

Geographical Study of Forest Resources in Renuka Forest Division of Himachal Pradesh Using Geospatial Techniques

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Abstract:

Forests are important source of subsistence, employment, revenue earnings, and raw materials to a number of industries and also play vital role in ecological balance, environmental stability, biodiversity conservation, food security and sustainable development of a region. Forests are the world's air conditioners and the earth's blanket; without them world would be a bleak and inhospitable place. Forests are renewable resource and nature's gift to mankind. The forest eco-system consisting of a variety of flora and fauna representing remarkable bio-diversity is essential for environmental stability and food security. They provide numerous goods and services and maintain life support systems essential for life on earth. The forest resource is under tremendous pressure. Intensified shifting cultivation, indiscriminate removal of timber, fuel wood, fodders and other forest produce, forest fire and encroachment has led to forest degradation and deforestation. The loss and degradation of forest results in soil erosion, loss of biological, damage to wild life habitats and degradation of watershed areas and deterioration of the quality of life. The present study assesses the extent and trends of forest cover in Renuka Forest Division for the periods 1972, 1989, 2001, and 2011

and also provides an overview on the main causes of forest cover change.

Key words: Forest; Ecological balance; biodiversity conservation; food security; sustainable development; Extend; Trends; Forest cover change.

Introduction

Forests are the green blankets that are naturally protecting the hill environment and preserving the natural resources. The recent researches show that the overwhelming population pressure, practicing of unscientific agricultural methods and the lack of awareness about the importance of forests among the populace in general are the prime causes for deforestation and degradation of forests. The rates of depletion, reason for the deterioration and remedial measures to restore it are the essential factors to assess the forest cover in any terrain. The inventory of forest resources and forest cover assessment and change detection in the rugged topography or hill sector is not an easy task and it is a time-consuming process. This can be made easier only through the high spectral, spatial and temporal resolution qualities of remote sensing techniques. Indeed, the precise database pertaining to forest cover information is an imperative input of formulating various management plans and also remote sensing technology can be effectively utilized for change detection and monitoring activities (Jessica et al. 2001). According to Macleod and Congalton (1998), in general, remote sensing considers following four aspects of change detection (a) detect the changes, (b) identify the nature of change, (c) measure the aerial extent of change and (d) assess the spatial pattern of change. Earlier, many researchers have carried out the change analysis through visual or digital interpretation. Forest cover change detection has been done, through visual interpretation

of satellite data by Unni et al. (1985), Roy et al. (1991a,b), Sukumar (1991), Porwal and Pant (1989), Kushwaha (1990). However, the following researchers Jessica et al. (2001), Pradhan and Awang (2008), Sakthive et al. (2010) Bharti et al. (2011), Hansen (2013) and Stibig et al. (2014) have done the forest cover change detection through computer assisted digital image processing (DIP) techniques. The basic principle of change detection through remote sensing is that the changes in spectral signatures commensurate with the change in land cover. The detailed procedure is to superimpose two period maps to find the change (Jessica et al. 2001). Moreover, the process of change detection is premised on the ability to measure temporal impacts (Sabins, 1987). According to Singh (1989), change detection is the process of identifying differences in the state of an object or phenomenon by observing it in different times (multi-temporal variations). It is evident that change detection can be precisely calculated using GIS technology and because of its high volume spatial and a spatial data handling capability. It enables to do overlay process with two or multi vector layers under single umbrella (Bhaduri et al. 2009). Some of the researchers have identified that the increase in vegetation cover has resulted in increased rainfall (Sharma, 2001; Dengiz et al. 2009) and decrease in forest cover has direct relationship with socioeconomic status and marginal worker force (Murali et al. 2002). Forests are a dynamic feature on the land surface. As true for other covers, forests too change in time and space. The changes may be positive i.e., re-growth, plantations etc., or negative such as degradation and depletion of forests due to population pressure other unscientific practices etc.

Study Area

The study area, Renuka Forest Division situated in Sirmour district (**Fig 1.1**). It lies between 77°17'34'' and 77°47'38'' east

longitudes and 30°31'11'' and 30°52'16'' north latitudes. It is bounded on the North by Chopal and Rajgarh Forest Divisions; on the East by Chakrata Forest Division of Uttarakhand; on the West by Nahan Forest Division and on the South by Paonta Sahib Forest Division. The geographical area of the division is 987 sq. km. and forest area of 549 sq. km. There are five forest ranges in Renuka division namely Renuka, Sangrah, Nohra, Shillai and Kafota. The entire tract is mountainous and varies in elevation from 620 metre to 3647 metre msl. The entire region of Renuka Forest Division falls within the catchments of Giri, Sainj and Tons rivers.

