps related to formerly settled refugees and SPLA. | - Cutting trees for construction and fuel wood - Burning (wild tree) | - Erosion wild life migration | - Protection |
| Dimma | Pa-1 (area of settlement and its immediate surrounding) | - Clearing vegetation for settlement, fuel wood, construction | - Gully and sheet erosion | - afforestation - soil conservation - protection |
| | Pa-2 (the area beyond Guracha river and it surrounding) | - vegetation clearing for farmland, fuel wood, construction | - Gully and sheet erosion | - reforestation - protection |
| | Pa-3 (area north of the camp) | - tree cutting for fuel wood, construction | | - protection |
| Pugnido | Pa-1 (the area of settlement and the immediate surrounding) | - deforestation for settlement, construction, fuel wood, farming burning. | - erosion and lose of shelter for wildlife | - reforestation - protection |
| | Pa-2 (the area in near vicinity and South and south east of the Camp) | - vegetation clearings for fuel wood, farming, construction and burning | - soil exposition for erosion, wildlife eradication | - reforestation - protection |
| | Pa-3 the rest of the area in the east north eastern and south eastern parts of the camp | - tree cuttings for fuel wood construction - Effected low densities of trees lose of shelters for wild life etc. | - low densities of trees lose of shelters for wild life etc. | - Protection of the area from human influence |
| Sherkole | Pa-1(the area around sherkole river and Kibur Hasmsa town, on the way to Komosha town) | - vegetation clearing for farm land, fuel wood and construction | - effected in soil exposure for erosion | - tree planing - Protection |

RECOMMENDATIONS

- ◆ **Preplanning and Especial attention for camp site selection mainly by applying remotely sensed data and geoinformation techniques.**
- ◆ **Natural forest reservation program should be applied by all concerned groups**
- ◆ **Environmental education. Although it takes longer time, it is very important to change the bad habits of hunting wildlife and clearing forest of indigenous people and the refugees Curriculum on environmental management and protection can meetings and belongingness concept have to be given both for the refugees and indigenous people.**
- ◆ **Afforestation of the already deforested areas by the indigenous trees has to be given due attention. Because these areas are the remaining less than or equal to 3% of the natal forest area, a special care and protection have to be given. But reforestation by exotic tree is not recommendable because it affects the natural balance of the original ecological system.**
- ◆ **Environmental monitoring using remotely sensed multi-temporal data and GIS need to be applied extensively as it is the best tried method/tool for the mitigation of environmental and related problems.**
- ◆ **Application of high resolution satellite images for planning and decision making of the refugee environment found to be very essential**
- ◆ **The spectral reflectance of different features of the Ethiopian environment needs further analysis when using the multi-spectral images due to its heterogeneous nature**
- ◆ **Soil conservation mechanisms and practice should be developed especially in Dimma, Sherkole and Bonga areas where the drainage density is so severe and the soil is already exposed to erosion.**
- ◆ **Developing and applying early warning system. This helps to give especial attention for environmentally sensitive areas.**

- ◆ **Providing the refugees with alternative material to build their houses, like tin sheets, building materials, plastics etc. might reduce the consumption of natural resources. The refugees hunt wildlife and clear natural vegetation for daily use and survival case. But to decrease their very dependence on the immediate environment, a regular and sufficient provision/supply of food, shelter, clothing, energy, medication, schooling etc. has to be made. Shelter and energy are the very important elements connected to the environment..**
- ◆ **A co-ordinated effort of all the concerned institutions such as the UNHCR-RLO, ARRA and the Regional Administration and so on plays decisive role in the protection of the environment. Refugees related environmental problems should not be left only to ARRA and UNHCR; other who are related to this directly and indirectly should be initiated to participate in this respect.**
- ◆ **Successive studies and monitoring have to be made in the areas of that a successful environmental management, use and protection can be practised and a sustainable environment exists.**
- ◆ **Similar studies and measures have to be made in other areas where refugees are staying because they are under similar or worst conditions with the areas under current study.**

