Vegetation Change Statistics For Rayalaseema Forest Area (India) Using Multi Temporal Optical Satellite Data

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Abstract- *Prior to 1996 there was no mechanism to monitor the Forest cover changes in Rayalaseema. However, these reports, which were brought out since 1987, did not provide the statistical information on the forest cover inside the notified forest which is under the control of forest Department and outside separately. The paper discusses land use and land cover change detection analysis with reference to forest encroachment Rayalaseema area of Andhra Pradesh state. Attentive selection of satellite imageries based on various attributes including radiometric resolution, spatial resolution, cloud free coverage and time lapse among others, is warranted for change detection analysis. This study mainly deals with the on-screen visual interpretation of multi-temporal remotely sensed images of Resourcesat-2 LISS III (23.5m) for the years 2009 to 2012 for studying forest cover change. The total notified forest area of notified forest area the State is 63,814 Km2 , which is 23.2 % of the geographical area Reserved. The state had 19601.14 Km of Dense forest & 2 2 22645.41 km open forest. This study successfully detected forest cover has increased by an area of 347.37ha i.e. 3.4737 KM2. It is found that waterbody area increased in 2012 by 1.16 ha compared to 2009 so due to waterbody construction lost 1.16 ha of forest in 2012.*

Keywords- Remote sensing & GIS, Land use/ Land cover

I. INTRODUCTION

Rayalaseema is a geographic region in the Indian state of Rayalaseema. It includes the four southern districts of Anantapur, Chittoor, Kadapa and Kurnool. As of 2011 census of India, the region with four districts has a total population of 15,184,908 and covers an area of 67,526 km^2.

The Forest of Rayalaseema is mostly deciduous in nature and its canopy density widely changes in different months. Experience has shown that complete digital interpretation, without input from visual editing does not give a satisfactory level of accuracy. Further, it was noticed that repeated digital classification was prone to interpretational errors and overlaying two classified images didn't give proper change image at times. It was therefore decided to use visual editing after classifying the image of 2011 to get a correct interpretation of areas not properly classified by the digital methods. NDVI slicing cum limited visual editing was resorted Rayalaseema area. With 2011 classified image as a base classification various year of images were classified and changes brought out by Erdas matrix tool and Visual comparison taking clues from Google, Bhuvan etc. The change areas both +ve and –ve are polygonised in Arc map software after swiping, keeping all previous year's polygons as a separate layer.

Over the years the digital interpretation of Satellite data had been done independently, as a result changes in Forest cover were prone to subjectivity results in interpretational errors. Therefore, APFD has switched over to Vector based approach like the FSI from 2011 in which forest cover is mapped in polygons (Vector) by defining clusters of pixels with boundaries.

II. METHODOLOGY

Study area

Rayalaseema consists of four districts Kadapa, Chittoor, Kurnool and Anantapur. Rayalaseema region is located in the southern region of the state of Rayalaseema. The Latitude and Longitude of Rayalaseema is 13.6213 and 79.4217 respectively.
MAP

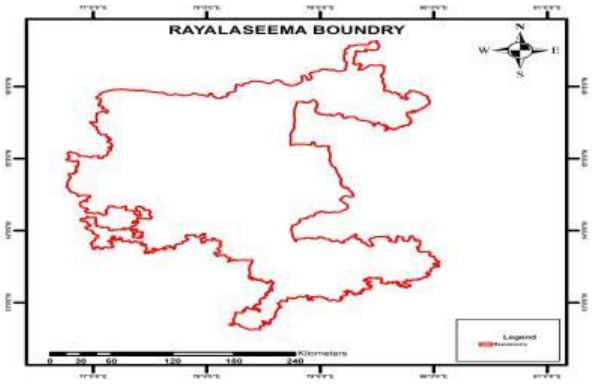

Fig.1: Study area

The climate of Rayalaseema is generally hot and humid. The summer season in this state generally extends from March to June. During these months the moisture level is quite high. The coastal areas have higher temperatures than the other parts of the state. In summer, the temperature generally ranges between 20 °C and 40 °C. At certain places the temperature is as high as 45 degrees on a summer day.

