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RESEARCH PAPER

Land use land cover change detection in Yellapur taluk of Uttara Kannada district using remote sensing and geographic information system techniques

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Abstract: The present study was carried out with the objective of assessment of land use land cover (LULC) change detection in Yellapur taluk of Uttara Kannada district between the years 1998 to 2018. The satellite data was downloaded from United States Geological Survey (USGS) Earth Explorer website such as Landsat 5 Thematic Mapper for the year 1998 and Landsat 7 Enhanced thematic mapper plus for the year 2018. The shape file of Yellapur taluk was created in Arc GIS and the images were clipped for the study area. Then the ground truth data for different land use land cover classes was collected with the help of GPS and LULC mapping was done under supervised classification using ERDAS IMAGINE for the year 1998 and 2018. The different land use and land cover classes identified were dense forest, sparse forest agricultural land, horticulture, settlements and water bodies. The results revealed that the change occurred over 20 years indicated that area under dense forest decreased by 4.62 per cent and area under sparse forest increased by 2.15 per cent. Agriculture land was decreased by 0.55 per cent, horticultural land increased by 1.55 per cent, settlements increased by 1.4 per cent and water bodies increased by 0.07 per cent. The change in LULC is due to increased population and settlements, people depend upon forests which builds pressure on forests. This investigation suggest that, there is a need to protect the existing forest and to increase green cover where anthropogenic activities exists. Remote sensing and GIS techniques provides quick, accurate and reliable data through which timely monitoring of the forests and other natural resources.

Key words: Anthropogenic pressure, Change detection, Forest, Land use

Introduction

The surface of the earth is continuously changing either due to anthropogenic intervention or due to natural phenomena such as occurrences of disasters, change in the course of rivers, deforestation, mining, urbanization etc. The process involving identification of the changes on the earth's surface over time is known as change detection. "Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times" (Singh, 2010). Over the years, humans have altered the surface of the earth for their survival, livelihood and have been deriving raw materials from the forest for their comfort. Unfortunately, expansion of the human population at an accelerated rate have resulted in unprecedented changes in our ecosystem globally. This in turn have affected our environment which is one of the factors for climate change.

Usually, the various changes that have taken place such as mining in forest area, conversion of agricultural land into settlements and other activities makes continuous supervision a cumbersome work. Conventional ground methods of land use mapping are labour intensive, time consuming and are done less frequently. Thus, with the advent of satellite remote sensing techniques, preparing accurate land use land cover maps and monitoring changes at regular intervals of time is relatively simpler. Timely and accurate change detection of earth surface features provides the foundation for better understanding relationships and interactions between human and natural phenomena to better manage and use resources (Lu *et al.,* 2004).

Hence, remote sensing and GIS methods are suitable for detecting changes that have occurred in a region over a period of time. Application of remotely sensed data has made it possible to study land use and land cover changes accurately and timely. Remote sensing techniques provide efficient tools for analysing change detection through NDVI and land use land cover mapping techniques.

Keeping these points in view, this study was taken up in Yellapur taluk in order to get the present information about the area and how it has changed over the years. This will help in understanding the relationship between human activities with utilization of natural resources and will provide the necessary precautions to be taken for conservation of the natural resources.

Material and methods

The present study was carried out in Yellapur taluk during the year 2018-2019. The study area is located in the Western Ghats section of Karnataka. Its area lies between the latitude of 14°43'0" N to 15°9'26" N and longitude of 74°26'16" E to 74°56'46" E, having average elevation of 541 m above mean sea level (MSL). The average rainfall in the district is 2741.7 mm. The study area is shown in Fig.1.

The survey of India (SOI) toposheet of Yellapur taluk of Uttara Kannada district was collected with a scale of 1:50000, which was used as a base map for delineation of the study area. The satellite imagery used for this study was Landsat 5 Thematic Mapper for the year 1998 and Landsat 7 Enhanced Thematic

