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ANALYSIS OF LAND USE/LAND COVER CHANGES USING REMOTE SENSING DATA AND GIS OF PARTS OF NORTHERN COASTAL TRACT OF RATNAGIRI DISTRICT, MAHARASHTRA, INDIA.

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ABSTRACT
Land use/land cover (LU/LC) and human/natural modifications have resulted in deforestation, biodiversity loss, global warming and increase in disasters. These environmental problems are often related to LU/LC changes. The present studies have been carried out to detect changes in land use/ land cover pattern of parts of Konkan coastal belt of Ratnagiri district, Maharashtra, India by using remote sensing data and GIS techniques. The area forms a part of Konkan which is blessed with extreme natural beauty and highly biological diversity. It lies in the vicinity of Western Ghat. Now a day the coastal tract of Ratnagiri is experiencing an environmental degradation due to harboring of number of projects like construction of thermal power stations, international ports, Konkan railway tracks, metallic roads, dams etc. The studies have been carried by using IRS P6 LISS III (June 2008) and IRS-R2 LISS III (March 2013) remote sensing data adapting supervised classification. The results have been confirmed by field visits carried out during Nov. 2008 and May 2013. It follows that the forest cover and agricultural land is reduced by 3.81% and 0.52% respectively while there is increase in waste land and built up land by 3.91% and 0.15% respectively. These LU/LC changes lead to severe environmental problems such as landslides, floods, degradation of ecosystems.

KEY WORDS: biodiversity, ecosystem, land cover, landslides, land use, remote sensing,

INTRODUCTION

The anthropogenic activities significantly alter the earth's surface. The presence of man on the earth and his use of land has had profound effects upon the natural environment. The term land cover originally referred to the kind and state of vegetation, such as forest or grass cover but it has broadened in subsequent usage to include other things such as human structures, soil type, biodiversity, surface and ground water (Meyer, 1995)..

The LU/LC pattern of a region is an outcome of natural and socio-economic factors. LU and LC are very important in current strategies for managing natural resources and for monitoring environmental changes. Remote sensing is an important tool applicable for developing and understanding the global, physical processes affecting the earth (Hudak and Wessman, 1998). Remote sensing and GIS studies help in integrated eco-environmental assessment (Long et.al. 2008). The Konkan coastal belt has given rise to diverse and sensitive ecosystem ranging from tropical evergreen forest to mangroves. It is blessed with extreme natural beauty and biological diversities of both natural and agricultural. The Konkan has witnessed remarkable expansion, growth and developmental activities such as construction of roads; railway tracks thermal power stations, harbors, buildings along with other anthropogenic activities. It is therefore aimed to create LU/LC map and to determine the trend, nature, rate, location and magnitude of land use, land cover change of the northern coastal belt of Ratnagiri district, Maharashtra, India.

STUDY AREA

The area selected for the study is a Shastri River Basin (SRB), a part of northern coastal tract of Ratnagiri district from Maharashtra state. It lies between lat.$17^0$05' N; long. $73^0$15' E and lat. $17^0$30'N ; long. $73^0$45'E (Fig. 1). It covers an area about 2098 Km^2 in the survey of India topographic sheet Nos. 47 G/3, 4, 7,8,11,12 and 47 H/9. In the study area, Sangmeshwar is a major township, which is accessible easily from Kolhapur and Mumbai. It is on the National highway No. 17 i.e. Mumbai – Goa highway. The area is also accessible by Konkan railway. The important places of tourist's interest are Marleshwar temple, Jaigarh fort, Prachitgarh fort and Tural, Aravali hot springs. The present coastal river basin lies between Western Ghats to the east and Arabian Sea to the west. Topography in the area is indeed varied and geomorphologically diverse. The area is hilly and is intercepted by major Jaigarh creek (Shastri River). Numbers of eroded, flat topped basaltic hillocks are present capped by laterites. Quaternary sediments and mud flats are exposed along the banks of creek. The area falls in tropical to subtropical humid climate with high rainfall, high temperature and high humidity. The area receives average 3000mm/year rainfall during the months of June to

September from the south-west monsoon. The area of investigation is a part of coastal tract hence the humidity is high. It reaches up to 90% in rainy season.

The study area is a part of Ratnagiri District, Maharashtra having maximum biodiversity (Gole, 2001). The grasslands atop the laterite hillocks and forest along the slopes due to tropical climate are climax ecosystems of the area. Apart from forests, the highly diverse patches of Mangroves are the most important components of the area. They are highly specialized plants of tropical ecosystem found along the interface of land and water, especially along inter-tidal zones. The climatic conditions are also suitable for mango, coconut and cashew plantation.

