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STUDIES ON CHANGES OF GREEN COVER IN THE NEW CAPITAL REGION OF ANDHRA PRADESH USING REMOTE SENSING DATA

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Abstract: ***The new capital region of Andhra Pradesh state that has been delineated by Capita Region Development Authority (CRDA) has a tremendous potential for urban and infrastructural development. As a consequence there will be a huge loss of forests and green cover, which will deteriorate the environment. This project work is taken up to estimate the loss of forest cover and its trend in the past. Use of Geo-informatics is immensely helpful in accomplishing such tasks with a lot of saving in time and energy. In this work, CRDA region is considered as a case study, and urban expansion and loss of forests and greenery have been studied over a period of 20 years from 1995 to 2015. For this study Landsat satellite images of 1995 and 2015 are used, which were down loaded from USGS Earth explorer. The output land use land cover images of 1995 and 2015 are used to observe the loss of forests/greenery. The results showed that built up of Vijayawada city has been increased from 162878.6 hectares in 1995 to 303155.3 hectares in 2015. Dense forest has been decreased from 150032 hectares to 57540.4 hectares, and also greenery decreased from 367564 hectares to 279084.8 hectares. The outcome of the present study reveals that there is a drastic reduction in the vegetative cover or greenery in the study area and unprecedented growth of urban area, and built-up area has been recorded. These developments deteriorate the environmental quality of the area, and proper environmental and urban management practices are to be adopted for mitigating the adverse effects.***

Key words: Loss of greenery, Land use Land cover, classification, Remote sensing data, Landsat

I. INTRODUCTION

Urbanization refers to general increase in population and the amount of industrialization of a settlement. Urbanization is a population shift from rural to urban areas, "the gradual increase in the proportion of people living in urban areas", and the ways in which each society adapts to the change. Cities are experiencing unprecedented urbanization and sprawl in recent times due to concentrated developmental activities with impetus on industrialization for the economic development of the region. Several regions around the world are currently undergoing rapid, wide-ranging changes in land cover. A country can be considered to be urbanized when over 50 percent of its population lives in the urban areas. Criteria used to define urban can include population size, space, density and economic organization. So due to rapid expansion of urbanization there is huge loss in greenery because most of the agricultural lands are changing to urban areas. In our study we want to explore the loss of greenery due to the rapid urban expansion using remote sensing techniques.

II. STUDY AREA

The Andhra Pradesh Capital Region is the area covering the proposed Andhra Pradesh Capital City and the conurbation or metropolitan area around it. The entire region is under the jurisdiction of Andhra Pradesh Capital Region Development Authority (CRDA). The Andhra Pradesh Capital Region Development Authority was notified on December 30th, 2014 by the Government of Andhra Pradesh, which replaced the existing Vijayawada-Guntur-Tenali-Mangalagiri Urban Development Authority (VGTMUDA). The extent of the region is spread across 7,068 km² in 58 mandals, of which 29 are in Krishna district and 29 in Guntur district. The capital region covers 18 mandals fully and 11 mandals partially in Guntur district. In Krishna district, it covers 15 mandals fully and 14 mandals partially under the jurisdiction of APCRDA. Singapore government arm IES, with which the AP government signed a memorandum of understanding for preparing the Master Plan for the state's new capital region, would complete its Stage-1 visioning exercise by mid-February and a detailed action plan as well as zoning by April end in Stage-2. The master plan for the main capital area spread over eight square kilo meters would be ready by the first week of June.

The Government of Andhra Pradesh has announced borders to the new capital city to be constructed across the districts of Guntur and Krishna. The total capital city will approximately spread across 29 villages and 2455 acres of land in various villages.

