THE USE OF REMOTE SENSING FOR ENVIRONMENTAL IMPACT ASSESSMENT AND DETERMINATION OF THE AREA AFFECTED BY REFUGEES IN NGARA DISTRICT NORTH WESTERN TANZANIA.

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ABSTRACT:
A multi-temporal satellite data along with other collateral information have been used to assess and monitor the environmental changes experienced by the area severely affected by refugees influx in Ngara district which is bordering Rwanda and Burundi countries. Since 1994 approximately 800000 refugees settled in the Ngara district refugee camps which covers the area of a radius of 10 to 15 km circular area around the camps, causing adverse environmental hazards which include, deforestation, soil erosion and water pollution. It was found that Musuhura, Rumasi, Lukole and Benako camps with their surrounding area covering 95000 ha, helped significantly in registering the deforested area in the watersheds. The environmental Impact Assessment (EIA) studies suggest that the forest loss which occurred during the period of 4 years has reduced forest regeneration for 35%, indicating that a deforested area will require at least a couple of years to rejuvenate within the respective camps. The analysis of the remote sensed data form the basis for planning for containing environmental impact and sustainable natural resources development planing strategies. The results of the use of satellite imagery shows the effectiveness, cost reduction and due to the use of the technique and especially greater accuracy and reliability.

1.INTRODUCTION:
In 1994, more than 100000 Rwandan refugees started to settle in large refugee camps in Ngara district, North-western Tanzania. Different camps were opened in the district. These camps have had considerable impact on the environment of the area. As a result the higher number of refugees, concentrated in a few area causing severe strain on the natural vegetation, soils and wildlife.
The immediate and enormous needs of wood by the refugees for fuel and construction of shelters as well as their use of grass in a big quantities especially for roofing have had a dramatic impact on the vegetation as a consequence arose the problem of deforestation.
A direct result from the refugee presence are signs of an increasing process of land degradation. The area around the refugee camps are virtually devoid of wood vegetation and there are signs of considerable soil erosion.

2.OBJECTIVES:

The study was intended to estimate the area "damaged" (deforested area) by refugees in the Ngara district between July 1994 and August 1996 in order to provide accurate information for rehabilitation and natural resources development planning for similar crisis.

3.THE STUDY AREA:

3.1 Location:
Ngara district is located between longitude $30^o15'$E and latitude $2^o10'$ and $3^o0'$S. The altitude ranges between 1,320m (the level of River Kagera) to about mean sea level.

3.2 Geology:
The district is predominated by pre-cambrian rocks of the Karagwe - Ankolean system. The main rock types are phillites, phllitic shales and mixed quartzites. Many parts have remnants of old landscapes which are characterised by laterites caps. Some parts have few granitic rocks.

3.3 Drainage:
The district has major rivers; the Kagera which marks the north-western border with Burundi and Rwanda, the Ruvubu river which flow around the southern border and crosses the district to join Kagera river. Also there are perennial and seasonal rivers and springs which are marked by the numerous valley bottoms across the district.

3.4 Rainfall:
The rain decreases from north-west to the south-east, ranging from approximately 1300mm to 700mm in the drier southern part of the district. The rainfall pattern shows a distinct dry season from June to September. However, there is a big variations in rainfall amount mainly due to high relief intensities, and consequent rain shadow area.

3.5 Phsiography:
The district falls in a series of dissected plateau at different altitude levels. Subsequent erosion and dissection has resulted into hills and valleys.

3.6 Vegetation:
The natural vegetation types in the district include, riverine forest, wooded grassland, bushed grassland, grasslands and the poorer drained parts of the minor valleys. Grasslands are characteristic of the area with shallow soils such as scarps and hill tops. Riverine forest is restricted to some parts of the Ruvubu river and the northern part of the district. Bushed and wooded grasslands are found all over the district.

3.7 Land use:
The main land use types of Ngara district are uplands agriculture, wetland agriculture, silviculture game reserve and livestock.

3.8 Soils:

Most of the soils of Ngara district have either dark reddish to red or brown to yellowish red clayey subsoil. Top soils have a wide range of characteristics in terms of thickness, field impression or organic matter content and texture.

4.METHODS:

The study used satellite images, Geographical Information Systems (GIS) and Global Positioning Systems(GPS) to collect useful information and to analyse the environmental impact of the refugees influx or affected by deforestation. To measure with accuracy the impact of the refugees on the natural resources (deforestation) since their arrival.

As a firs step a lad cover map of the region before refugees impact was established. This was produced using a satellite image of 1994. Two sets of (30m by 30m) were used to which was taken before the refugee influx (1994) an another one of which was taken after the refugee influx (one of two years after).

To complete a set of data required for analysis, an air flight was carried out to take some aerial photographs. Aerialphoto of 1:25000 and a satellite images (Colour TM composite Landsat TM 453) interpretation was done concurrently in order to assess the land cover changes during a period of refugees settlements.

Afterwards, a second set of image taken two years after (1996) was compared to the 1994 land cover map. This made possible to assess the area affected by refugees deforestation..

5.RESULTS:

5.1 Impact in terms of area damaged by deforestation .

The interpretation shows that deforestation area over a period of two years can be put in two levels of affected area; high, middle and slight. This makes possible the relation between these levels and cut trees.

- high: 70% to 100% of the cut trees;
- moderate: 30% to 70% of the cut trees.
- slight 0% to 30% of the cut trees.

The attribute of deforestation levels is determined by the photo interpreter. This can be done accurately for forest gallery and the areas where the natural vegetation is visible in 1994, 1995 and 1996. In burnt area it was not possible to interpret deforestation levels.

5.2 Accuracy:

There is high degree of accuracy for those areas which were initially covered by savannah. Of different factors which are believed to have been contributed to reduction of accuracy include;

- the impossibility to recognise the vegetation types in areas affected by bush fires and therefore areas cut by refugees.
- the deforestation caused by the local population between 87 (aerial photographs) and the refugee influx;
- the deforestation caused by the local population between 94-96.

5.3 Surroundings of the refugee camps;

The original vegetation (savannah and forest gallery) inside and around camps, within a radius of 2km from the camps, have been clear felled. The damages decrease further away and the limits between two levels of deforestation become diffuse.

6.CONCLUSION:

It is difficult to distinguish at smaller resolution of (30m*30m) of an image in this regard a large scale aerial photo interpretation remain the best technique. It is impossible to characterise the vegetation types masked by bush fire. In this case black and white aerial photographs are useful.

Field checking may be required to validate more of this types of interpretation. The tools used in this exercise are of greater importance in determining of intervention in land degradation necessary such as refugee influx.

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