The summer is followed by the monsoon season, which starts during July and continues till September. This is the season for heavy tropical rains in Rayalaseema. The major role in determining the climate of the state is played by South-West Monsoons. About one third of the total rainfall in Rayalaseema is brought by the North-East Monsoons around the month of October in the state.

The winters in Rayalaseema are pleasant. This is the time when the state attracts most of its tourists. October to February are the winter months in Rayalaseema. Since the state has quite a long coastline, [3] the winters are comparatively mild. The range of winter temperatures is generally from 13 °C to 30 °C.

Locals and tourists generally find that cotton summer clothes are best suited to coping with the climate of Rayalaseema.

Satellite data and maps used

Remote sensing imageries were selected based on various attributes including radiometric resolution, spatial resolution, cloud free coverage and time lapse data. Detailed description of remotely sensed data is given in Table 1. Digital remotely sensed data of Resourcesat-2 LISS III (23.5m) for the years 2010 to 2012 were visually interpreted using photo interpretation elements like size, shape, shadow, tone, texture, association, location and pattern.

The Satellite data for the entire division was procured from the National Remote Sensing Centre (NRSC), Hyderabad in digital format. It was multi spectral (LISS- III Sensor) data of IRS Resourcesat-2 satellite with a spatial resolution of 23.5m.

One scene of LISS – III covers an area of about 20,000 km2 (141 km X 141 km). There are considerable overlaps (15 to 20 percent) among adjacent scenes. At the borders of the State or for islands, the whole scene has to be procured even though the Area of Interest (AOI) may be small. Thus, a total of 2 scenes covering the entire division were procured for two years.

Table 1: Details of the remotely sensed data used for the study area are summarized here

S. No.	Satellite	Sensor	Path	Row	Date of pass	Resolution	
						Spatial	Spectral
1	Resourcesat-2	LISS-III	103	60	November 08, 2010	23.5M	0.52-0.59 µm
							0.62-0.68 µm
							0.77-0.86 µm
							1.55-1.70 µm
2	Resourcesat-2	LISS-III	103	61	December 02, 2010	23.5M	0.52-0.59 µm
							0.62-0.68 µm
							0.77-0.86 µm
							1.55-1.70 µm
3	Resourcesat-2	LISS-III	103	60	November 27, 2011	23.5M	0.52-0.59 µm
							0.62-0.68 µm
							0.77-0.86 µm
							1.55-1.70 µm
4	Resourcesat-2	LISS-III	103	61	November 27, 2011	23.5M	0.52-0.59 µm
							0.62-0.68 µm
							0.77-0.86 µm
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							1.55-1.70 µm
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							0.62-0.68 µm
							0.77-0.86 µm
							1.55-1.70 µm

Image processing and workflow

The 2011 image has been previously classified as Dense Forest, Open Forest, Scrub, Non-Forests and water with an accuracy of 85%. This Classified image was taken as the

basis for bringing out forest cover changes of 2010 to 2012. The change polygons were also taken into account to determine the changes by overlaying them on the classified image till 2012. This year fresh classification was done using 2010 images and the change polygons were obtained between 2010 -2012 based on the fresh classification. Because of the new classification the statistics showing the Dense Forest, Open Forest, Scrub, Non-Forests and water to certain extent varied from 2012 classification.

The Erdas Auto sync module was used to register the 2011 image taking 2010 images as base. After this, the 2012 image was classified into various classes and the Erdas matrix tool was used to determine various changes from each class of 2011 to each class of 2012 were arrived at. The 2011 & 2012 change polygons were overlaid on the 2012 FCC and changes between 2011 and 2012 only were determined by manual Polygonization. Arc Map was used for change Polygon determination by swiping. Various polygon changes of 2010 to 2012 as well as 2010 to 2012 images and compartment layer were kept as layers in Arc Map to examine the changes.

