Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 8
Open Access

Extraction Of Vegetation From Satellite Image Using Ndvi And Change Detection Of Vegetation-- A Matlab Approach,Ananthapur District, Andhra Pradesh, India

S Ashok Kumar [1], B Vijay Saradhi [2] M Rajesh[3]
[1, &2] Department of Civil Engineering, College of Engineering (A), Andhra University,
[3] Department of Geo Engineering, College of Engineering (A), Andhra University
Visakhapatnam, Andhra Pradesh, India

Cite this paper as: S Ashok Kumar , B Vijay Saradhi , M Rajesh (2024). Extraction Of Vegetation From Satellite Image Using Ndvi And Change Detection Of Vegetation-- A Matlab Approach,Ananthapur District, Andhra Pradesh, India. *Frontiers in Health Informatics*, *13 (8) 3626-3634*

Abstract:
This paper introduces a Technique for extraction of Vegetation using normalized difference of Vegetation index (NDVI) using MATLAB, which is efficient and fast. NDVI has found a wide application in vegetative studies as it has been used to estimate crop yields, pasture performance and rangeland carrying capacities among others. It is often directly related to other ground parameters such as percent of ground cover, photosynthetic activity of the plant, surface water, leaf area index and the amount of biomass. This paper also includes change detection vegetation for different Years.
Keywords: NDVI, Photosynthetic Activity, Leaf Area Index.

Introduction

Satellite image analysis has been a focused research area in the image processing, for the last few decades. In general satellite images contains several bands. These bands are due to spectral reflectance of various features on earth. Many earth surface features of interest can be identified, mapped and studied on the basis of their spectral characteristics. Now a days extraction of features from satellite images is very important to estimate the vegetative cover of earth surface, The amount of deforestation from year to year and growth of urbanization. To extract Vegetation from satellite images using remote sensing various methods are used. But the technique normalized difference vegetation index(NDVI) is an efficient method. Here mainly the bands of satellite Images are separated and vegetation cover is extracted. It is superior to techniques called supervised and unsupervised techniques. This method implementation using MATLAB is very fast and by implementing the code we can find the vegetation cover within fraction of second.