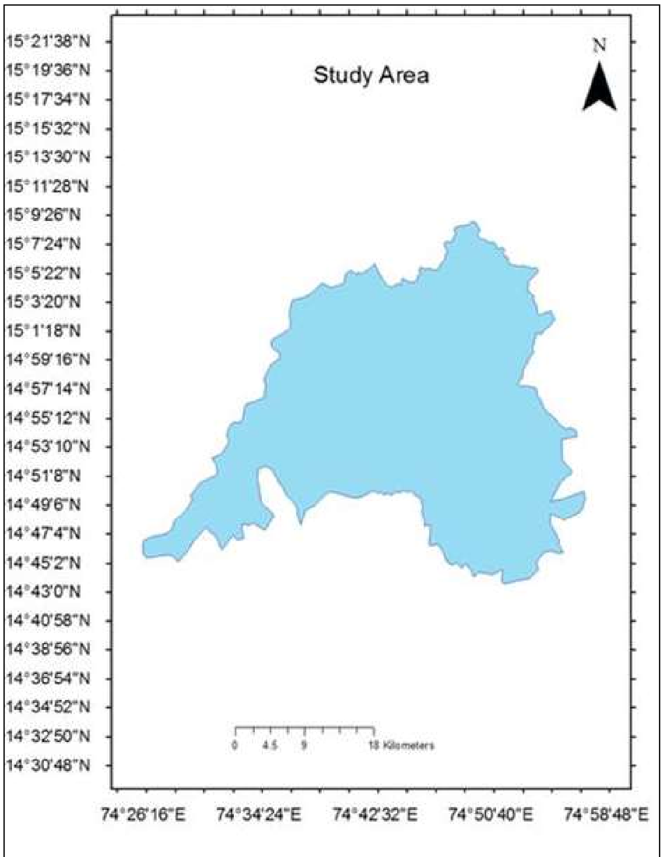

Fig. 1: Study area – Yellapur Taluk

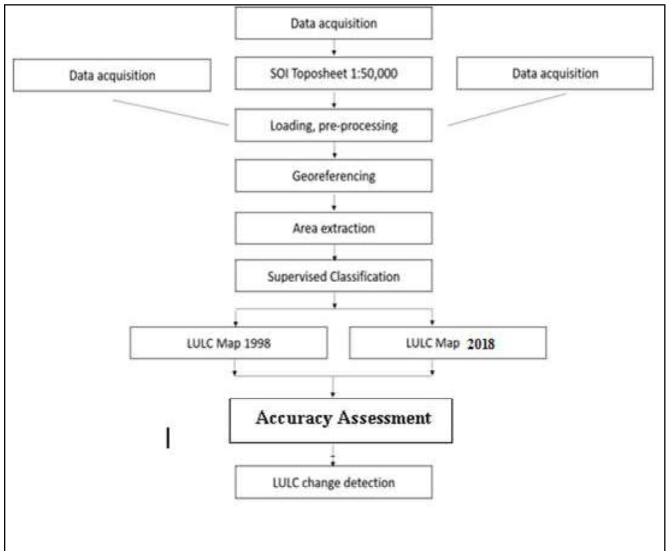

Fig. 2: Flow chart for methodology of change detection

Mapper plus for the year 2018. These maps were downloaded from United States Geological Survey (USGS) Earth Explorer website. The shape file of Yellapur taluk was created in Arc GIS software. Toposheet of the study area are georeferenced and projected to UTM system using Arc GIS. The images of Yellapur taluk for the year 1998 and 2018 was clipped using Yellapur shape created. The satellite data are pre-processed for radiometric and geometric corrections before preparation of the maps.

The area of interest (AOI) was clipped in ArcGIS software. The shape file of Yellapur taluk was laid over the satellite images for both the years (1998 and 2018) and then the AOI was extracted.

The AOI file was placed over satellite image and subset the area. The land use and land cover maps of study area for the year 1998 and 2018 was prepared using supervised classification. Land use/ Land cover changes were determined using post classification change detection method and the land use/ land cover statistics derived from data sets Landsat TM (1998), Landsat ETM+ (2018) was computed and compared for quantification of change. The flow chart on detailed methodology of this study has been presented in Fig.2.

The LULC classes created based on ground truth were assessed for their accuracy in ERDAS software by creating random points on the map and comparing each points falling on the classes with secondary reference data /Google Earth. This provides the accuracy report. The overall accuracy and the Kappa coefficient was determined by using the following formula given by Jensen (2005):

$$\text{Overall accuracy} = \frac{\text{Total number of correctly classified pixels (diagonal)}}{\text{Total number of reference pixels}} \times 100$$

$$\text{Kappa coefficient} = \frac{(NxA)\text{-}B}{N2\text{-}BH} \times 100$$

Where,

N = Total number of classified pixels

A = Sum of diagonal value

B = Sum of r product (Row total × Column total of the same class).

