GIS & Remote Sensing Technique to ExamineLanduse / LandcoverChanges: A Case Study of emerging industrial hub of District Solan, Himachal Pradesh

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ABSTRACT *Land and water resources are the decisive factors for the socio- economic development of any country. Since now land is becoming a scare resource because of immense agricultural and demographic pressure. Hence, information on land use / land cover and possibilities of their optimal use is vital for the selection, planning and implementation of land use scheme to meet the increasing demands for basic human needs and welfare. The recent remote sensing and GIS techniques can be useful measure to generate data and information for sustainable development. In this paper an attempt has been made to study the changes in land use and land cover of Western part of Solan district. The study was carried out using Remote Sensing and GIS approach using Landsat imageries of 2000 and 2010. GIS software is used to prepare the thematic maps. The result of the work shows a rapid growth in built-up area between 2000 and 2010.*

INTRODUCTION:

All Human activities are based on natural resources and land is the most important resource. Rapid Growth of population is increasing more pressure on land resource. Human activities are mounting the demand on the existing land resources to fulfil their basic needs based on agriculture, forest, pasture, urban and industrial land use. Information on the degree and type of changes in the land resources is essential for proper planning, management and to regularize the utilization of such resources (Gautam N.C. & Narayanan, E.R., 1983).India is also facing a problem of natural resource scarcity, especially that of water in view of population growth and economic development (Yadav et al., 2013). As a result land use / land cover (LULC) changes have become a central focus point of interest within the environment scientist community (Meyer et al., 1996). Consequently, evaluating and understanding of the extent and spatial distribution of LULC is a vital significant to the study of environmental changes at various level (Ojima et al., 1994). Moreover, scientific investigation of these types of issues serves as a valuable tool to increase efficiency of LULC and also to decrease the negative societal and environmental impacts associated with the land use / land cover.

Present geo-spatial technologies such as geographical information system (GIS), remote sensing and photogrammetry have capability to analyse the real world problems and to give effective spatial solutions. The repetitive nature of spatial data has proved to be very useful in mapping land use / land cover pattern, trends and change within the time. Thus, geo-spatial techniques are capable to detect changes over the period within the specific region with low cost, less time and better accuracy. Different spatial layer can be produced from satellite data to analyse in geo-spatial environment such as drainage, lithology, land use / land cover, geomorphological conditions and degraded landforms. These data sets are the fundamental requirement of the geographical information system (GIS) that provides an excellent mean of spatial database analysis and interpretation (KotokyP., et al., 2012). Quantification of land use / land cover changes is possible through GIS techniques on different scales and resolutions (Sharma et al., 2001). Studies based on geo-spatial techniques are helpful in understanding the dynamics of human activities in space and time.

During the period of 70s and 80s satellite data were used in simple interpretation or as a reference map (Merified P.M., & Lamar D.L., (1975) Rib H.T., & Liang T., (1978) but at present with the advancement in tools,spatial analyses are possible. Remote sensing and GIS techniques have been applied by various researchers of different disciplines such as forest, agriculture, planning, disaster management and natural resources etc. (CracknellA.P., (2000); SabinsF.F., (1997); Dixon,T.H., (1995).

Therefore, accurate and updated spatial land cover information is necessary to understand and asses the environmental consequences of changes over the time period (Giri et al., 2005). The application of GIS and RS is rapidly expanding worldwide for planning, management and solution of real world problems. Few examples of on-going / completed Geospatial Projects of Government of India under NNRMS (National Natural Resource Management System) are Forecasting Agricultural output using Space, Agro meteorologyand Land based observations (FASAL); National Agricultural Drought Assessment and Monitoring System; National Wastelands Monitoring; Potential Fishing Zone; Ground Water Prospects Mapping; Accelerated Irrigation Benefit Program; Watershed monitoring and development; Remote sensing based Integrated Mission for Sustainable Development; Water Resources Information System; Biodiversity Characterization; National Wetlands Inventory and Assessment; Snow and Glaciers; Coastal Zone Studies; National Urban Information System; Natural Resources Census and Space Based Information System for Decentralized Planning (SIS-DP).

