International Research Journal of Earth Sciences
Vol. **1(1),** 11-15, April **(2013)** *Int. Res. Earth Sci.*

Land use Land Cover Change Detection Using Remote Sensing and GIS Techniques - A Case Study of Golaghat District of Assam, India

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Available online at: www.isca.in
Received 11th November 2012, revised 3rd January 2013, accepted 24th February 2013

Abstract

Changes in Land use Land cover is a dynamic process taking place on the surface and it become a central component in current strategies in managing natural resources and monitoring environmental changes. Digital change detection is the process that helps in determining the changes associated with land use and land cover properties with reference to geo-registered multi temporal remote sensing data. The objective of this paper is to analyse the land use land cover changes in Golaghat district of Assam. Using multi temporal remote sensing data (LANDSAT ETM 1989, and IRS LISS III 2009) land use land cover changes has been performed. Result shows the change that has been occurred during 20 years of period.

Keywords: Land use, land cover, change analysis.

Introduction

Land is the most important natural resources on which all activities are based. Land use unlike geology, is seasonally dynamic and indeed is more changing. The increase in population and human activities are increasing the demand on the limited land and soil resources for agriculture, forest, pasture, urban and industrial land uses. Information on the rate and kind of changes in the use of land resources is essential for proper planning, management and to regularise the use of such resources[1]. India is facing a serious problem of natural resource scarcity, especially that of water in view of population growth and economic development.[2] As a result Land use Land Cover (LULC) change has become a topic of tremendous interest within the human dimensions of the Environmental change research community[3]. Consequently, quantifying and understanding the extent and spatial distribution of LULC is a crucial importance to the study of Environmental change at various scales[4]. Moreover this type of analysis provides a valuable tool to increase the efficiency of land use and land cover, and to diminish the negative environmental and societal impacts related to LULC. Application of remotely sensed data made possible to study the changes in land cover in less time, at low cost and with better accuracy[5]. Remote sensing technology and Geographic Information System (GIS) provide efficient methods for analysis of land use issues and tools for land use planning and modelling. Analysis of satellite data in conjunction with drainage, lithology, and land use land cover collateral data facilitates effective evaluation of geomorphological conditions and status of degraded landforms. This data set is the core of the Geographic Information System (GIS) that provides an excellent means of spatial data analysis and interpretation[6]. It also provides a powerful mechanism, not only to monitor degraded lands and environmental changes, but also permits analysis of information of other environmental variables[7]. In this present study, an investigation has been carried out in Golaghat district of Assam to detect the land use land cover changes.

Study Area: Golaghat district, the present study area is physiographcally a part of the Brahmaputra valley of Assam covering about 3480 sq. km (figure-1). Although the valley exhibits quite a monotonous landscape, the study area is a combination of landscape with altitudinal variation in the valley itself from flood plain areas of the Brahmaputra and its tributaries through high old alluvium to still higher foot hills areas of the tertiary folds in Nagaland and the Cambrian land mass in Karbi Anglong to the south and to the west respectively. The extension of the district from $25^0$45' N to $27^0$55' N and from $89^0$4' E to $96^0$2' E longitude.

Golaghat district covers an area of 348004.12 hectres with only 6·27 per cent of the Brahmaputra valley. The boundary is demarcated by Nagaland state in the south, Jorhat district on the east Nagaon and Karbi Anglong district on the west and northern limit by the Brahmaputra River. The area is characterized by Tarai belt on the southern part of the district which offers the region conditions congenial for luxuriant forest cover. Nambar Reserve forest, Diphu Reserve forest, Rengma Reserve forest on the southern part and Kaziranga Reserve forest on the western part of the district are the notable seats of Tarai plant growth. The area is characterised also by the presence of a series of swamps and beels along the Brahmaputra River and Dhansiri river.

The annual variation of the mean monthly temperature ranges from 24^0 to 37^0C in the month of August and 10^0 to 32^0C in the

month of January. This condition is very much suitable for crop growth. Moreover the region also receives good amount of rainfall every year. In the month of July it has been recorded as 377 mm, making it an ideal environment for cultivation. According to 2001 census, the total population of the study area is 9,46,279 persons.

