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Examining The NDVI, NDBI And NDWI Changing Pattern In Darrang District, Assam Using Geospatial Technologies.

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Abbreviation
RS- Remote sensing
GIS-Geographic information System
NDVI- Normalized Difference Vegetation Index
NDBI- Normalized Difference Built up Index
NDWI- Normalized Difference Water Index
LANDSAT OLI- Operational Landsat imager
LANDSAT TM+ Landsat Thematic Mapper

ABSTRACT :

In the present study, efforts have been made to identify and map Normalised Difference Vegetation Index (NDVI), Normalised Difference built-up Index (NDBI)and Normalised Difference Water Index (NDWI) in Darang district, Assam. Using remote sensing and GIS identify the values of NDVI, NDBI and NDWI. Satellite data of three year, 1999, 2004, 2023 have been used in the study. High NDVI values were concentrated in the year 1999. The NDVI values for the years 1999, 2004 and 2023 are 0.50 to-0.35, 0.48 to -0.29 and 0.50 to -0.18 respectively. The NDBI values of the Nagaon district for the year 1999 are 0.45 to 0.63, for 2004 the NDBI values are 0.73 to -0.96 and for the year 2023 are 0.24 to -0.41.The NDWI value indicates that the water index increases in the water bodies from the year 1999 to 2023.

Keywords: NDVI, NDBI, NDWI, RS

1. INTRODUCTION :

Remote sensing (RS) and Geographic Information Systems (GIS) are emerging tools and technologies that allow us to monitor, investigate, and analyse the changes not only on the earth's surface features but also the atmospheric phenomena using multi-temporal satellite data. GIS plays a vital role in monitoring, mapping, managing, storing, and developing huge amounts of spatial and non–spatial data. Geospatial techniques are widely applied in the observation, detection and analysed of changes on the earth's surface, including climate, environmental degradation, urbanization, industrialization, and its spatial-temporal impact on weather and climate at global and local scales (Sharma & Arote 2022).

In recent times, there has been renewed interest in understanding the dynamics of land cover change and its relationship with several environmental parameters. (Alademomi et.al.,)

The remote sensing indices such as Normalized Difference Vegetation Index (NDVI), Normalized Difference Built-up Index (NDBI), Normalized Difference Water Index (NDWI) help extract vegetation, water bodies and built-up areas.(Jothimani et.al. 2021). Normalized Difference Vegetation Index calculated from reflectance measured in the visible and near infrared channels. NDVI was introduced by Rouse et al. (1973). NDVI uses the visible and near-infrared bands to measure the density and vigour of green vegetation by comparing the amount of visible light reflected to the amount of near-infrared light reflected. The principle of applying NDVI in vegetation mapping is that vegetation is highly reflective in the near infrared and highly absorptive in the visible red. NDVI is the main vegetation indicators for vegetation estimation and monitoring through remotely sensed technology (Shah et.al. 2022). The NDVI lies ranges between -1 to +1 (Shah and Siyal, 2019).

According to Chen et. al., Normalized Difference Built-up Index (NDBI) is a valuable tool in remote sensing and geographic information systems for mapping and analysing built-up areas in urban landscapes. It's providing insights into urban development patterns, land use changes, and environmental impacts, making it a valuable resource for researchers, planners, and decision-makers. The Normalized Difference Built-up Index (NDBI) uses the NIR

and SWIR bands to emphasize manufactured built-up area. For urban growth, development and urban sprawl built-up mapping is an essential indicator (Shah et al. 2022).