Methodology

In the present study, for assessing the temporal changes in the forest cover, the Landsat TM, Landsat ETM+ and Indian Remote Sensing Satellites (IRS) RESOURCESAT-2 were used. Moreover, the forest working plan reports and administrative maps were also taken into account. Digital image processing software Erdas Imagine 10 and ArcGIS 10 were used for the processing, analysis and integration of spatial data to reach the objectives of the study. The final maps which represent the forest cover changes during 1972, 1989, 2001 and 2011 were also generated.

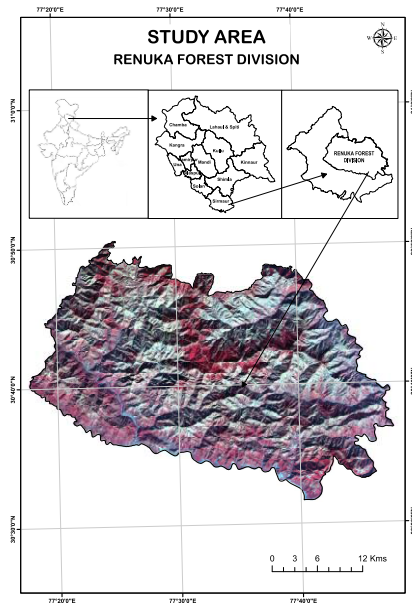


Fig 1.1

Forest Cover of the Renuka Forest Division

The assessment of changes in forest cover, between 1972 and 2011 has been analyzed with the help of remote sensing and geographic information system (GIS) (**Table 1.1**), in the Renuka forest division of Sirmour district. The trend of forest cover changes over the time span of 39 years has been examined.

Table: 1.1 Forest Cover of the Renuka Forest Division from 1972-2011

	Forest Cover 1972		Forest Cover 1989		Forest Cover 2001		Forest Cover 2011	
	Area in Sq.km.	% age	Area in Sq.km.	% age	Area in Sq.km.	% age	Area in Sq.km.	% age
Forest	610	61.80	634	64.24	558	56.53	549	55.62
Agriculture	178	18.03	115	11.65	102	10.33	190	19.25
Open Land/Grass Land/Shrub	190	19.25	230	23.30	320	32.42	242	24.52

Land								
Water Body	9	0.91	8	0.81	7	0.71	6	0.61
Total Area in Sqkm.	987	100.00	987	100.00	987	100.00	987	100.00

Source: Data calculated by author from satellite imageries of Landsat MSS, TM, ETM+ and RESOURCESAT-2

Forest Cover Changes of the Study Area from 1972-2011

In the study area (**Fig 1.2**), forests, which were occupying 610 sq.km in 1972, is found to occupy 634 sq.km in 1989. The forests, which occupied cover in 61 percent for the study area in 1972 increased to 64 percent in 1989. All these observations clearly prove that during the period 1972-1989 forests have increased intensively due to efforts were underway to restore and rehabilitate degraded areas by bringing them under massive afforestation, social forestry and fuelwood/fodder development programs. It also increased due to afforestation programme carried out by forest department mainly in Renuka range (Ghataun), Kafota range (Tatiyana), Shillai Range (Shri Kyari, Chyali, Bhatnaul, Kota pab, Khatva, Milla, Jaswi, Lani, Baror, Dabar, Jarwa, Jakandon, Naipanjanor, Tatwa Beyong), Sangrah Range (Daskana, Taikri, Panjah, Bhaltar, Lajwa, Arat, Ranphuwa, Uncha Tikkar) and Nohra Range (Manal, Chokar, Pipli, Bandal, Shilli, Bhangar, Bhangari, Nohra, Bhog, Charna, Ghandoori, Chunvi and Sail). In these forest ranges Deodar and Kail were planted. However, the natural growth in tree cover has been also noticed during the field survey. In the study area, open land/grass land/shrub land, which occupied 190 sq.km. during 1972 got increased to 230 sq.km in 1989. In terms of percentage, open land/grass land/shrub land, which occupied 19 percent of the study area in 1972, got increased to 23 percent in 1989. Thus it is clear that during the period 1972-1989, open land/grass land/shrub land have increased. This indicates that there was no human interference in the hill ecosystem during this period.

