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VEGETATIONAL CARTOGRAPHY ANALYSIS UTILIZING MULTI-TEMPORAL NDVI DATA SERIES: A CASE STUDY FROM RAJKOT DISTRICT (GUJARAT), INDIA

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Abstract

The present study aims at enhancing the detection process in utilization of satellite image analysis based on the Normalized Difference Vegetation Index (NDVI). The aforementioned technique is one among the pioneers of remote sensing analytical process that could simplify the multi-spectral data. NDVI is the highly preferred indexing method for the assessment of vegetation and analysis of the vegetation change detection. The ability to compute an NDVI using any multispectral sensor with a visible range and near-IR range has led to its popularity and widespread use of Landsat TM image Remote Sensing data. In the present research satellite image processing using NDVI differencing was employed for the vegetation change analysis. Remote Sensing data provides information on parameters that helps in prioritization of vegetation like size and area of the vegetation. A variation with the NDVI was performed for the year 1990 and 2020. It includes the comparison of annual average NDVI between the year 1990 and 2020. Here, the greenish yellow pixels indicate a bigger amount of vegetation space. The variation in vegetation analysis is an economical way for recording the changes discovered in every land use class. Over a decade, there have been considerable variations in vegetation is observed from agricultural land, mountain ranges, and in dry farming areas. NDVI threshold values recorded as 0.22 for Vegetation. Thus NDVI is highly effective for recording surface characteristics in the visible region, which aids policymakers in making firm developmental plans.

Keyword: NDVI, vegetation index, geographical information system, remote sensing, multi-spectral data

1. Introduction

The Normalized Difference Vegetation Index (NDVI), one among the pioneers of remote sensing analytical process accustomed to alter the complexities of multi-spectral mental imagery, is currently the foremost widespread index used for vegetation assessment. (Huang *et al*., 2021)

Changing conditions because of increasing vegetation fragmentation create land cover and alter detection analysis a particularly necessary thought for sustainable vegetation management. This study applied NDVI to observe vegetation cover changes utilize Landsat satellite Data (Appiah Mensah *et al*., 2019)

In the recent past, researchers have reported the utilization of NDVI for vegetation watching assessing the crop cover, drought observance and agricultural drought assessment at national and world level. Recently, the researchers have utilized remote sensing techniques for estimating the vegetation standing of growing crops by deciding the acceptable wavelength or combination of wavelengths to characterize crop deficiency.

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Vegetation index (VI) could be a straightforward and effective measuring parameter, that the earth to point the planet surface vegetation covers and crops growth standing in remote sensing field. In addition, several other researchers have widely used NDVI (Bhandari *et al*., 2012).

NDVI has higher sensitivity corresponding with crown density amendment than alternative vegetation index. Lands satellite (Landsat) 8 OLI (Operational Land Imager) and 7 TM (Thematic mapper) includes band variation to record NDVI. Using red and near infrared band, it will derive NDVI. NDVI calculates vegetation index based on red and close to near red reflectance received by Landsat (Zaitunah *et al*., 2018).

2. Materials and Methods

Study Area: A Rajkot district is in the centre of the Saurashtra region of Gujarat and is located on the banks of the Aji and Nyari rivers. The city is spread in the area of 170.00 km². Rajkot districts lies between 22.3°N latitude to 70.78°E longitude. It has an average elevation of 128 metres (420 ft) (Fig.1). The data of Landsat 7 and 8 used for the vegetation cartographic analysis includes over the year of 1990 and 2020.

