Forest Change analysis of Jim Corbett National Park, Uttarakhand: A remote sensing and GIS approach

Shivani Agarwal 1, Kanchan Puri1, Dr. G Areendran2, Krishna Raj2, Himanshu Govil2, Sraboni Mazumdar2 and Madhushree Munsi2

1 Guru Gobind Singh Indraprastha University, Delhi-110006
2 Indira Gandhi Conservation Monitoring Centre (IGCMC), WWF India, New Delhi-110003

Abstract:
Forest is an important one among other natural resources but due to extreme poverty, the forests here are under the threat of deforestation. For sustainable utilization of the forested ecosystems, it is essential to know the natural characteristics, extent and location, its quality, productivity, suitability and limitations of various land-uses. Land-use is the purpose for which human exploit the land cover. Forest resources are the important material foundation of national sustainable development and it needs to monitor the status and change of forest resources timely for reasonable exploitation of forests and its renewal. Application of remotely sensed data made possible to study the changes in land cover in less time, at low cost and with better accuracy in association with Geographical Information System (GIS) that provide suitable platform for data analysis, update and retrieval. Remote sensing techniques are particularly suited for providing reliable, up-to-date and comprehensive data on land-use/land-cover. The main focus of the paper is to assess the land use/ land cover (LULC) change in Jim Corbett National Park using remote sensing and Geographical information System (GIS). The impact was assessed using an information extraction method applied to IRS LISS III imagery in GIS domain. In this project ARC GIS 9.3 and Arc view 3.2a were used for GIS analysis and ERDAS Imagine 9.3 was used for image processing.

This study highlights the state of forest cover of Jim Corbett National Park. In this study, using satellite imagery IRS LISS III data, Land Use Land Cover, Forest cover change (area wise) from 2000 to 2007 was done. Information on LULC changes give the overall perspective of the landscape characteristics & can be used for monitoring the changes in the forested areas & natural resources.

Keywords: Land use / Land Cover Change, Image classification, Change analysis

About the Author:
Ms Shivani Agarwal, M.Sc. in Biodiversity and Conservation
Pursuing Masters from Guru Gobind Singh Indraprastha University, Delhi and doing M.Sc. Dissertation work at IGCMC, WWF India on the topic “Potential Habitat Mapping for Rhinoceros unicornis (Indian Rhino) in Himalayan Region: A Geostatistical Analysis”. The present work was also carried out in the IGCMC, WWF India during the summer internship.

E mail ID: shivani.2909@gmail.com,
Contact No: +91 – 9911644335
Introduction

India is a developing country experiencing high population growth where unemployment has been exacerbating the overall situation with a great pressure on natural resources. Forest is an important one among other natural resources but due to extreme poverty, the forests here are under the threat of deforestation. For sustainable utilization of the forested ecosystems, it is essential to know the natural characteristics, extent and location, its quality, productivity, suitability and limitations of various land-uses. Land-use is the purpose for which human exploit the land cover (Fresco 1994).

Land-use/land-cover (LULC) pattern is the result of anthropogenic interaction with the natural environment. Besides affecting the quality of life of the people living in the area, it also affects surface run-off as also erosion intensity that control the reservoir life. Resources, ecosystem, biophysical environment, and land-use on the surface of the earth undergo changes over time. It is obviously constrained by environmental factors (e.g. soil characteristics, climate, topography, and vegetation) (McCracker et al. 1998) and human forces (Fernandez et al. 1992) political and economical forces (Medley et al. 1995). Information about land-use change is necessary to update land cover maps and for effective management and planning of the resources for sustainable development (Alphan 2003; Muttitanon et al. 2005). The knowledge of spatial land cover information is essential for proper management, planning and monitoring of natural resources (Zhu, 1997).

Change detection is a process of identifying and analyzing the differences of an object or a phenomenon through monitoring at different times (Singh 1989; Mouat et al. 1993). The application of change analysis to different problem domains e.g. land use/cover change dynamics, global change analysis, monitoring of pressure on the environment, monitoring of agricultural production, assessing damages due to forest fires and deforestation, and monitoring damages due to natural calamities like floods, earthquakes, and volcanic eruption etc. (Anwar 2002). Application of remotely sensed data made possible to study the changes in land cover in less time, at low cost and with better accuracy (Kachhwaha 1985) in association with Geographical Information System (GIS) that provide suitable platform for data analysis, update and retrieval (Star et al. 1997; McCracker et al. 1998; Chilar 2000). Remote sensing techniques are particularly suited for providing reliable, up-to-date and comprehensive data on land-use/land-cover and hence, are particularly useful in developing countries where recent and reliable spatial information is lacking (Dong et al. 1997).

The present study was taken so as to prepare the database of Corbett National Park with the help of toposheets, & to see the changes in the forest cover of the core area, and in the buffer zone of the reserve forest due to factors like encroachments, logging, natural causes etc, with the help of satellite imageries of 2000 & 2007, which could further help in explaining the cause of decline of the wildlife & natural habitat, climate etc.

