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Study of Vegetation Cover Using NDVI of Wardha District

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ABSTRACT: Analyzing the vegetation cover of a region (wardha) by calculating the Normalized Difference Vegetation Index (NDVI) of that district. The study is regarding evaluating the variance in NDVI as an impression of various natural factors like precipitation, erosion, replenishment of water bodies, forest cover, etc. of the area. NDVI values represent state of vegetation condition. Thus perspective anything that could alter vegetation condition could alter NDVI value.

KEYWORDS: ArcGIS, NDVI, Raster, PreMonsoon, Post-Monsoon, USGS Earth Explorer,Diva GIS

I. INTRODUCTION:

The investigations were performed as a Case study on Wardha district, with area 6,310 km^2 (2,440 sq mi), of Maharashtra. This research paper presents the vegetation cover of the study area by the analysis of Satellite image based on Normalized Difference Vegetation Index (NDVI). NDVI employs the Multi-Spectral Remote Sensing data technique to find Vegetation Index, land cover classification, vegetation, water bodies, agricultural area, thick forest, thin forest with few band combinations of the remote sensed data. Land Resources are easily interpreted by computing their NDVI for Land Cover classifications. Data from three consecutive years (2018, 2019, and 2020) was taken and analysed in the software called ArcGIS 10.5. The data from each year was analysed for two different periods, premonsoon and post-monsoon NDVI is the most common formula to calculate value of vegetation index (NDVI) give information related to primary production of vegetation. The Vegetation analysis can be helpful in predicting the unfortunate natural disasters to provide humanitarian aid, damage assessment and furthermore to device new protection strategies.

Many researchers have reported the use of NDVI for vegetation monitoring. Vegetation index (VI) is a simple and effective measurement parameter, which is used to indicate the earth surface vegetation covers and crops growth status in remote sensing field. On the basis of wavelength, remote sensing is classified into three types as: visible and reflective infrared remote sensing, thermal infrared remote sensing, and microwave remote sensing. There are several indices for highlighting vegetation bearing areas on a remote sensing scene. NDVI is a common and widely used index.

II. SOFTWARE USED

ARCGIS 10.5 Arc GIS is a family of client software, server software, and online geographical information system (GIS) services developed and maintained by Esri. ArcGIS was first released in 1999 and originally was released as ARC/INFO, a command line-based GIS system for manipulating data. ARC/INFO was later merged into ArcGIS Desktop, which was eventually superseded by ArcGIS Pro in 2015. ArcGIS Pro works in 2D and 3D for cartography and visualization, and includes Artificial Intelligence (AI).ArcGIS is a geographical information system (GIS) software that allows handling and analysing geographic information by visualizing geographical statistics through layer building maps like climate data or trade flows. The system has the capacity to create geographical information accessible throughout a company, institution, privately or publicly on the internet. Therefore, the software essentially works as a platform whereby geographical information can be linked, shared and analyzed.

It is used by a whole host of academic institutions and departments, both in the humanities and sciences, to develop and illustrate ground-breaking research. Further, it is used by several governments and private/commercial institutions worldwide. The system has the capacity to create geographical information accessible throughout a company, institution, privately or publicly on the internet. Therefore, the software essentially works

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as a platform whereby geographical information can be linked, shared and analyzed.

III. STUDY AREA:

In this project, the investigations were performed as a case study on the Wardha district of Maharashtra state with has an area of 6310km². The data of Landsat 8 was downloadedfromthe https://earthexplorer.usgs.gov/for pre and post monsoon periods of three different years (2018, 2019 and 2020).Interpretations of land cover were done with image contrast technique using ArcGIS

10.5 (ArcMap 10.5) software. Information about land use/ land cover classes and associated information was collected and the feature class such as barren land, water bodies, agricultural land and dense forest were recognized for Pre and Post monsoon sessions of all three years.

IV. METHODOLOGY:

Downloaded data from LANDSAT -8 from https://earthexplorer.usgs.gov/ for Pre and Post Monsoon periods of 3 consecutive years (2018, 2019, and 2020) of Wardha district.

