LAND USE AND LAND COVER CHANGE DETECTION INGAGAS RIVER VALLEY WATERSHED USING REMOTE SENSING AND GIS

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ABSTRACT

Land use and land cover change is digitally detected by using remote sensing and geographical information system (GIS) techniques. In the present study, theland use and land cover changein the Gagas river valley watershed is quantitativelyanalyzed. To find the change from 1965 to 2008, Survey of India (SOI) toposheets of the year 1965 and LISS III 2008-year data have been used. Supervised classification method with maximum likelihood technique has been used in ERDAS and ArcGIS softwares to categorize the images into three classes, viz., forest, agriculture and barren land. During the last four decades, it was found that due to afforestation in the Gagas river valley watershed the forest cover has been increased by about 8.4 % (or 2.20 km^2) and the agricultural and barren land have decrease by 0.13 % (0.164 km^2)and by 7.3 % (3.864 km^2), respectively.

KEYWORDS: Land use, Land cover, Topography, Remote sensing, GIS

INTRODUCTION

The terms, Land use and land cover are often used interchangeably [Dimyati *et al*., 1996][1].As per[Longley, 2001][2], "land cover refers to the physical materials on the surface of a given parcel of land, while land use refers to the human activities that takes place on or make use of land, e.g., residential, commercial, industrial etc." [Jensen, 2007][3] in his investigation of urban landscape reflect land use as away by which human beings utilize land, while land cover exists as a natural environmental system. Land use and land cover are important factors in understanding the interactions of the human activities with the environment, and thus it is necessary to be able to

simulate changes. By Landsat satellite data and adopting supervised classification techniques, [Prakasam,2010][4]studied the land use and land cover change in the Kodaikanal region of Western Ghats in Tamil Naduto observe changes during a span of 40 years from 1969 to 2008. [Zubair, 2006][5] used remote sensing and geographical information system (GIS) technologies to detect the land use and land cover changes in Ilorin,Nigeria, from 1972 to 2001 through Landsat TM images of 1972, 1986 and 2001, and using maximum likelihood algorithm of supervised classification method to delineatefive land use and land cover classes for the study, i.e., farmland, wasteland, forest, built-up area and waterbodies. Appliying remotely sensed data made possible to study the changes in land cover in less time,at low cost and with better accuracy [Kachhwala, 1985][6]with GIS that provided a suitable platform for data analysis, update and retrieval [Star *et al.*, 1997][7],[Chilar, 2000][8]). In land use and land cover change detection can be performed on a temporal scale such as a decade to assess landscape change caused due to anthropogenic activities on the land [Gibson, 2000][9].In this study, an attempt has been made to map out the status of land use/land cover of Gagas river valley watershed in 1965and in 2008 for detecting the land consumption rate and the changes that have taken place during the last four decades.