The present study has been taken up in order to understand the changes that have taken place in land use/land cover in western parts of Solan district of Himachal Pradesh. This area has become the industrial hub of Himachal Pradesh in recent times. It is believed that this rapid urbanization and urban sprawl might have influenced on the land use/land cover patterns resulting in a possible impact on the environment. This work is taken up to better understand this aspect.

OBJECTIVE

The aim of this study is to produce a land use/land cover map of western part of Solan district of Himachal Pradesh in order to detect the changes that have taken place over a given period using change detection method and to determine the location and magnitude of land use / land cover change.

DATA AND METHODOLOGY

In the present study, for evaluating the temporal changes in the land use and land cover, Landsat ETM+ satellite data has

been used. ERDAS IMAGINE 2011 and ArcGIS 9.3 GIS software has been used for Image processing and analysis. The land use/land cover classes include agriculture land, dense forest, sparse forest, settlement, water body and open land and waste land. Land use / Land cover map of 2000 and 2010 was generated as a final product. Later Change Detection methodology was done for the images to find out the changes that have taken place in the study area using ERDAS IMAGINE 2011.

STUDY AREA

Study area is a semi hilly area of Solan District Himachal Pradesh. Total 325 square kilometer geographical area has been taken for the present study. Geographical extent of the area is $30^0 54'18.19''$ to $31^0 07'36.18''$ North latitude and $76^0 36'47.28''$ to $76^0 51'20.84''$ East Longitude. Study area is an emerging region for industries as it hosts production units for leather, steel, chemicals, thread mills and breweries etc. Nalagarh and Baddi are the major locations within the study area. Nalagarh is a city and municipal committee in district Solan of Himachal Pradesh. Baddi is an industrial town and Nagar Panchayat in the southwestern of district Solan. The area has concentration of national and multination companies.
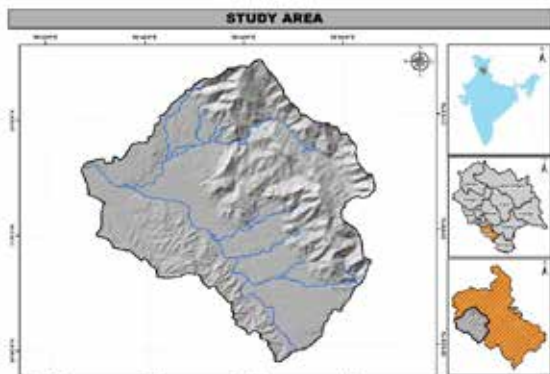

Figure: 1

RESULTS AND DISCUSSIONS
Image Classification -2000

As per the outcome of 2000 Landsat image, out of total geographical area 37% area is under agriculture; 25% area is dense forest; 5% area is settlement; 25% area is under sparse forest; 7% area is open land or waste land and 1% area is covered by water bodies.

TABLE 1.1 Land use / Land cover changes (2000 – 2010)

Class	Year 2000 (% age)	Year 2010 (% age)
Agriculture	37	35
Dense Forest	25	24
Settlement	5	10
Sparse Forest	25	19
Open Land / Waste Land	7	11
Water bodies	1	1