2. LITERATURE RIVIEW:

Pattanayak & Diwakar,2018, studied NDVI, NDBI and NDWI of 2009 and 2011 to 2013 of Hyderabad city using LISS-III images were calculated and the spatial and temporal characteristics were revealed. High NDVI values were concentrated in Dec2011of Hyderabad city. Difference between the maximum and minimum NDVI values in four dates was 1.198,0.977, 1.984 and 1.065, respectively. High NDBI values were concentrated in Dec 2011 Hyderabad city. Difference between the maximum and minimum NDBI values in four dates was 0.997, 0.994, 1.983 and0.722, respectively.
Sharma & Arote ,2022, This paper study analyses the LST of Kamrup Metropolitan district of Assam, along with the Normalized difference water index (NDWI), Normalized difference vegetation index (NDVI), Normalized difference built-up index (NDBI), and soil moisture index (SMI) of the Kamrup Metropolitan District for a period of 19 years 2000 to 2019 using remote sensing (RS) and Geographic information system (GIS) techniques. For LST map of 2000 the lowest radiant temperature is 14.9 °C in the forest area, and the highest radiant temperature is 28 °C in the built-up area. This paper study further attempts to compare water, forest, agriculture, vegetation, built-up. area, barren land, and soil moisture with the surface temperature of both years. Special emphasis is given to compare the temperature distribution with different aspects. The highest value of NDVI for 2000 is 0.59 and for 2019 it is 0.48.These values indicate a negative change in terms of vegetation cover. NDVI values varied from 0.1 to 0.59. Less vegetated areas, including built-up areas and water bodies, have the lowest NDVI values. The reflection from the soil is high and it produces low values in the NIR band as well as the same for the built-up area and produces high values in the red band. As water absorbs more energy, the bands get darker values resulting in less reflectance. The highest values for both the years 2000 and 2019 i.e. 0.48 and 0.59 respectively indicate the density of green healthy vegetation, which are mainly distributed in less populated areas.NDVI ,NDBI LST Analyse the vegetation cover, temperature, and built-up area.

3. OBJECTIVE OF THE STUDY

The purpose of the study is to highlight the NDVI, NDWI and NDBI in the study area of Darrang district for the year 1994, 1999, 2004 and 2023 using Satellite imagery to analyse the changing pattern.
The objective of the study include:
1.To estimate the NDVI, NDWI and NDBI for Darrang district.
2.To identify the changing pattern of these indices and statistically analyse.
3.To establishes the correlation between NDVI with other indices.

4. STUDY AREA

Darrang district is one of the most important administrative districts of Assam. It is situated between 26°12N to 26°57N latitudes and 91°42E to 92°22E longitudes. The district covers an area of 3481 Sq.km. which is surrounded by Arunachal Pradesh and Bhutan in the North, River Brahmaputra in the South, Sonitpur in the East, and Kamrup in the West respectively. It lies 70 kms from Guwahati connected through National Highway 15 with neighbouring districts such as Kamrup, Udalguri and Sonitpur. Nearest airport is at a distance of 70 km from Darrang District. Mangaldai is the headquarter which lies in the heart of the district. According to the census of 2011, the total population of Darrang District is about 9.28 lakh.Sex ratio of the district is 954/1000 male, and the literacy rate is 63.08%.

5. DATABASE AND METHODOLOGY

Satellite data of different years were used for identifying the green space and Landsat 8 OLI for 2023 were taken into consideration for obtaining the changing trend. The details of the data used for the study are shown in table.1.1

Table: 1.1 Datasets

SI	Satellite	Year	Sensor types	Spatial resolution	Source
1	Landsat 8 OLI	1999	OLI/TIRS	30m	USGS, Earth Explorer
3	Landsat 4	2004	TM+	30m	USGS, Earth Explorer
4	Landsat 4	2023	TM+	30m	USGS, Earth Explorer

Normalised Difference Vegetation Index:

The amount of vegetation as well as the greenery of an area can measure with the help of Normalized Difference Vegetation Index (NDVI). A high NDVI values highlights a high degree of greenness as well as healthy green (Curran, 1980). NDVI is used based on the vegetation responses to absorption and reflection of near-infrared and red lights. (Hazarika et.al., 2023). NDVI is calculated using for formula-

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

Normalized Difference Built-up Index: NDBI highlights artificial built-up areas by using the Near Infrared and Short-Wave Infrared bands. NDBI is expressed as follows-