MATERIALS AND METHODS

The studies have been carried by using multispectral IRS P6 LISS III (June 2008) and IRS-R2 LISS III (March 2013) remote sensing data procured from National Remote Sensing Center (NRSC), Hyderabad, India. The satellite data obtained from NRSC (bands2, 3and4) were geo-corrected with the help of Ground Control Points (GCPs) using GPS and known points on Survey of India toposheets.

A Supervised signature extraction with maximum likelihood algorithm was used to classify the digital remote sensing data for land use/ land cover mapping. Extensive and detailed field work was carried using GPS before preprocessing and classification of satellite imageries. This method helps to obtain accurate locational point data for each land use/land cover class included in the classification and for locating training sites. The satellite data was enhanced before classification using ERDAS Imagine 9.2 for better quality of image and better classification accuracy. In Supervised classification, spectral signatures are developed for specific locations (training sites) in the image. Generally a vector layer is digitized over the raster scene. The vector layer consists of various polygons overlying different land use types. The training sites help to develop spectral signatures for outlined areas. The LU/LC maps pertaining of two different periods (June 2008 and March 2013) were prepared (Fig 2 and Fig 3) and used for post classification comparison .On the basis these maps the changes in the LU/LC categories were identified and presented in table nos.1, 2, 3 and 4. The detailed methodology adapted is given in the flowchart.

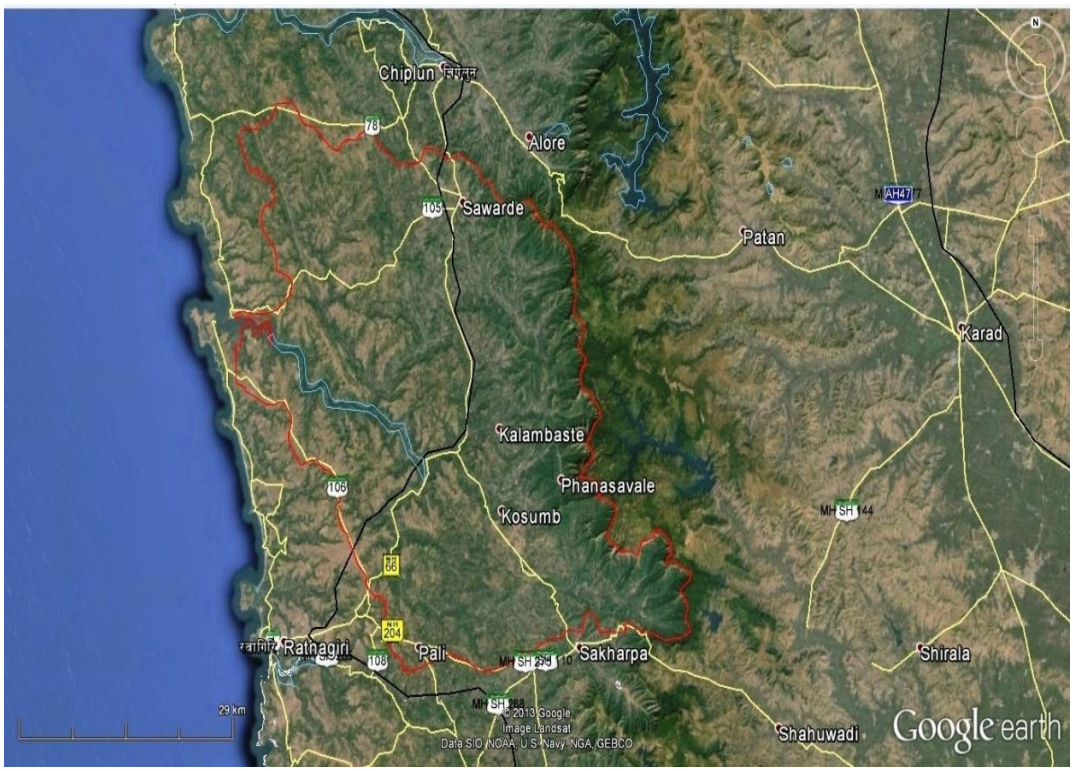


Figure 1. Area of Investigation (from Google Earth)