Proposed Borders:

East: 10.5 KMs (From Autonagar Y Junction to Prakasam Barrage – touching old national highway), North: 18 KMs (Near Borupalem to Prakasam Barrage – Across the river Krishna),West: 8 KMs (Near Borupalem, Ananthavaram to Nekkallu till 1.2 km),South: 16 KMs (Autonagar Y Junction to 1.2 kms after Nekkallau).The villages to be included in the capital city are as follows: Dondapadu, Rayapudi, Tallayapalem, Thulluru, Malkapuram, Mandadam, Ananthavaram, Nelapadu, Venkatapalem, Krishnaya Palem, Vundavalli, Inavolu, Penumaka, Neerukonda, Kuragallu, Errabalem, Dolasnagar, Navuluru, Autonagar. Total capital will be divided into five clusters. Each cluster will cover 65–

850 acres which includes parks, schools, hospitals, roads, commercial establishments and other civic and commercial amenities

The Andhra Pradesh new capital city at Guntur and Vijayawada will cover all the towns and villages in the following mandals:

Krishna District Mandals: Ibrahimpatnam, Penamaluru, Gannavaram, Vungutur, Kankipadu, Vuyyur, Aagiripalli, Pamidimukkala, G.Kondur, Vijayawada Rural, Vijayawada Urban, Pedaparupudi, Kanchikacharla, Veerulapadu, Totla Vallur. All the villages and towns in these mandals will come under the purview of CRDA.Guntur District Mandals: Kollur, Amruthaluru, Tadepalli, Guntur, Chebrolu, Medikonduru, Peda Kakani, Vatti Cherukuru, Mangalagiri, Tullur, Duggirala, Amaravathi, Kollipara, Vemur, Tenali, Tadikonda, Chunduru and Pedakurapadu.

The location of the study area is shown in the following figure 2.1.

III. METHODOLOGY

In our study we mainly explored the loss of greenery in CRDA region from 1995 to 2015. for our work we collected the landsat imagery from usgs website ,the images of 1995 are from the satellite landsat 5 which has 7 bands and the images of 2015 are from the satellite landsat 8 which has 11 bands. The study area for our work is extracted from four scenes with path-rows 143-48,143-49,142-48,142-49.the four scenes imagery of years 1995 and 2015 are downloaded from earth explorer. The images are processed in erdas by Mosaicing, Stacking, Histogram Equalization. After the processing of imagery, the imagery is subsetted to the required study area, then classification of imagery is done using supervised classification. The image is classified based on maximum likelihood and it is classified into six classes. The classified six classes of land use types are water, sand, built-up , light vegetation, dense vegetation, open land.After classification of two images i.e 1995 and 2015 the areas of landuse of six classes are calculated and change detection between 1995 and 2015 is done. Finally with the results are presented in the form of graphs ,pie charts ,line diagrams are presented.

The detailed description about the methodology adopted is presented below in the figure 3.1

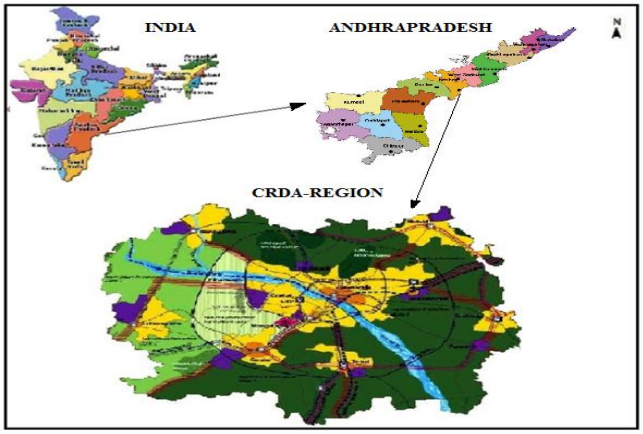

Figure 2.1 Location of study area of CRDA REGION

A. Data Collection

In Data collection we have collected Toposheets from Survey of India, Satellite images of 1988, 2008 and 2014 from USGS Earth explorer web site, VMC city map and other data from Municipal authorities. A toposheet is a shortened name for 'Topographic sheet'. They essentially contain information about an area like roads, railways, settlements, canals, rivers, electric poles, post offices etc. According to their usage, they may be available at different scales (e.g. 1:25000, 1: 50000 etc., where the former is a larger scale as compared to the latter). They are made on a suitable projection for that area and contain lat-long information at the corners. Thus any point on it can be identified with its corresponding lat-long, depending upon the scale (i.e. if the scale is large, more accurate lat-long).Topo sheets of 1:50,000 scale for the corresponding region with No65D/5, 65D/6, 65D/7, 65D/9, 65D/10, 65D/11, 65D/12, 65D/13,65D/14, 65D/15, 65D/16from Survey of India. The arrangement of toposheets are shown in figure 3.2, The study area extracted from the toposheets in the figure 3.4.

