Role of Geospatial Techniques for Land Use/Land Cover Change Detection Mapping: A Case Study of Rudrapur Block of Uttarakhand

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Abstract- This present study was conducted to detect land use/land cover changes between 1990 to 2006 using satellite images of Land Sat TM (1990) and IRS LISS-III (2006) and digital topographic maps. The land use/land cover classes in the study area are divided into six categories. The Agriculture land has decreased between 1990 to 2006.There was an increase in built up land. Initially, a land use/cover map for LISS III 2006 image was prepared, and then the same vector layer was displayed over the Land sat TM 1990 images. Redrawing and editing were carried out wherever necessary by studying the respective image. The land use/cover polygon themes for 1990 and 2006, obtained from visual interpretation were converted into grid format and imported to ERDAS imagine as an image file for further analysis. Then the 1990 and 2006 maps were overlaid using matrix function in ERDAS imagine for detecting relative changes. Change matrices were identified from attribute table of the overlaid 1990 - 2006 images. The paper concludes that with the passage of time agriculture land is decreased and built-up area increased due to increase in human population.

Keywords: — RS & GIS, Land use/land cover, Resourcesat-2, LISS-III and Change detection.

I. Introduction

Land surface has always been an area of interest for geographers and researchers working on spatial analysis. Urbanization is the important aspect to study because a major portion of population is shifting from rural to urban. Thus, study of urbanization is of great interest now-a-days. Land use land cover change has become a central component in current strategies for managing natural resources of a region. Urban expansion has brought serious losses of agriculture land, vegetation and water bodies. Land use/land cover (LU/LC) changes are affected by human intervention and natural phenomena such as agriculture, population growth, consumption, patterns, urbanization, economic development, etc. As a consequence, timely and precise information about (LU/LC) changes of the area are extremely important for understanding relationship and interaction between human and natural resources for better planning. Remote Sensing (RS) and Geographic Information System (GIS) technology are providing new tools for monitoring these fast land use changes. Geospatial Techniques are therefore are the most suitable technique to determine Land Use/Land Cover Change in quite short time period and with high accuracy too. This present study was planned using IRS-Resourcesat-2 (LISS-III) data to demarcate land use/land cover change mapping of Rudrapur block of Uttarakhand.

II. Objectives

I. To study the land use/land cover status in study area
II. To analyze the land use/land cover changes from the year 1990–2006 using multi-temporal satellite data.

III. Study Area

Rudrapur is located in the state of Uttarakhand sharing borders with Uttar Pradesh. Rudrapur is a city and a municipal board in Udham Singh Nagar district in Uttarakhand falls under 28°59′N 79°24′E having an elevation of 284 meters (932 ft.). Rudrapur is located in the fertile Terai region. The climate varies from Sub-tropical and sub-humid with three distinct seasons i.e. summer, monsoon (rainy season) and winter. The maximum temperature in the district goes up to 42ºC during the summers and the minimum temperature is between 1 and 4ºC.