Figure: 2

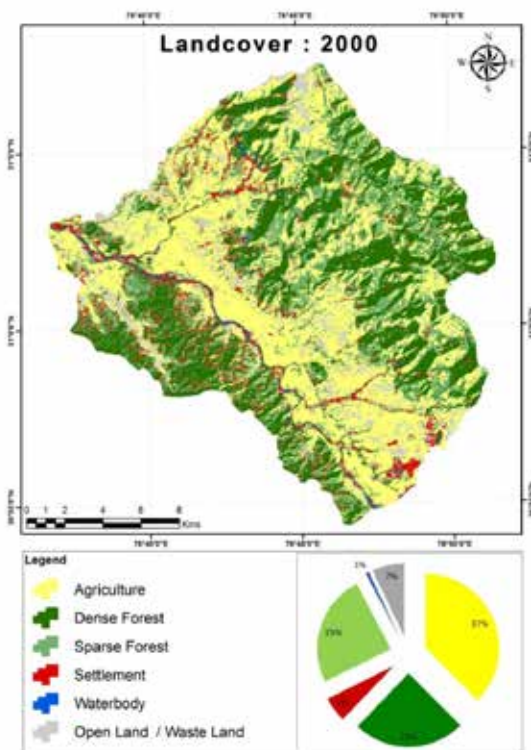### Image Classification -2010

According to the 2010 image 35% area is under agriculture; 24% area is dense forest; 10% area is settlement; 19% area is under sparse forest; 11% area is open land or waste land and 1% area is covered by water bodies out of the total geographical area.
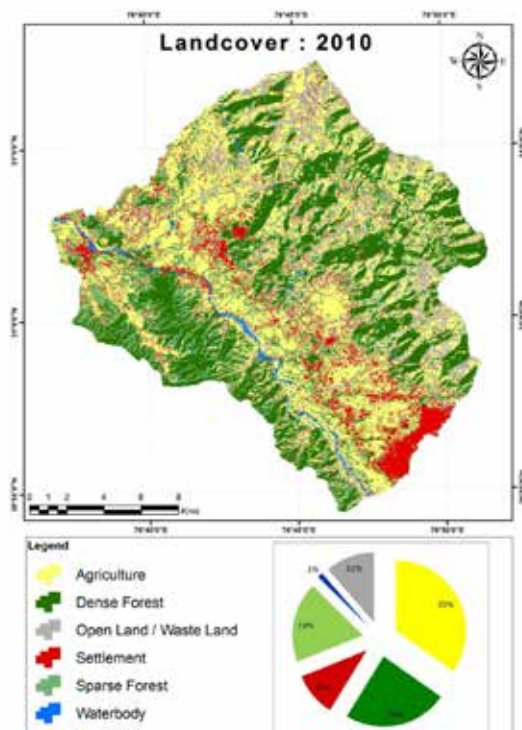

Figure: 3

Due to geographical factors, industrialisation in Himachal Pradesh is mostly concentrated in the border areas or the gateways of Himachal Pradesh in areas like Paonta Sahib, Kala Amb, Parwanoo, Barotiwala, Baddi, Nalagarh. Inspite of the best efforts, other areas of the state have been relatively unaffected by the process of industrial development

As per the results / analysis of the study area (Table 1.1), agriculture land has been decreased by 2 % of the total geographical area from 37 % to 35 %; similarlydense forest has been decreased by 1 % from 25 % to 24 %. Settlement or built-up area has been increased by almost double i.e. from 5 % to 10 % of the total geographical area, within the period of ten years. Sparse forest has also been decreased from 25 % to 19 %; Open land / Waste land has increased by 4 % from 7 % to 11 %; there is no change in the area of water bodies which remained same.

Thus, this geographical approach of management gives us a new way to visualise the world around, that where are the things in what quantity, density and what is inside the entity. Beside this one can find the change in an area over time to anticipate future conditions.

CONCLUSION

This paper focuses on LU/LC changes in Western part of Solan district of Himachal Pradesh India, using remote sensing data and GIS technology. Our results clearly show that LU/LC changes were significant during the period from 2000 to 2010. There is significant expansion of built-up and open waste land area. On the other hand there is decrease in agricultural area and forest areas. This study clearly indicates the significant impact of population and its industrial development activities on LU/LC change. This study proves that integration of GIS and remote sensing technologies is effective tool for urban planning and management. The quantification of LU/LC changes of Solan area is very useful for environmental management groups, policy makers and for public to better understand the surrounding.

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