65 D/1	65 D/5	65 D/9	65 D/13	65 H/1
65 D/2	65 D/6	65 D/10	65 D/14	65 H/2
65 D/3	65 D/7	65 D/11	65 D/15	65 H/3
65 D/4	65 D/8	65 D/12	65 D/16	65 H/4

Figure 3.2 Arrangement of toposheets

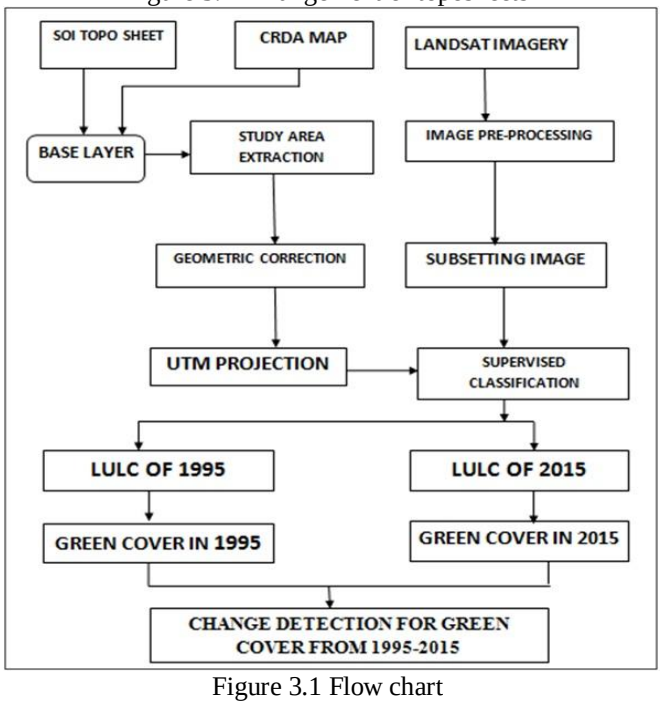

Figure 3.1 Flow chart

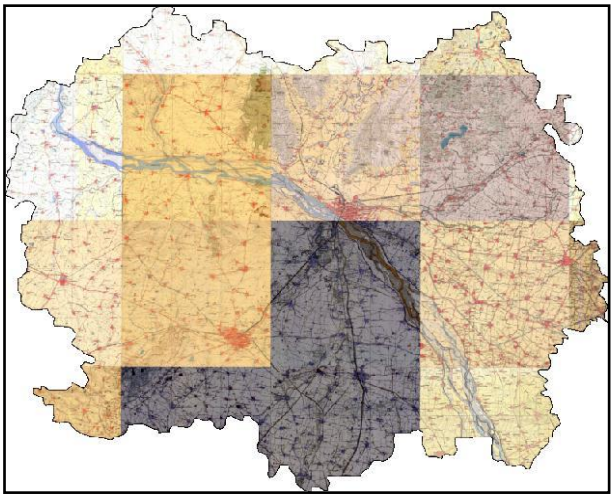

Fig 3.3 Study Area extracted from toposheets clipped

B. Image Preprocessing

After downloading the images required for the present work, they image pre processing was performed to make them suitable for interpretation. The image processing software ERDAS 9.1 was used for this work. Using this area of interest the satellite imagery were subset so that only Vijayawada area remains in the image. Now the image is ready for classification. figure 3.4 shows the true colour image of satellite.

