Land Use /Land Cover Change Detection Using Geospatial Technique:A Case Study of Sahaspur Block in Dehradun District (Uttarakhand)

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Abstract-The satellite data used in the present study includes a Landsat MSS image taken in 1976 and IRS 1D LISS III image from 2009. The MSS image taken from the Global Land Cover database was radiometrically and topographically corrected. Subset of the LISS III satellite image was rectified for inherent geometric errors using Landsat data in a modified UTM coordinate system using distinctive features. A land use/cover map for LISS III 2009 image was prepared, and then the same vector layer was displayed over the Landsat MSS 1976 image. The land use/cover polygon themes for 1976, and 2009, obtained from visual interpretation were converted into grid format and imported to ERDAS imagine as an image file for further analysis. Then the 1976 and 2009 maps were overlaid using matrix function in ERDAS imagine for detecting relative changes. Change matrices were identified from attribute table of the overlaid 1976 and 2009 images.

Keywords: LU/LC, GIS & RS, LISS-III Data , Change Detection.

I. INTRODUCTION

Land use/land cover (LU/LC) changes are affected by human intervention and natural phenomena such as agricultural demand and trade, population growth and consumption Patterns, urbanization and economic development, science and technology, and other factors. As a consequence, timely and precise information about Land use/ Land Cover (LU/LC) change detection of earth's surface is extremely important for understanding relationships and interactions between human and natural phenomena for better decision making. Hence, information on land use/land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for monitoring fast land use changes.

Changes in land use and land cover date to prehistory and are the direct and indirect consequence of human actions to secure essential resources. This may first have occurred with the burning of areas to enhance the availability of wild game and accelerated dramatically with the birth of agriculture, resulting in the extensive clearing and management of Earth's terrestrial surface that continues today. More recently, industrialization has encouraged the concentration of human populations within urban areas (urbanization) and the depopulation of rural areas, accompanied by the intensification of agriculture in the most productive lands and the abandonment of marginal lands. All of these causes and their consequences are observable simultaneously around the world today.

Determining the effects of land-use and land-cover change on the Earth system depends on an understanding of past land-use practices, current land-use and land-cover patterns, and projections of future land use and cover, as affected by human institutions, population size and distribution, economic development, technology, and other factors. The combination of climate and land-use change may have profound effects on the habitability of Earth in more significant ways than either acting alone. While land-use change is often a driver of environmental and climatic changes, a changing climate can in turn affect land use and land cover. Climate variability alters land-use practices differently in different parts of the world, highlighting differences in regional and national vulnerability and resilience. LU/LC changes in Sahaspur block have been studied from 1976 to 2009.

II. Objectives

- ✓ To study the land use/land cover status in study area
- ✓ To analyze the land use/land cover changes from the year 1976–2009 using multi-temporal satellite data.
- ✓ To generate land use /land cover and change map of Sahaspur block.

III. STUDY AREA

Dehradun is located at an altitude of 640 meters (2100 ft) above sea level. It is located on the foothills of Shivalik Range. The district is situated in the north-west corner of the state. Dehradun lies between 29°58' and 31°2' 30" north latitudes and 77°34' 45" and 78°18' 30" east longitudes. Total area of the district is 3088 sq km. Summer are warm, winters are very cold but bright and sunny. The district, at present comprises 6 Community development blocks Chakrata, Kalsi, Vikasnagar, Sahaspur, Raipur and Doiwala. This study area falls in Sahaspur block. Sahaspur with a population of approximately 26,472. Lying at an elevation of 1558 m, which makes it a high-altitude city. Sahaspur is 21.47 km distance from its District Main City Dehradun and 21 km distance from its State Main City Dehradun.

