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Evaluating Spatio-Temporal Dynamics of Land Use Land Cover in Romshi Watershed of Jhelum Basin, Jammu and Kashmir-India

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Abstract: Mapping of land use land cover (LULC) change is fundamental method for assessment, managing and protection of natural resources of a region and the information on the existing land use is one of the prime pre-requisites for suggesting better use of terrain. Remote sensing and Geographical Information system (GIS) provide fundamental tools which can be useful in the investigation of LULC changes at all levels viz, watershed and catchment as well as at basin levels. Remote sensing becomes useful as it provides synoptic view and multi-temporal land uses land cover data that are often required. In the present study, spatio-temporal changes has been studied in the Romshi watershed of Jhelum basin that has been experiencing a lot of land use land cover changes due to both socioeconomic and natural factors. Spatial extent changes in forest cover (8640.239 to 6756.592 ha), horticulture (6891.458 to 8519.483 ha), built-up (858.91 to 2830.438 ha) and agriculture (19483.05 to 18060.83 ha) were observed in the study area within a time period of 13 years from 1992-2005. It was found that deforestation, increase in population and urbanization is the main factors responsible for the land use land cover change over the time in the watershed.

Key words: Remote sensing · Satellite imagery · Spatiotemporal · Watershed

INTRODUCTION

Land use land cover changes are dynamic, widespread and accelerating process, mainly driven by natural phenomena and anthropogenic activities, which in turn drive the changes that would impact natural ecosystems [1]. Due to anthropogenic activities, the landscape is being significantly changed in one way or other. Besides, human needs on the earth have had a profound effect upon the natural environment thus resulting into an observable pattern in the land use land cover over time [2]. Land is one of the important components of life support system. Unfortunately it has been overused and abused all through the course of human civilizations [3].

Land is becoming a scarce resource due to immense agriculture and demographic pressure. Understanding landscape pattern, changes and interactions between human activities and natural phenomenon are essential for proper land management and decision improvement [4]. Preparing landscape characteristics maps can help to detect changes. Change detection is one of the landscapes ecological aims. Over the past years, data from earth sensing satellites has become very useful and applicable in mapping the total landscape, managing natural resources and in studying the environmental changes [2].

Viewing the earth from space is now crucial to the understanding of the influence of human activities on natural resources over time. Multispectral remotely sensed data collected from satellites provide a synoptic analysis of landscape pattern and changes at local, regional and global scales over time on a regular basis [5]. Remote Sensing (RS) and Geographic information system (GIS) are providing new fundamental tools that facilitate advanced ecological management. Geographic Information Systems (GIS) together with satellite data provides policy and decision-makers a unique view of the total landscape, increases the accuracy of data gathering and analysis which enables to improve natural resource monitoring and management [5].

Recent studies have revealed widespread application of geo-spatial information technologies in the decision-making process of land use mapping and monitoring for

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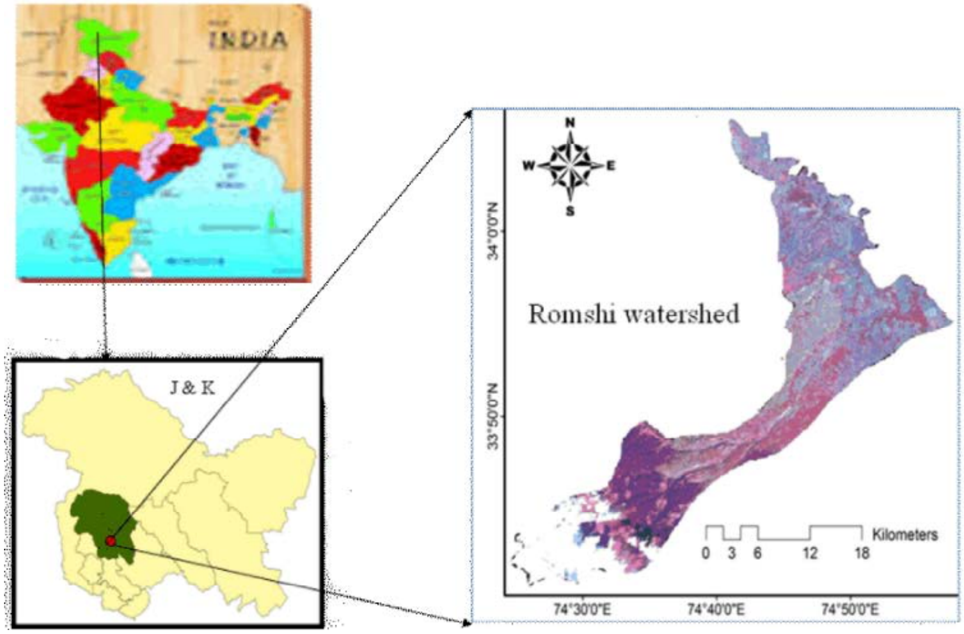