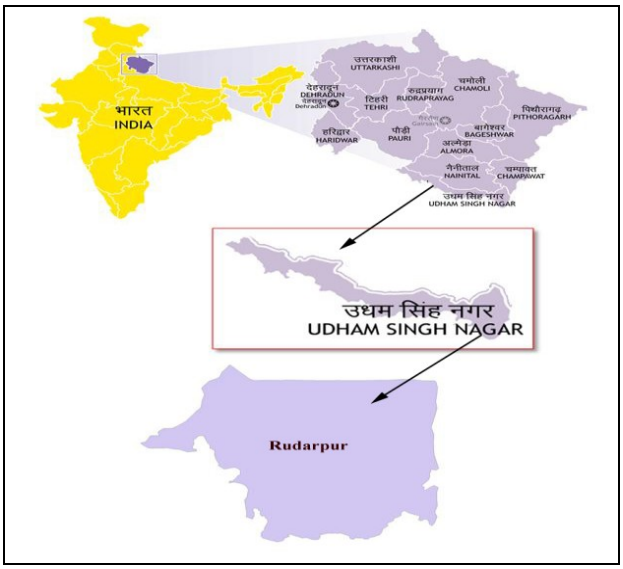

Fig. 1- Location map of Rudrapur block

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IV. Materials & Methodology

The satellite data used in the present study includes Land sat TM image from 1990 and IRS LISS III image from 2006. The ground-truth data required for visual interpretation and accuracy assessment of IRS images was collected from the field in April, 2006. Socio-economic information and natural resource use pattern of the local communities was generated using questionnaire method. The TM and MSS images taken from the Global Land Cover database were radio metrically and topographically corrected. Subsets of the LISS III satellite image were rectified for inherent geometric errors using Land sat data in a modified UTM coordinate system using distinctive features. Besides these satellite images, Quick Bird data was also used for large scale mapping.

4.1 Software Used:

ERDAS IMAGINE 9.3: In this study ERDAS was applied in importing, image rectification and Geo-referencing.

Arc GIS 10: for digitization, preparation of land use/land covers layer and for composition and generation of maps

GPS

4.2 Methodology

The land use/cover polygon themes for 1990 and 2006, obtained from visual interpretation were converted into grid format and imported to ERDAS imagine as an image file for further analysis. Then the 1990 and 2006 maps were overlaid using matrix function in ERDAS imagine for detecting relative changes. Change matrices were identified from attribute table of the overlaid 1990 - 2006 images.

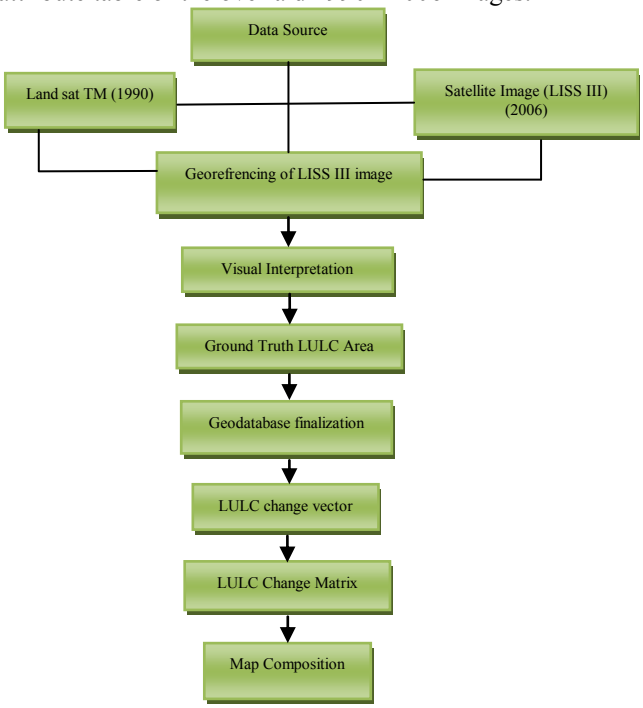


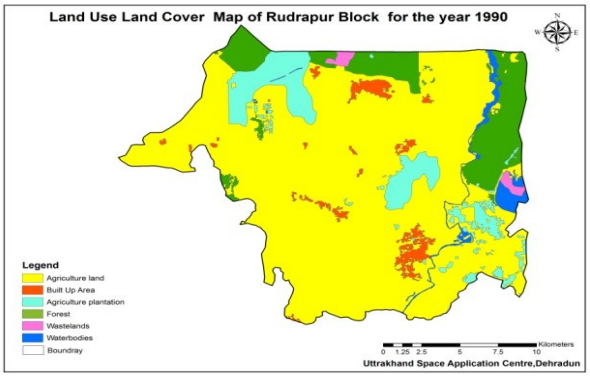
Fig. 2- Methodology flow chart for land use/land cover and change detection.