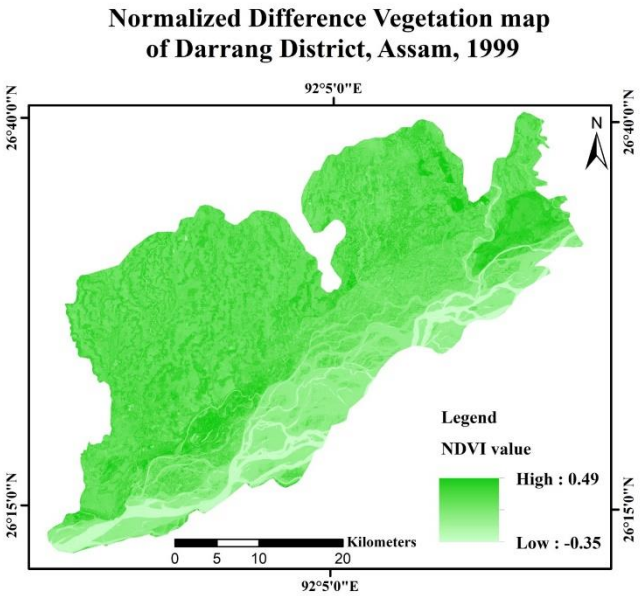
$$\text{NDBI} = \frac{(SWIR - NIR)}{(SWIR + NIR)}$$

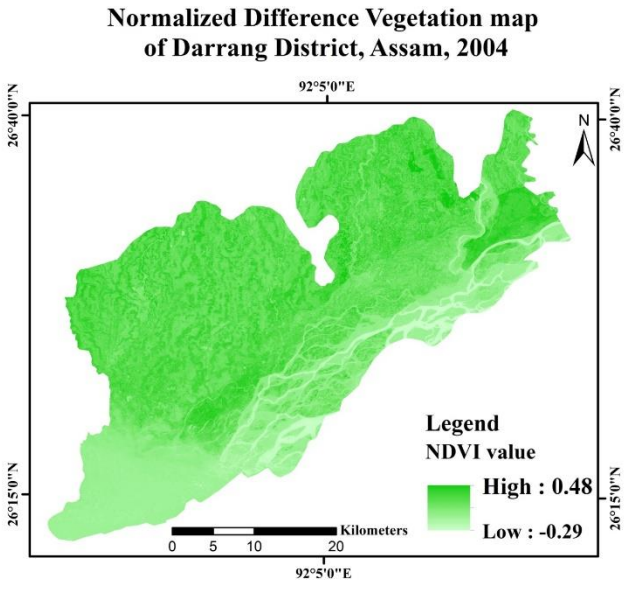
Normalized Difference Water Index: NDWI a two-ratio approach is widely used for the delineation water bodies (Hazarika, et.al.,2023). NDWI calculated using the formula -

NDWI= (GREEN-NIR)/ (GREEN+NIR)