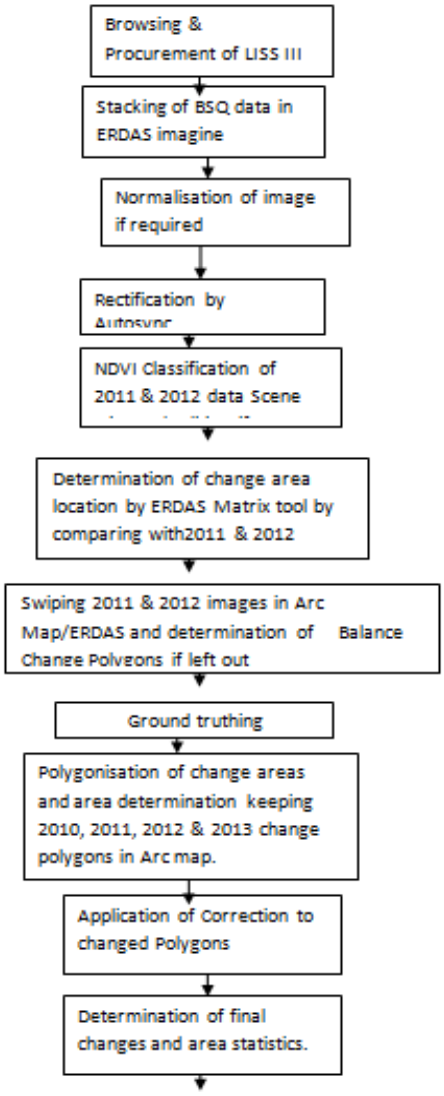
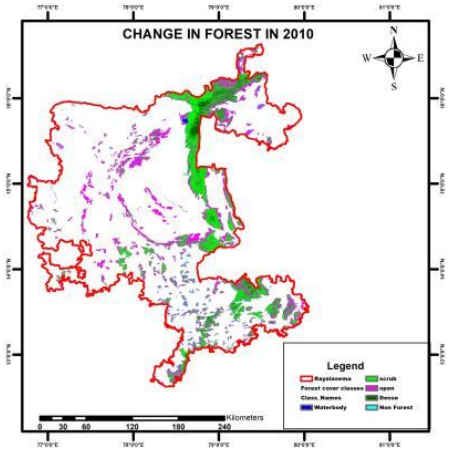


Fig. 2: Flowchart showing different steps followed in forest encroachment mapping and analysis.