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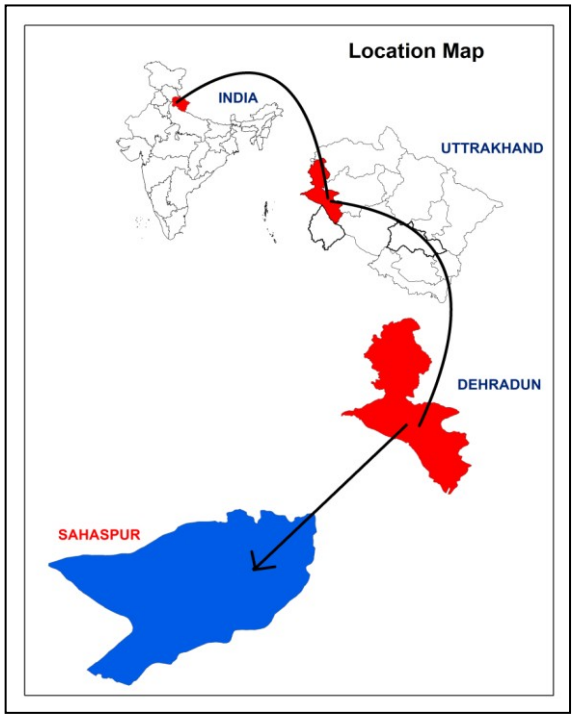

Map 1. Location map of Sahaspur block

IV. Database Requirement

The satellite data used in the present study includes a Landsat MSS image taken in 1976 and IRS 1D LISS III image from 2009. The ground-truth data required for visual interpretation and accuracy assessment of IRS images was collected from the field in April, 2006. The spatial resolution of LISS-III is 23.5 m in Green, Red, NIR and SWIR bands with 24 days revisit time. MSS image taken from the Global Land Cover database were radiometrically and topographically corrected. Subsets of the LISS III satellite image were rectified for inherent geometric errors using Landsat data in a modified UTM coordinate system using distinctive features.

4.1 Software Used

Arc GIS 9.3: Arc GIS 9.3 software was used for preparation of land use/land covers layers and for composition and generation of maps.
Microsoft Office: for database preparation.
Erdas Imagine 9.3 In this study ERDAS was applied in importing, image rectification and Geo-referencing.

4.2 Methodology

The methodology followed was on-screen visual interpretation using interpretation keys like tone, shape, texture, size, pattern and association, etc. The approach of generalization of features by effectively utilizing intensive ground truth information for image interpretation was adopted in doubtful areas. Initially, a land use/cover map for LISS III 2009 image was prepared, and then the same vector layer was displayed over the Landsat MSS 1976 image. Redrawing and editing were carried out wherever necessary by studying the respective image.
Then the 1976 and 2009 maps were overlaid using matrix function in ERDAS imagine for detecting relative changes. Change matrices were identified from attribute table of the overlaid 1976-2009 images.