Landsat 8: -Are the important remotely sensed metrics for ecosystem monitoring and land surface process assessment, among which Normalized Difference Vegetation Index (NDVI) has been most widely used. The newly launched Landsat 8 Operational Land Imager (OLI) sensor, together with its predecessor Landsat 7 Enhanced Thematic Mapper Plus (ETM +), provides continuous earth observations with an 8-day interval. The design improvements of the new sensor, including narrower near-infrared waveband, higher signal-to-noise ratio (SNR), and greater radiometric sensitivity highlight the need for investigating the land surface observation properties, especially its consistency with data from its predecessors and other satellite sensors. This study aims to evaluate the characteristics of Landsat 8 OLI-derived NDVI against Landsat 7 ETM + by cross-comparison and by comparing with Moderate ResolutionImaging Spectroradiometer (MODIS) and Geostationary Ocean Color Imager (GOCI)-derived NDVIs as well as in-situ NDVI measurements.

Mosaicking: -

A mosaic is a combination or merge of two or more images. In ArcGIS, you can create a single raster dataset from multiple raster datasets by mosaicking them together. Alternatively, you can create a mosaic dataset and create a virtual mosaic from a collection of raster datasets**.**

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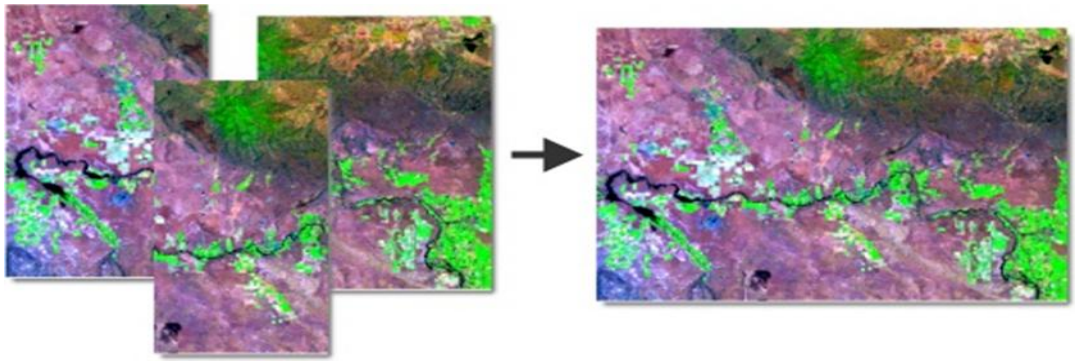
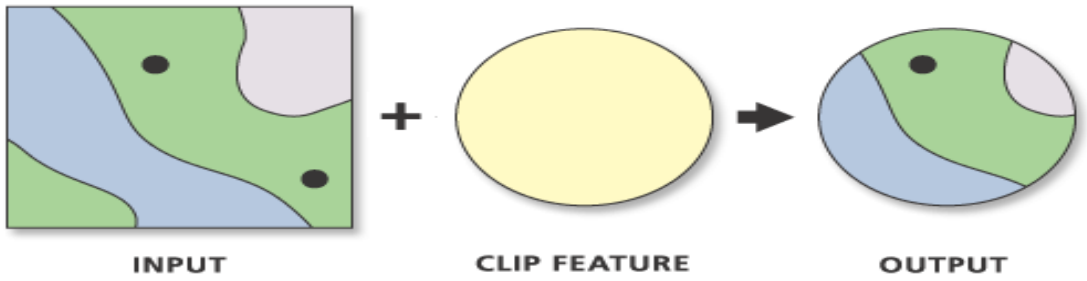
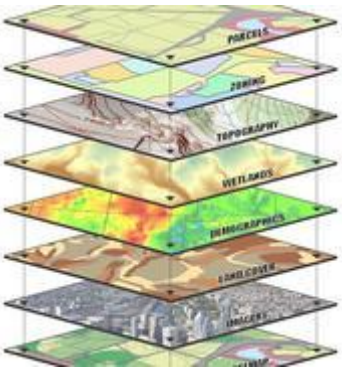


Clipping: -Use this tool to cut out a piece of one dataset using one or more of the features in another dataset as a cookie cutter. This is particularly useful for creating a new dataset—also referred to as study area or area of interest (AOI)—that contains a geographic subset of the features in another, larger dataset.