Study area

The area Ananthapur district under the investigation lies between the 76’-50’’ to 78’-30’’ East Longitude and 13’-40’’to 15’-15’’ North Latitude. The area is located in and around Ananthapur District of Andhra Pradesh(Figure 1). District forms the important part of Rayalaseema region. Its northern and central regions are a high plateau, generally undulating, with large granite rocks or low hill ranges rising occasionally. In the southern parts, surface is more hilly. Six rivers flow within the district. Penna,Chitravathi,Vedavathi,Papagni,warnamukhi and Thadakaleru. The important river in the District is Pennar. It has its origin in the Nandi Hills of Karnataka State where it is called "UTTARA PINAKINI" and enters this District in the extreme South of Hindupur Mandal and flows through Parigi, Roddam, Ramagiri, Kambadur, Kalyandurg, Beluguppa, Uravakonda,Vajrakarur,Pamidi, Peddavadugur, River which has its origin in Karnataka State enters this District in Parigi Mandal and joins Pennar River at Sangameswarampalli of Parigi Mandal. Another significant river in the District is "CHITRAVATHI". Its origin is in Karnataka State. This river enters the District near Kodikonda village of Chilamathur Mandal and flows North over Rocky and Hilly uplands of Gorantla,Puttaparthi, Bukkapatnam, Kothacheruvu, C.K.Palli, Dharmavaram, Bathalapalli, Tadimarri and Yellanur Mandals and falls into Pennar River at Gandikota in Cuddapah District. VEDAVATHI or HAGARI RIVER also an important one in the District has its origin in Karnataka State and flows through Gummagatta, Brahmasamudram, Beluguppa, Kanekal and D.Hirehal Mandals and enters Bellary District of Karnataka State. Bhairavanithippa Project (B.T.Project) constructed on this river. Peddapappur and Tadipatri Mandals and finally enters Cuddapah District. District has 949 villages. Apart from these streams like KUSHAVATHI in Chilamathur Mandal, SWARNAMUKHI in Agali Mandal, MADDILERU in Nallamada, Kadiri and Mudigubba Mandals, PANDAMERU in Kanaganipalli, Raptadu, Ananthapuramu B.K.Samudram and Singanamala Mandals, PAPAGNI in Tanakal Mandal are important water supply sources to various large and medium irrigation tanks in the district. The study area covering a total area of around 19130 sq.km. The economy of the district is predominantly agrarian with very few industries. With a very scanty rainfall of 563 mm, district is one of the most backward district of the state. Prominent crops are groundnut, rice, sunflower, chilly, bengalgram, sorghum and cotton. Silk trade, limestone quarrying iron and diamond mining constitute th few industries here. Temple town of Lepakshi with famous Veerabhadra, A wonderful example of Vijayanagara architectural style and art is located in Ananthapur. The total 63 Mandals of Ananthapur district are grouped into three revenue divisions. Ananthapur Division (20 Mandals) Vidapanakal, Vajrakarur, Guntakal,Gooty, Peddavadugur, Yadiki, Tadpatri, Peddapappur, Singanamala, Pamidi, Garladinne, Kudair, Uravakonda, Atmakur, Ananthapur, Bukkarayasamudram, Narpala, Putlur, Yellanur and Raptadu. Dharmavaram Division:(17 Mandals) D.Hirehal, Bommanahal, Beluguppa,Kanekal, Rayadurg, Gummagatta, Brahmasamudram, Settur, Kundurpi, Kalyandurg, Tadimarri, Bathalapalle, Kanaganapalle, Kambadur, Ramagiri, Chennekothapalle and Dharmavaram. Penukonda Division:(26 Mandals)Mudigubba, Nambulipulikunta, Tanakal, Nallacheruvu, Gandlapenta, Kadiri, Amadagur, Obuladevaracheruvu, Nallamada, Gorantla, Puttaparthi, Bukkapatnam, Kothacheruvu, Penukonda, Roddam, Somandepalle, Chilamathur, Lepakshi, Hindupur, Parigi, Madakasira, Gudibanda, Amarapuram, Agali, Talupula and Rolla. The soils in Ananthapuramu District are predominantly red except Kanekal, Bommanahal, Vidapanakal, Uravakonda, Vajrakarur, Guntakal, Gooty, Pamidi, Peddavadugur, Yadiki, Tadipatri, Yellanur, Peddapappur and Putlur mandals. In these Mandals red and black soils occur almost in equal proportion. Thus 76% red soils and 24% are black soils. There are 929 inhabited villages, out of 964 total Revenue villages of the District. The number of villages in size group of 500 to 1999 forms 32.79% of the total inhabited villages . The size group of 2000 to 4999 forms 41.37% and the size group of 5000 to 9999 forms 13.57% only out of total villages, while 81 villages (8.80%) of total inhabited villages are having population less than 500. There are 32 villages with more than 10000 population excluding Towns(2011 census).

