FOREST COVER ASSESSMENT USING REMOTE SENSING AND GIS: A CASE STUDY OF CHAMOLI DISTRICT, UTTARAKHAND, INDIA

Praveen Mishra And Mohan Singh Panwar
Department of Geography,H.N.B. Garhwal University, Srinagar, Uttarakhand, India
mishra.geo@gmail.com

ABSTRACT

Forests are complex biotic systems that are essential links between the land and its inhabitants, more so in the young Himalayas, which are rendered geo-physically unstable due to active tectonic forces that are acting on them. The paper examines the forest diversity and change in forest cover of the Chamoli District of Uttarakhand Himalayas. As forests constitutes about 70 per cent of the area of Chamoli, they are the only natural resources, which can be utilized for development of the Chamoli district, which incidentally happens to be one of the most backward regions of the country. The large percentage of area under forests also makes it important for this non-cash based economy. In the time span of 17 years 1989 to 2006 shows the increase in the forest cover. For the forest cover assessment, the satellite imagery (data) is procured from the Geo Spatial Data Library (GSDL) in digital format. Landsat-TM for October 1989 and Landsat-ETM for November 2004 had been used for the study using Erdas Imagine 8.7 image processing software and the analysis had been done using ArcGIS 9.0. Information about environmental awareness and perception, Forest Institutions as forest panchayats, customaries law and existing traditional knowledge about the forest use and forest conservation, source of livelihood, literacy, female literacy, etc. is to be collected through a pre-printed structured questionnaire. A separate questionnaire is to be prepared for interviewing Government officials and non-governmental officials (NGOs) and other institutions as Panchayats, Mahila Mangal Dal, Youth Mangal Dals, Self Help Groups, Environmental Protection Committees, Forest Fire Prevention Committies, Van Panchayats, Lath Panchayats exsisting in the village to get information about the government's as well as NGO's role in spreading environmental awareness and it's effectiveness.

Keywords:Remote Sensing, Biodiversity, Natural Resource Management, Sustainable Livelihood, Traditional Knowledge and Technology.

INTRODUCTION

Forest Cover Assessment, which means a periodic assessment of forest cover. It provides a quantitative measure of the extent of land area under forest/tree cover along with the density. It helps in monitoring the changes in the cover. Forest cover information serves useful purpose for national and state policy planning. The National Forest Policy, 1988 envisages bringing one-third of the geographic area of the country under forest/ tree cover for maintaining ecological balance and environmental stability.

Forest covers means presence of trees in a given area. Forest density depicts the closeness of tree canopy in a given area. All the lands with a forest cover of trees with canopy density of more than 40 per cent forms closed or dense forest. Open forest implies all the lands with a forest cover of trees with canopy density of five to 40 per cent. The tree cover of less than five per cent density can

be described as scrubland. The changes in forest cover and density in different time periods, in a given area, shows the form and rate of deforestation and regeneration process.

In recent period, Remote Sensing data have become the most basic tool of analysis to assess the forest cover change in any region especially in the Himalayan region. For the forest cover assessment, the satellite imagery (data) is procured from the Geo Spatial Data Library (GSDL) in digital format.

STUDY AREA

The study took place in the Chamoli district of newly formed state of Uttarakhand. Established on the 9th November, 2000. Uttarakhand is the 27th state of India. The Uttarakhand is divided into two regions Kumaun and Garhwal. Chamoli is situated in the Garhwal division. The Chamoli district extends from 29°90' N to 31° 6' N Latitudes and from 79°10' to 80° 15' E Longitudes. It appears like an irregular rectangle in shape with its average breath of 88.57 Km. from east to west and average length of 128.02 km, from north to south, The Chamoli District with an area of 7520 Sq. Km. covers the central and northeastern part of Garhwal Himalaya. It is bounded by China in the north, Uttarkashi Garhwal in northwest, Tehri Garhwal in South-West, Pauri Garhwal in south. Administratively the district is divided into six tehsils i.e. Joshimath, Chamoli, Pokhri, Karnprayag, Tharali and Gairsain. Gopeshwar is the districts headquarter located in the Chamoli tehsil. Subsequently these six tehsil is further divided into nine blocks i.e. Joshimath, Tharali, Deval, Karnprayag, Narayan Bangar, Dasholi, Ghat, Pokhri and Gairsain.

MATERIALS AND METHODS

To acquire accurate information and do a comparative study, of the changes in the forest cover and forest density during 1989 to 2004, study area has been monitored using remote sensing technology. The entire study has been Figurehead through interpretation of False Colour Composite (F.C.C.) on 1:250, 000 scale of 1989 and 2004; obtained from the Landsat-TM and the Landsat-ETM satellite data respectively.