Figure 3.4 True colour image of Landsat satellite

C. Classification of Images

The classification of the satellite images is done by two ways: unsupervised and supervised. In the unsupervised classification, by giving the number of classes the software itself will do the classification, where as in supervised classification we define the training data (or signature) that tells the software what types of pixels to select for certain land use.

D. Land Use and Land Cover Image Development

The satellite images which are done with pre processing, supervised classification of land use land cover. The results are shown below. The classification is done with three six classes of land use types i.e. Water, Sand, Built-up Area, Light Vegetation, Dense Vegetation and Open Land.

IV. RESULTS AND DISCUSSION

The satellite images which are done with pre processing, supervised classification of land use land cover. The results are shown below. The classification is done with three six classes of land use types i.e. Water, Sand, Built-up Area, Light Vegetation, Dense Vegetation and Open Land. Figure 4.1 shows the LULC image of 1995 and Figure 4.2 shows the LULC image of 2015. The Land use Land cover image in the year 1995 shows that the greenery (light vegetation, dense vegetation) is more. Most of the CRDA region is occupied with greenery than that of other land use types and in 2015 shows that light vegetation and dense vegetation is decreased that is there is an increase in built-up and open land .Dense Vegetation, Light Vegetation are decreased and converted to Open land and Built-up area. Thus there is a decrease in the as shown Dense Vegetation, Light Vegetation.

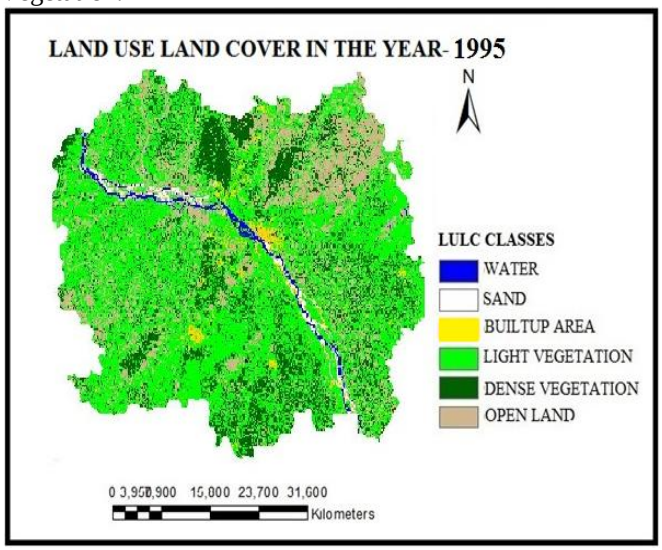

Figure 4.1 Land Use Land Cover image of 1995

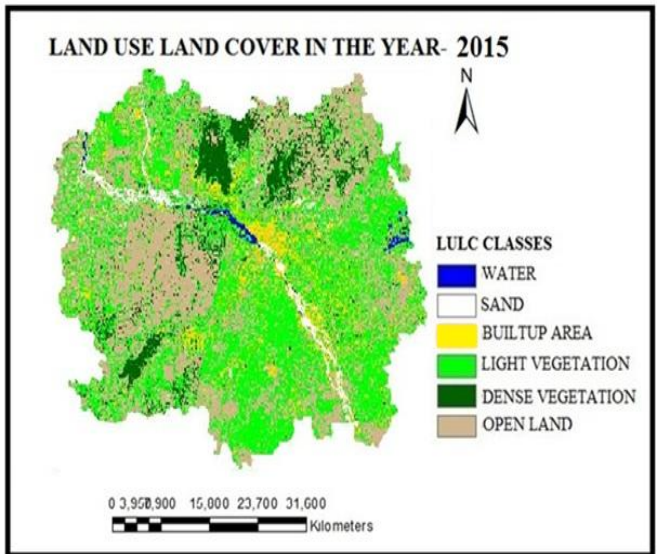

Figure 4.2 Land Use Land Cover image of 2015

Table 4.1 Change Detection during 1995- 2015

LAND USE TYPE	Area in 1995(Hectares)	Area in 2015(Hectares)	Change in 1995-2015	Change %
WATER	9529.94	4914.9	-4615.04	-0.643033
SAND	7555.59	21263.6	13708.01	1.909995
BUILT UP	162878.6	303155.5	140276.9	19.545374
DENSE VEGETATION	150032	57540.4	-92491.6	-12.887246
LIGHT VEGETATION	367564	279084.8	-88479.2	-12.328181
OPEN LAND	18123.6	49724.53	31600.93	4.403091
TOTAL	715683.73	717698.73	0	0