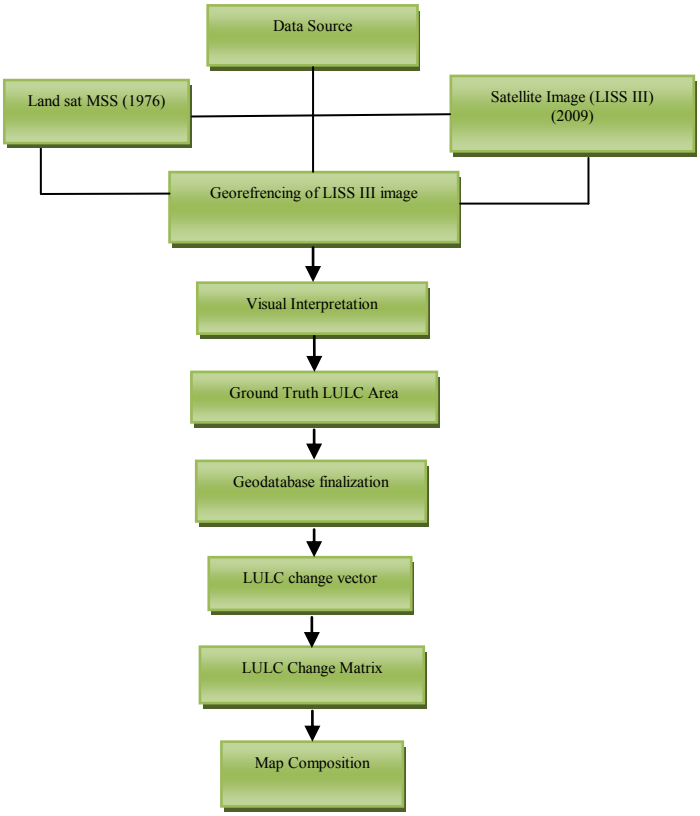

Fig. 1- Methodology Flow Chart

V. Results and Discussion

The land use/land cover maps of Sahaspur block for the year 1976 and 2009 are shown in Map 2 &3. The changes of LULC classes during the 1976 and 2009 are shown in table 1 and LU/LC change matrix table shown in table 2. Results show that Built-up increased during the (1976-2009) period. Agricultural land area decreasing from 1976-2009 due to conversion of agriculture land into built-up and industrial area.

Class	**Year 1976**		**Year 2009**	
	Area		**Area**	
	Sq km	**%**	**Sq km**	**%**
Agriculture	139.61	34.30	138.59	34.08
Agriculture Plant.	0.99	0.24	0.63	0.16
Built-up	16.96	4.16	27.18	6.60
Forest dense	157.33	38.66	179.64	44.18
Forest Plantation	13.65	3.35	9.62	2.36
Forest scrub	36.18	8.89	3.16	0.78
Forest open	16.57	4.07	26.84	6.60
Tree clad	1.88	0.46	2.31	0.57
Wasteland	3.06	0.75	3.23	0.79
Water bodies	20.77	5.10	15.80	3.88
Total	**407**	**100**	**407**	**100**

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

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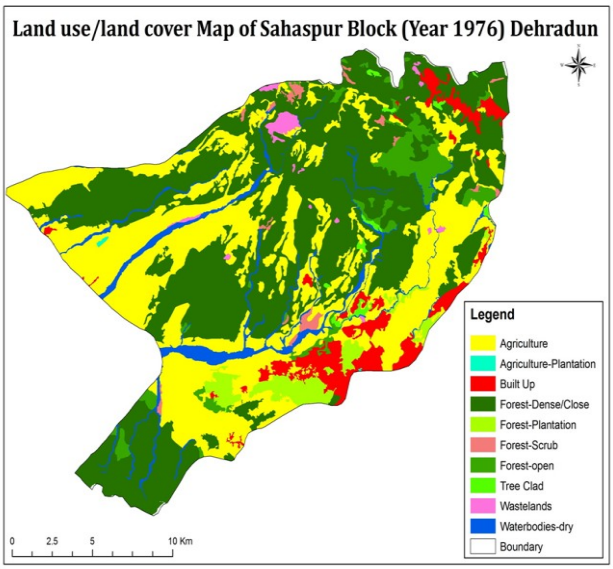
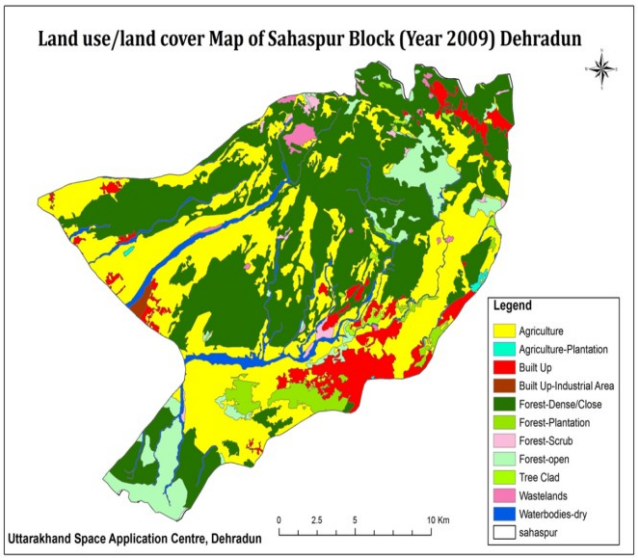
Class	Agriculture	Agri. Plant.	Built-up	Forest dense	Forest Plantation	Forest scurb	Forest open	Tree clad	Waste land	Water bodies
Agriculture	13103.65	0.00	620.18	76.84	8.12	0.00	6.68	5.70	0.00	67.80
Agri. Plant.	0.00	63.82	36.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Built-up	0.00	0.00	1467.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forest dense	186.97	0.00	1.84	14541.29	0.00	12.04	959.56	0.00	0.00	8.47
Forest Plantation	73.50	0.00	387.07	0.00	905.01	0.00	0.00	0.00	0.00	0.00
Forest scurb	0.00	0.00	121.31	3158.38	0.00	290.48	0.00	12.73	6.80	3.74
Forest open	0.00	0.00	7.89	0.00	0.00	0.00	1642.12	7.83	0.00	0.00
Tree clad	2.71	0.00	0.00	4.26	0.00	0.00	0.00	181.27	0.00	0.00
Wasteland	0.00	0.00	0.00	15.49	0.00	0.00	0.00	0.00	290.42	0.00
Water bodies	310.18	0.00	22.46	121.82	0.00	13.36	62.96	23.85	25.86	1496.33