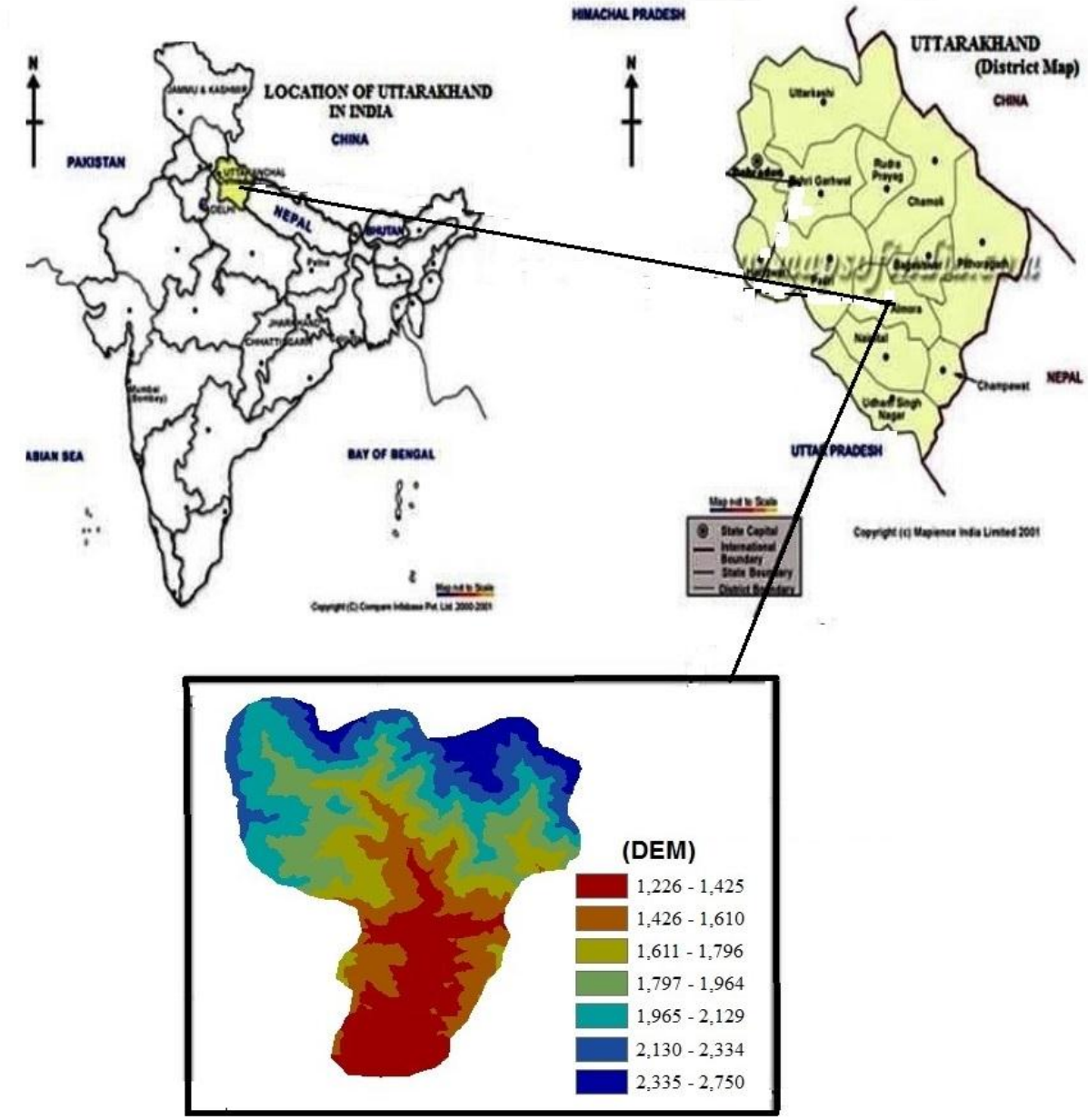

Figure 1: Location map of study area

Study Area

The study area, viz., the Gagas river valley watershed, lies in theLesser Himalayan terrain of Kumaun Himalaya in AlmoraDistrict of Uttarakhand State (Figure 1). It liesbetween 79° 26' 20"–79◦ 31' 50" E long and 29°45' 01"–29° 50' 32" N lat, and encompasses an area of 52.94 km^2. Study area is located enroute to Kausani-Bageshwar road in district Almora of Uttarakhand state.The topography of the region varies from 2750 m above mean sea level in the head reaches in the north-eastern part to 1226 m above mean sea level at the outlet in the southern part of the basin. The average annual rainfall stands at 1160 mm.More than 80% of the annual precipitation in the region occurs during the south-western monsoon, which starts in the third week of June and last upto mid-

October [Asthana, 2003][10]. Of the remaining 15% rainfall is caused by cyclones and 5% by thunderstorms distributed over the rest of the year. The watershed enjoyscool temperate climatic conditions where the temperature varies from above 30° in summer to about -2° C in winter.

Methodology

To work out the change detection analysis, topographical sheets and remotely sensed data are extremely valuable.The Survey of India topographic sheets 53O5, 53O6, 53O9 and 53O10ofthe year 1965 and LISS III satellite data for the year 2008have been utilized for this study. To find out the change from 1965 to2008, i.e., over a period of 43 years, vectorization and digital image analysis were carried out using ArcGIS and ERDAS Imagine software packages. For LISS III satellite data false colour composite (FCC) images were produced using 4, 3, 2 bands. Digital land use/land cover classification through supervised maximum likelihood classification technique was employed to perform the land use classification. The land useland cover classes include forest, barren and agriculture land.

Results and discussion

Land use/land cover status

The results are thematically presentedin Figures 2 and 3 and diagrammatically shown in Figures4 and 5; and given in Table 1. Land use/land cover status of thewatershed for the year 1965, is illustrates by Figure 2and figure 3 depictspattern of spatial distribution of land use/land cover forthe year 2008. This reveal that in 1965, about 23.82 % (or12.61 km^2) area was under agriculture,49.56 % (or 26.24 km^2) area under forest and 26.62 %(or 14.094 km^2) area under barren land. During 2008,the watershed area under these land categories was found to be 23.75 % (or 12.446 km^2) under agricultural land, 56.83 %(or 30.268 km^2) under forest land and 19.42 % (or 10.23 km^2) under barren land.

