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ASSESSMENT OF LAND USE /CHANGE ALONG ANDHRA COAST USING REMOTE SENSING

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INTRODUCTON

Land is a basic natural resource, which plays dynamic role in the economic growth of the country. Therefore, land resources are essential for society, and it should be preserved. Land-use/cover change adds a lot to deviations in climate at all aspects. The vegetation covers and built structures affect the variations climate (Ellis, 2007). According to Loveland and Acevedo, (2015), land change studies, generally try to explain to the driving forces and proximate causes about land changes and its magnitude of changes is taking place.

Coastal region is attractive area for the people from ancient time to the present because of its unique location and benefited environment (Mahapatra et al., 2013). With only 20% of all land area, coastal areas are now the home of nearly half of the global population and this percentage is continually increasing year by year (Burke et al., 2000). Increased coastal population and intense development threaten and degrade global coastal ecosystems by the changing land-use/cover in the form of replacing the mangroves land into agriculture, industry, sand mining, and construction of breakwaters which are triggering change in coastal dynamics and possible reshaping of the shorelines. UNDP, (2007) also stated that during the past 40 years, human population has doubled in coastal region and to increase by the same rate again in the next 40 years which lead to the land transformation. It is directly producing negative impacts on land resource. Moreover, the same phenomena are undergoing in the Andhra coast, where the coastal land forms are severely altering by the impact of land-use/cover changes. Several studies revealed that due to increasing population and climatic variability, there are negative impact on vegetative cover, shoreline change, landforms, biodiversity, groundwater, soil and air along coastal regions (Mahapatra et al., 2013).

STUDY AREA

The study area occupies the coast along Andhra Pradesh that is the part of the eastern coast of India. It is a passive continental margin settled during Late Jurassic period (Bastia and Nayak, 2006). The state is one of the largest states in India, with having an area of 160,205 km². According to Primary Census Abstract (2011), the population of the state is 49,386,799. It has

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around 4.9 % of the country's geographical area and 4.0% of the country's population. As a port, it also plays a vital role in the economic activity of the state and the whole country. Other commercial hubs of the state include; Vijayawada, Tirupati, Kurnool, Guntur, Kakinada, and Rajahmundry. The state is enriched with a different physio-graphic features ranging from Eastern Ghats, Coastal plains to deltas and Nallamala Forest (Kawade et al., 2016).

METHODOLOGY

Land-use/cover change analysis was done taking 3 km width from the shoreline along the Andhra Pradesh coast over a period of time.This 3 km coastal belt is segregated from both the images through ERDAS Imagine, 2014 software. In total, six images from two satellite imageries were taken to find out changes in land-use/cover through the same software (ERDAS Imagine, 2014) with supervised classification technique. This study utilizes remote sensing and GIS capabilities to monitor the LULC changes between 1973 and 2015. Satellite imageries (LANDSAT MSS, 1973 and LANDSAT 8, 2015) have been acquired from USGS website. The digital image processing and statistical spatial analysis has been done using ERDAS Imagine 2014 and ArcGIS 10.4. These multi-band imageries were first layer stacked and then mosaicked to mask the study area. Re-sampling certainly enhances comparability among various data sets of equal pixel size. Through masking in ERDAS Imagine, an area of 3 km from the shoreline towards land was masked from 1973 and 2015 imageries of Andhra coast. In this study, total of five LULC classes were assigned as water, vegetation, Built-up, sand and barren land. Description of these land-use/cover classes is represented in Table 1.1. The reflectance of the chosen signatures was classified by supervised classifier (Foody et al., 1992).

Table 1.1

Land cover	Description
Water	Lake, Streams, Rivers, Canals, Ponds, Reservoirs, aqua-culture, Salt Marshes
Vegetation	Shrubs, open forest, mangroves, cropland, plantation, natural vegetation which can either be evergreen or deciduous.
Built-up	Land covered by man-made structures. Residential areas, industries, dams, roads, etc.
Sand	Open dry sand
Barren	Sand dune, Follow land, Bare grounds, Salt pan, River sediment basins, land with no vegetation cover

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Analysis of Land-use/cover Change (1973-2015)

Images from Landsat 1-4 (MSS) and Landsat 8 for 1973 and 2015, respectively, have been used in this study. These images are classified independently by using supervised classification (Sohail, 2012). The various land-use/cover classes are interpreted in the study area in two years, i.e., 1973 and 2015 along Andhra coast the overall accuracy between 72% and 83%. The result is presented in the form of map, charts and statistical tables. They include the static and change land-use/cover of each class. The detail analysis of land-use/cover of Andhra coast through Kappa coefficient statistical has been discussed below.