Fig. 1: Location of Study Area

natural resource assessment and management at different locations of the globe. The present work was carried out to analyze the land use land cover change in Romshi watershed of Jhelum basin using geospatial techniques.

Study Area: The latitudinal extension of the Romshi watershed is 33° 41'-33° 59' and the longitudinal extension is from 74° 31'-74° 59', covering an area of about 495.03 km^2, shown in Figure 1. It is one of the left bank tributaries of river Jhelum, has its source at Kacchgalu Pass in the Pir Panjal mountain range, wherefrom it flows for a distance of 54 km and joins the master stream at Kakapora Pulwama [6]. The Romshi divides itself into three streams at Danzab, which are called Mamshi, Kamshi and Romshi [6]. About three miles further down near present Kakapora, the waters of freshet Romshi mingles with river Jhelum. Romshi watershed supports a varied topography with altitudinal extremes ranging from 1600m-4600m above a.m.s.l. It is bounded by lofty Pir Panjal mountain range on south. Its relief is very diverse comprising of steep slopes, plateaus, plains and meadows. The area experiences temperate climatic conditions, with average winter and summer temperatures ranging from 5 to 25°C, respectively.

MATERIALS AND METHODS

Data Sets Used: Two date satellite imageries of 1992 and 2005 were used for analyzing the spatiotemporal changes in land use land cover of Romshi watershed. Images of same seasons were used in order to minimize the impacts of the changing season on the mapping pattern. Satellite imageries of Landsat TM (15 Oct, 1992) with a spatial resolution of 30 m and Path/Row-149/36 and Path/Row-149/36 and IRS LISS-III (19 Oct, 2005) with a spatial resolution of 23.5 m and Path/Row-92/46 were used.

Methodology: The study of monitoring land use land cover changes in Romshi watershed was first started with a topographic map and comparing this topographic map with satellite image. The flowchart of the methodology adopted in this study is given in the Figure 2.

Data Pre-Processing: Pre-processing has involved scanning and digitization of Survey of India Topo-sheets at 1:50000 scale to serve as the base map. Processing has involved application of various GIS function and advanced digital image processing technique including contrast manipulation and edge enhancement, to increase the interpretability of the image data. The images were geometrically rectified and registered to the same projection namely, Transverse Mercator WGS 1984, in order to carry out the spatial analysis.

Image Classification: Based on certain fundamental image characteristics (viz; tone, texture, pattern, size, shape, shadow coupled with site/location and associated features), which help in interpretation of earth features;

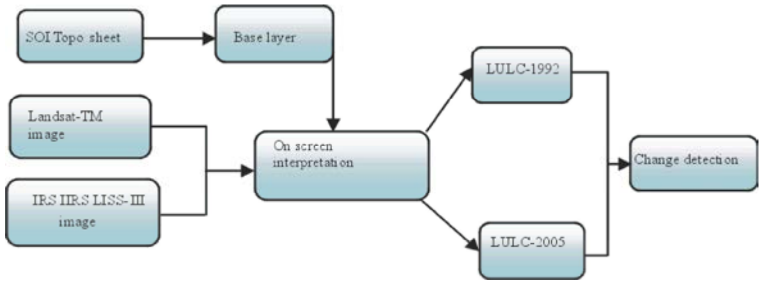

Fig. 2: Flowchart of Methodology

classification of digital images through on screen interpretation approach was carried out. National natural resources management system (NNRMS) standards [7] were used for categorizing LULC classes in the watershed.