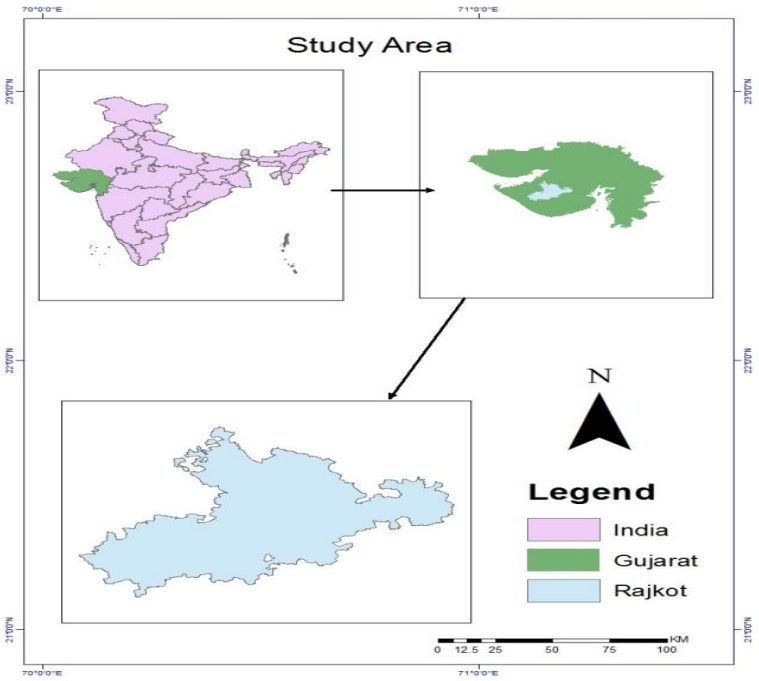

Figure 1: Study area map (Rajkot district).

Datasets

The datasets used in the present research were USGS Landsat satellite Level-1 data Product consisting of raster data of multi-spectral image data within the form Digital Numbers (DN)

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In this analysis process, for Landsat 8 using Band 4 (Red), Band 5 (Near-Infrared) was used for generating NDVI maps. The spatial resolution of Bands 4 and 5 was 30 m. and Landsat 5 using Band 3 (Red), Band 4 (Near-Infrared) was used for generating NDVI maps. On requirement, mosaicking and subsetting was done on all raster images used in this analysis by using the vector boundary of the districts mentioned earlier.("Landsat 7 (L7) Data Users Handbook," 2019; "Landsat 8 (L8) Data Users Handbook," 2019)

Image processing

a) Layer Stacking: The layer stacking of bands was done on the QGIS 3.16

b) Mosaicking the layer stacked image tiles were mosaicked so clipped with study area shape file.

c) Image rectification was done to correct distortions resulting from the image acquisition method.

d) Projection: The image downloaded is in Universal Transverse Mercator (UTM) projection and it is re-projected to Geographic WGS 84, spheroid and datum Everest. (Singh et al., 2016)

NDVI computation

The normalized difference vegetation index (NDVI), (Equation 1) is that the ratio of the difference between the near-infrared band (NIR) and the red band (R) and the total of those two bands (Carlson and Ripley, 1997; Yengoh et al., 2014).

NDVI = (NIR — RED) / (NIR + RED) ..... (Eq. 1)

Where NIR denotes Landsat-5 TM Band 4 and Landsat-8 OLI Band 5, and RED denotes Landsat-5 TM Band 3 and Landsat-8 OLI Band 4. NDVI values range between -1 and +1. Increase in positive NDVI values indicate dense vegetation, while negative values around zero or declining values suggest non-vegetation surfaces such as water and bare terrain (Naif *et al*., 2020).

3. RESULTS AND DISCUSSION

Remote Sensing information provides data on parameters that helps in prioritization of vegetation like size and space of the vegetation region. Vegetation with area of few many hectares that's, small vegetation may be mapped and studied very well by satellite information itself. Grasses, shrubs, and trees form up the majority of plant cover in vegetation.

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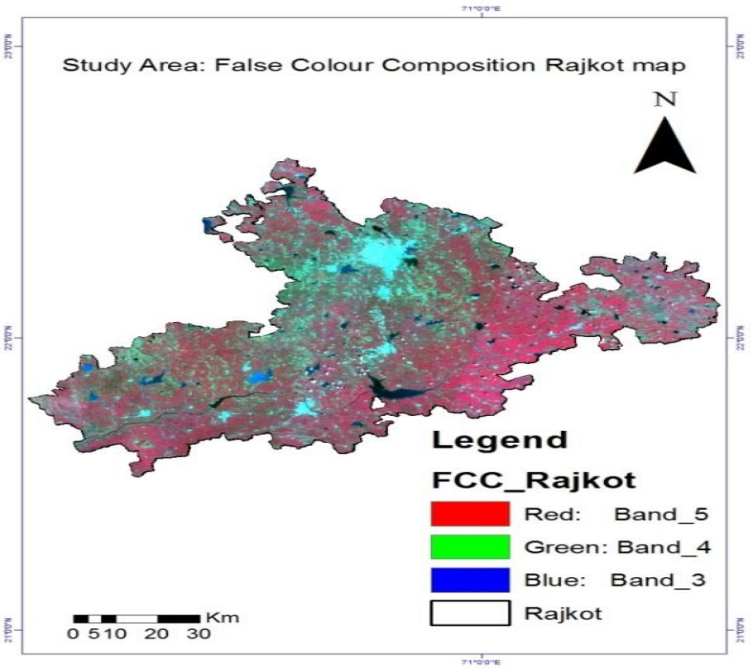

Figure 2: False Colour composition Rajkot district map.

