Change Detection of Different Natural Resources For Udham Singh Nagar District of Uttarakhand State During Last 24 Years by Using Remote Sensing and GIS Technique

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Abstract:
Land use and Land cover are linked to climate and other environmental changes in a complex way such as, exchange of Greenhouse gases between plants, soil and atmosphere. Land is becoming scarce community due to immense agriculture in other purposes. Any change in land use/ land cover affect ecosystem, biodiversity, agriculture productivity and other goods and services of the society. Hence, information on land use/ land cover and possibilities of their optimal use is essential for the selection, planning and implementation of land use methods to meet the increasing demands for basic human needs and welfare. Various processes influence the speed of the change and the type of land use.

Over the past few years, Udham Singh Nagar district of Uttarakhand having total geographical area 3055 sq.kms. has found tremendous land use change due to various Industrial and urban growth. Udham Singh Nagar is located in Tarai area of Kumaon region. Availability of resources, vast land, infinite raw material, good transportation facilities and a well-know excess to market has attracted a number of industrialists towards Udham Singh Nagar and consequently the good agricultural land of Udham Singh Nagar has been converted into an established industrial area. That's why it identified as industrial district of Uttarakhand. Availability of various satellite sensors at different spectral and temporal resolution plays an important role in generating information about latest land use/land cover pattern in area and in dynamic changes. The information in digital form extracted from satellite data under Geographical Information System (GIS) to provide a suitable platform for data analysis, update and retrieval.

The objective of the present study was to know about the transformation of various land use/ land cover at different time period and also to understand the dynamics and impact of changes. In this study Landsat TM 1990 and LISS III 2013-14 (Rabi, Kharif and Zaid season) has been used to map the various thematic information (Land use, wasteland, wetland, forest cover, soil map and agriculture land) and subsequently Land use dynamics of different land cover changes were identified using onscreen image interpretation, tonal and texture characteristics of the image, various digital image processing techniques and by using spatial modeling. The study reveals that during 24 years extreme change in agricultural land due to urban growth. Finally the eight land-use types are identified as- Dense forest, Open forest, Scrub, Agriculture, Fallow land, Water body, Settlement and Sand. A significant change in land-use is observed with in the area over the study period. The results shows that there is a significant decrease in Agriculture (about 6.51 %) which can be correlated to the conversion of agricultural land into industrial/residential land (18.76%), mainly in the Rudrapur area of Udham Singh Nagar district. Open forest increased by 21.13% which can be associated with conversions from dense forest (7.3%). Increase in the exposure of scrub about 7.13% and decrease in the extent of water body about 12.66%.

Keywords: land use/land cover, Change detection, Natural resources, Remote sensing and GIS, Spatial modeling

1. Introduction

Land use and Land cover are linked to climate and other environmental changes in a complex way such as, exchange of Greenhouse gases between plants, soil and atmosphere. Land is becoming scarce community due to immense agriculture in other purposes. Any change in land use/ land cover affect ecosystem, biodiversity, agriculture productivity and other goods and services of the society.

Accurate and updated land cover change information is required to understand and assess the environmental consequences of such changes (Giri et al., 2005). Hence, information on land use/ land cover and possibilities of their optimal use is essential for the selection, planning and implementation of land use methods to meet the increasing demands for basic human needs and welfare. Various processes influence the speed of the change and the type of land use.

The urbanization is a major concern of many world regions (Samat et al., 2011) which includes outward spreading of a city with poor planning. The unplanned urbanization has been creating problems like pollution, traffic, deforestation, and congestion of places. Land use changes at the peri-urban area is a complex and dynamic process that involves both natural and human systems (Xiao et al., 2006). Urban expansion can be said as the transformation of the rural areas as cities and towns, but this urbanization is coming along with a cost. This cost can be easily seen as degradation of the environment, above all in the loss of farmlands and forest. In state like Uttarakhand the migration from rural hilly terrains and remote areas to urban centers is at an alarming rate during the last decade. The results of Census of India clearly suggest the tremendous increase in population in the districts of Dehradun, Udham Singh Nagar and Nanital while districts which are in hilly regions showing negative growth rate, which mainly forms the motivation of this study. The high population growth results in unplanned urbanization and changes in the land use patterns of the urban centers. In order to design an appropriate urban planning system the land use transformation must be evaluated.