In the year 1989, the forests occupied 634 sq.km, which is about 64 percent of the study area and the open land/grass land/shrub land was 230 sq.km, which makes about 23 percent of the area (**Fig 1.3**). The forests have been decreased to 558 sq.km, 56 percent in 2001. This shows the massive loss of forests as about 76 sq.km area of forests declined during the period 1989-2001. During the period 1989-2001 forests have decreased due to illegal encroachments by villagers and the forest cover in certain region has depleted at a faster rate as a result of over exploitation for meeting the daily human needs of fuel fodder and fibre. The decline in the forest cover has been the result of lopping and chopping for fuel wood and other purposes and growth of roads and other infrastructural facilities.

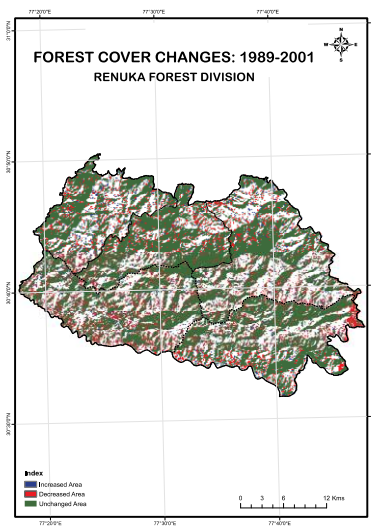


Fig 1.2

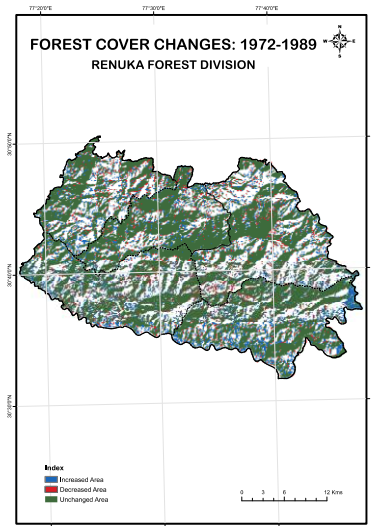


Fig 1.3

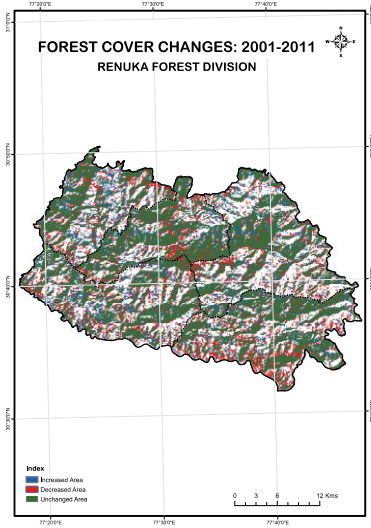


Fig 1.4

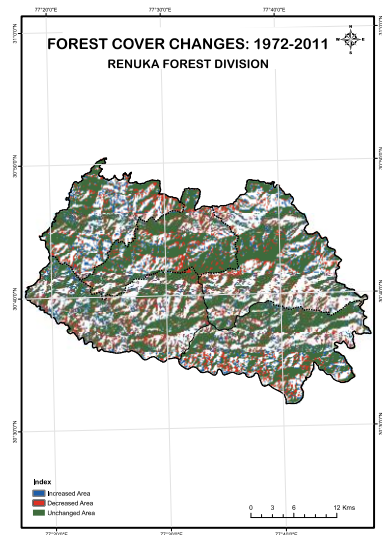


Fig 1.5

However in 2001, open land/grass land/shrub land occupied 320 sq.km, covering about 32 percent of the study area about 90 sq.km area is occupied by open land/grass land/shrub land during the period 1989-2001. The analysis shows that during the period 1989-2001, open land/grass land/shrub lands have increased.

The forests, which were occupying 558 sq.km in 2001, is found to occupy 549 sq.km in 2011(**Fig 1.4**), registering a decline of about one percent to total forest cover. The study reveals that this decline in forest cover may be attributed to intensive agriculture activities emerging due to growing human pressure. The field survey revealed that some of the areas have witnessed large-scale depletion and degradation of forest cover. The mention may be made of Charag, Ganu, Cho Boghar forests in Renuka Range, Khajuri, Jamna Pabar forests in Kafota Range, Balokothi, Koti Bonch, Kharkhan, Loja, Manal, Bandauli forests in Shillai Range and Jamal Nihog, Bhajond forests in Nohra Range. The open land/grass land/shrub land,

has registered a sharp decline from 320 sq.km (32 percent) to 242 sq.km (24 percent) during 2001 to 2011.