Aforementioned fig. 2, reveals the false colour composition of study region. It is generated through Red, Green and near infrared band. Here, red colour shows vegetation and black shade colour show about presence of water body. Other colours like, cyan showing built up area in above map.

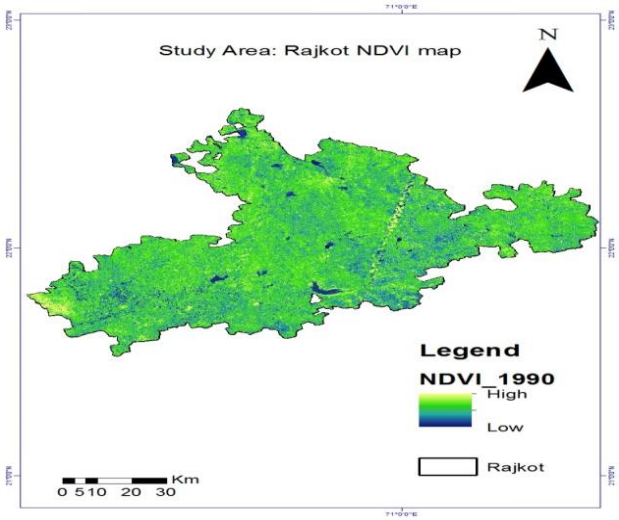

Figure 3: Normalized Difference Vegetation Index (NDVI) Map (Year 1990).

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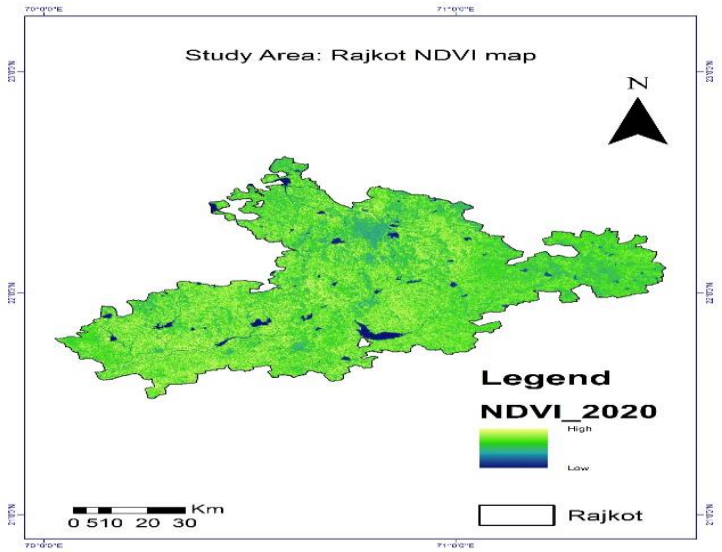

Figure 4: Normalized Difference Vegetation Index (NDVI) Map (Year 2020).

A comparison with NDVI change is analysed. The figure 5 compares the annual average NDVI between the year 1990 and 2020, wherever the greenish yellow pixels indicate a larger quantity of vegetation area. (Black and Stephen, 2014)

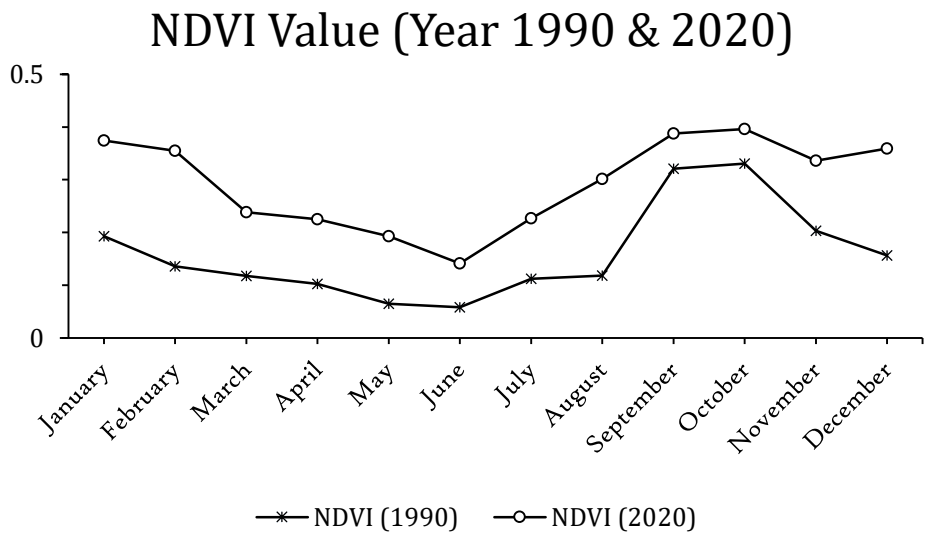

Figure 5: Graphical representation of average NDVI value about Rajkot district for the year 1990 and 2020