Change Detection: In order to determine the changes in the LULC that have occurred over the observation period from 1992 to 2005, change detection analysis was performed [8]. Change detection analysis encompasses a broad range of methods used to identify, describe and quantify differences between images of the some scene at different times or under different conditions. Change detection involves a straight forward approach to detect changes between a pair of images that represent the initial and final stage.

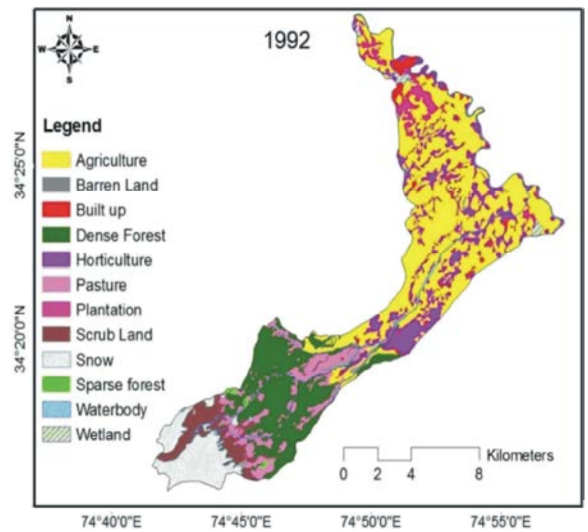

Fig. 3: LULC map of Romshi watershed-1992

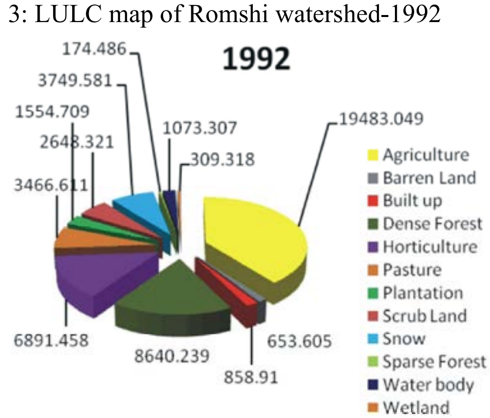

Fig. 4: Pie diagram of LULC classes-1992

RESULT AND DISCUSSION

The land use categories such as agriculture, barren land, built-up, dense forest, horticulture, pastures, plantation, scrub land, snow, water body and wetland have been identified and mapped from both the images as shown in Figures 3 and 5. Changes in the spatial extent of the land use land cover classes was found within a time period of 13 years from the 1992-2005 (pie diagrams 4&6). The change detection analysis is presented in Table 1. From the analysis of the data in Table 1, it is clear that dense forest the most dominant land use class in the watershed has decreased by -3.8% and has suffered a great loss in the study area followed by agriculture (-2.87%), pastures (-1.24%) and plantation (-1.15%). The LULC classes that have increased in spatial extent are built-up, horticulture, scrub land, barren land and sparse forest. The area under built-up has increased from 1.74% in 1992 to 5.72% in 2001. However, the water body has shrunk from 2.17% to 1.26%. The details of the areal coverage and proportion of different LULC types found in 2001 and 2005 are given in the Table 1. Also from the analysis of the data, it is observed that the area under the built-up has significantly increased by 3.98%. Similarly, the horticulture is showing an increase in area by 3.29%. For the spatial statistics of the other LULC categories, refer to Table 1.

Shifting in land use land cover types was found in the watershed over the last 13 years, particularly, agriculture lands are being converted to settlements and forests are converted to agriculture lands in order to meet the demands of the increasing population [3, 9].

