

Land Use and Land Cover Change Detection of Lakhimpur District, Assam Using Remote Sensing and GIS Techniques

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Abstract

Increasing pressure exerted by human being on the planet earth has lead to several changes in the environment which results into loss of natural resources, ecological imbalances, global climate change, global warming etc. Monitoring of changes through accurate mapping of LULC helps in identifying the level destruction made by anthropogenic factors in a particular area. In this paper, LULC mapping has been done by using multi-temporal Landsat data for a period of 1998 and 2020 for Lakhimpur district to detect the changes. In the mapping of LULC the district has been categorised into six groups namely agricultural land, forest land, sand bars, settlement, sparse vegetation and water body and the analysis shown both positive and negative changes.

Keywords: Land Use, Land Cover, Change Detection, Arc GIS, Satellite Imagery.

Introduction

Both the term land use and land cover often use interchangeably though these are two different terminologies (Veerawamy, et al., 2017, Dimiyati et al., 1996). While Landcover denotes the physical and natural features exists on the surface of the earth, landuse change connotes transformation of land from one form to another (Panda & Tanuja, 2017). Landuse and land cover changes over the surface of the earth attributed to both anthropogenic and environmental factors (Spruce. et al., 2020, Tran. et al., 2015). The existing pattern of land use and land cover is the reflection of physical and socio-economic factors and their utilization by man (Rawat et al., 2013) in a particular area. This changing pattern of LULC results into the loss of forest cover, biodiversities, water bodies etc which leads to several natural disaster landslide, erosion, global warming and so on. Therefore, all together this LULC changes has negative consequences on environment and natural landscape (Sumathi et al. 2011). With the increase in population industrialization and urbanization has taken in a rapid rate which increases the built-up area for human settlement on one hand and deforestation on the other (Lambin, 1999). Deforestation means clearance of large forest tract which imbalance the ecological set-up of the environment and this imbalance exerts negative

impact on wildlife and biodiversity (Veldkamm&Lambin, 2001). Hence proper monitoring and detection of LULC is essential for sustainable development and planning of a particular area.

Objectives

The major objective of the present paper is to analyse the changes that has taken place in Lakhimpur district from 1998 to 2020 in terms of land use and land cover change.

Study Area

Lakhimpur district is located in the North East corner of the state and lies on the North bank of river Brahmaputra. It is bounded by lower Subansiri on the North, Dhemaji in the East, Majuli in South and Biswanath district on its west. The district covers an area of 2277 square kilometres. According to 2011 census, the district has a population of 10,42,137 and literacy rate of 78.39%.