The total land-use/cover for Andhra coast in 1973 was 2914.04 km^2 while that of 2015 was 2893.99 km^2. Land use/cover in 1973 was 20.05 km^2 larger than of 2015. This represents a percentage decreasing of 0.68 %. This decreasing or increasing in land area along the coast could be attributed to relative rise and fall in water levels, especially, sea level (Dadson, 2016; Murali and Kumar., 2015).

Analysis of Land-use/cover (1973)

The land use data of the year 1973 shows that the vegetation with mangroves occupies the highest class with 1651.08 km^2 (56.65%), covering more than half of the total area along this sector. The barren land, which include sand dune, fallow land, salt pan, river sediment basin, land without no vegetation cover occupy 594.96 km^2 (20.41%) area and become second highest class. Open sand area covers 194.61 km^2 (6.67%) area. Water bodies which include natural and man-made water features such as, lake, streams, river, canals, ponds, aqua-culture, and salt marshes a total of 392.16 km^2 (13.45%), built up land found to be of 81.23 km^2 (2.78%), It composed of areas of intensive with much of land covered by structures which included cities, towns, and villages, industrial and commercial complexes (Table 7.9).

Analysis of Land-use/cover (2015)

The land-use/cover in 2015 along the Andhra coast showed that the Vegetation with mangroves is also the largest component of the land-use/cover and occupied 1580.50 km^2 which is the 54.61% of total area. Barren land is occupied the 716.69 km^2 and become the second largest component of LULC with the cover an area of 24.76 % of the total area. Water bodies occupy 415.70 km^2 (14.36%) areas, built- up land is 103.84 km^2 (3.58%) and sand occupied the 77.26 km^2 (2.66%) area during 2015 (Table 7.9).

Dynamics of Land-use/cover (1973-2015)

The data of land-use/cover along Andhra coast shows the significant changes with regards to various features class in between 1973-2015.The data indicates that the maximum decrease is

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noted in sandy area which was 6.67% in 1973 and 2.66% in 2015. The net change is -4% with the rate of -2.79 km^2/y during 1973 to 2015 (Table 7.9). According to Swarn et al., (2011) deposition of sand is a natural protector of the coast from erosion; if it is removed from any part of the beach can increase the erosion which may cause changes in the shoreline. They revealed that there are mining of beach sand along the Gangavarm, Palaalsa and Appikonda along the coast which was one of the reasons of temporal changes in shoreline with other anthropogenic activities like dredging the backwater cannels and construction of groynes and jetties perpendicular to the coast.

The area under vegetation with mangroves has decreased from 56% in the year 1973 to 54.61% in the year 2015 with net decrease of -2.04%. The annual decreasing rate is -1.68 km^2/y (Table 7.9). Forest land continuously degraded due to agriculture, aquaculture (Shrim culture) and tree-felling activities, oil and pesticides pollution and due to forces of natural degradation. It is also converted into fishponds and salt beds (Dan et al., 2016).

On the contrast, rest of the classes such as barren land, water bodies and built-up land shows the increasing trends. Barren land shows the maximum increasing with the rate of 2.89 km^2/y. This feature class covered the 20.41% area in 1973 and 24.76% in 2015 where net change is 4.34% during this interval. Built-up area and water bodies haveslightly increased from 2.78% to 3.58% and from 13.45% to 14.36% with the rate of 0.53 km^2/y and 0.56 km^2/y respectivelyin given time span (Table 1.2).

Table 1.2 Land-use/cover change along Andhra Pradesh coast

Land-use/cover	1973		2015		% change in area 1973-2015	Annual change rate km^2/y
	Area ($km^{2)}$	Area (%)	Area (km^2)	Area (%)		
Vegetation with mangroves	1651.08	56.65	1580.5	54.61	-2.04	-1.68
built up	81.23	2.78	103.84	3.58	0.8	0.53
Water body	392.16	13.45	415.7	14.36	0.9	0.56
Barren Land	594.96	20.41	716.69	24.76	4.34	2.89
Sand	194.61	6.67	77.26	2.66	-4	-2.79