Table 1: Changes in areal extent of LULC classes in study area from 1992-2005

		Area					
		1992		2005		Change	
S. No	LULC Classes	Hectares	%	Hectares	%	Hectares	%
1	Agriculture	19483.05	39.36	18060.83	36.48	-1422.22	-2.87
2	Barren Land	653.605	1.32	952.758	1.92	299.153	0.60
3	Built up	858.91	1.74	2830.438	5.72	1971.528	3.98
4	Dense Forest	8640.239	17.45	6756.592	13.65	-1883.65	-3.80
5	Horticulture	6891.458	13.92	8519.483	17.21	1628.025	3.29
6	Pasture	3466.611	7.00	2852.729	5.76	-613.882	-1.24
7	Plantation	1554.709	3.14	986.894	1.99	-567.815	-1.15
8	Scrub Land	2648.321	5.35	3732.399	7.54	1084.078	2.19
9	Snow	3749.581	7.57	3509.982	7.09	-239.599	-0.48
10	Sparse Forest	174.486	0.35	467.988	0.95	293.502	0.59
11	Water body	1073.307	2.17	624.212	1.26	-449.095	-0.91
12	Wetland	309.318	0.62	209.29	0.42	-100.028	-0.20
	Total area	49503.59	100	49503.59	100		

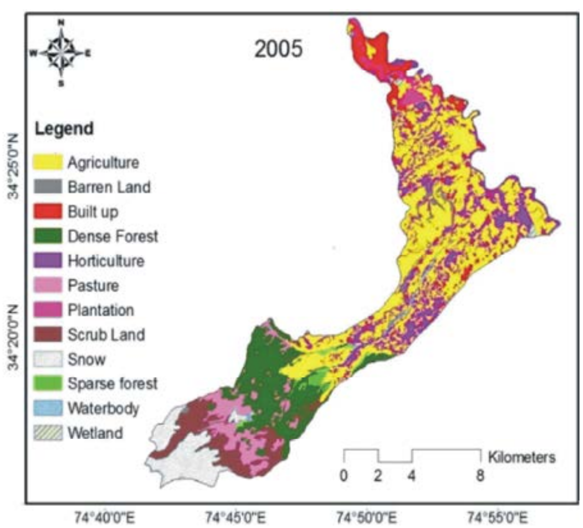

Fig. 5: LULC map of Romshi watershed-2005

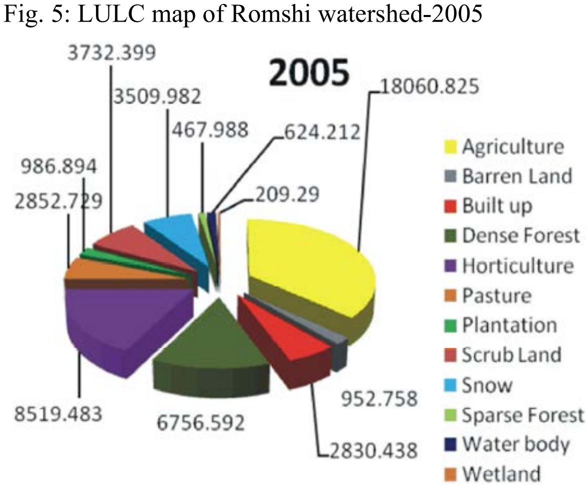

Fig. 6: Pie diagram of LULC classes-2005

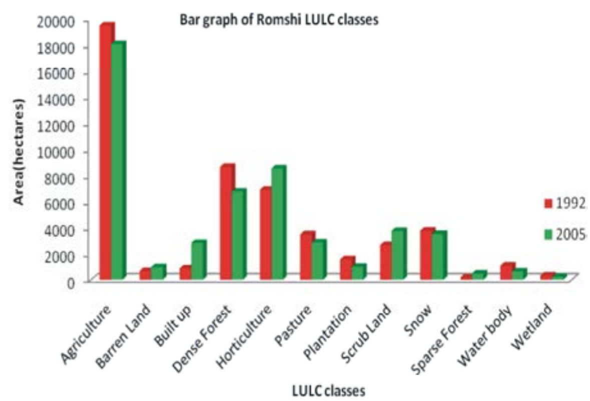

Fig. 7: Bar diagram depicting change in LULC classes from 1992-2005

Besides built-up is the important class of almost every LULC classification scheme, it increases because of urbanization and increase in population [10], as demographic growth stimulates structural changes through multiplier effects [11]. All other anthropogenic influences within the watershed particularly in terms of increase in the infrastructure development and increase in horticulture added by the impacts of the deforestation have accelerated the deterioration of the watershed structure and function [12, 13]. The agriculture land has shown a decreased trend in area, from output maps it is easily inferred that most of the horticulture land comes from agriculture land and also infrastructure development occurs on the agriculture fields [3]. The increasing trends in horticulture land in the area is that latter require less amount of water and hence are climatologically more viable [14, 3] and is economically more profitable. Land under forests has reduced and could be as result of well known environmental problems such as deforestation, urbanization etc. [15, 3].