Table 1. Area under different land use/land cover classes in the Gagas river valley watershed

Land use	1965		2008		Change 1965-2008	
	(Km^2)	%	(Km^2)	%	(Km^2)	%
Agricultural land/River bed	12.610	23.82	12.446	23.75	0.16	-0.13
Forest	26.240	49.56	30.268	56.83	2.20	8.4
Barren/Built up land	14.094	26.62	10.230	19.42	3.864	-7.3

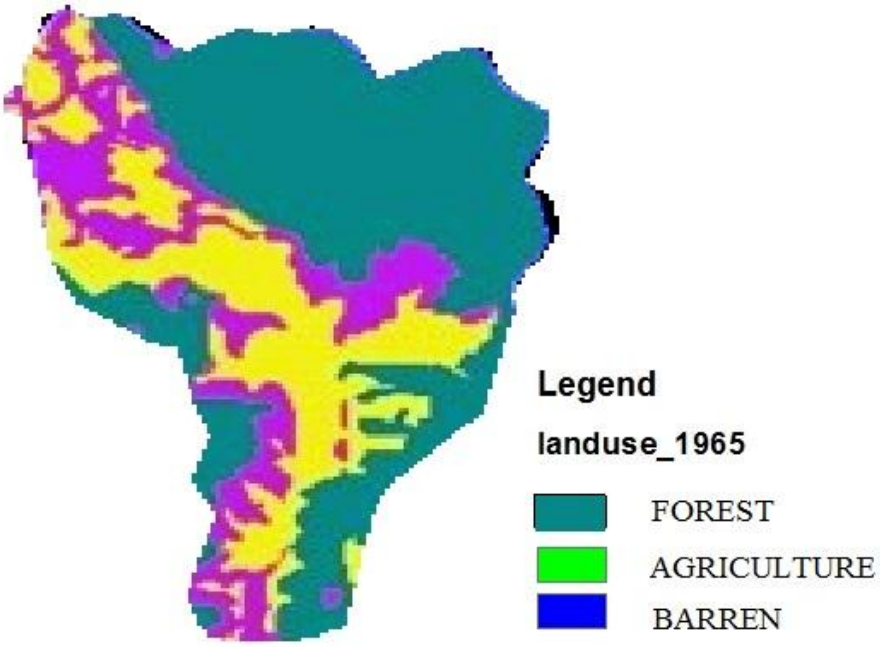

Fig. 2 Land use / land cover map of Gagas river valley watershed during 1965

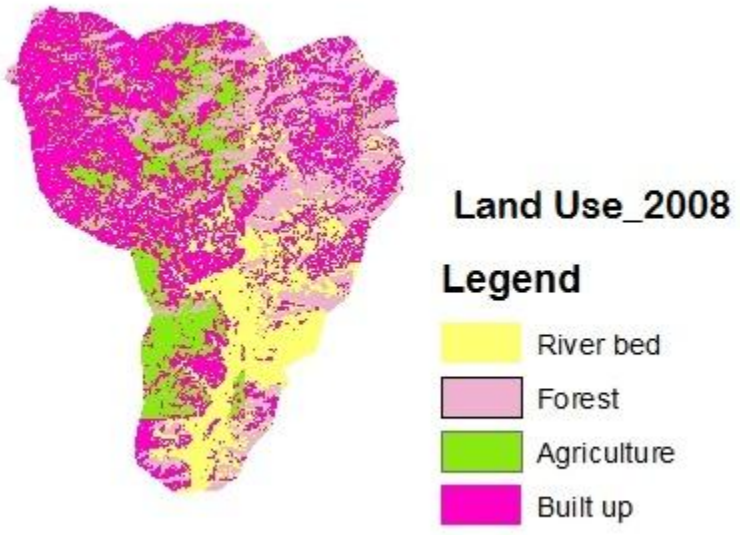

Fig. 3 Land use / land cover map of Gagas river valley watershed during 2008

Land use/land cover change

The data given in Table 1 reveals that both the positiveand negative changes have occurred in the land use/land coverarea of the Gagas river valley watershed. During the last fourdecades, the forest land has increasedfrom 26.24 km^2 in 1965 to 30.268 km^2 in 2008, which is 8.4 % of the total watershed area. The barrenland decreased from 14.094 km^2 to 10.23 km^2 in the period of study. This decrease accounts for 7.3 % of the total watershed area. The agricultural land has slightly

decreased from 12.61 km² to 12.446 km², which accounts for 0.13% of thetotal watershed area (Figure 4 and 5).