6. RESULT AND DISCUSSION

NDVI highlighted the vegetation index, NDBI highlighted the built up and NDWI highlighted the water index. NDVI aim to assess the biomass quantity, while NDWI was developed to identity water bodies. NDVI values of different indices the highest and lowest vegetation. The maximum values indicate the healthy vegetation over area is highest and the minimum values are displayed on the barren land. Satellite data of three year, 1999, 2004, 2023 have been used in the study. High NDVI values were concentrated in the year 1999. The NDVI values for the years 1999, 2004 and 2023 are 0.50 to-0.35, 0.48 to -0.29 and 0.50 to -0.18 respectively. The NDBI values of the Nagaon district for the year 1999 are 0.45 to 0.63, for 2004 the NDBI values are 0.73 to -0.96 and for the year 2023 are 0.24 to -0.41.The NDWI value indicates that the water index increases in the water bodies from the year 1999 to 2023. (fig: 1.1) Due to the growth of urbanization, transportation vegetation cover decreases and built-up increases. Here an interrelationship between NDVI, NDBI and NDWI that while built up increases the vegetation cover and water bodies decrease. Calculated the NDVI statistics ; Minimum value is -0.18 for the year of 2023, for 2004 minimum value is 0.48 and for 1999 NDVI map minimum value is 0.50. The maximum values for NDVI map of 2023, 2004, 1999 years are 0.59, -0.29 , -0.35 , mean values are 0.17, 0.08, 0.10 and standard deviation values are 0.12, 0.12 and 0.13. For NDBI statistics the minimum values for these three years 2023, 2004 , 1999 are -0.42, -096, -0.64, maximum values are 0.25, 0.73, 0.46 ,mean values -0.05, 0.12, 0.13 and standard deviation values 0.09, 0.12, 0.16. For NDWI statistics the minimum values for these three years 2023, 2004 , 1999 are -0.45, -0.80, -0.80, maximum values are 0.22, 0.94, 0.94 ,mean values -0.15, -0.22, -0.22 and standard deviation values 0.11, 0.15 and 0.15.





