Normalized Difference Vegetation Index (NDVI) based Land Cover Classification using ArcGIS

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Abstract—*The Normalized Difference Vegetation Index(NDVI) is one of the most widely used vegetation index which uses red(RED) and near infrared (NIR)bands of electromagnetic spectrum, and is utilized for the analysis of remote sensing images to obtain the vegetation information of the target area. In this paper the land cover classification of Vijayawada region, Krishna district, Andhra Pradesh is analyzed using NDVI.Landsat8 images of different dates were collected and derived NDVI values. Versatile bands of Landsat images are used to acquire the information of vegetation, water bodies, bare soil, and urban by calculating NDVI. Present study concentrated on making out the difference between the vegetation indexes of various land cover types by performing supervised classification.*

Key Words: Remote sensing, Normalized Difference Vegetation Index (NDVI), Land cover, multi spectral images.

1. INTRODUCTION

Earth environment can be understood in a better way using Remote Sensing technology [1]. It is the Science and Art of getting information and extracting the attributes in form of Spectral, Spatial and Temporal about few physical objects, area development, such as vegetation, land cover classification, urban area, agriculture land and water resources without coming into physical contact of these objects [2]. Landsat is one of the most used remote sensing satellites .Features of Landsat 8 are as follows: It has two different operating sensors

i) Operational Land Imager (OLI)

ii) Thermal Infrared Sensor (TIRS) sensors,

Which have a total of 11 bands, consisting of 9 bands (band 1 - 9) situated at OLI and 2 bands (bands 10 and 11) at TIRS [3].

Change detection of Land cover is one of the most important techniques, widely utilized for planning and managing land [4]. In recent years, geographic information system and remote sensing have been hired for several applications including land cover change detection [5].

Vegetation coverage for various time periods and for peculiar areas can be obtained using Normalized Difference Vegetation Index(NDVI) .The NDVI aims to find land cover change caused by human action such as construction and development, and to analyze changes in vegetation because of environmental changes [6]. The NDVI is used as an index of measurement of balance among the energy accepted and gives out by earth objects [7]. The NDVI can be computed by the combination of Red and NIR bands of Landsat8 images. This paper mainly aims to find out land cover changes of Vijayawada city by using the NDVI.

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

2. STUDY AREA

Vijayawada is a historic city located at the geographical centre of Andhra Pradesh state in India on the banks of Krishna River with latitude 16^{0}03'11" N and longitude 80^0 03'91" E. The climate is equatorial, with hot summers and moderate winters. The peak temperature reaches 47 ℃ in May-June, while the winter temperature is 20-27^0 C. The mean humidity is 78% and the mean annual rainfall is 103 cm.

3. METHODOLOGY:

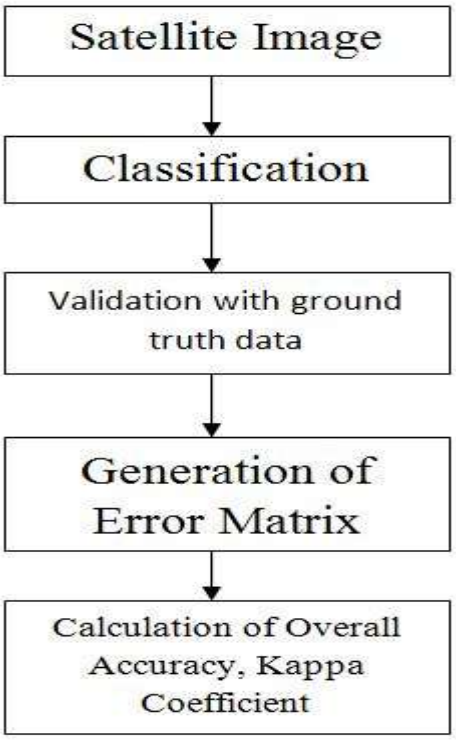

Fig. 1: Methodology

This study utilized Landsat satellite images of 2019. Landsat OLI images, each with a 30 m resolution, are gathered from United States Geological Survey (USGS) website, Earth Explorer (http://earthexplorer.usgs.gov/).Band 4 and Band5 are used for land cover classification of ROI where ROI in this study is Vijayawada. The band description of Landsat8 images are shown below

TABLE 1. Characteristics of OLI and TIRS sensors on image Landsat 8

Sensors	Band	Spectrum	Wavelength (μm)	Spatial Resolution
OLI	1	Coastal aerosol	0.433 – 0.453	30 m
	2	Blue	0.450 – 0.515	30 m
	3	Green	0.525 – 0.600	30 m
	4	Red	0.630 – 0.680	30 m
	5	NIR	0.845 – 0.885	30 m
	6	SWIR 1	1.560 – 1.660	30 m
	7	SWIR 2	2.100 – 2.300	30 m
	8	Panchromatic	0.500 – 0.680	15 m
	9	Cirrus	1.360 – 1.390	15 m
TIRS	10	TIRS 1	10.6 – 11.19	100 m
	11	TIRS 2	11.5 – 12.51	100 m