Objective: The main objective of the present paper is to analyse nature and extent of land use land cover changes in Golaghat district of Assam in the past 20 years.

Methodology

The base map of the study area is prepared from the Survey of India 1:50000 scale topographical sheets (83F/6, F/10, F/13, F/14, F/15,G/9,J/2,J/3. To make the change analysis of the study area, two images from the satellite LANDSAT ETM and IRS LISS III (path-row: 112-53) 1989 and 2009 is used which is obtained from National Remote Sensing Centre, Hyderabad . Both are acquired between February and April during the dry season. The resolution is 30 metre/pixel in LANDSAT and 23 metre in LISS III image. Digital land use land cover classification through supervised classification method is done to perform the LULC classification in ERDAS IMAGINE 9.1 software environment. Area statistics of each land use category is calculated in hectors in attribute table in ERDAS IMAGINE 9.1 (table-1). Recoding method is also done for converting pixel value into proper class.

This software consists of accuracy assessment tool. The land use land cover map should be in raster format to run this tool. By applying random points in accuracy assessment window we got accuracy report which contains overall classification accuray .In this land use land cover classification, overall classification accuracy is 81%. Ground checking is also done by collecting GPS points to make the confirmation of result obtained for different land use characteristics.

Results and Discussion

The general land use of an area depicts an idea of overall areal utilisation of resources, natural or cultural. In this paper, changes in the land use and land cover of Golaghat district are evaluated from the differences between twenty years of period (1989-2009) in figure-2 and figure-3. The findings of the present investigation are presented in table 1 cited below. The table shows 9 categories of land use i.e. crop land, tea plantation, dense forest, riverine grassland, scrubland, settlement zone, open forest, sand bar and water body. It is estimated from the table that in the year 1989 the region is dominated by scrubland (27.86%) land use type, followed by riverine grassland (20.46%), settlement (17.16%), cropland (7.77%),open forest (7.35%) tea plantation (7.26%), sand bar (5.92%) water body (3.43%) and dense forest(2.78%). In the year 2009, the land use percentages are riverine grassland (25.94%), cropland (25.88%), settlement (19.33%), tea plantation (8.48%), scrubland (6.91%), sand bar (5.31%), open forest (3.07%), dense forest (2.67%) and water body (2.41%).