Geo-referencing: -
Georeferencing means that the internal coordinate system of a digital map or aerial photo can be related to a ground system of geographic coordinates. A georeferenced digital map or image has been tied to a known Earth coordinate system, so users can determine where every point on the map or aerial photo is located on the Earth's surface



NDVI Calculation: -
Normalized Difference Vegetation Index (NDVI) quantifies vegetation by measuring the difference between near-infrared (which vegetation strongly reflects) and red light (which vegetation absorbs).

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

NIR- Near Infrared Reflectance (Band 5 of Landsat 8 data)
RED- Red Visible Reflectance (Band 4 Landsat 8 data).

Reclassification: -
Reclassification is the process of reassigning one or more values in a raster dataset to new output values. The Reclassify tool is available in the Spatial Analyst extension in both ArcMap and ArcGIS Pro.

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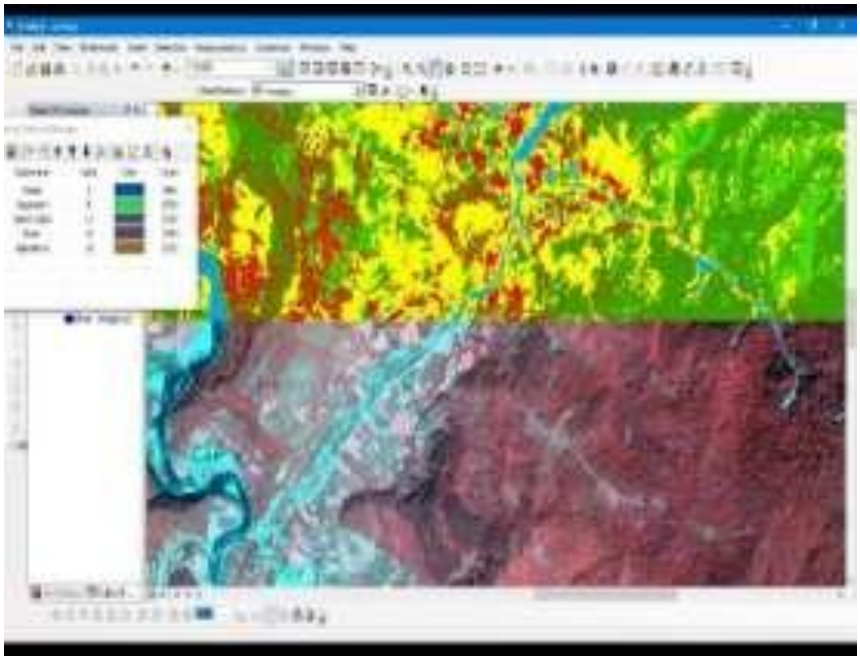