Data collection and preprocessing

The remote sensing data of the October 1989 (Landsat TM) and November 2004 (Landsat ETM) is used for the assessment of forest cover. The period of satellite data is of utmost importance. The reflectance from the forest is dependent on the growth of the crown and its chlorophyll content. A deciduous forest would, therefore, not give proper reflectance in leafless period. Thus, data of the spring/summer season for such forests is not suitable for interpretation. During the rainy season, it is difficult to find cloud free data and similar reflectance of agriculture and similar areas poses problems in delineation of forest cover during this period. Therefore, the data of rainy season is often not suitable for the assessment. The data period suitable for interpretation for most of the forest areas of our country is October to January.

Digital interpretation

For digital interpretation, satellite data is procured in digital form from GSDL. Using Digital Image Processing (DIP) software Erdas Imagine 8.6, the data is downloaded on the computer. Radiometric

and stretch corrections are applied for removing radiometric defects and improving visual impact of the FCC. Geometric rectification of the data is carried out with the help of Global Positioning System (GPS) data, which is collected at the time of fieldwork, for assigning geographical coordinates to the image.

For classification of the data, first the non-forest areas are masked out from the scene by delineating them. SOI toposheets, vegetation map of preceding cycle and ground truth information of the past are used for masking non-forest areas. After masking out the non-forest areas, density classification of the forest cover is done by Normalised Difference Vegetation Index (NDVI) transformation of the masked image. Threshold values for different density classes are determined on the NDVI image and the forest cover is classified accordingly. Shadow areas in the scene are treated separately. Classification of the forest cover is done as dense forest, open forest Scrub Land, Barren/Others and Snow Cover. All these analysis has been done with the help of GIS software like Arc-Info, Arc-View, Auto-Cad, ArcGis.

RESULTS

The paper shows the forest scenario in the assessment year of 1989 to 2004. The time span of 15 years shows the positive change in the forest cover. Total forest cover has increased by 43 per cent in 2004 from 39.9 per cent in 1989. There has been a major change in the dense forest cover. It has increased to 25.37 per cent in 2004 from 19.7 per cent since 1989. The open forest increased marginally by 1 per cent. It was 11.68 per cent in 2004 while it was 10.61 per cent in 1989. The other changes are very low like Barren land reduced by 3 per cent and snow cover also by 3 per cent (Table 1.1 and Figure 1.1 and 1.2) The 56.68 per cent of dense forest have not changed since 1989, one per cent dense forest converted into open forest, 26.77 per cent into scrub land, 15.53 per cent turned into others. The open forest shows the maximum increase, 78.83 per cent of the open forest comes under the dense forest category and 17.25 per cent does not have any change. The scrubland also have the same trend like open forest. 28.42 per cent of scrubland converted into dense forest, 62.54 per cent into open forest and 8.98 per cent to others. Only 0.04 per cent area does not have any change. In the others category 5.79 per cent area converted into dense, 10.84 per cent into open forest and 2.76 per cent into scrubland and 14.02 per cent into snow cover. 4.43 per cent area of snow cover changed into dense and 29.34 per cent into the others (Table 1.2).

Table: 1.1 Comparative assessment of forest cover in the Chamoli District (in Km²)

Class	1989	2004
Dense	1527.06	1965.81
Open	822.51	905.35
Scrub	740.35	503.45
Barren	2902.58	2666.26
Snow	1746.93	1698.58