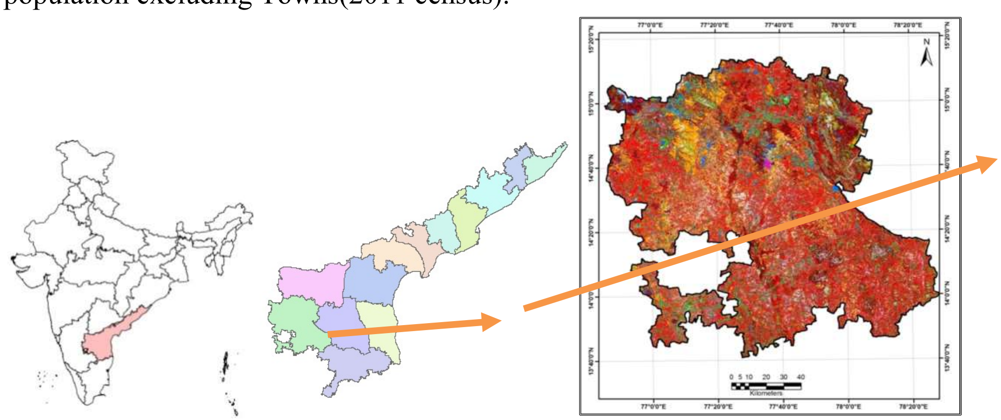


Figure1. Location map of the study area (Resourcesat-1, LISS IV satellite imagery, 2008)

Materials and Methods

The investigation zone covers 2 sequences of the Survey of India (SOI) toposheets, they are 57 G/10,57 G/6,57 G/2,57 C/14,57 K/5,57 K/1,57 G/13,57 G/9,57 G/5,57 G/1,57 C/13 57 J/8,57 J/4,57 F/16,57 F/12,57 F/8,57 F/4,57 B/16,57 J/7,57 J/3,57 F/15,57 F/11,57 F/7,57 F/3,57 B/15,57 J/2,57 F/14,57 F/10,57 F/6,57 F/2,57 B/14,57 J/1,57 F/13,57 F/9,57

F/5,57 F/1,57 B/13,57 I/4,57 E/16,57 E/12,57 E/8,57 E/4,57 A/6 scale 1:50,000. These toposheets are geo-rectified and projected to polyconic projection (the Metric system units – meters are used as in the present study).

The Ananthapur toposheet map has been scanned and saved in .jpg format and then it is imported into image format (.img) using ERDAS IMAGINE 2014 software. The study area boundary is digitized and overlaid on Mosaic toposheet and demarked the study area boundary on 1:50000 toposheet and verified by ground truthing. Necessary corrections were made and checked in the field with the help of GPS. Image processing was carried out for Resourcsesat-1, LISS IV satellite imagery. In this analysis, level-1 and level-2 categories have been identified as per the guidelines given by the NRSC(1990).

Remote Sensing:

Remote sensing is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation. Earth surface features of interest can be identified, mapped, and studied on the basis of their spectral characteristics. These spectral characteristics variation is shown in different bands like NIR, Red and Blue etc. Especially Live green plants absorb solar radiation in the photo synthetically active radiation (PAR) Spectral region, which they use as a source of energy in the process of photosynthesis. Leaf cells scatter (i.e., reflect and transmit) solar radiation in near-infrared spectral region, strong absorption would overheat the plant possibly damaging the tissues. Live green plants appear relatively dark in the PAR and relatively bright in the near-infrared. Clouds and snow tend to be rather bright in the red (as well as other visible wavelengths) and quite dark in the near-infrared. NDVI is calculated from the visible and near infrared light reflected by vegetation. Using remote sensing not only feature like Vegetation but also we can estimate Leaf Area Index, biomass, chlorophyll concentration in leaves, plant productivity, fractional vegetation cover, accumulated rainfall, etc.

NDVI:

The Normalized Difference Vegetation Index (NDVI) is a numerical indicator that uses the visible and near-infrared bands of the electromagnetic spectrum and is adopted to analyse remote sensing measurements and assess whether the target being observed contains live green vegetation or not. Generally, healthy vegetation will absorb most of the visible light that falls on it and reflects a large portion of the near-infrared light. Unhealthy or sparse vegetation reflects more visible light and less near-infrared light. Bare soils on the other hand reflect moderately in both the red and infrared portion of the electromagnetic spectrum since we know the behaviour of plants across the electromagnetic spectrum, we can derive NDVI information by focusing on the satellite bands that are most sensitive to vegetation information (near-infrared and red). The bigger the difference therefore between the near-infrared and the red reflectance, the more vegetation there has to be. The NDVI algorithm subtracts the red reflectance values from the near-infrared and divides it by the sum of near-infrared and red bands.