The remote sensing and GIS are considered as an effective monitoring and decision-support tool in urban planning and change detection in natural resources. Availability of various satellite sensors at different spectral and temporal resolution plays an important role in generating information about latest land use/land cover pattern in area and in dynamic changes. The information in digital form extracted from satellite data under Geographical Information System (GIS) to provide a suitable platform for data analysis, update and retrieval. An attempt is carried out in this study, to map the status of land use and land cover of the Udhamsingh nagar district of Uttarakhand state in 1990 and 2013-14 using Landsat TM data, LISS-III data and merged Cartosat-1 and LISS-IV data

2. Objective of the Study
The objective of the present study was
- To know about the transformation of various land use/ land cover (LULC) during last 24 years.

3. Study Area
Over the past few years, Udham Singh Nagar district of Uttarakhand state having total geographical area 3055 sq.kms. has found tremendous land use change due to various Industrial and urban growth. Udham Singh Nagar is located in Tarai area of Kumaon region with $28^042'$ -$31^027'$N and $77^034'$- $81^002'$E. Availability of resources, vast land, infinite raw material, good transportation facilities and a well-know excess to market has attracted a number of industrialists towards Udham Singh Nagar and consequently the good agricultural land of Udham Singh Nagar has been converted into an established industrial area. That's why it is important to see the changes in different natural resources.
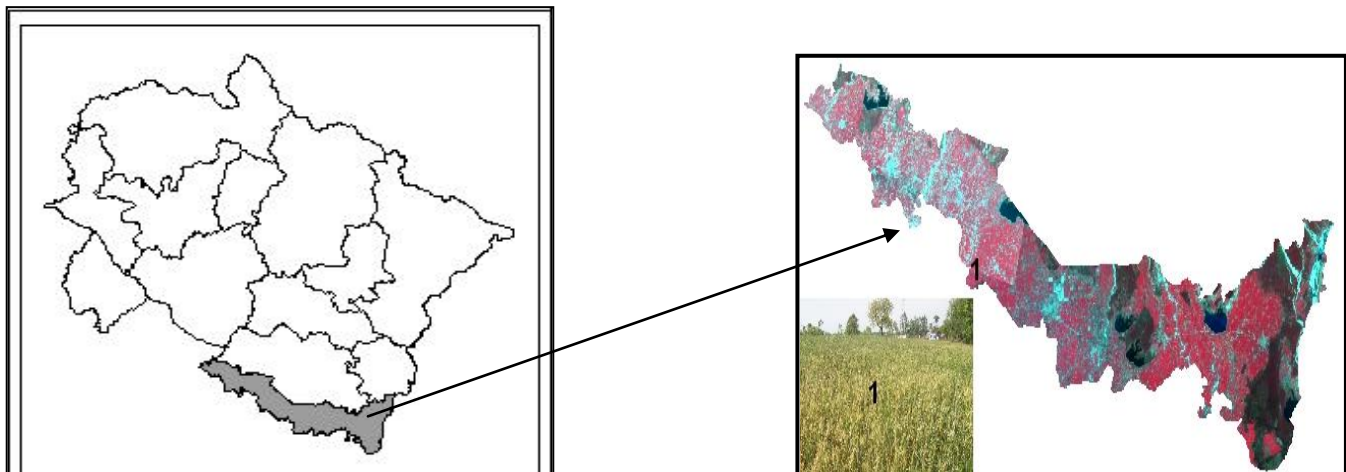

Figure 1: Satellite imagery of study area

4. Data Used

4.1. Satellite Data
LANDSAT TM data
IRS-P6-Resourcesat-2: LISS-III data
Merged Cartosat-1 and LISS-IV data

4.2. Collateral Data
- Shape file of the boundary of districts of Uttarakhand state from SOI has been used.
- Topo-sheets and images of the study area were also used for GT (Ground Truth).
- Ground truth sheet

5. Methodology
The major steps involved in the methodology that has been formulated:
- Acquisition of satellite data
- Data processing
  - Geo-referencing of Data Landsat TM and LISS-III data
  - Orthorectification of CARTOSAT-1 and LISS-IV data(Merged product of Cartosat data and LISS-IV data)
  - Mosaicing of different geo-referenced scenes
  - Data subset

5.1. First method:
- Generation of thematic layers for the year l990 and 2013-14 by visual interpretation in GIS environment.
- Change has been finding out in MS EXCEL sheet by exporting thematic layer statistics for 1990 and 2014 layer.