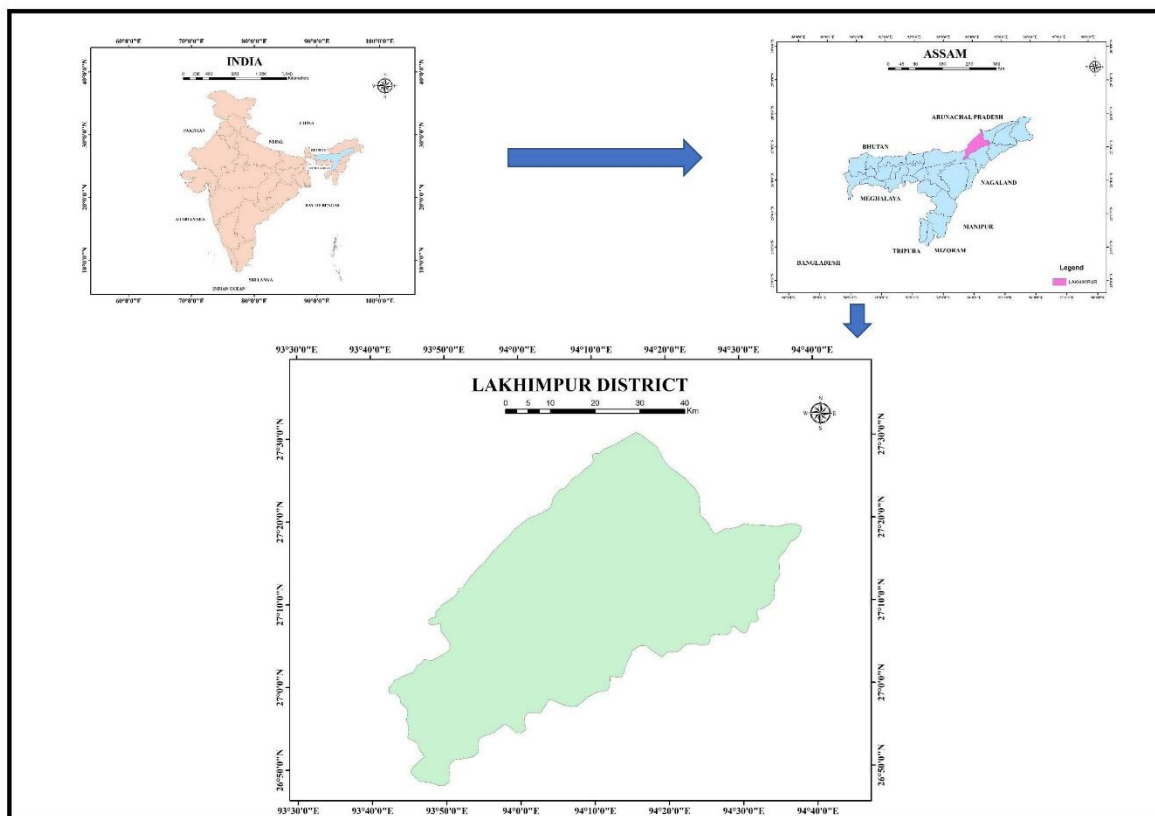


Fig. 1 Location map of the study area

Database and Methodology

The present study is based on both primary and secondary data. For secondary data, an extensive review of literature has been conducted such as research publications, census data, administrative atlas, statistical handbooks. For the primary data, we have taken two clouds free Landsat images from the United States Geological Survey website. The classification of a satellite image has achieved using Iso cluster unsupervised classification method. To assess

the changing pattern of landscape dynamics, two land use and land cover maps have been prepared with the help of ERDAS IMAGIN and Arc GIS software.

Table 1: Types of Satellite Data Used in the Study Area

Satellite	Sensor	Acquisition date	Resolution	Path/Row
LANDSAT 5	TM	1998-12-17	30m	135/41
LANDSAT 8	OLI-TIRS	2020-12-29	30m	135/41

Results and Discussion

Changes in land use and land cover bring several negative consequences on the environment setting of particular place. Detection of land use land cover changes for the selected district Lakhimpur has witnessed both positive and negative change over the study of 1998 and 2020. With the passing time, population pressure on the earth surface has increased and increasing population demand more things in terms of food, settlement and so on. As human needs have no limitation, it leads to various developmental activities which results into rapid rate of urbanization and industrialization. This has results into clearance of large forest tract, vegetation cover, water bodies, and natural resources etc. the study area Lakhimpur district witnessed several changes in terms of land use and land cover which has negative impacts on its environment. The analysis of satellite imagery depicted both positive and negative changes in terms of selected categories of land use and land cover.

Table 2: Land use and land cover statistics of the study area in percentage (1998-2020)

Categories	1998	2020
Water body	6.77	5.30
Agricultural land	22.78	31.67
Settlement	10.61	34.30
Sparse vegetation	15.35	5.54
Sand bars	7.33	5.85
Total	100	100

Forest which is considered as one of the most important natural resources on the planet earth faced severe deterioration in the study area. Forest tracts play a vital role in maintaining ecological set up of the environment as well as it fulfil human needs by providing food, fuel and so on. In the study area, there have been remarkable changes in terms of area occupied by forest land from 1998 to 2020. As in 1998, forest land covers 845.45 square kilometre (37.12%) which decreases to 393.93 square kilometre (17.30%) in 2020. The forest area has declined by 19.82% over the period which may be due to increasing population pressure that leads to more built-up areas in the district for settlement as well for various developmental activities.