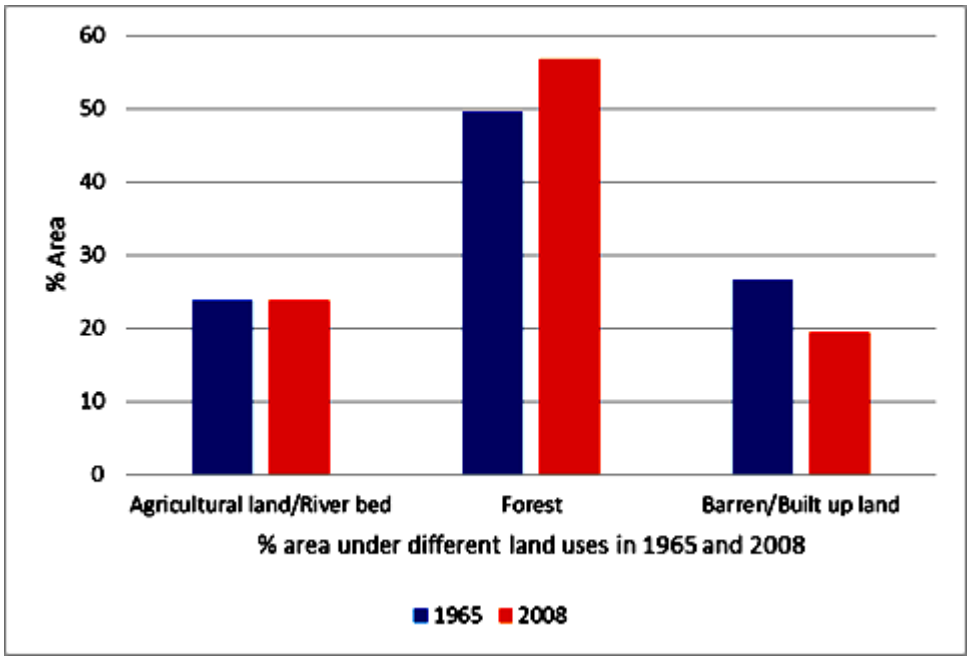

Figure 4: Comparative change in land use and land cover in the Gagas river valley watershed

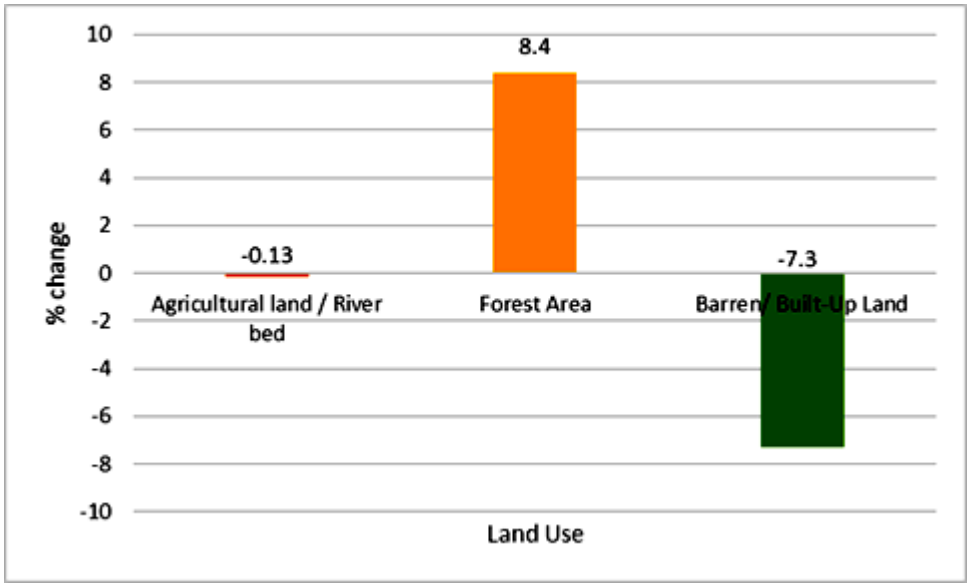

Figure 5: Change in land use/land cover area during 1965–2008 in the study area

Conclusion

The remote sensing and GIS techniques were used to determine the temporal changes inland use/land cover the Gagas river valley watershed in Almora district of Uttarakhand. Land use/land cover change was found through LISS III imagery of 2008 and topographic sheets of 1965. The study revealed that the major land use in the study area was for agriculture. The area under agricultural land reduced slightly, i.e., -0.13% (0.16km^2), due to construction of new buildings on the agricultural land and abundance of agricultural land caused by migration of local people. The barren land, also decreased by 7.3 % (3.864 km^2) which converted into forest land due to afforestation. The area under forest land, has increased by about 8.4 % (3.62 km^2) during the last four decades. Thus, the present study incorporates remote sensing and GIS technologies for temporal analysis and quantification of the spatial phenomena, of land use and land cover change detection which is otherwise not possible to carry out using conventional mapping techniques.

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