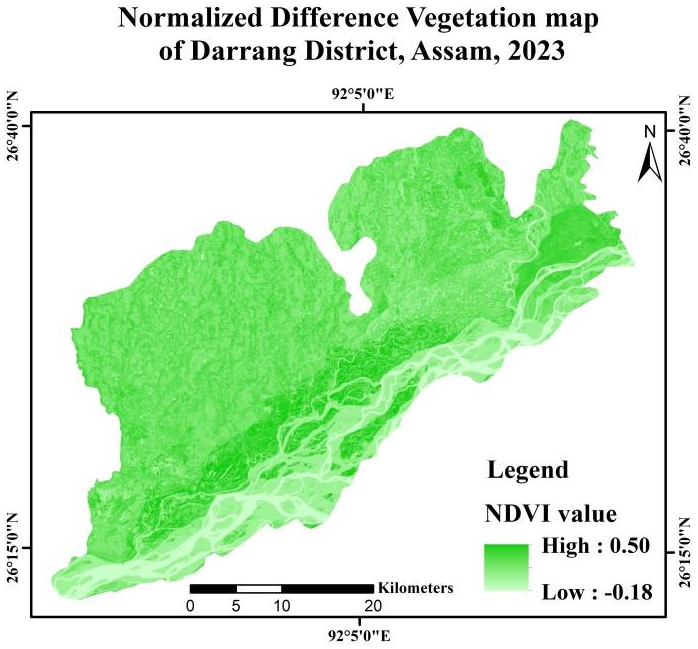


Fig: 1.1NDVI map of Darrang district

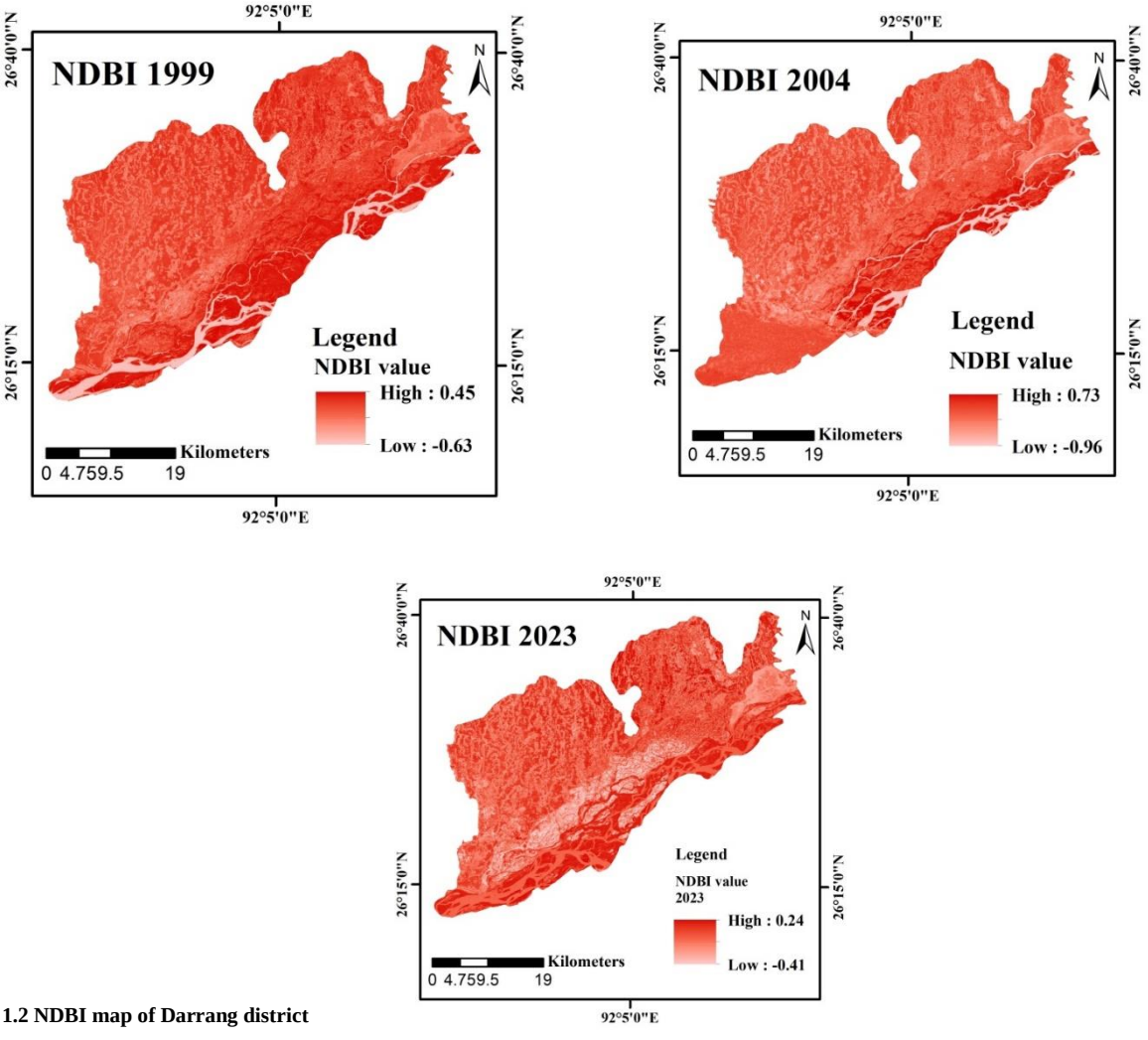


Fig: 1.2 NDBI map of Darrang district

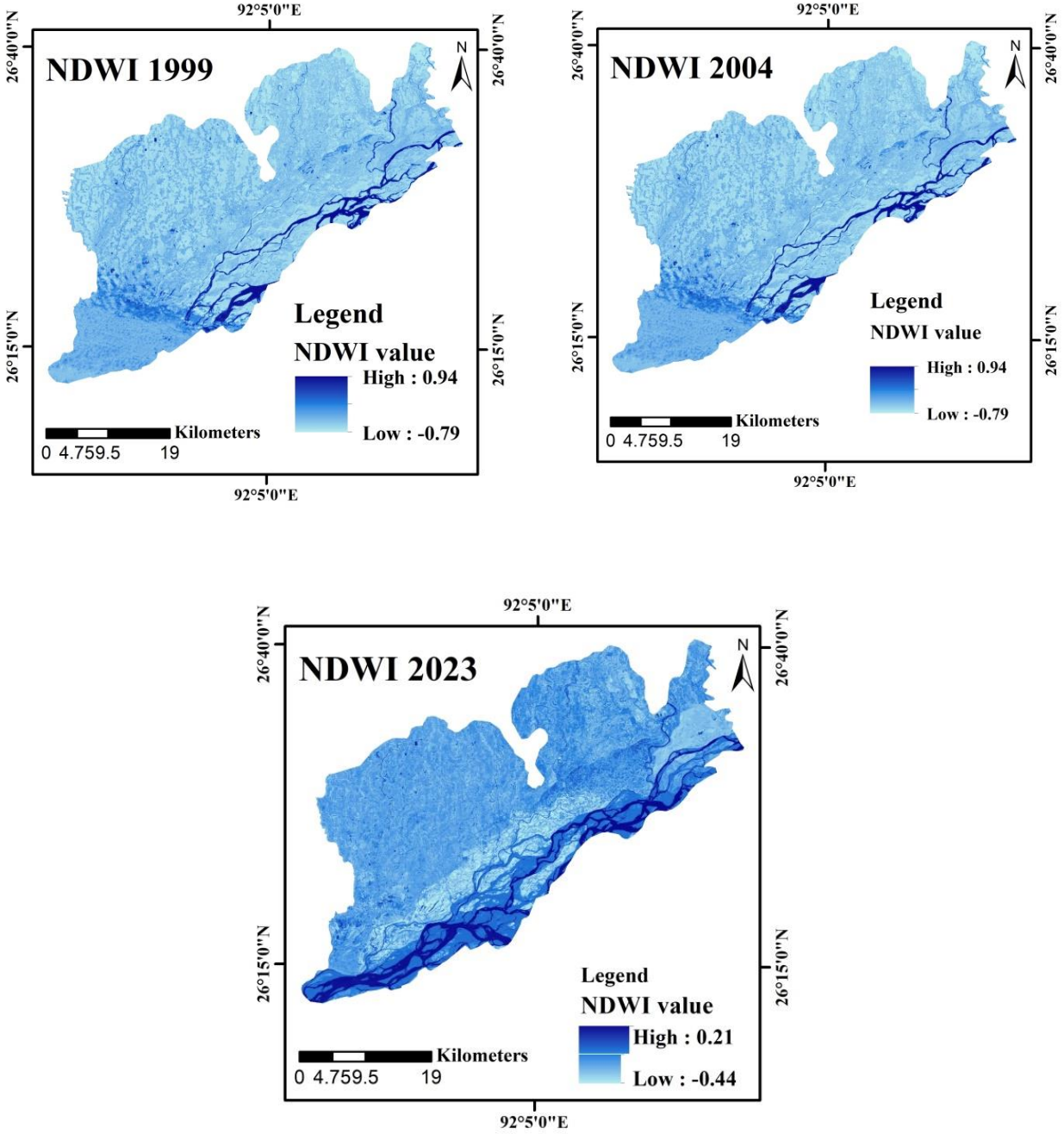


Fig:1.3 NDWI map of Darrang district

Table: 1.2 NDVI statistics

Year	Minimum	Maximum	Mean	Standard deviation
2023	**-0.18**	**0.59**	**0.17**	**0.12**
2004	**0.48**	**-0.29**	**0.08**	**0.12**
1999	**0.50**	**-0.35**	**0.10**	**0.13**

Table:1.3 NDBI statistics

Year	Minimum	Maximum	Mean	Standard deviation
2023	**-0.42**	**0.25**	**-0.05**	**0.09**
2004	**-0.96**	**0.73**	**0.12**	**0.12**
1999	**-0.64**	**0.46**	**0.13**	**0.16**

Table: 1.4 NDWI statistics

Year	Minimum	Maximum	Mean	Standard deviation
2023	**-0.45**	**0.22**	**-0.15**	**0.11**
2004	**-0.80**	**0.94**	**-0.22**	**0.15**
1999	**-0.80**	**0.94**	**-0.22**	**0.15**

Table: 1.5 Ranges of NDVI values

Year	High	Low
2023	**0.50**	**-0.18**
2004	**0.48**	**-0.29**
1999	**0.50**	**-0.35**