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The Change Detection analysis is an efficient way of describing the changes observed in each land use category. Over a decade, there were considerable variations in agricultural land, hilly area with vegetation and in dry farming. NDVI threshold of 0.22 value for Vegetation.(Gandhi *et al*., 2015)

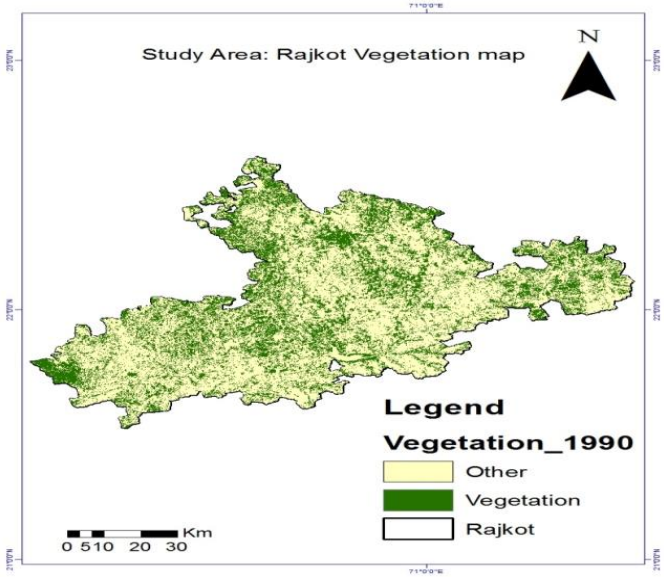

Figure 6: Vegetation map of Rajkot district (Year 1990).

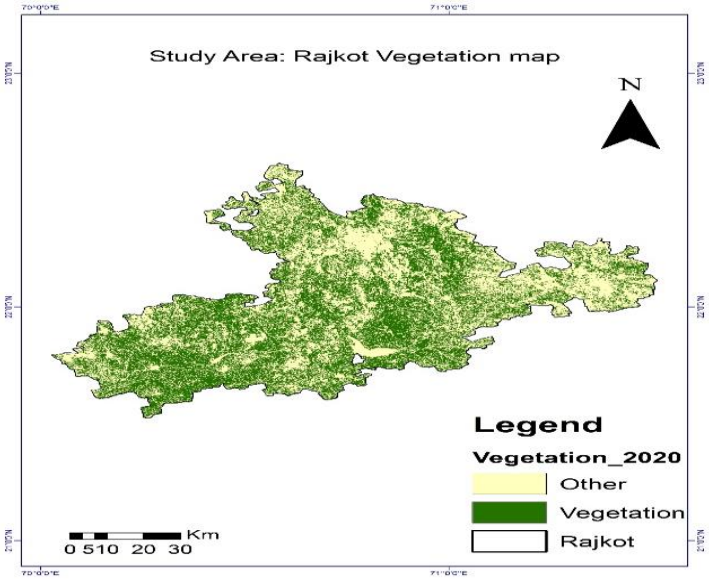

Figure 7: Vegetation map of Rajkot districts year 2020

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From the present study, using NDVI technique the vegetation cover of the region is extracted and calculated to detect the change that has taken place over past thirty years. The NDVI relates to the photosynthetic activities of the living plants. The higher the NDVI values, the more “green” the cover types. It implies that the NDVI increases as the green biomass increases.

4. CONCLUSION

The significance of the present study on using NDVI to map the vegetation area between the study periods reveals the increase in vegetation area. Yet another important observation is that the water bodies percentages were significantly lower during 1990 than that of during 2020. This suggests that lower precipitation also have an effect on NDVI values like observed from the study area. NDVI relation for vegetation change analysis precipitation scenario can be included to understand the correlation with NDVI. The future scope includes the usage of other indices such as Enhanced Vegetation Index (EVI) or Perpendicular Vegetation Index (PVI) for similar threshold-based vegetation cover classification and analysis.

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