A. Change Detection

Each of the Land use Land cover Map Classified is assessed for the change that was taken place in the each class. The area of Water has decreased to an extent of 4615.04 ha from 1995-2015 and there is a change of 0.643033 %. The class Built-up area has increased enormously by a change of 140276.9 ha with a 19.545374 % change from 1995-2015. Class dense vegetation decreased enormously by a change of 92491.6 ha with a 12.887246 % change from 1995-2015and Light vegetation has decreased enormously by a change of 88479.2 ha with a 12.328181% change from 1995-2015and Open land is increased by an area of 31600.93 ha with a change of 4.403091%.This shows that the land which is used for Dense and Light vegetation's in 1995 are converted to open land and built-up land. Change detection between the years 1995 and 2015 is shown in the table 4.1.We can observe in the change detection table that there is a huge change in the greenery (light vegetation and dense vegetation) from 1995 to 2015 and in the figure 4.3 bar graph shows the areas of LULC classes.

B. Analysis

The light vegetation and dense vegetation change analysis presented in this work was based on the statistics extracted from two Land use Land cover maps of the CRDA Region. The changes in the land cover during the study period. The changes for greenery from 1995 to 2015 are represented in the form of pie chart, bar charts and line diagrams below in the figures 4.4, 4.5, 4.6, 4.7, 4.8.

V. CONCLUSION

In this work urban expansion and consequent loss of greenery and forest cover was estimated for the new capital region of Andhra Pradesh state. The reduction of forests/green cover is studied from the past to the present. The land use land cover of the past and present were studied to extract urban expansion, loss of greenery and to find their rates of change. For this purpose, remote sensing techniques were used. In this work CRDA region is considered as a case study, and urban expansion and loss of forests and greenery has been studied over a period of 20 years from 1995 to 2015. For this study Landsat satellite images of 1995 and 2015 are used which were down loaded from USGS Earth explorer. After pre processing satellite images are classified into six classes by supervised classification techniques using ERDAS imagine software. Our focus is only on forest/greenery area and its change, hence six types of land use land cover classes were considered for classification of images.