CONCLUSION

The results reveal that the study area experienced some significant changes in its land use land cover categories. The nature and extent of these change showed some variations across time and space. These changes are attributed to socio-economic and environmental variables and host of other factors. Over all the areas that has declined in their spatial extents are dense forests, agricultural, water bodies and areas that has increased are built-up, sparse forests and horticulture which posed a major threat to the environmental and natural systems of the region. Other interesting findings touch on an impending infrastructure development in the study area. This will not only threaten the carrying capacity of an already fragile ecosystem, but it poses enormous challenges for both environmental and natural resource managers and policy makers in the region if not confronted with urgency it deserves.

REFERENCES

1. Rahdary, V., A. Soffianian, S. Maleki Najfabdai, S.J. Khajeddin and Pahlavanravi, 2008. Land use and land cover change detection of Mouteh wildlife refuge using remotely sensed data and geographic information system. World Applied Sciences Journal, 3: 113-118.
2. Tiwari, M.K. and A. Saxena, 2011. Change Detection of Land Use/ Land cover Pattern in an Around Mandideep and Obedullaganj Area, Using Remote Sensing and GIS. Gopalax -International Journal of Technology And Engineering System (IJTES), pp: 2.
3. Irfana, S., I. Rashid and S.A. Romshoo, 2013. Land use land cover dynamics as a function of changing demography and hydrology. GeoJournal, 78: 142-153.
4. Kamusoko, C. and M. Aniya, Landuse/cover change and landscape fragmentation analysis in the Bindura district Zimbabwe, Land Degradation and Development.
5. Singh, P. and S. Singh, 2011. Landuse Pattern Analysis Using Remote Sensing: A Case Study of Mau District, India. Archives of Applied Science Research, 3: 10-16.
6. Bhat, C.M., 2009. Vitasta- A part of our identity. http://ikashmir.net/chanderbhat.
7. ISRO, NNRMS standards, 2005. A National standard for EO images, thematic and cartographic maps, GIS databases and spatial outputs. ISRO NNRMS Technical Report, 112: 235.
8. Baker, C., R. Lawerence, C. Montagne and D. Pattern, 2007. Change detection of wetland ecosystem using Landsat imagery and change vector analysis. Wetlands, 27: 610-619.
9. Kombe, W.J. and V. Kreibich, 2000. Reconciling informal and formal land management: An agenda for improving tenure security and urban governance in poor countries. Habitat International, 24: 231-240.
10. Uma, J. and B. Mahalingam, 2011. Spatio-temporal changes of land use and land cover analysis using remote sensing and GIS: A case study of Kanchipuram District Coastal Stretch–Tamil Nadu. International Journal of Geomatics and Geosciences, 2: 188-195.
11. Fazal, S. and A. Amin, 2011. Impact of urban land transformation on water bodies in Srinagar City, India. Journal of Environmental Protection, pp: 2.
12. Ray, S. and I.A. Ray, 2011. Impact of population growth on environmental degradation: Case of India. Journal of Economics and Sustainable Development, 2: 72-77.
13. Clark, M., 2012. Deforestation in Madagascar: Consequences of population growth and unsustainable agricultural processes. Global Majority E-Journal, 3: 61-71.
14. Romshoo, S.A. and I. Rashid, 2012. Assessing the impacts of changing land cover and climate on Hokersar wetland in Indian Himalayas. Arabian Journal of Geosciences. Doi: 10.1007/s12517-012-07619.
15. Abbas, I.I., K.M. Muazu and J.A. Ukoje, 2010. Mapping land use-land cover and change detection in Kafur Local Government, Katsina, Nigeria (1995–2008) using remote sensing and GIS. Research Journal of Environmental and Earth Sciences, 2: 6-12.