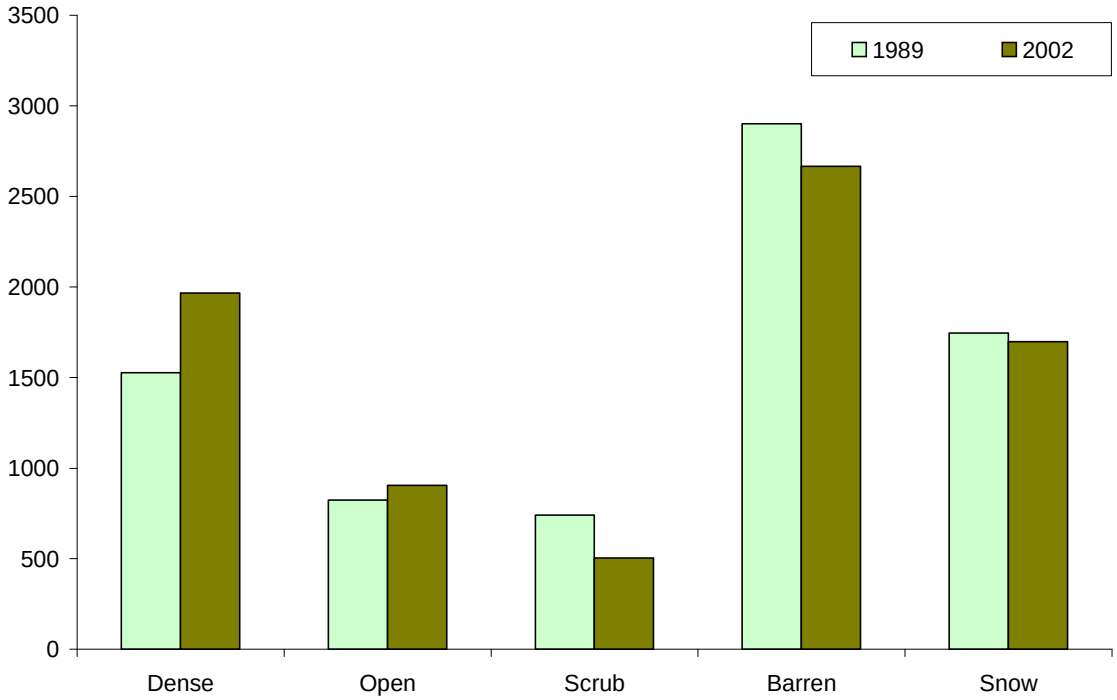

Figure 1.1: Change in Forest Cover area in Chamoli District

Table 1.2: Change in Forest Cover, 1989-2004

Change	Per cent
Dense to Open	1.00
Dense to Scrub	26.77
Dense to Others	15.53
Dense to Snow Cover	0.02
Open to Dense	78.83
Open to Scrub	0.46
Open to Others	3.45
Open to Snow Cover	0.02
Scrub to Dense	28.42
Scrub to Open	62.54
Scrub to Others	8.98
Scrub to Snow Cover	0.02
Others to Dense	5.79
Others to Open	10.84
Others to Scrub	2.76
Others to Snow Cover	14.02
Snow Cover to Dense	4.43
Snow Cover to Open	0.13
Snow Cover to Scrub	0.92
Snow Cover to Others	29.34

The area has shown the increasing trend since 1989. The reason behind this is the development of the area, awareness among the people of Chamoli, economic growth of the people, government policies and initiatives and most importantly participation of the local people in forest management after new forest policy. In this time period the developmental activities has taken place in the area and so is the economic growth. The literacy level has increased, male population has migrated to the plain area for jobs, agriculture has reduced or decreased and the farmlands converted into forestland also helped. The government initiatives of Afforestation, Joint Forest Management and other schemes have increase the forest cover.