V. Results & Discussions

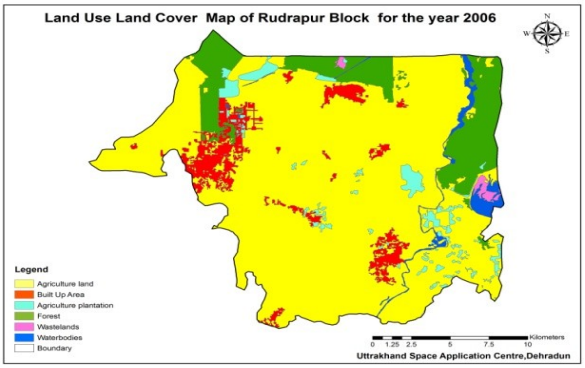
The land use categories such as built up land, agriculture land, agri. plantation water body, wasteland and forest have been identified and mapped from the Land sat TM and IRS LISS III of 1990 and 2006. The change detection is presented in map 3. About 2.32% of the areas were occupied by built-up land during 1990, which increased up to 6.21% in 2006. The area occupied by the agriculture is about 70.93% (1990) and 57.28% (2006). This is due to shifting of agricultural land to built-up. Table 1 shows the change in land use pattern. The land use/land cover of Rudrapur block for the year 1990, and 2006 are shown in maps 1&2. The changes of LULC classes during the 1990 and 2006 are shown in Table 1. Results show that agriculture land decreased during this period due to conversion of agriculture land into built-up area. The change matrix of LU/LC is shows in table 2.

Table 1: Area estimates of Land use/land cover in Rudrapur Block

Class	Year 1990		Year 2006	
	Area (Sqkm)	Area (%)	Area (Sqkm)	Area (%)
Agriculture Land	311.61	70.93	251.63	57.28
Built-up	10.20	2.32	27.26	6.21
Agri plantation	37.66	8.57	84.48	19.23
Forest	67.77	15.43	63.68	14.50
Wastelands	3.12	0.71	3.35	0.76
Waterbodies	8.95	2.04	8.89	2.02
Total	**439.29**	**100.00**	**439.29**	**100**



Map: 1 LU/LC map of Rudrapur Block (1990)



Map: 2 LU/LC map of Rudrapur Block (2006)

Class	Agriculture Land	Built-up	Agri plant	Forest	Wastelands	Water bodies
Agriculture Land	24584.58	1216.57	5363.94	0	0	0
Built-up	0	1019.98	0	0	0	0
Agri. plant	390.47	232.31	3016.99	122.89	0	0
Forest	87.84	257.13	66.75	6345.2	39.91	15.20
Wastelands	0	0	0	0	251.14	23.78
Waterbodies	0	0	0	0	44.35	851.15

Table.2 LU/LC change area estimates of Rudrapur block (1990-2006)

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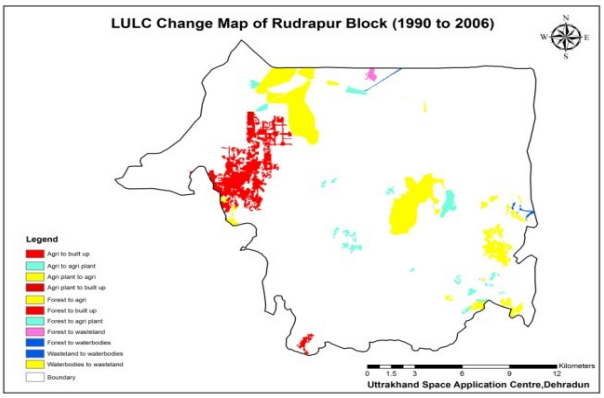

Map: 3 LU /LC cover change map of Rudrapur Block (1990-2006)

V.I Conclusions

Results of this study indicated that patterns in land-use change and the processes threatening the environment in the Rudrapur Block were related. It was observed that (i) agriculture was the principle economic activity that remained in subsistence level showing high dependency on natural resources by the local communities; instead of this due to increase in human population and in search of employment there is a conversion of agriculture land into built-up land and industrial area: (ii) a net decrease in dense forest resulted from agriculture land expansion, forest resources extraction, increasing human and livestock population another human interferences led to the continuous reduction of forest area and their degradation: It also showed relationship of land use change with that of environmental vulnerability during the past 16 years in Rudrapur Block. These findings provide quantitative basis and support for ecosystem.

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