Table: 1.6 Ranges of NDBI values

Year	High	Low
2023	**0.24**	**-0.41**
2004	**0.73**	**-0.96**
1999	**0.45**	**0.45**

Table: 1.7 Ranges of NDWI values

Year	High	Low
2023	**0.21**	**-0.44**
2004	**0.94**	**-0.79**
1999	**0.94**	**-0.79**

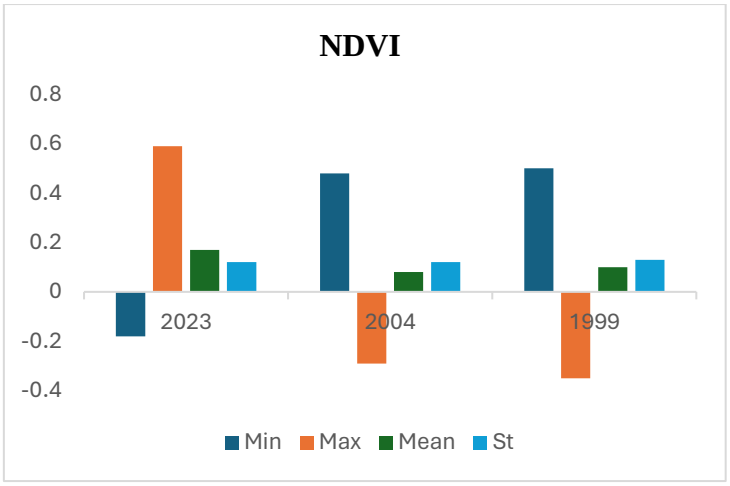


Fig: 1.8 Comparing NDVI values using the Bar Graph

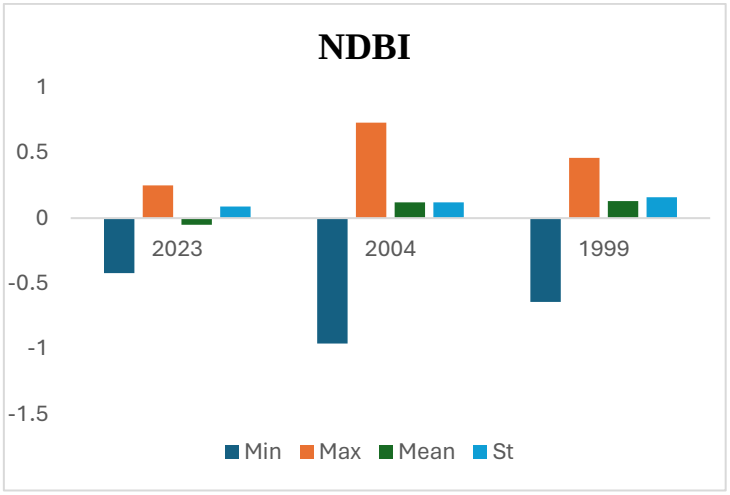


Fig:1.9 Comparing NDBI values using the Bar Graph

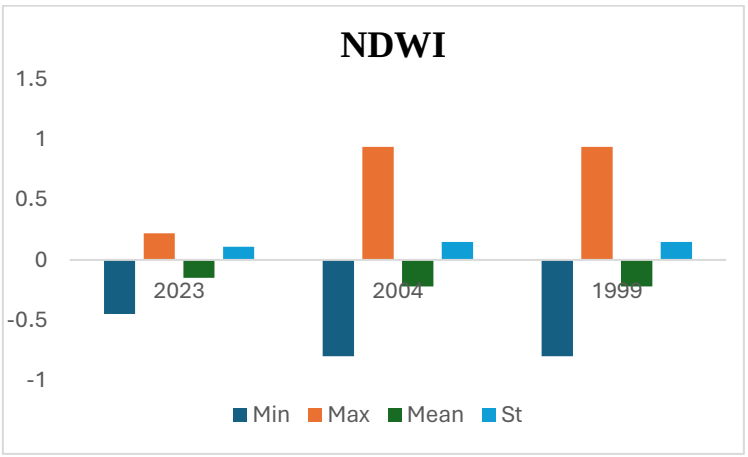


Fig: 1.10 Comparing NDWI values using the Bar Graph

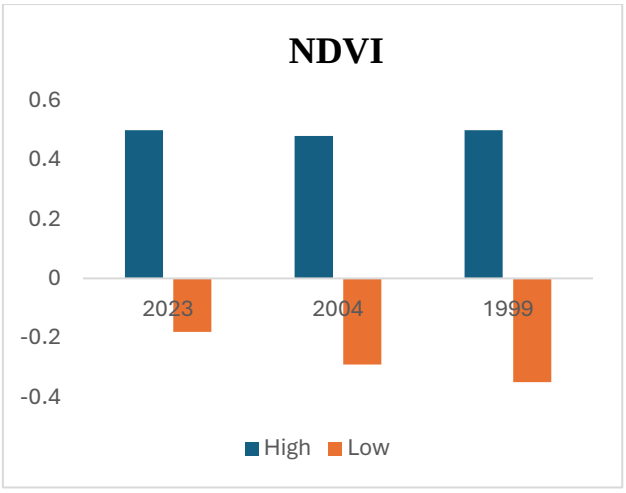


Fig:1.11 Comparing Ranges of NDVI values

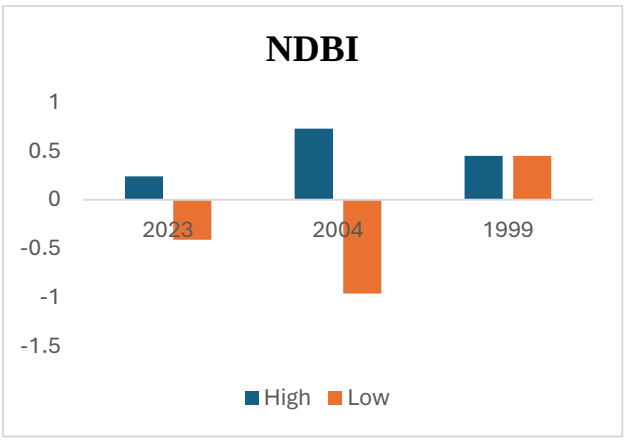


Fig:1.12 Comparing Ranges of NDBI values