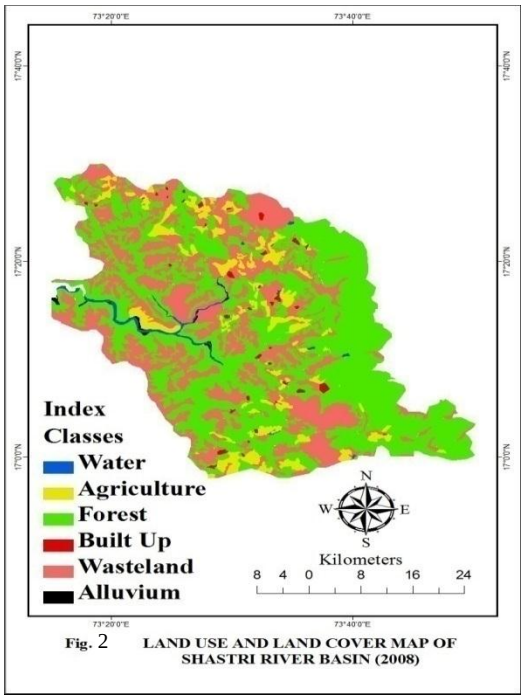


Fig. 2 LAND USE AND LAND COVER MAP OF SHASTRI RIVER BASIN (2008)

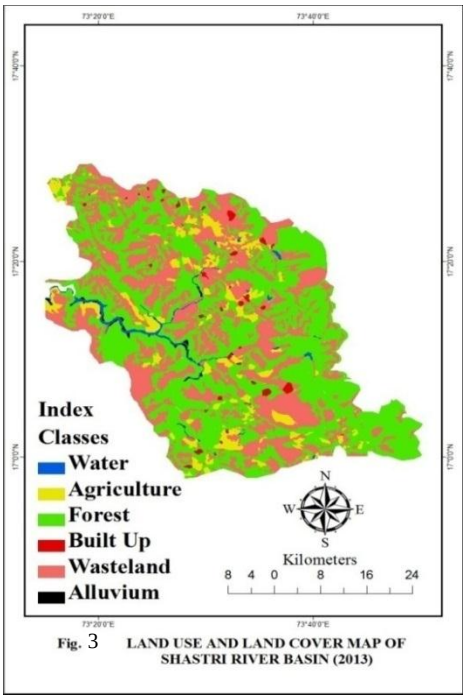
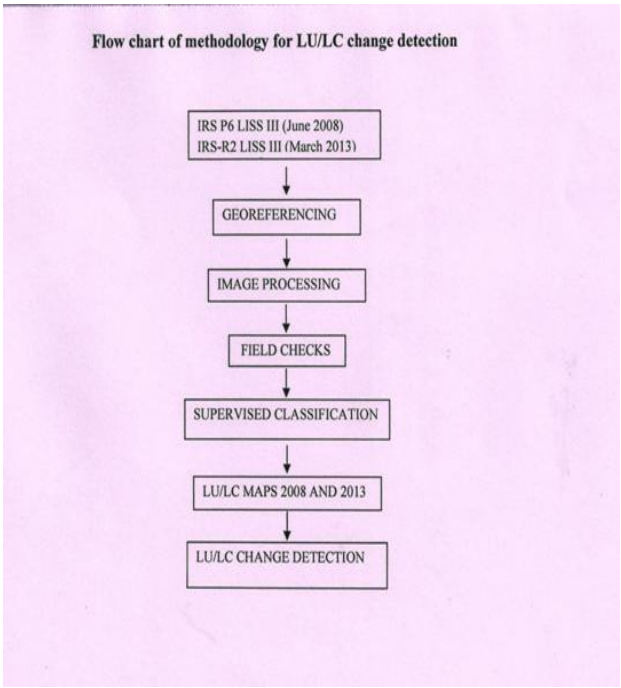


Fig. 3 LAND USE AND LAND COVER MAP OF SHASTRI RIVER BASIN (2013)



RESULTS AND DISCUSSION

In this study, totally, six LULC classes were established as water, agriculture, forest, built up , waste land, alluvium. Description of these land cover classes are presented in Table 1.

TABLE 1. LAND COVER CLASSES

Sr. No.	Land cover class	Description
1.	Water	Creek, river, tanks
2.	Agriculture	Paddy land, mango and cashew gardens, coconut
3.	Forest	Deciduous, mixed forest with high density trees
4.	Built up	Residential, industrial, transportational, commercial, construction
5.	Waste land	Areas with no vegetation cover, uncultivated land
6.	Alluviam	Mud flats, sand-silt bars along the creeks

Two dated satellite images were compared by supervised classification technique and employed to detect changes in the land use/ land cover types in ERDAS Imagine 9.2. The main reason behind the LU/LC changes includes rapid population growth, lack of valuation of ecological services, poverty and ignorance of biophysical limitations and use of ecologically incompatible technologies. Present study area is rapidly developing. During the past few decades, the study area has witnessed increase in population, industrialization, and transportation activities causing negative impact on the environmental health of the region. The study area covers 2098 km^2 and LU/LC changes were estimated from Jun. 2008 to Mar. 2013. The statistical results of LU/LC changes in terms of percentage and area are given in Table Nos. 2 and 3 respectively.