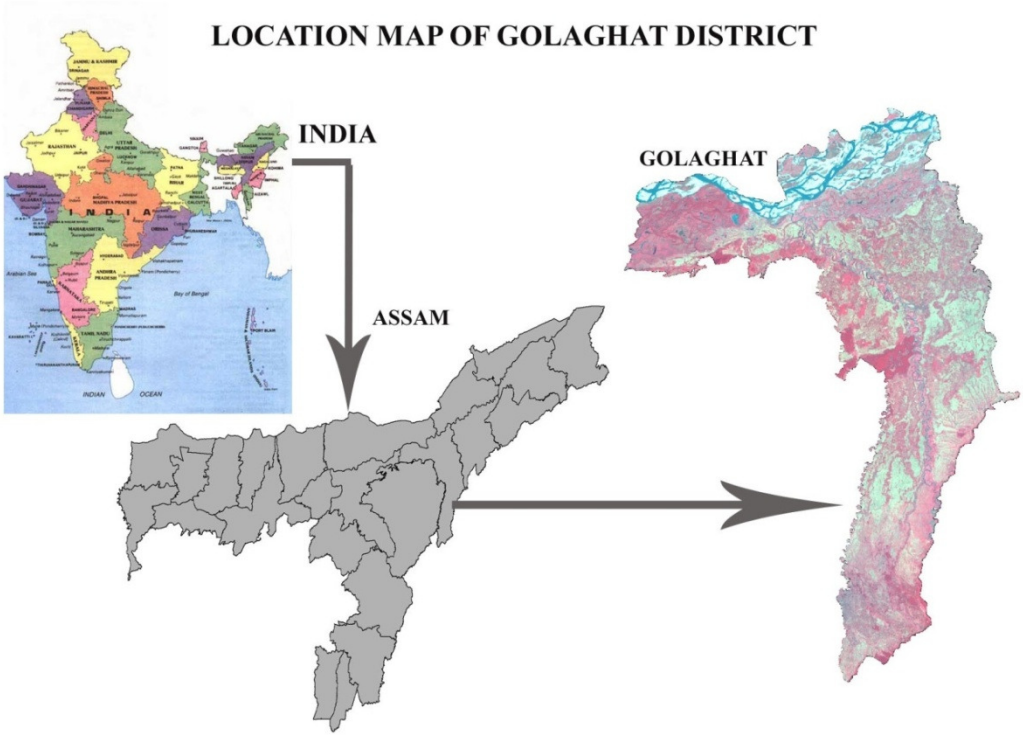

Figure-1

Golaghat district is not an urbanized area. It is a mixture zone of agriculture, forest and grassland. Here we found the area is dominated by scrubland. Scrubland is a land which is very prone to deterioration due to erosion. Scrublands are associated with moderate slopes in plains and foothills and generally surrounded by agricultural lands. The district contains such physical characteristics that as a result we found scrubland domination here in 1989. But the percentage of area is decreased in the year 2009, it is because of the scrublands are converted into croplands or agricultural lands. It is worth observing that about 19% cropland area is increased during the study periods.

During the last 20 years the change in other land use categories are negligible. The percentage of open forest is decreased (1.39%) because of human population growth and conversion of forest into agricultural land.

Tea is another important economic cultivation in this area. The increase of percentage (8.48%) is a good sign from the view point of economic development of the area. In the upper Assam tea is predominant cultivation.

Riverine grassland is found mostly in upper part of the district along Brahmaputra river, Kaziranga National Park, and along Dhansiri river. The area is increased at the rate of 0.21%.

Settlement is also increased by the rate (0.11), which is very obvious due to human population growth. The main settlement towns of this area are, district head quarter Golaghat, Bokakhat, Dergaon and Sarupthar.

In Golaghat district three researve forests are found namely, Diphu, Dayang, Nambor and Rengma. Containing these forest and also Kaziranga national Park the area of dense forest is 9663.57 hectores in 1989, decreased in 2.67% in the year 2009. The decrease in dense forest warrants immediate proper attention as it provides sustainable environmental conditions for existing flora and fauna of that area.

Water is one of the most indispensable resources and is the elixir of life[8]. Water bodies included wetlands, ponds, streams and rivers. Water bodies cover only 3.43% of the total area in the year1989 which decreases to 2.415 in 2009 probably due to seasonal variation. The change of sand bar which is found along Brahmaputra River is almost same (5.92%).