Results and discussion

The LULC map prepared for the year 1998 and 2018 depicts the changes that have occurred in the study area for a period of 20 years which is shown in Fig. 3 and 4. The result revealed that the area under dense forest has reduced drastically by 6062.24 ha and the area under sparse forest has increased by 2821.53 ha.

According to Haque and Basak, (2017), 40 per cent of the total area in Tanguar Haor, Bangladesh was converted into other land use over a period of 30 years. Forest lands and high vegetation area were rapidly decreasing, water bodies and large lakes were shrinking at much faster pace due to widespread development and increases settlements.

In the year 1998, the area occupied by dense forest was 79,188.67 ha (Table 1), sparse forest by 35,531.5 ha, agriculture land by 5,852.34 ha, horticulture by 3,641.13 ha, settlements by

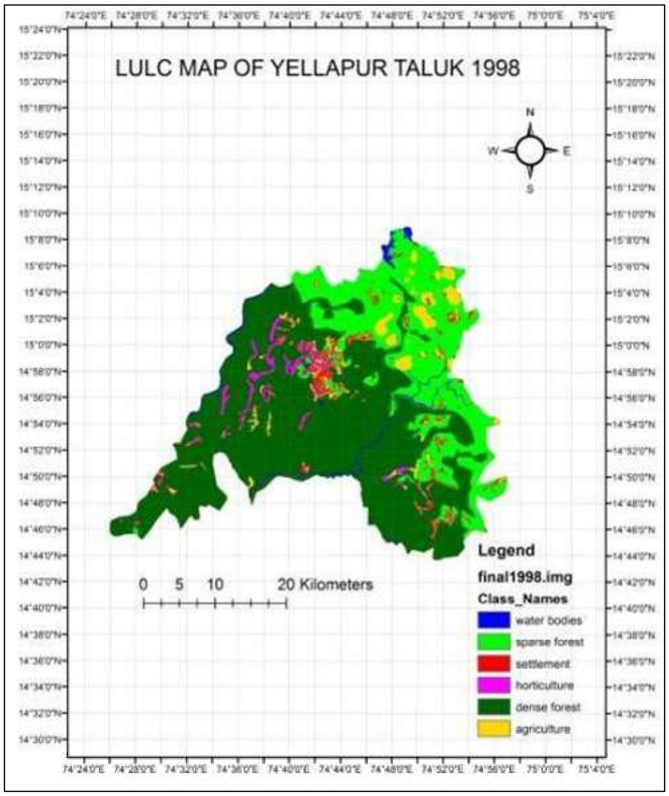

Fig. 3. LULC map of 1998 for Yellapur taluk

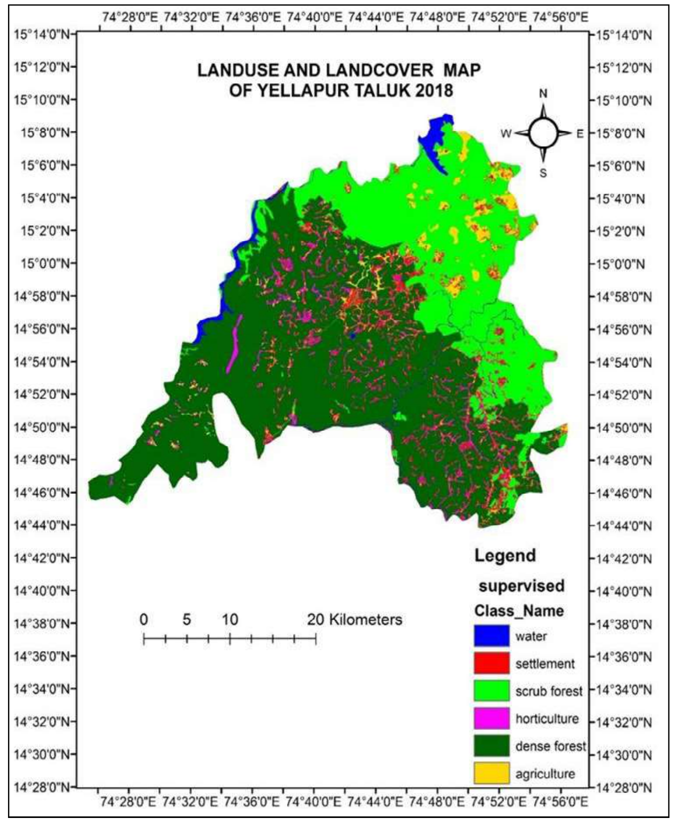

Fig. 4: LULC map of 2018 for Yellapur taluk

Table 1. LULC classes and changes occurred in Yellapur taluk for the year 1998 and 2018