TABLE 2. CHANGES IN LU/LC (IN %)

Sr. No.	Class Name	Area in %		Change in %
		2008	**2013**	
1	Water	0.98	1.16	**0.18**
2	Agriculture	7.44	6.91	**-0.52**
3	Forest	56.72	52.91	**-3.81**
4	Built up	0.79	0.94	**0.15**
5	Waste land	33.84	37.75	**3.91**
6	Alluvium	0.24	0.33	**0.10**

TABLE 3. CHANGES IN LU/LC (IN SQ.KM.)

Sr. No.	Class Name	Area in km^2.		Change in km^2.
		2008	**2013**	
1	Water	20.50	24.30	**3.80**
2	Agriculture	156.00	145.00	**-11.00**
3	Forest	1190.00	1110.00	**-80.00**
4	Built up	16.50	19.70	**3.20**
5	Waste land	710.00	792.00	**82.00**
6	Alluvium	5.00	7.00	**2.00**

The changes observed in LU/LC from 2008 to 2013 are described as below

1 .Changes in Water Bodies:

The creeks, streams/rivers, tanks etc. are considered under this category. The prominent water bodies are easily detected on satellite imagery by their black and dark blue tones. The changing rate of water bodies of this area is showing increasing trend. There is approximately 0.18 % (3.80 sq.km.) increase of water bodies since last 5 years (from Jun. 2008 to Mar. 2013).

2 .Changes in Agriculture Land:

The low to medium cultivation and paddy, coconut, mango and cashew are the predominantly crops of this area. The crop growing conditions observation gained through the image interpretation reveals that the study area is predominantly comes under unfavorable due to Plateau and rocky, hilly, undulating topography. The changing rate of agricultural land of this area is showing decreasing trend. There is approximately 0.52 % (11sq.km.) decrease of agricultural land since last 5 years (from Jun. 2008 to Mar. 2013).

3 .Changes in Forest Area:

The changes in land use related to forest have important environmental consequences for many biological, chemical and physical processes of soil. The degradation of forestland areas in India is not at all satisfactory. India alone is losing more than 1.5 million hectare of forest cover each year and 22 million hectare of forestland have been destroyed during the last three decades due to over exploitation, misuse (Tiwari, 1982) the depletion of forestland significantly affects the species conservation for this naturally rich part of Konkan, which in turn contributes towards destabilization of biodiversity of the region. The changing rate of forest land of this area is showing decreasing trend. There is approximately 3.81% (80 sq.km.) decrease of forest land since last 5 years (from Jun. 2008 to Mar. 2013).

4 .Changes in Built Up :

Increase in population is mainly responsible for increase in growth of industries, constructions and settlement. The identification of settlement in satellite imagery was based on tone and colour. They have tone of grayish and light bluish colour. This unit includes roads and other infrastructure related to human beings like railway tracks, crushing units, dams, ports etc. The changing rate of built up of this area is showing increasing trend. There is approximately 0.15% (3.20 sq.km.) increase of built up since last 5 years (from Jun. 2008 to Mar. 2013).

5. Changes in Waste Land:

Waste land is described as degraded land, which can be brought under vegetation cover with reasonable effort. The patches are registered throughout the basin. The study area comes under hilly, rugged as well as plateau region, so maximum portion of the waste land is categorized under barren rocky waste. It follows that forest cover in the area has been converted in to a waste land indicating human interference. The changing rate of waste land of this area is showing increasing trend. There is approximately 3.91% (82.00 sq.km.) increase of built up since last 5 years (from year Jun. 2008 to Mar. 2013).

6. Changes in Alluvium:

The area of investigation comprises of major and some minor creeks. It receives heavy to very heavy rain fall causing floods. During flooding the sand, silt and clay get distributed in the form of tidal flats. There is approximately 0.10% (2.00 sq.km.) increase of built up since last 5 years (from Jun. 2008 to Mar. 2013).

CONCLUSIONS

This paper aims investigating land use/land cover changes occurred in Shastri River Basin (SRB), from coastal belt of Ratnagiri district, Maharashtra between 2008 and 2013using remote sensing and GIS. During this period under observation, out of the total land area, 1916 km^2 remains unchanged, which is equal to 91.33% of the total area. However, 80 km^2 (3.81%) of the forest area was converted to wasteland, which is considered as one of the significant changes in land use practices. The total forest cover is continuously degrading and transforming into various land use/land cover category. The studies also show decrease in agricultural land due to increase in water and alluvium along the creeks may be due to flood. The area is experiencing recently variety of anthropogenic activities like construction of thermal power stations, international harbours, dams, stone crushing units' etc. causing environmental degradation. The present exploratory study has clearly indicated that an integrated approach is warranted to protect the natural land resource of the region in view of its rich biodiversity.

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