5.2. Second Method:
- Supervised classification (from ground truth collection by 100 points) for the year 2013-14 LISS-III data.
  - This methodology is appropriate for plain area but in hilly area some pixels were going into shadow portion so it is difficult to classify those pixels so a new method has been adopted –Breakpoint editor in ERDAS IMAGINE 9.3 is used to highlight those pixels which are going to shadow portion in satellite image so digitized this area and add to the classified area.
- Spatial model generation for change detection between classified images.
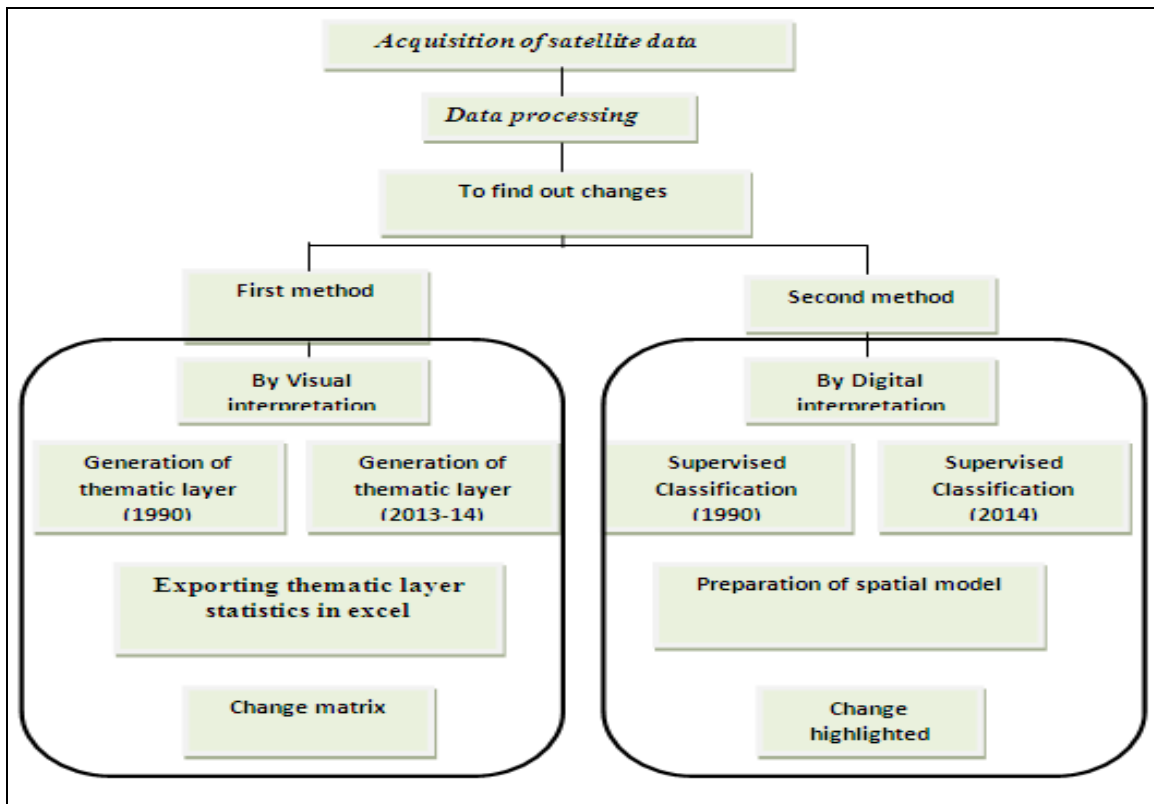- Change has been found out during last 24 years.

