ISSN: 2278-0181
ISNCESR-2015 Conference Proceedings

Landuse Landcover Change Detection in Costal Andhra Pradesh Region using Remote Sensing Techniques

Mohammed Ateeque Ahammed Khan
Department of Remote Sensing
Birla Institute of Technology
Ranchi, India

Jai Kumar
Department of Remote Sensing
Birla Institute of Technology
Ranchi, India

Dr. A. P. Krishna
Registrar, Department of Remote Sensing
Birla Institute of Technology
Ranchi, India

***Abstract*— Advances in remote sensing science, and in our ability to analyze spatial & temporal changes in our landscape, hold great promise for putting to rest any questions of the relevancy of remote sensing to local land use decisions. Identification of LU/LC change as the modern time approaches is trending towards the urbanization of the regional surroundings of already established units. An approach to identify and quantify the fields of change caused due to this urbanization activity through Remote sensing techniques is being done in this study.**

Keyword – Spatial, Temporal, Classification, Urbanization,

I. INTRODUCTION

A series of human operations on land with the interaction to obtain products & benefits using land resources ,which covers earth surface ,water resources ,bare rocks ,wet lands etc, causes the change in the natural development of the region and affects the natures weathering process occurring in the respective region observing land use/land cover change from the years 1992to 2006 & 2006 to 2014 in features which are identified through Remote sensing techniques like built-up , forest , agriculture etc. We could analyze quantitatively the development or decrement occurring in these features over the years, due to the human need for sustainable development keeping in balance the nature human interaction .This evaluation is then formulated with objective of delineating units of land use and land cover change as to their suitability for combining economic activate with regarding the legal conservation areas. The strongest change of ecosystem change detected thus far appear to correspond to expansion of Urban sprawl & over all agriculture plantations & decrease in other field of observation .the change is observed using Landsat TM & OLI sensors.

II. APPROACHES

A. Aim

To quantify the spatial patterning of land cover patches, land cover classes, or entire landscape mosaics of a geographic area & to identify the developmental/degradation effects of the changes over the study area in favor of the balanced development and intelligent use of resources available for the social & economic development of the area.

B. Study Area

The Coastal Andhra Pradesh area is located along the south eastern part of the Indian continent & on the west boundary of Karnataka. Region lies between 13.594° and 18.291°N latitude and 79.558° and 83.725°E longitude. Andhra Pradesh has got a coastline of around 972 km, which gives it the 3rd longest coastline in the nation. It covers three developing cities with total area of 121507.3503 Km^2. The study area comprises of significant population & economic growth in recent decades. The migration of the rural population to urban cities in context of the occupation/academics purposes has also resulted for the increased need of city planning in the study region.

III. RESEARCH ISSUES ON LU/LC CHANGES MONITORING

Advances in remote sensing science, and in our ability to analyze temporal changes in our landscape, hold great promise for putting to rest any questions of the relevancy of remote sensing to local land use. This assumption was the foundation for the formation of the "NAUTILUS" (Northeast Applications of useable technology In Land planning for Urban Sprawl) Regional Earth Sciences Application Center (RESAC) at UConn. Concern about change in the size and quality of many of the world's landuse systems has been growing as more and more wetlands are being converted to agricultural or urban use and by natural factors like drought. As a prelude to their conservation, it is necessary to map them, determine whether or not they have changed over speci ed time periods and quantify the changes. Area-wide land use and land cover mapping projects (Civco and Hurd, 1999) have utilized multi-temporal and multi-resolution remote sensing data (Zhou and Civco, 1998). In order to be able to plan and implement meaningful policies and effective schemes to sustain regional development, there is a crucial need to know the land use/land cover patterns in a particular region (Lillesand, Keifer 1994, Lillesand, Kiefer & Chipman 2004, Lu et al. 2004). Recent efforts have addressed improved methods for LULC change detection (Hurd et al., 2001).

The preprocessing of the data for the delineation of the error induced by the Rayleigh scattering and the high humidity & haze effect caused by the atmosphere using following methods:

A. Atmospheric Corrections for Landsat Imagery

The data acquired from the USGS data repository of Landsat 4, 5, 8, are unprocessed data of 8 bit to 16 bit depending on the sensor respectively. This data has been subjected for radiometric calibrations & application of the FLAASH tool for the removal of the aerosol affect & the haze effect caused due to the topographical surroundings of the region of study, using the tropical model over the flat zone assumptions, also the delineation of the cirrus clouds using the k-t model for the Landsat 8 images has been applied which is a cause of error for the mis-identification of the fallow land with the scrub land in the topographical regions.

The output imagery is enhanced imagery with high spectral and spatial resolution without the haze and topographical effects for the high accuracy identification of the landuse classes using LULC Classification techniques.

B. Classification Technique

- Unsupervised Isodata Classification Technique was used to classify the 5 scenes of years 1991, 2006 & 2014, resulting in 15 different classified imageries.