NDVI = (NIR-RED) / (NIR+RED)

This formulation allows us to cope with the fact that two identical patches of vegetation could have different values if one were, for example in bright sunshine and another under a cloudy sky. The bright pixels would all have larger values and therefore a larger absolute difference between the bands. This is avoided by dividing by the sum of the reflectances. Theoretically, NDVI values are represented as a ratio ranging in value from -1 to 1 but in practice extreme negative values represent water, values around zero represent bare soil and values over 0.6 represent dense green vegetation.

Algorithm:

Steps Involved:

1. Take satellite Image.

2. Separate the NIR and Red bands from satellite image.

3. Apply $\mathrm{NDVI} = {(\mathrm{NIR} - \mathrm{RED})}\Big/{(\mathrm{NIR} + \mathrm{RED})}$

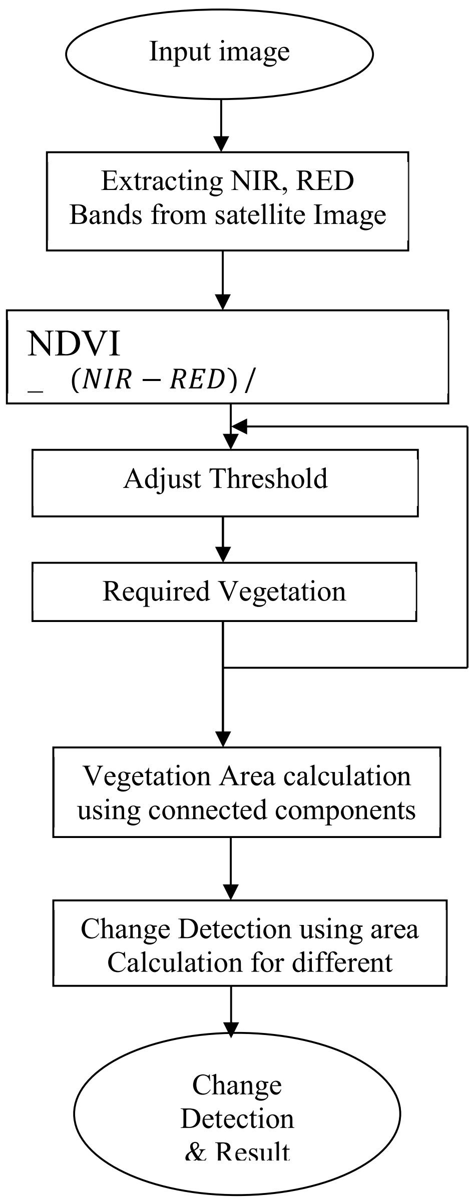
4. Adjust the threshold to get required vegetation Extracted Image. If we not get the exact Image then change the threshold until we get required image.

5. After getting required image,Calculate area of vegetation using connected components for different years and calculate percentage change using

Change $= \frac{\text{initial area} - \text{final area}}{\text{inital area}}$

6. % change = change*100.

Flow Chart showing change detection percentage in Ananthapur district from the year 2008 to 2018 :



Results:

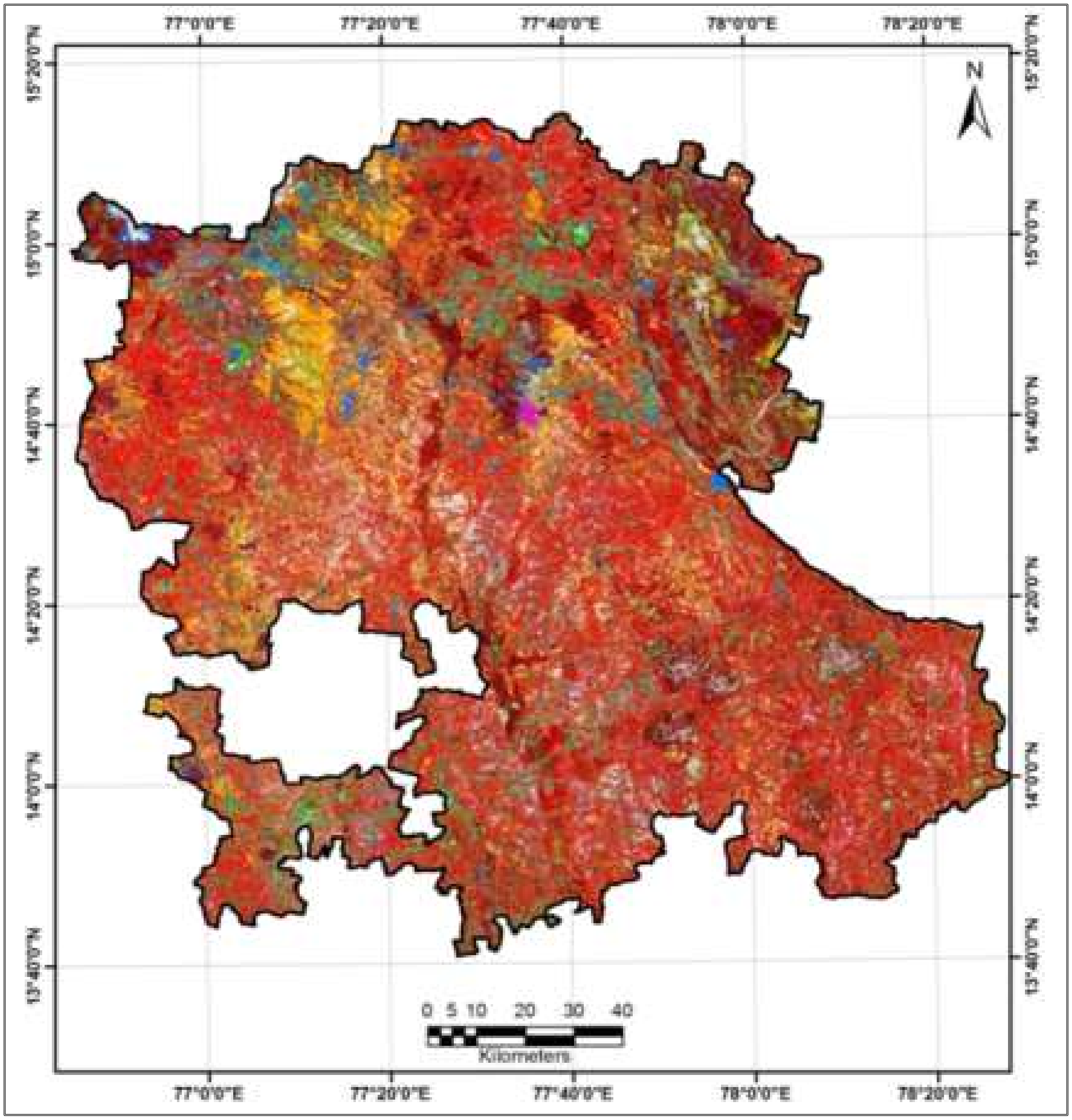


Fig. 2 Ananthapur Input Image in 2008

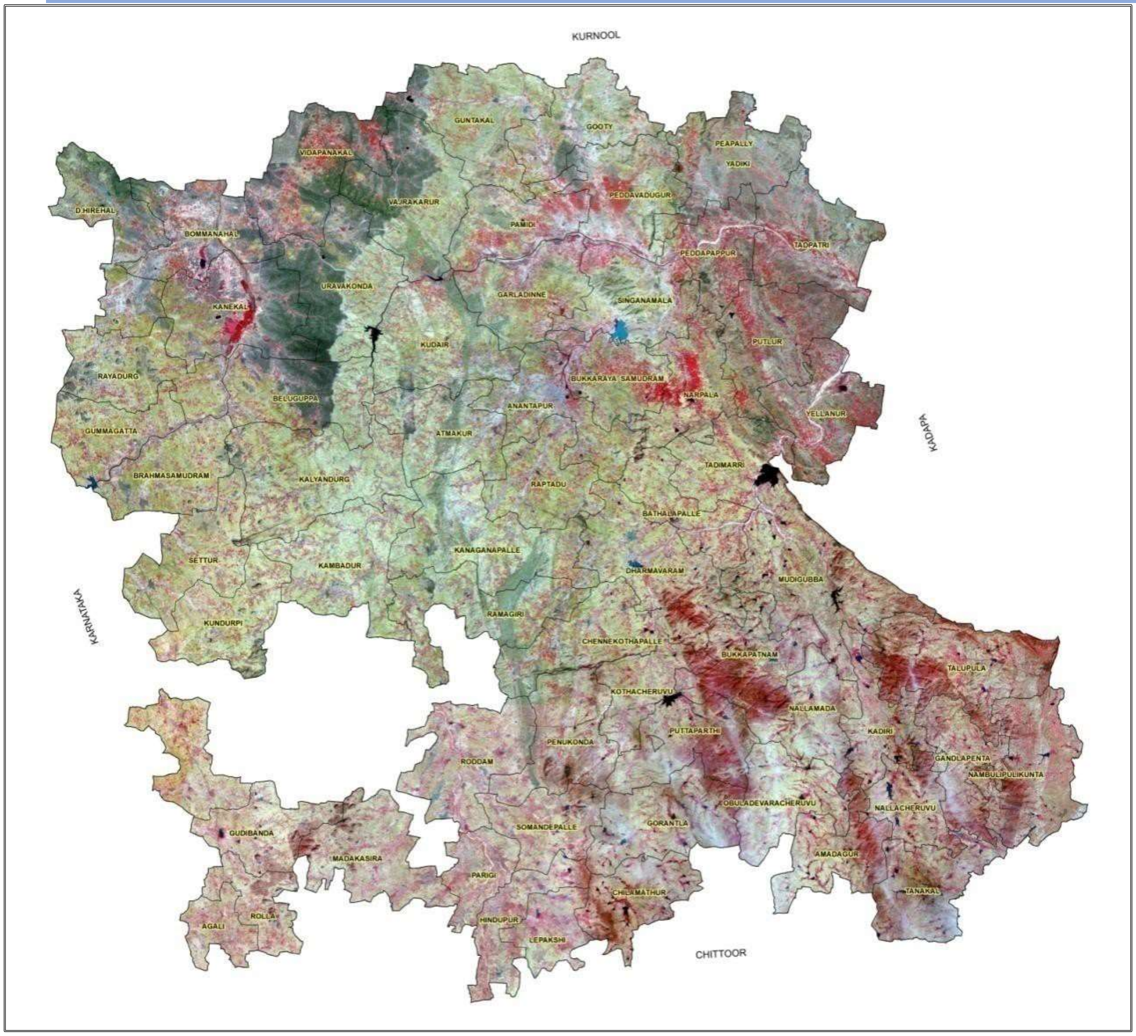


Fig. 3 Ananthapur Input Image in 2018

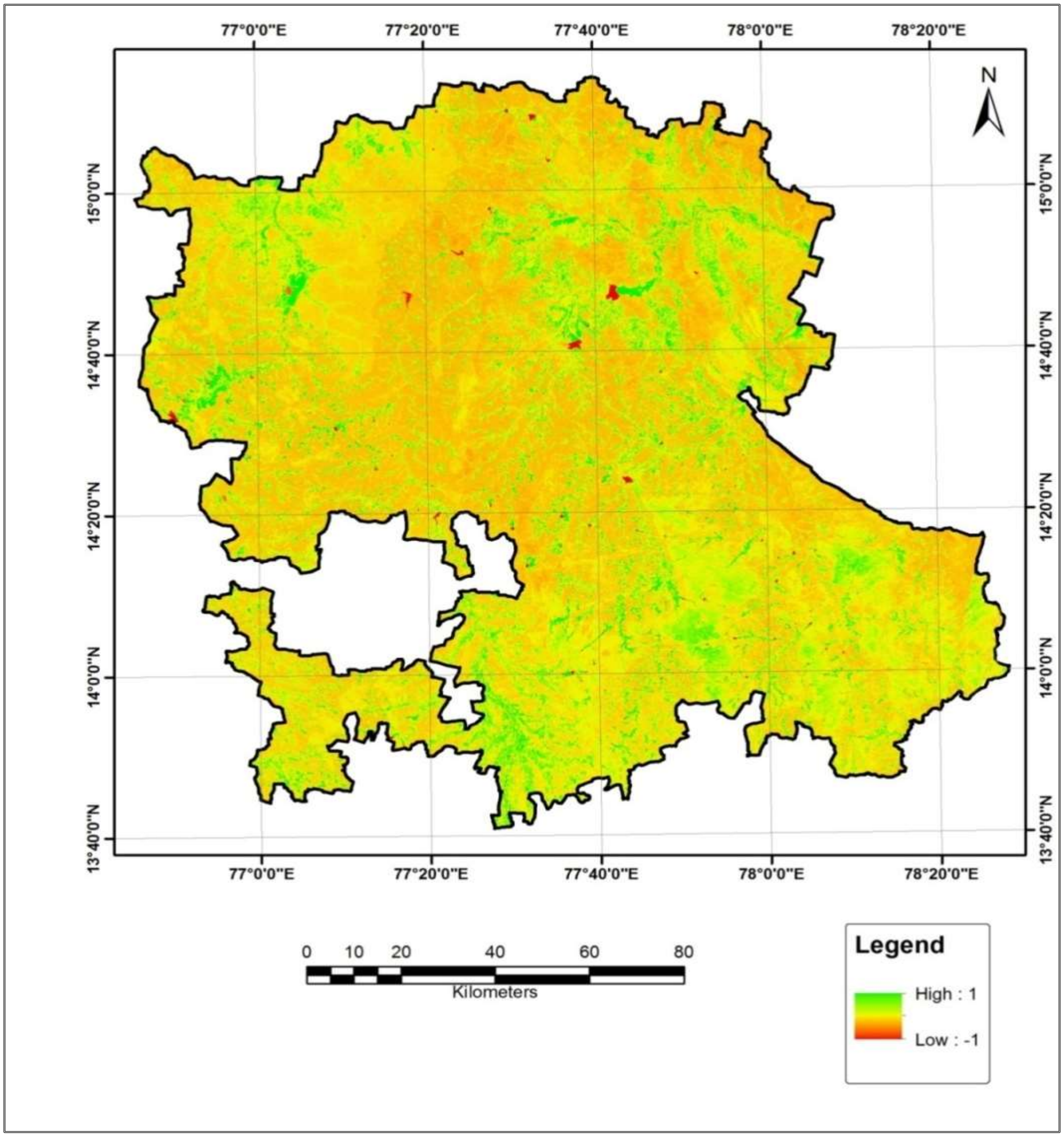


Fig. 4 NDVI Image in 2008

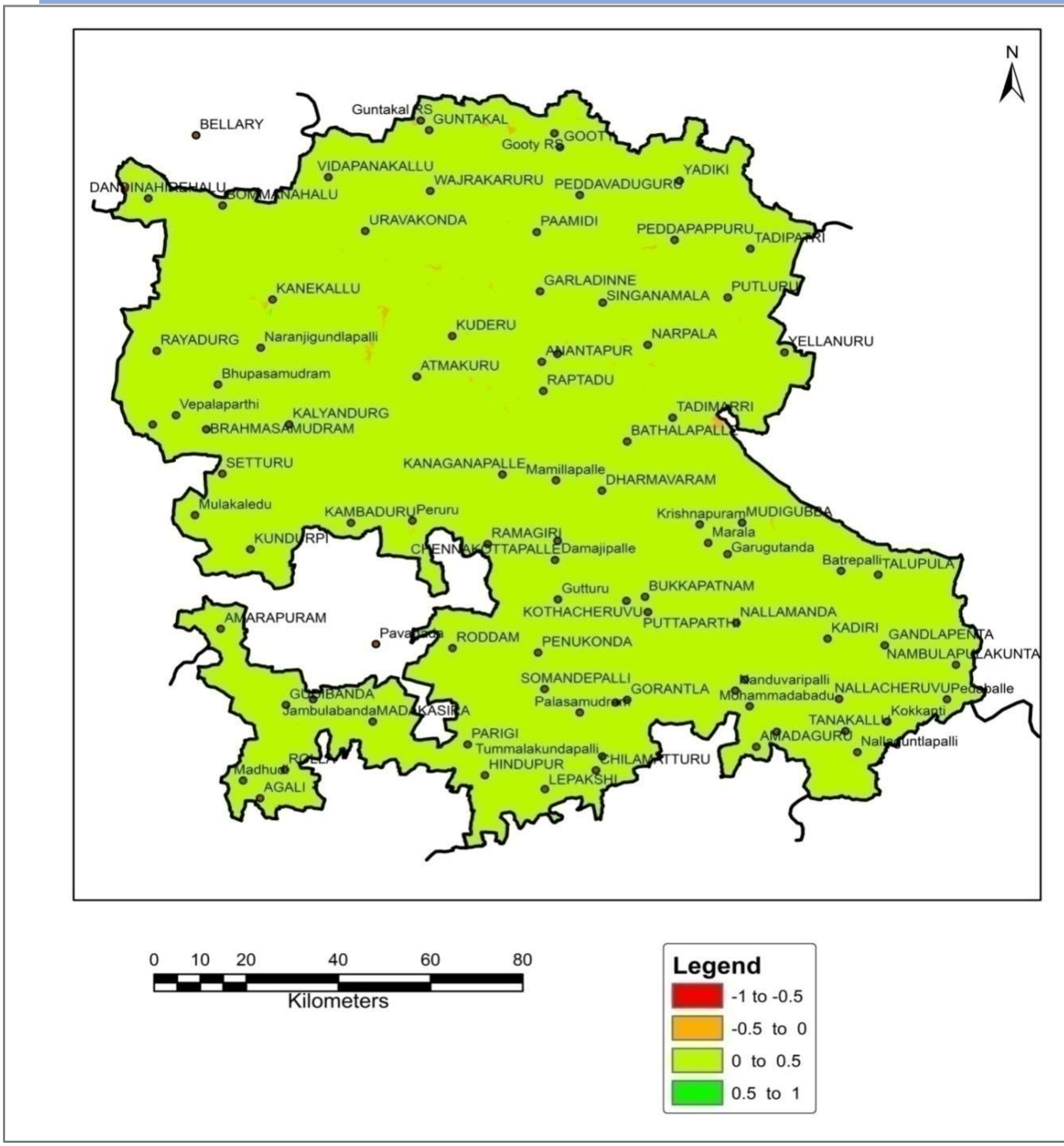


Fig. 5 NDVI Image in 2018

Change detection Results:

1. Vegetation of 2008 satellite image

Area= 17440.1 Sq. kms

2. Vegetation of 2018 satellite image

Area= 13927.67 Sq. kms

Percentage change:

$$\text{Change} = \frac{\text{initial area} - \text{fina area}}{\text{inital area}}$$

% change = change*100.

% change 2008-2018:

% change = 20.14

Conclusion:

From above results,It is concluded that k-means clustering is a good method for extraction of features like vegetation,water etc. It is extended to extract urban areas, finding area of features, change detection of features in successive years i.e. change of vegetative cover, amount of deforestation, percentage change in forest area etc. Clearly from above results decrease in forest area due to rapid urbanization, growth in constructions. In future, This is also extended to predict area of damage due to forest fire, flooding etc.

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