Table 3: Land use and land cover statistics of the study area in sq. Km. (1998-2020)

Categories	1998	2020
Water body	154.26	120.78
Agricultural land	518.86	721.33
Forest land	845.45	393.93
Settlement	241.71	781.18
Sparse vegetation	349.66	126.37
Sand bars	167.07	133.42
Total	2277.01	2277.01

The table has clearly depicted the scenario of each category of land use and land cover from 1998 to 2020. Except built up area all other categories has declined their area under coverage. Water bodies which include both natural and manmade features including ponds, lake, wetlands, cannels etc declined their area over the period. These water bodies play a significant role by providing habitats for various species. But in the study area under water body has declined by 33.48 square kilometres from 1998 to 2020.

Agriculture plays a vital role among the people who lives in an agrarian society. The economy of the state of Assam is mainly dependent on agriculture. Therefore, in the study area also, with increasing population area under agriculture also increased. In Lakhimpur district the livelihood of the people mainly dependent on agriculture. Hence area under agriculture in the district increased by 8.89% (202.47 square kilometres).

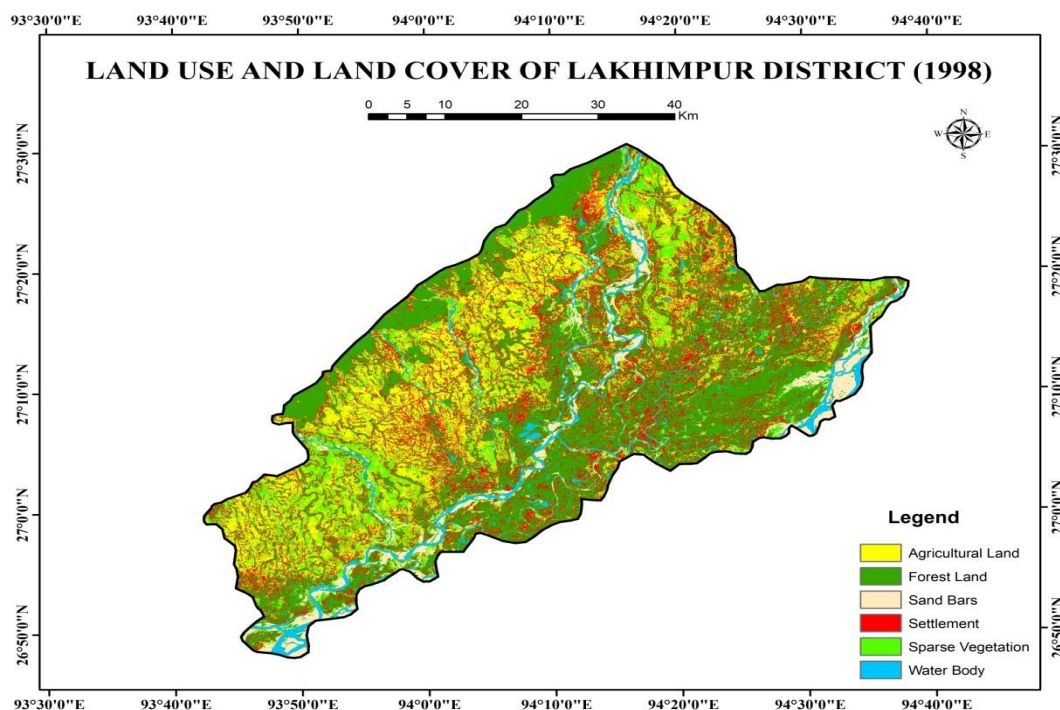


Fig. 2 Land use and land cover map of Lakhimpur district, 1998

Settlement areas which are indicated by red colour in the images witnessed increasing population pressure on the district. Increase in built up areas indicated clearance of forest cover, sparse vegetation and water bodies. In the study area, there is a remarkable increase in settlement area in 2020, which occupy 781.18 square kilometres witnessing an increase of 539.47 square kilometres from 1998.