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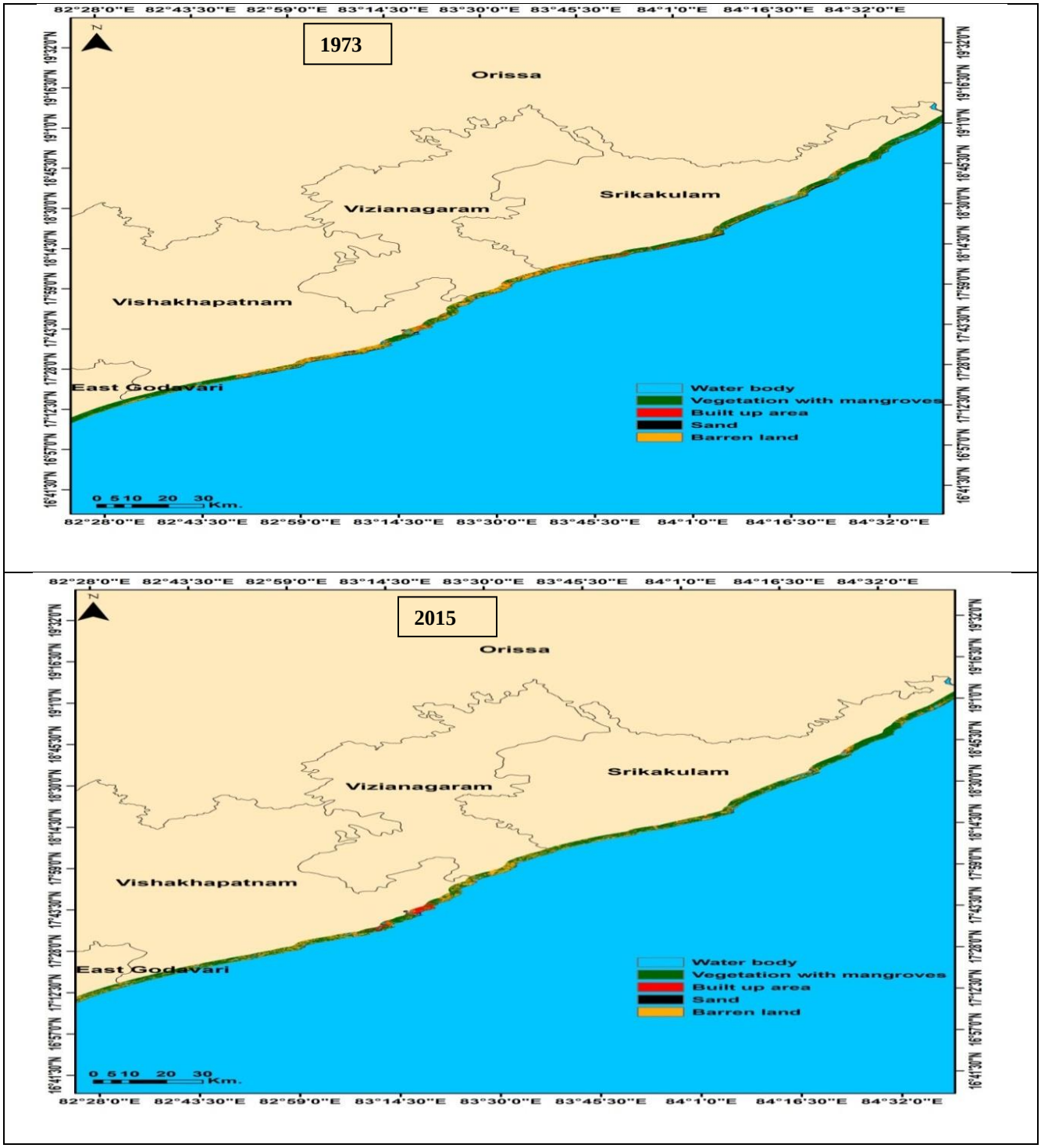
Fig. 1 Land-use/ cover of Northern Andhra coast (a) 1973 and (b) 2015



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Conclusion

The goal of this chapter was to evaluate the land-use/ land cover changing along the Andhra coast using the high resolution remote sensing data and geographic information system tools. A significant finding is that, Vegetation with mangroves is the dominated class in both year along the Andhra coast which covered 56.65% area in 1973 and 54.61% in 2015. But it shows the decreasing trend. Barren land is the second highest feature class that occupied an area of 20.41% in 1973 and 24.76% in 2015 and showing increasing pattern. Water bodies and built-up area also show the increasing pattern. On the contrast, sandy area shows the decreasing pattern during this time span. Share of sandy land was 7.81% to total in 1973 which became 2.66% in 2015 which indicates that sandy feature class is a maximum decreasing class along Andhra coast. The result of LULC dynamic clearly indicated the pattern of land use has changed over the period. Land under sand has decreased during the 1973-2015 along coast. This is may be due to shoreline/beach erosion and other processes like cyclones tsunami and sea level rise. Anthropogenic impact like sand mining, major constructions, shore protection structures and tourism activities also have the impacts on sand along coast.

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