Figure 2: Showing methodology to detect the change

6. Result

6.1. Geo-Referencing of Satellite Data
Image-to-image registration was done with an accuracy level of less than half a pixel.

Change detection Changes showing in different natural resources during last 24 year are mentioned below:
The results shows that there is a significant decrease in Agriculture (about 6.51 %) which can be correlated to the conversion of agricultural land into industrial/residential land (18.76%), mainly in the Rudrapur area of Udham Singh Nagar district. Open forest increased by 21.13% which can be associated with conversions from dense forest (7.3%). Increase in the exposure of scrub about 7.13% and decrease in the extent of water body about 12.66%.
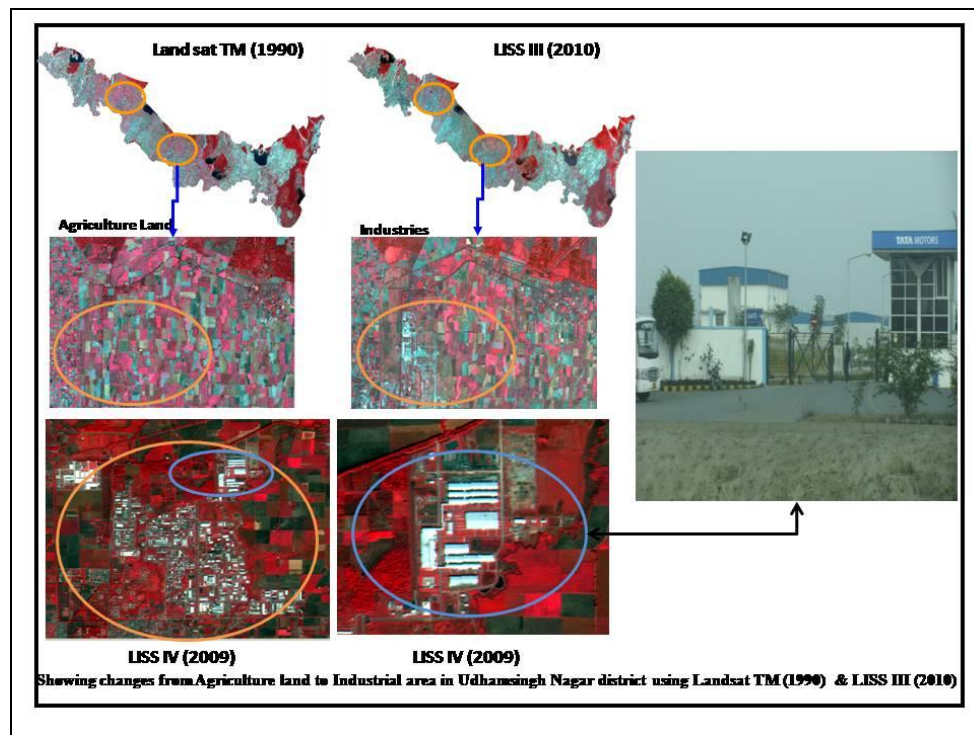

Figure 3: Showing changes from Agricultural area to Industrial area from satellite data

7. Conclusion

Accurate and updated land cover change information should be with the govt. Hence, information on land use/ land cover and possibilities of their optimal use is essential for the selection, planning and implementation of land use methods to meet the increasing demands for basic human needs and welfare. Technological development in different areas can provide a tremendous role in monitoring LU/LC (Land Use/ Land Cover).Remote sensing and GIS. The remote sensing and GIS are considered as an effective monitoring and decision-support tool in urban planning and change detection in natural resources. Availability of various satellite sensors at different spectral and temporal resolution plays an important role in generating information about latest land use/land cover pattern in area and in dynamic changes. Regular monitoring should be done for natural resources, to see the change is negative or positive. Strategy should be developed to monitor the negative change. Such type of studies could help to monitoring the natural resources, so govt. can use this information for the selection, planning and implementation of land use methods to meet the increasing demands for basic human needs and welfare.

8. References

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