Study Area:

Corbett Tiger Reserve, the first Tiger Reserve to be established in the country in 1973 under ‘Project Tiger’ includes Corbett National Park, Sonanadi Wildlife Sanctuary and a buffer zone surrounding the National Park and Sanctuary. The reserve, located partly along a valley between the Lesser Himalaya in the north and the Shiwalik in the south, has a sub-Himalayan belt structure. The Corbett Tiger Reserve covering a total area of 1288.32 sq. km. is situated at the southern part of Uttaranchal comprising of Pauri Garhwal, Nainital and Almora districts. This park displays amazing landscapes and diverse flora and fauna. The area extends from 78° 39’ 40” E to 79° 09’ 23” E longitude and 29°48’ N to 29°23’ 32” N latitude. The average altitude of the region ranges between 360 m (1,181 ft) and 1,040 m (3,412 ft). The park receives about 1500 mm to 1600 mm of rainfall mainly during the monsoon though some winter rain always occurs. The temperature ranges between 4°C in winter to 42°C during the summer season.
Fig:1 – Location Map of Jim Corbett National Park, Uttrakhand

Materials and Methodology:

Materials Required:

Satellite data: The satellite images used were IRS 1D LISS III & IRS P6 LISS III of 2000 & 2007 respectively, provided by IGCMC, WWF-India.

Toposheets: Survey of India toposheets numbered 53-K-14, 53-K-10 and 53-K-15 and a paper map of that area, provided by IGCMC, WWF-India, were used.

Software: ERDAS Imagine 9.3, ArcGIS 9.3 and Arc View 3.2a

Methodology:

The toposheets and paper maps were georectified and were used for generating spatial database (Village, Range offices, Rest houses, Gates, Road network, Fire lines, Drainage, Corbett boundary, and Rivers). The georectified toposheets and papers maps were further used for geometric correction of the satellite images.

The images were then used for land use/land cover classification. Ground control points (GCP’s) collected were used for georectification and land use land cover classification. The LULC maps and the spatial database generated were further used for change detection analysis.
Fig: 2 - Flowchart of Methodology

Result and Analysis:

The study area was classified into 10 classes namely Dense forest (with 40% canopy cover), Open forest (10-40% canopy cover), Scrub forest (less than 10% canopy cover), water body, Agriculture, River Bed, Built Up, Open Land, Rocky Exposure, and Grassland using georectified images.
Change Detection Analysis:

Change Detection Analysis compares Land Use Land Cover map of two time periods pixel by pixel to calculate the changes in number of pixel present in each class. The study showed that dense forest has increased over the time whereas open forest area has decreased, which can be due to better management strategies/policies. However, the area under grassland has decrease which may be a threat to tiger habitat. The built up area has also increased due to tourism activities.

**TABLE 1**

Area Statistics of Core Area of Corbett National Park

<table>
<thead>
<tr>
<th>CLASS NAMES</th>
<th>NET CHANGE (sq.km)</th>
<th>Gain/ Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Body</td>
<td>-14.79</td>
<td>Loss</td>
</tr>
<tr>
<td>Dense Forest</td>
<td>90.35</td>
<td>Gain</td>
</tr>
<tr>
<td>Open Forest</td>
<td>-90.55</td>
<td>Loss</td>
</tr>
<tr>
<td>Scrub Forest</td>
<td>36.26</td>
<td>Gain</td>
</tr>
<tr>
<td>Agriculture</td>
<td>-4.49</td>
<td>Loss</td>
</tr>
<tr>
<td>Open Land</td>
<td>-15.52</td>
<td>Loss</td>
</tr>
<tr>
<td>River Bed</td>
<td>7.24</td>
<td>Gain</td>
</tr>
<tr>
<td>Rocky Exposure</td>
<td>-0.22</td>
<td>Loss</td>
</tr>
<tr>
<td>Built Up</td>
<td>0.15</td>
<td>Gain</td>
</tr>
<tr>
<td>Grass Land</td>
<td>-8.34</td>
<td>Loss</td>
</tr>
</tbody>
</table>
Conclusion:

The study highlights the importance of geospatial tools in change detection studies. The present studies show that the dense forest is increased due to the plantation and effective conservation policies. The forest resources of Jim Corbett National park is under pressure owing to the growing tourism activities and hence monitoring of the forest resources is of great importance. Information on LULC changes give the overall perspective of the landscape characteristics & can be used for monitoring the changes in the forested areas & natural resources. Also any change in the forest cover would impact the ecosystem functioning and thus affecting the floral and faunal diversity. The Tiger population might fluctuate with decrease in the grassland area. Therefore it is necessary to monitor the forest cover & the changes in the forest cover for the betterment of the reserve area including the tiger population, also the activities like to control poaching. These inputs are useful to delineate potential conservation area & monitoring parameters in ecologically fragile landscapes. The land use / land cover classification and the forest type classification which also provides the area under each class, could be an essential tool for ecological modeling, proper management of the resources. Also the estimate of forest cover assessed in study, would enables foresters to develop good conservation strategies in order to conserve the forest, if there is any loss of the forest cover.

References:

7. FSI, 2006. An Overview on Projects In Forest Survey of India, Ministry of Environment & Forests (Government of India), Dehradun