III. RESULTS

MAPS



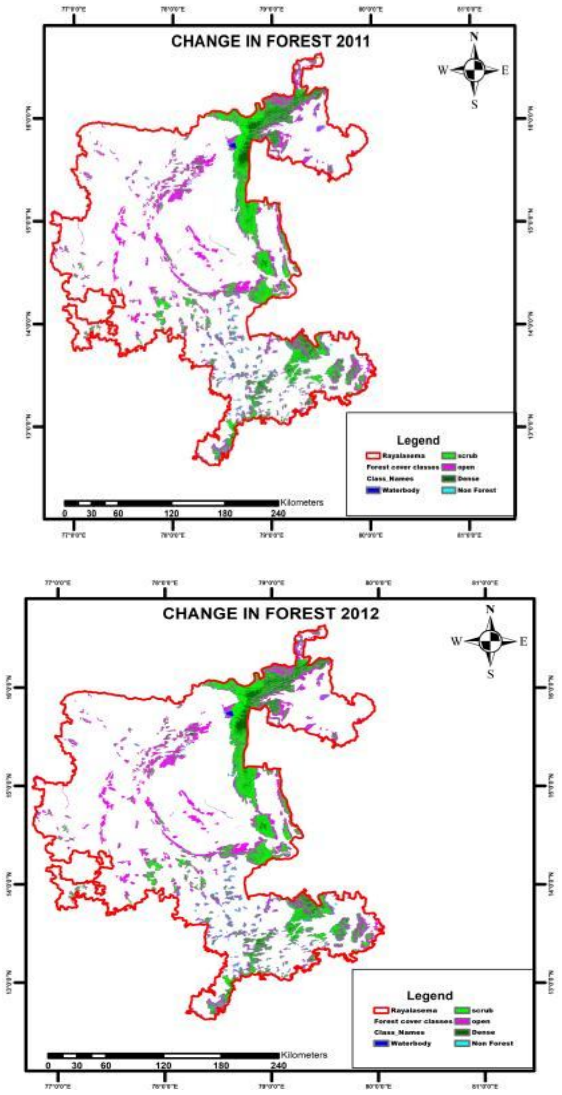


Figure**3**: Maps showing change vegetation change in rayalaseema forest area

Table 2: CHANGE IN FOREST IN 2010

2009	2010				
	Dense forest	scrub	non-forest	Waterbody	total2009
Dense forest	8702.24	0.03	0.25	0	8702.52
scrub	0	4078.66	3.38	0	4082.04
non-forest	0	0	2977.69	0	2977.69
Waterbody	0	0	0	107.85	107.85
total 2010	8702.24	4078.69	2981.32	107.85	
net change	0.28	3.35	-3.63	0	

Table 3: CHANGE IN FOREST IN 2011

2010	2011				
	Dense forest	scrub	non-forest	Waterbody	total2010
Dense forest	8696.86	0	5.47	0	8702.33
scrub	0	4070.25	8.44	0	4078.69
non-forest	0	0.16	2981.2	0	2981.36
Waterbody	0	0	0	107.85	107.85
total 2010	8696.86	4070.41	2995.11	107.85	
net change	5.47	8.28	-13.75	0	

Table 4: CHANGE IN FOREST IN 2012

2011	2012				
	Dense forest	scrub	non-forest	Waterbody	total2011
Dense forest	9259.66	0.98	0.92	0	9261.56
scrub	6.3	4468.2	6.5	0	4481
non-forest	0.08	6.92	2368.68	0	2375.68
Waterbody	0	0	1.16	98.07	99.23
total 2010	9266.04	4476.1	2377.26	98.07	
net change	-4.48	4.9	-1.58	1.16	

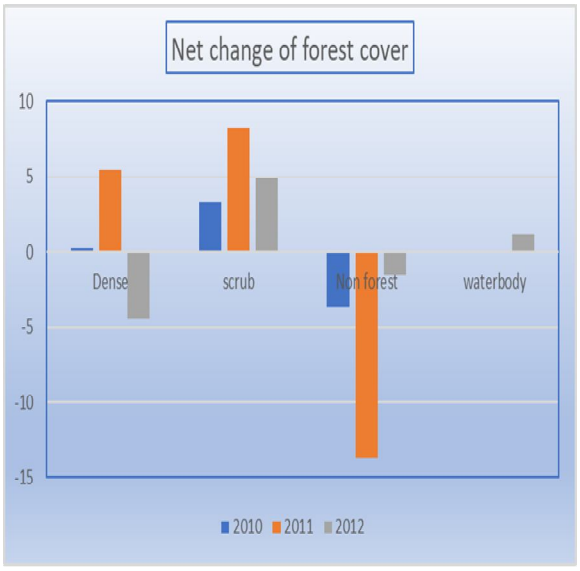


Figure 4: showing net change statistic

Figure 3 shows the maps of forest change in rayalaseema region, figure 4 discusses the statistics of forest cover change, in these there if huge decrease in non-forest area. This sudden decrease in 2011 non-forest area indicates huge land encroached for the purpose of agriculture or other. so, there is need for forest department to re occupy the forest land and promote plantation activities

IV. CONCLUSION

This present research work has been carried out at Rayalseema area for detection of forest cover changes that has occurred. The objective of this study was to identify and analyse change detection of forest cover using multi-temporal RS data and GIS based and its spatial distribution by preparation of various thematic and NDVI. The satellite data was visually interpreted and after making thorough field check, the map was finalized. The forest cover classes interpreted in the study area include dense, moderate and open forest, scrub and water bodies. From the current study it is evident that there is considerable decrease in the forest cover for the period of 2011 to 2012 thereby resulting the inference of the burgeoning population is playing a very active role towards decrease of the forest cover. Hence save forests and save life should be our motto to take care of our future generations.

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