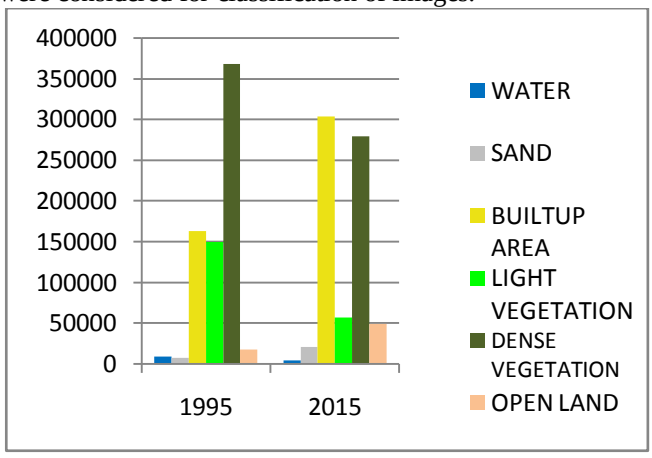

Figure 4.3 Bar graph showing change in greenery from 1995 to 2015

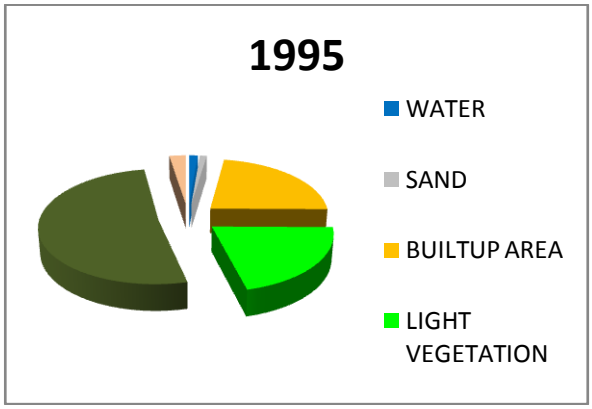

Figure 4.4 Pie chart showing change in greenery in 1995

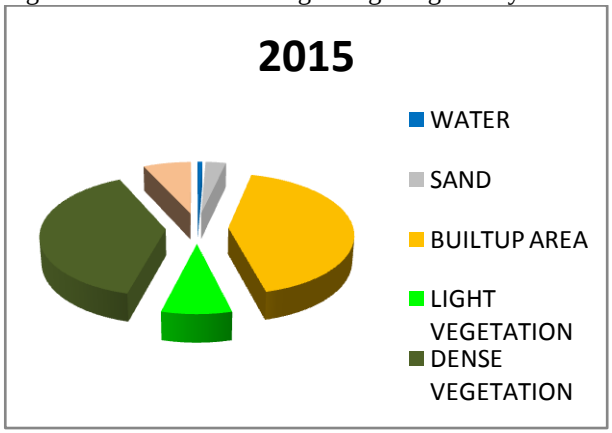

Figure 4.5 Pie chart showing change in greenery in 1995

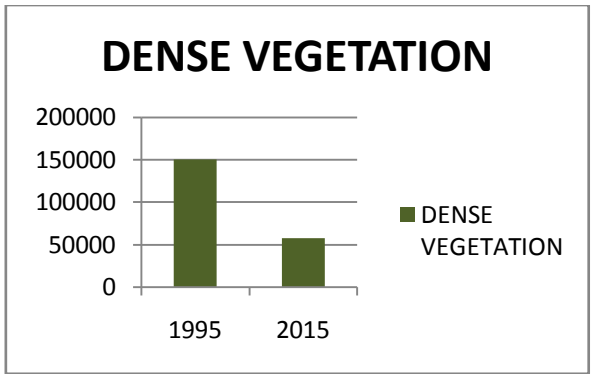

Figure 4.6 Bar chart showing change in Dense Vegetation from 1995 to 2015

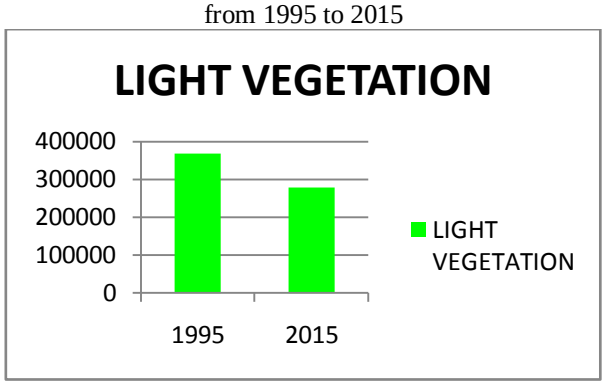

Figure 4.7 Bar chart showing change in Light Vegetation from 1995 to 2015

Built-up area (Urban), Water, Sand, Dense vegetation, Light vegetation and Open land are the six classes chosen according the existing geographical features of the study area. From the classified images the extent of urban growth, loss of forest cover and loss of greenery were calculated and presented in tables and graphs for analysis from 1995 to 2015. Urban or built-up area has been increased from 162878.6 hectares to 303155.5 hectares and consequently dense forest has been decreased from 150032 hectares to 57540.4 hectares and also greenery decreased from 367564 hectares to 279084.8 hectares. The output images and analysis are also presented for understanding the extent of urban growth. The outcome of the present study reveals that there is a drastic reduction in the vegetative cover or greenery in the study area and unprecedented growth of urban area and built-up area has been recorded. These developments deteriorate the environmental quality of the area and proper environmental and urban management practices are to be adopted for mitigating the adverse effects.

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