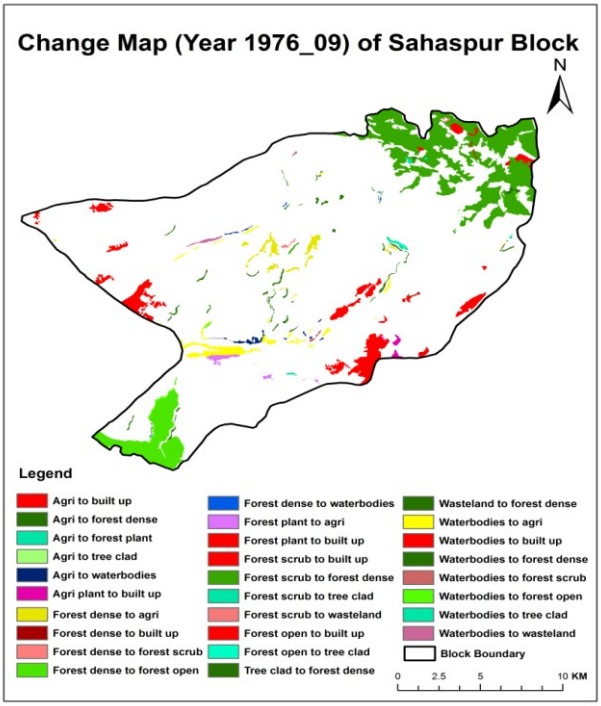
Table 2 LULC change Area estimates of Sahaspur Block (1976-09)



Map 2. LU/LC map of Sahaspur Block (1976)



Map 3. LU/LC map of Sahaspur Block (2009)



Map 4. LU/LC change map of Sahaspur Block (1976, 2009)

VI. Conclusion

The study area has been divided into ten major categories such as Built Up, Agricultural Land, Agricultural Plantation, Forest open , Forest scrub, Forest dense, Forest Plantation, Tree clad Wastelands ,Water bodies. The present study revealed that good Agricultural Land in this block which has been reduced from 139.61 sq km to 138.59 sq km from 1976 to 2009. Most of the area has gone to built up due to fast urbanization. It is suggested that the industrialization and urbanization should be restricted to wasteland or unproductive lands. The built up area has in-creased from 16.96 sq km to 27.18 sq km during these time period. Agriculture was the principle economic activity that remained in subsistence level showing high dependency on natural resources by the local communities; increase in human and livestock population enforced fast and steady expansion of the

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agriculture land: It also showed relationship of land use change with that of environmental vulnerability during the past 33 years in Sahaspur Block. These findings provide quantitative basis and support for ecosystem.

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