- Isodata is an algorithm which splits & merges the clusters of the signatures of the imagery according to the user defined threshold values for parameters, which then is proceeded by the iterative process over the sample space until the best possible result is obtained.

- This technique allows user to clusterize the spectral response of the land feature captured by the remotely sensed image and also to process the data with the sample space varying with abnormal variance distributions.

- This algorithm however sometimes fails and results to merge the data into one cluster and can be easily identified for the corrections.

C. Meathodology & Apprach

As mentioned previously, changes in a number of these vegetation characteristics can occur simultaneously along with the urban activities. For example, an increase in agriculture plantation in a waste/wetland riverine ecosystem may represent a shift in species composition and/or abundance, and lead to an increase in net primary production. Using remote sensing to detect changes in vegetation structure and function may require monitoring at contrasting spatial and temporal scales. As with many other remote sensing applications, different remote sensing spatial, temporal, radiometric and spectral resolutions need to be considered to study signals of change in coastal ecosystems. The initial modification to topographic vegetation composition under a changing climate may be expected to occur at shrub wastelands and water reservoirs present in the locality. Satellite multispectral imagery with ground resolution elements of less than 1 km (e.g., Landsat Thematic Mapper (TM), (OLI Sensor)) can provide suitable data sets for studying vegetation structural changes and urban dynamics.

The application of the FLASSH tool using the ENVI 5.1 after the Radiometric Calibration of the images for the bands lying in the range of 0.452µm – 1.567µm, comprises of the process of atmospheric correction. This results with the data comprising of the reflectance values of the surface region. This allows us to easily distinguish and utilize the property of unique spectral reflecting responses of the landuse features over the above mentioned wavelength range.

This data is subjected to Unsupervised Isodata Classification dividing each scene into 40 to 55 classes for the identification of the spatial features over the region. This classified data is manually then classified into the user defined classes through visual interpretation techniques and a Level II Classification Maps are generated for the region of study, consisting of the following classes: Built-up Land, Agriculture Plantation, Forest Land, Waste-Land, Wetland, Water-Bodies, and Clouds.

Finally the field wise area is calculated for the respective year using the classified imageries of the five scenes, and thus the change in each of the respective fields is observed.

D. Data Integrity & Assesment

The data used for the project is the Satellite Imagery – Landsat 4 (TM), 5 (TM) and 8 (OLI)

- Landsat Thematic mapper (TM) – Image consist of seven spectral bands with a spatial resolution of 30 meters for bands 1to 5 and 7. It consists of 8 bit data. Approximate scene size is 170 km north-south by 183 km east-west.

- Landsat 8(OLI)- Operational land image and thermal Infrared sensor. Image consist of nine spectral bands with a spatial resolution of 30 meters for 1 to 7 and 9. It consists of 16 bit data. Approximate scene size is 170km north –south by 183km east-west.

- Processing is done using ENVI 5.1, Erdas 1991, Arc Map 9.2.

- Kappa Statistics technique used for accuracy assessment of the classified image. This analysis is discrete multivariate technique which calculates the producer's and user's overall accuracy, as well as the Kappa accuracy level. It reflects the difference between actual agreement and the agreement expected by chance. This statistic compares the accuracy of the system to the accuracy of a random system.

IV. CONCLUSION & DISCUSSIONS

As discussed above, we now see the general trends changes in the following results mentioned as follows.

A. General Trends

General trends in land cover change were identified at the rural, and city levels. As summarized in Table I , the results of satellite image classification (Fig.) suggest that the urban area has experienced significant land conversions mainly due to urban expansion. At the urban scale, the built-up land cover increased over the past decade at an average rate of 0.23% per year, and the non-forest vegetation cover bore the major burden of urbanization. The forestland cover increased relatively at the rural level. The Built-up Land class, which was the smallest land cover among the six detected classes, doubled its extent, as major man-made industrialization development occurred over the study period. Studying the spatial and temporal heterogeneity of the land cover changes at the Level II Classification allowed us to identify fast and slow sprawling areas that could not be detected at the small scale level. There has been a substantial decrease in the classes of wastelands, wetlands & also a considerable amount of decrease in the agricultural plantations also over the years.

The decrease in the wastelands, contributes to the economic use of these lands for the socio-economic exploitation of the natural resources available at first hands. Simultaneously the increase in the forest cover over the hilly regions is a huge merit ecologically.

However with limited temporal resolution data, it is still impossible for the spatial prediction of the LULC classes distributions, due to the limited availability of the regional data.

B. Observations

The Landsat Imagery of the year 1991, 2006 & 2014 have been represented with Band combination of 3 2 1 (True Colour Composite) after the application of the Atmospheric corrections applied from the ENVI 5.1 tools. These images were subjected to the Unsupervised Isodata Classification following LULC Maps were generated, with the overall accuracy of 86% to 90%, tested using the Kappa-statistics meathod generated from Erdas 9.2 tools. However the lowest accuracy was observed in the scene of path 142, row 50 of the year 2006, with accuracy of 82% and k-statistics was 0.8380.