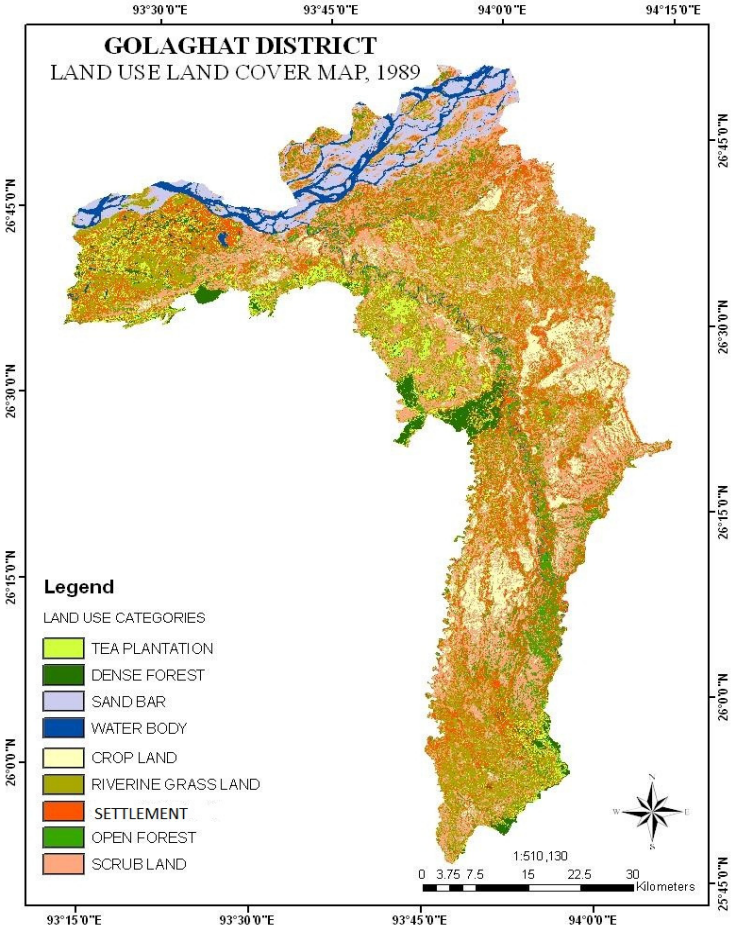

Figure-2

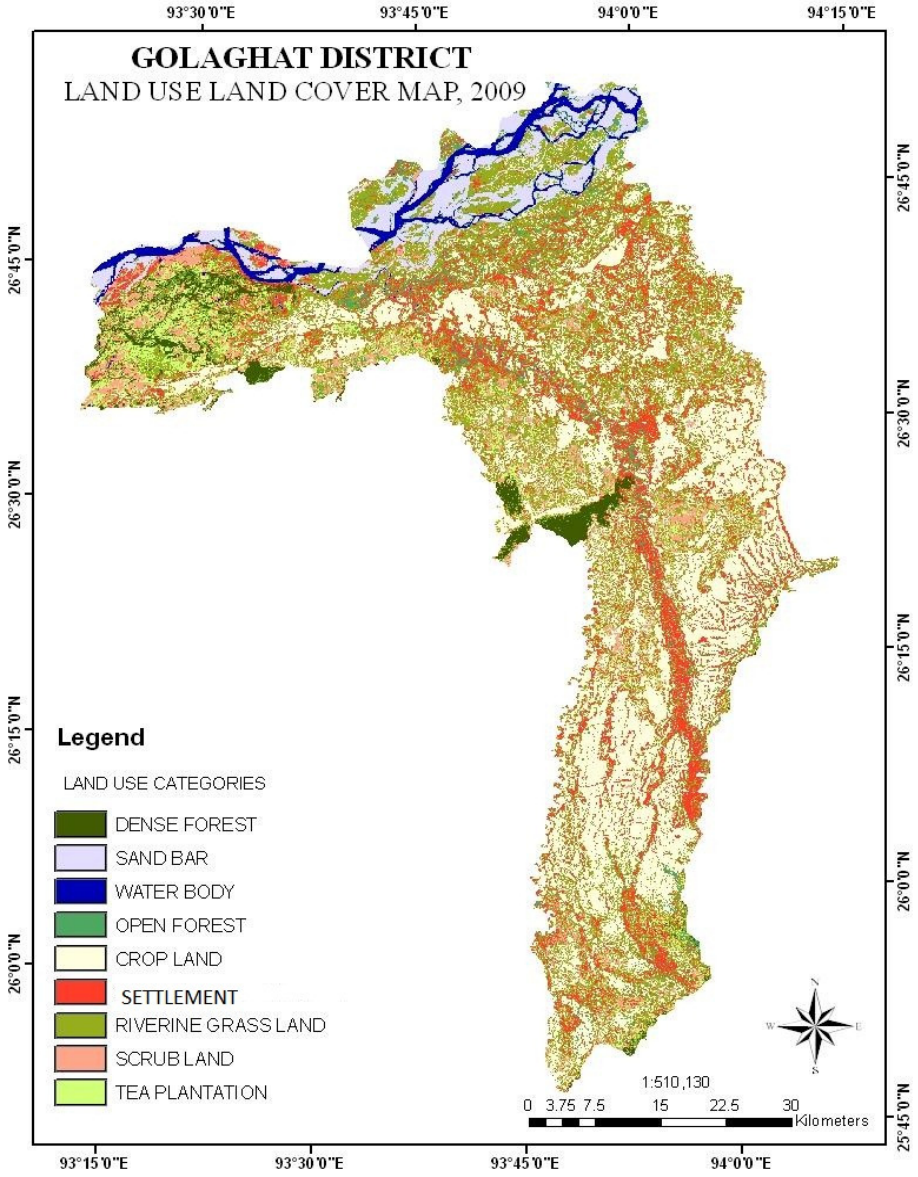

Figure-3

Table-1
Land use land cover change analysis, 1989-2009

Land use category	Land use, 1989 (in hacter)	Land use, 1989 (In %)	Land use, 2009 (in hacter)	Land use, 2009 (In %)	Change	Change Rate
Dense forest	9663.57	2.78%	9301.3	2.67%	-0.10%	-0.03895
Sand bar	20612.88	5.92%	18476	5.31%	-0.61%	-0.11566
Water body	11928.69	3.43%	8388.57	2.41%	-1.02%	-0.42202
Open forest	25578.72	7.35%	10695.97	3.07%	-4.28%	-1.39144
Cropland	27056.79	7.77%	90059.11	25.88%	18.10%	0.699566
Settlement	59733	17.16%	67257.19	19.33%	2.16%	0.11872
Reverine grass land	71218.17	20.46%	90276.3	25.94%	5.48%	0.211109
Scrubland	96955.38	27.86%	24050.24	6.91%	-20.95%	-3.03137
Tea plantation	25256.92	7.26%	29499.44	8.48%	1.22%	0.143817
TOTAL	348004.12	100.00%	348004.12	100.00%		

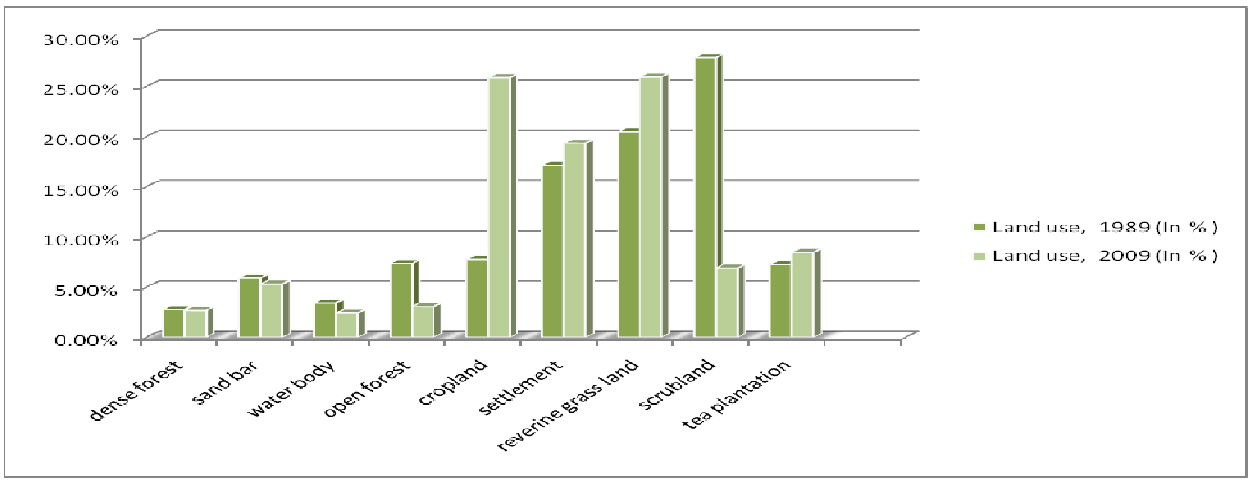

Figure-4
Land use land cover change, 1989-2009

Conclusion

The land use/land cover pattern of a region is an outcome of both natural and socio-economic factors and their utilization by man in time and space. Land is becoming a scarce commodity due to immense agricultural and demographic pressure. 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[9]. Land use/ Land cover changes also involve the modification, either direct or indirect, of natural habitats and their impact on the ecology of the area[10]. In this study, using satellite images of 1989 and 2009 land use changes were evaluated in Golaghat district of Assam. The study revealed that the major changes occurred in cropland and scrubland. The reason behind this is the area under scrubland is converted into agricultural or crop zone. We can conclude that satellite data has the unique capability to detect the changes in land use quickly and accurately. The high resolution satellite data such as LISS III data and LANDSAT ETM are good source to provide information accurately. Accurate land cover change information is necessary for understanding main factors causes and environmental consequences of such changes.

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