TABLE 2. Band characteristics for object imagery on image **Landsat** 8

Band	Description
1	Aerosol studies and coastal areas
2	Bathymetric mapping, differentiates soil from vegetation and leaves from conifer vegetation
3	Emphasize the peak of vegetation to assess the strength of vegetation
4	Differentiate the vegetation angle
5	Emphasize the content of biomass and coastline
6	Discriminates soil water content and vegetation; penetrate a thin cloud
7	Enhancement soil moisture content and vegetation, thin cloud penetration
8	Resolution 15 m, image sharpening
9	Enhancement detection of contaminated sirus clouds
10	Resolution 100 m, temperature mapping and soil moisture counting
11	Resolution 100 m, enhancement of temperature mapping and soil moisture counting

Input Landsat8 OLI images are acquired from United States Geological Survey (USGS). Band4 and Band5 are combined using composite bands. NDVI technique is applied on composite signal generated. Using Interactive supervised classification image is classified into various types like agriculture, vegetation, urban barren land, and water. Classified data is validated with ground truth data and error matrix is generated. Quality parameters (Overall Accuracy, kappa coefficient) are calculated using error matrix.

4. RESULTS AND DISCUSSION: In this work Landsat8 images are acquired using USGS database and classified using NDVI to obtain overall accuracy. The acquired image is of Vijayawada area, Andhrapradesh, India. Landsat images are analyzed using Remote Sensing and ArcGIS 10.3 software.

The classified image contains five classes built-up, agriculture, vegetation, scrub land and water bodies. The error matrix is calculated and obtained results are compared with previous results.

Table 3: Class wise area for years 2008, 2014, 2019

Year	2008(Area in hectares)	2014(Area in hectares)	2019(Area in hectares)
Built-up	6370.24	6440.20	6905.25
Agriculture	20791.00	19248.20	18358.86
vegetation	3654.01	5908.34	6253.05
Scrub land	1886.97	2061.09	2210.03
Water bodies	1108.12	962.51	834.06

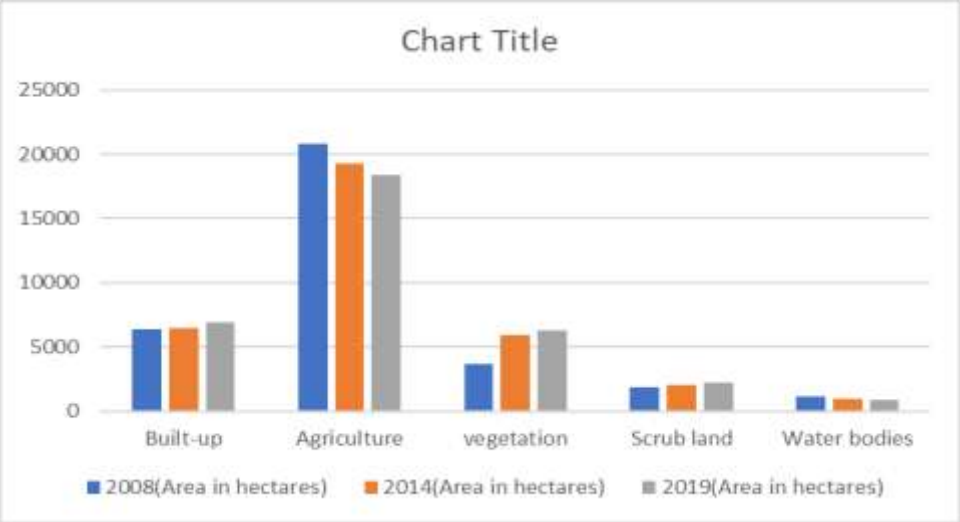

Fig. 2: Land cover change

Table 4: Error matrix of classified image

Land Cover	Built-up	Agriculture	vegetation	Scrub land	Water bodies	Column total
Built-up	13	1	0	1	0	15
Agriculture	0	13	0	1	1	15
vegetation	1	0	12	0	0	13
Scrub land	0	0	1	12	0	13
Water bodies	0	1	1	0	12	14
Row total	13	15	15	14	13	70

From the above table (using Error matrix) the Overall Accuracy (OA) and kappa coefficient are obtained as 88%, 0.85.

5. CONCLUSION:

The NDVI is an important indicator used to determine land use and land cover changes because of urban and economic development. Changes in land cover can be observed through extracted values of the NDVI map. From the results it is observed an amount of decrement in dense vegetation due to various reasons such as urban and economic development because of population growth and deforestation. Results obtained can be used as indicators for future trends to get land cover changes and for distinguishing effective factors on vegetation cover for the improved understanding of planners and decision makers on the issue.

6. REFERENCES:

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