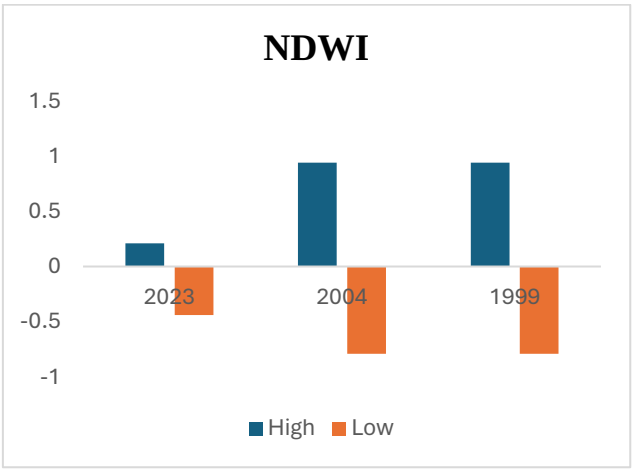


Fig:1.13 Comparing Ranges of NDWI values

7. CONCLUSION :

Spectral indics can enhance the landscape feature, several cases have similar values. In case of NDVI, NDBI and NDWI calculated in the present study to extract the vegetation, built up and water bodies in Darrang district. In the present study, spatial temporal trends of NDVI, NDBI and NDWI have systematically analyzed using Landsat8 and Landsat 4 remote sensing data. Comparing the NDVI, NDBI, NDWI values using Bar graph. The present study indicate that the vegetation and water bodies have decreased in small amout.

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