1) Spatial patterns of LULC Changes: As shown in the Fig 1, the increase in the built-up land is observed in the coastal regions along with the agricultural plantation around the water bodies & rich hydro genic ecosystem. But the increase of the Forest land is occurring away from the coastal region in the northwest part of the region of study, causing the reduction of the Barren lands & scrublands to enrich with the tropical forests, resulting in enriched biodiversity of the region.

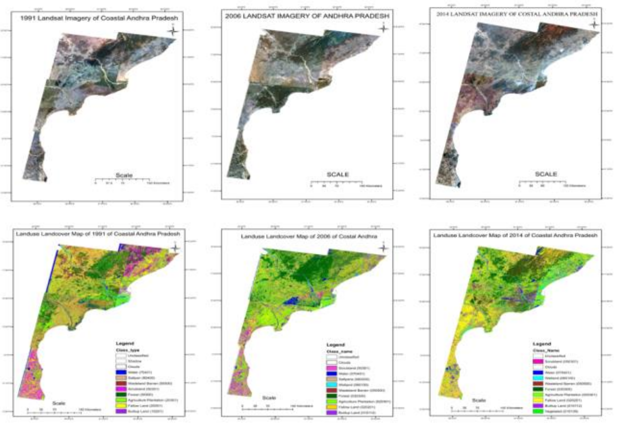

Figure 1. Fig 1 LULC change from 1991 - 2014

TABLE I CHANGE STATISTICS

LULC Classes	**Year of Observations (Area in %)**			**Changes occured**
	1991	***2006***	***2014***	
Built-up Land	2.46	3.65	7.70	5.24
Agriculture Land	25.96	27.59	23.48	**-2.48**
Forestland	11.92	15.52	13.97	2.04
Wasteland	10.99	4.01	3.81	**-7.18**
Wetland	2.74	2.30	1.79	**-0.94**
Water bodies	45.90	46.92	49.22	3.32

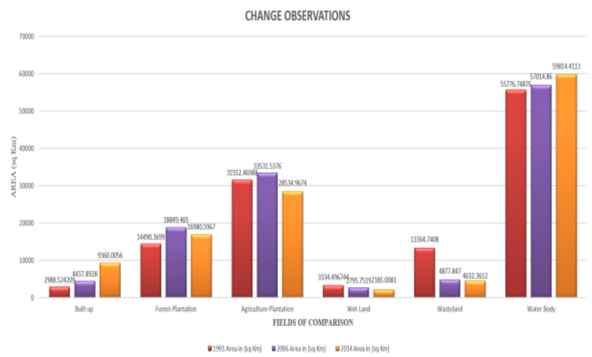

Figure 2. Fig 2 Change representation in Area (Km^2)

From the above Table and graphical representation, it can be consolidated that there has been a rapid change in the field of built-up class & wasteland, while relatively less changes have occurred in the other field classes, but overall there is a need of controlled planning of growth over the spatial distribution required for the best possible use of the natural resources available without causing adverse effect over the biodiversity of the region.

ACKNOWLEDGMENT

Initiating this project has been a great reward for us & I would like to express my special thanks to Dr. A. P. Krishna sir for reviewing the manuscript in detail and extending his full support through, for the completion of this work.

REFERENCES

The raster processing and data analyzing has been done using primarily 2 applications Erdas 9.2 & Arc Map 9.2. These are remote sensing application with raster graphic editor abilities aimed primarily at geospatial raster data processing, allowing us to numerous operations over the image & discovering geographic information in generated output Map layouts.

[1] Eric F. Lambin, "Change detection at Multitemporal Scales: Seasonal and Annual Variation in landscape variables" Photogrammetric Engineering & Remote Sensing, vol. 62, No. 8, pp. 931-938, August 1996.

[2] Fuling Bian, Yichun Xie, Xiaohui Cui, Yixin Zeng, Geo-Informatics in Resource Management and Sustainable Ecosystem, 1st ed., Part 1. Springer: Wuhan, 2013, pp.425–435.

[3] Adel Shalaby, Ryutaro Tateishi, "Remote sensing for mapping and monitoring land cover and land use change in the north western coastal zone of egypt," Applied Geography, 27 (2007) 28 - 41, 2006 Elsevier Ltd.

[4] Wei Ji, "Characterizing urban aprawl using multi-stage remote sensing images and landscape metics," Computers, environment and urban systems, 30 (2006) 861-879, 2005 Elsevier Ltd.

[5] C. Muniyati, "Wetland change detection on the Kafue flats, zambia, by classification of a multitemporal remote sens ing image dataset," International Journal of remote sensing, Vol 21, No. 9, pg. 1787-1806