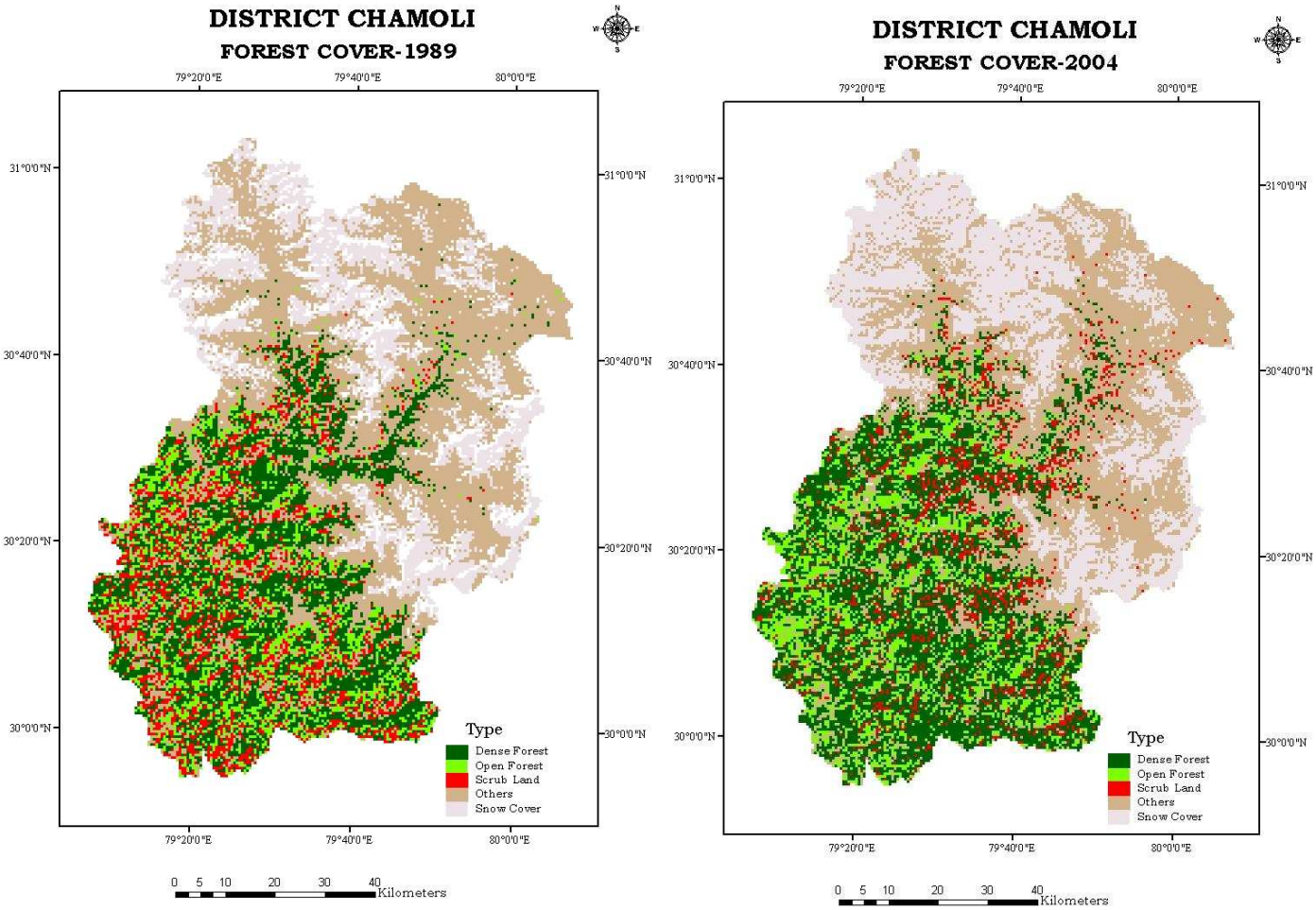

Figure: 1.2: Forest Map of Chamoli District 1989 and 2004

CONCLUSION

Indigenous and traditional knowledge is an integral dimension of all societies but is more intact in areas, such as high-altitude remote Himalayan villages, where inaccessibility and isolation have acted as barriers to outside forces for a long period of time. Temperate vegetation (coniferous forest) is found extensively in the highland and is under used due to inaccessibility. While, in the lowlands and mid-slopes, forests are over used because of high concentration of population. Under

such circumstances, sustainable use of forest resources is inevitable. Forest resource management is also essential to control soil erosion and landslide in an ecologically fragile terrain.

The local people are now more aware towards conservation of their environment and they are actively participating in the different programmes and schemes, which are initiated by the local authorities and forest department from time to time. People of the area also getting the benefits of the development and economic growth. The villages, which are near to road having all modern facilities like LPG, electricity etc. they are now very less dependent of the natural resources. The women of the area are now educated and they are more actively taking part in the conservation of forest resource around them. Due to all these factors, the forest cover of Chamoli has shown regrowth or regeneration.

REFERENCES

Bajracharya, D. 1983a. Deforestation in the food/fuel context: historical and political perspectives from Nepal. *Mountain Research and Development*. 3. Pp. 227-240.

Bajracharya, D. 1983b. Fuel, food or forest? Dilemmas in a Nepali village. *World Development*. 11. Pp. 1057-1074.

FAO. 1985. Monitoring and evaluation of participatory forestry projects. Pub. Policy and Planning Service FAO Forestry Department Rome, 1985. Pp. 1-4.

FAO. 1993. Forest Resources Assessment 1990 -- Tropical Countries. Forestry Paper No. 112. Food and Agriculture Organization of the United Nations: Rome. p. 57.

Franklin, S.E. 2001. *Remote sensing for sustainable forests management.* Pub. Lewis Publishers Washington, D.C. p. 75.

Ramakrishnan, P.S., K.S. Rao, B.P. Kothyari, R.K. Maikhuri & K.G. Saxena. 1992. Deforestation. In: Singh, J.S. (Ed.) *Restoration of Degraded Land: Concepts and Strategies*. Rastogi Publications. Meerut. p. 123.