It is also inferred that forests cover in the study area has also been notably changed from 1972 to 2011 (**Fig 1.5**). It also indicates that the area under agriculture and human habitation has substantially increased. Extensive damage to forests has been also caused by open grazing of cattle by local people and nomadics, Gujjars coming from lower Shiwalik of Sirmour district and shepherd coming from Kinnaur. These cattle not only damage the new saplings but also make the soil under their hoof compact and prevent new sprouting. Nomadic people practicing transhumance cause widespread damage to hill forests. The construction activities in the form of buildings, means of transport and communication, dams, installed hydropowers and reservoirs and mining and quarrying have adverse impact on the forest lands. Commercial activities like resin extraction, oil extraction, fruit guarding and plantation also lead to massive deforestation. The massive encroachment has reduced the forest to few relict pockets. Due to excessive biotic pressure, heavy exploitation for the purpose of timber, fuelwood extraction, grazing and other local uses, the forest cover has been reduced and many areas are degraded. The forest cover in the region incurred major losses during last decade due to increase in population.

Conclusion

The present study is an integrated approach of remote sensing, GIS and analysis of socio- economic data used for forest cover changes. This study has showed the utility of satellite images and GIS to monitor changes in the forest cover of the study area. The result shows that most of the forest cover has been under the human pressure depleting and degrading its originality over the years. The forest cover changes study is of fundamental significance, as the land resources play a strategic

role in the determination of man's economic, social and cultural progress. In fact the land use of a region is always characterized by the spatial variations and is profoundly influenced by physio-socio-economic factors. The study of forest cover changes in land use is important in the field of geography.

REFERENCES

- Bharti, R.R., Ishwar, D.R., Adhikar, B.S. and Rawat, G.S. (2011): Timberline Change Detection Using Topographic Map and Satellite Imagery: A Critique, *Tropical Ecology*, 52(1): PP 133-137.
- Dwivedi, A.P. (1993): Forests, the Ecological Ramifications, Natraj Publishers, Dehradun, PP 14-15.
- EOSAT (1992): Landsat TM Classification International Georgia Wetlands in EOSAT Data User Notes, EOSAT Company, Lanham, MD, (7)1.
- EOSAT (1994): EOSAT's Statewide Purchase Plan Keeps South Carolina Residents in the Know, in EOSAT Notes, EOSAT Company Lanham, MD, 9(1).
- Hansen, et al. (2013): High-Resolution Global Maps of 21st Century Forest Cover Change, *Science Magazine*, 342 (6160): PP 850-853.
- Hansen, M.J., Franklin, S.E., Woudsma, C. and Peterson, M. (2001): Forest Structure Classification in the North Columbia Mountains Using the Landsat TM Tasseled Cap Wetness Component, *Canadian Journal of Remote Sensing*, 27(1): PP 20-32.
- Jessica, P.K. et al. (2001): Forest Change Detection in Kalarani Round, Vadodara, Gujarat a Remote Sensing and GIS Approach, *Journal of the Indian Society of Remote Sensing*, 29: PP 129-135.

- Kennedy, R.E., Cohen, W.B. and Schroeder, T.A. (2007): Trajectory Based Change Detection for Automated Characterization of Forest Disturbance Dynamics, *Remote Sensing of Environment*, 110: PP 370-386.
- Khullar, D.R. (2010): India: A Comprehensive Geography, Kalyani Publishers, New Dehli.
- Kushwaha, S.P.S. (1985): Environmental Monitoring and Cyclone Impact Assessment on Sriharikota Island, India, Project Report, National Remote Sensing Agency, Hyderabad.
- Kushwaha, S.P.S. (1990): Forest Type Mapping and Change Detection from Satellite Imagery, *ISPRS Journal of Photogrammetry and Remote Sensing*, 45: PP 175-181.
- Kushwaha, S.P.S., Kuntz, S. and Oesten, G. (1994): Applications of Images Texture in Forest Classification, *International Journal of Remote Sensing*, 15(11): PP 2273-2284.
- Macleod, R.D. and Congalton, R.G. (1998): A Quantitative Comparison of Change Detection Algorithms for Monitoring Eelgrass from Remotely Sensed Data, *Photogrammetric Engineering And Remote Sensing*, 64(3): PP 207-216.
- Opeyem, A.Z. (2006): Change Detection in Land Use and Land Cover Using Remote Sensing Data and GIS: A Case Study of Ilorin and its Environs in Kwara State, Msc Thesis, Department of Geography of Ibadan, Ibadan.
- Ota, T. et al. (2011): Influence of Using Texture Information in Remote Sensed Data on the Accuracy of Forest Type Classification at Different Levels of Spatial Resolution, *Journal of Forest Research*, 16(6): PP 432-437.
- Pandey, A.C. and Nathawat, M.S. (2006): Land Use and Land Cover Mapping through Digital Image Processing of Satellite Data- A Case Study from Panchkula, Ambala and Yamunanagar Districts, Haryana State, India.