Classes	Area in 1998		Area in 2018		Difference	
	ha	%	ha	%	ha	% over total area
Dense forest	79188.67	60.34	73126.43	55.72	-6062.24	-4.62
Sparse forest	35531.50	27.07	38353.03	29.22	2821.53	2.15
Agriculture	5852.34	4.45	5127.93	3.90	-724.41	-0.55
Horticulture	3641.13	2.77	5670.43	4.32	2029.3	1.55
Settlements	4479.14	3.41	6314.96	4.81	1835.82	1.4
Water bodies	2534.00	1.93	2634.00	2.00	100.00	0.07
Total	131226.78	100	131226.78	100	-	-

4,479.14 ha and area occupied by water body was 2,534 ha. These classes accounts for about 60.34 per cent of dense forest, 27.07 per cent of sparse forest, 4.45 per cent of agricultural land, 3.41 per cent of settlement, 1.93 per cent of water bodies and 2.77 per cent of horticulture. The maximum area was covered by dense forest and the least was covered by water bodies.

Similarly in the year 2018, Dense forest covered about 73,126.43 ha of area, sparse forest covered about 38,353.03 ha area, agriculture land covered about 5,127.93 ha of area, horticulture covered about 5,670.43 ha area, settlements covered around 6,314.96 ha area and water bodies covered around 2,634 ha area (Table 1). These classes accounts for about 55.72 per cent of dense forest, 29.22 per cent of sparse forest, 3.90 per cent of agricultural land, 4.32 per cent of horticulture, 4.81 per cent of settlement and 2 per cent of the land was covered by water bodies. The maximum area was covered by dense forest and the least area was covered by water bodies.

The changes that have occurred in Yellapur taluk for a period of 20 years have been recorded and analysed with the aim to try and understand the trend/pattern of different land use systems. This gives us a clear picture on the status of forest and to figure out the reasons/driving forces for changes that has occurred over the years.

The results states that during a period from 1998-2018, the area of dense forest decreased by 4.62 per cent (6062.24 ha), sparse forest increased by 2.15 per cent (2821.53 ha). It clearly suggests that there was conversion of dense forest into sparse forest. This is mainly due to forest degradation and conversion of forest land into non-forest land. Due to increased population, the forest lands have been converted and degraded to meet the daily requirements of the people such as collection of timber, fuelwood for energy of NTFP and areca processing etc. Encroachment of forest land by the people has also resulted in forest degradation. Thus deforestation and degradation taken place has resulted change in the land use pattern which in turn affects forest cover (George, *et al.,* 2016).

Agriculture land decreased by 0.55 per cent (724.41 ha), horticultural land increased by 1.55 per cent (2029.3 ha), settlements increased by 1.4 per cent (1835.82 ha) and water bodies increased by 0.07 per cent *i.e.* by 100 ha. There is conversion of agricultural land or wet lands into buildings or settlements**.** According to a report released by Census of India (2011), there is increase in human population in Yellapur taluk from 16,938 to 20,452 from 2001-2011, which signifies that there is increase in human interference, increase in settlements and built up area.

The ever growing human population is considered as a major threat to forests (Reddy *et al.,* 2016). Agricultural expansion, plantation development, logging and mining, urbanization and construction of water harvesting structures are primary responsible factors for deforestation (Geist and Lambin, 2002).

There was increase in the area of horticulture by 1.55 per cent. This indicates that farmers are shifting gradually from agriculture towards areca plantations for increased income. Forest encroachment cases and conversion of forest land into areca plantations are increasing in recent times of Uttara Kannada district.

The accuracy assessment was done after merging the misclassified pixels. The pixel of other class and of different reflectance was classified into the correct classes by the software by confirming the classes through Google Earth. The overall accuracy of the LULC classification for the year 1998 and 2018 was 90.58 per cent and 92.10 per cent, respectively. The Kappa coefficient for the year 1998 and 2018 was 0.87 and 0.89, respectively.

Conclusion

Based on the study, it was be concluded that there was decrease in dense forest. The dense forest in Yellapur taluk has been degraded into sparse forest. Hence, increasing green cover in and around the settlements can help in protection of dense forests. Increased pressure on forest due to anthropogenic activities are the main reasons for decrease in dense forest.

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