Sparse vegetation which is another important natural element which maintains the ecological balance of the environment has gone through severe deterioration over the period from 1998 to 2020. Increasing settlement and built up areas, agricultural land leads to severe destruction vegetation cover. As shown in the table, the area under sparse vegetation occupies 349.66 square kilometres in 1998 which declined to 126.37 square kilometres in 2020. There is an overall decreased of 9.81 % area under sparse vegetation. The satellite images have also witnessed declined in area under sand bars in the district. In 1998, sand bar occupy 167.67 which is decline by 33.65 square kilometres in 2020.

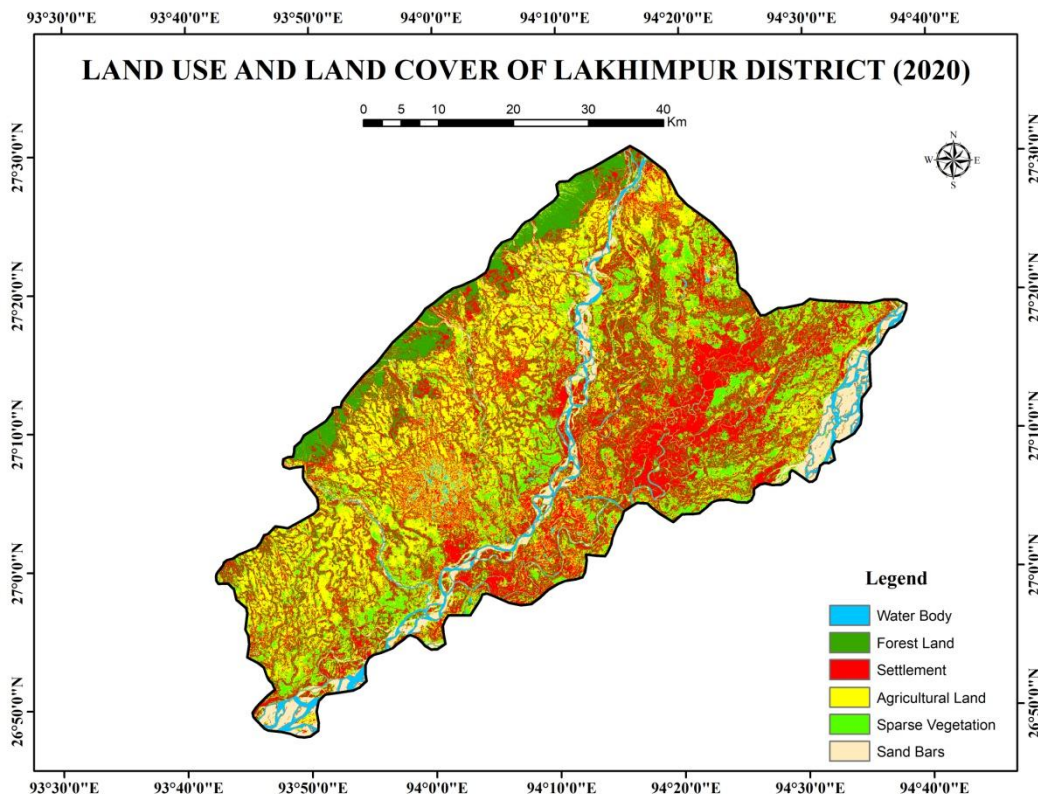


Fig. 3 Land use and land cover map of Lakhimpur district, 2020

Conclusion

The study conducted in Lakhimpur district of Assam and it has revealed that the major land use in the district is built-up area or settlement. During the study period (1998-2020), the area under settlement has been increased by 23.69% due to construction of buildings, roads on agricultural land, vegetation and forest tract which resulted into decline in areas under forest and sparse vegetation, forest cover and sparse vegetation decline by 19.82% and 9.81

respectively. The assessment of land use and land cover changes in the study area helps in analysing the changes that has taken place in the district over the years.

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