- Pandian, M. et al. (2014): Land Use and Land Cover Change Detection Using Remote Sensing and GIS in Parts of Coimbatore and Tiruppur Districts, Tamil Nadu, India, *International Journal of Remote Sensing and Geoscience*, 3(1): PP 15-20.
- Panigrahy, S.D. et al. (2010): Timberline Change Detection Using Topographic Map and Satellite Imagery, *Tropical Ecology*, 51: PP 87-91.
- Phong, L.T. (2004): Analysis of Forest Cover Dynamics and Their Driving Forces in Bach Ma National Park and Buffer Zone Using Remote Sensing and GIS, Msc Thesis, ITC, Enschede, the Netherland.
- Phung, T.T. et al. (2014): Impacts of Changes in Mangrove Forest Management Practices on Forest Accessibility and Livelihood: A Case Study in Mangrove- Shrimp Farming System in Ca Mau Province, Mekong Delta, Vietnam, *Science Direct*, 36: PP 89-101.
- Porwal, M.C. and Pant, D.N. (1989): Forest Cover Type and Land Use Mapping Using Landsat Thematic Mapper- A Case Study for Chakrata in Western Himalayas, Uttar Pradesh, *Journal of the Indian Society of Remote Sensing*, 17: PP 33-40.
- Pradhan, B. and Awang, M.A.B. (2007): Forest Fire Susceptibility and Risk Mapping Using Remote Sensing and Geographical Information Systems (GIS), *Disaster Prevention and Management*, 16(3): PP 344-352.
- Roy, P.S and Giriraj, A. (2008), Land Use and Land Cover Analysis in Indian Context, *Journal of Applied Sciences*, 8(8): PP 1346-1335.
- Roy, P.S. (1991a): Tropical Forest Type Mapping and Monitoring, *International Journal of Remote Sensing*, 129: PP 2205-2225.
- Roy, P.S. (1991b): Forest Cover and Land Use Mapping in Karbi Analog and North Cachar Hills Districts of Assam

- Using Landsat MSS Data, *Journal of the Indian Society of Remote Sensing*, 19: PP 113-123.
- Sakthive. R, Manivel, J.R., Pugalanthi, R. and Vijay, A. (2010): Remote Sensing and GIS Based Forest Cover Change Detection Study in Kalrayan Hills, Tamil Nadu, *Journal of Environmental Biology*, 31(5): PP 737-747.
- Stibig, H.J. et al. (2014): Change in Tropical Forest Cover of Southeast Asia from 1990 to 2010, *Biogeosciences*, 11: PP 247-258.
- Sukumar, R. (1991): Long Term Monitoring of Vegetation in a Tropical Deciduous Forest in Mudumalai, South India, *Current Science*, 62: PP 608-616.
- Tansley, A.G. (1920): The Classification of Vegetation and the Concept of Development, *Journal Ecology*, 8: PP 118-149.
- Tansley, A.G. (1947): British Ecology during the Past Quarter Century: the Plant Community and the Ecosystem, *Journal Ecology*, 27: PP 513-534.
- Tiwari, M.K. and Saxena, A. (2011): Change Detection of Land Use/ Land Cover Pattern in an Around Mandideep and Obedullaganj Area, Using Remote Sensing and GIS, *International Journal of Technology and Engineering System*, 2(3).
- Unni, N.V.M. et al. (1985): Evolution of Landsat and Airborne Multispectral Data and Aerial Photographs for Mapping Forest Features and Phenomenon in a Part of Godavari Basin, *International Journal of Remote Sensing*, 6: PP 419-431.