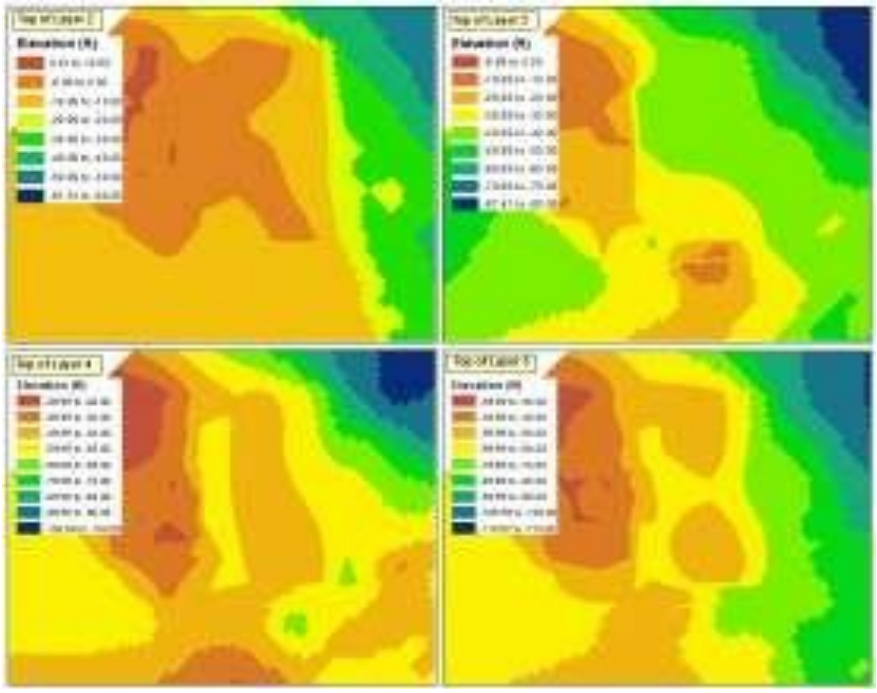

V. OBSERVATIONS ANDRESULTS:

After undergoing the process of calculating NDVI value for Wardha district in Maharashtra, India, from ArcGIS software, we have categorized our project in various comparisons like Year wise comparison for the year of 2018, 2019& 2020 and Taluka-wise comparison of NDVI data for different years and they are 2018, 2019& 2020. Also, we have considered the data of two different periods from each year that is, pre-monsoon and post-monsoon. The results and conclusion for the same has been given below: -

International Journal of Advances in Engineering and Management (IJAEM)
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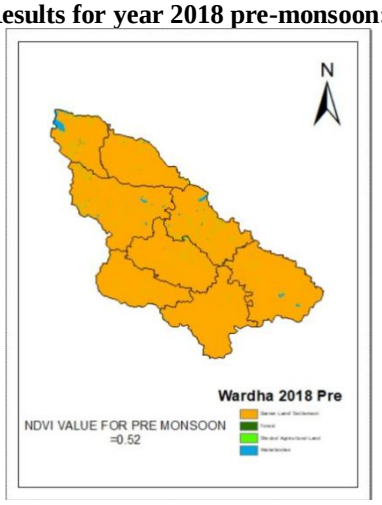
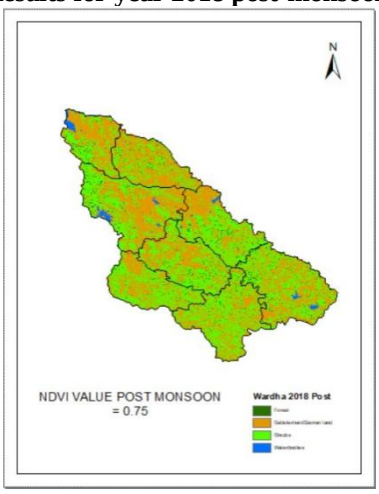
NDVI Results for year 2018 pre-monsoon: -



NDVI value for the year 2018 has been calculated for Wardha District and based upon it the particular land type i.e.,Forest Land, Barren Land/Settlements, Shrub/Agricultural Land and Water Body has been identified and classified as given in the above image.

Legend describes the NDVI values and the characteristics for different features. In other words, on a pixel-by-pixel basis subtracts the value of red band from the value of NIR band and divides by their sum. Very low value of NDVI (0.2 and below) correspond to barren areas of rock, sand, or snow. Moderate values represent shrub and grassland (0.2 to 0.6), while high value indicates temperate and tropical rain forests (0.6 to 1). Bare soil is represented with NDVI values, which are closest to 0 and water bodies are represented with negative NDVI values.

NDVI Results for year 2018 post-monsoon: -



TALUKA-WISE RESULT OF NDVI FOR 2018 PRE AND POST MONSOON: -

2018 Pre-Monsoon

Sr. no	Tehsil	Area (sqkm)	Water bodies (%)	Shrubs/Agriculture (%)	Barren land/Settlement (%)	Forest (%)	NDVI value
1.	Wardha	761	0.017	1.03	98.82	0.01	0.59
2.	Seloo	765.13	0.85	1.94	98.42	0.088	0.62
3.	Samudrapur	1109.69	0.47	0.30	90.80	0.001	0.55
4.	Karanja	823.50	0.103	0.63	77.82	0.017	0.54
5.	Hinganghat	1058.63	0.084	0.18	83.73	0.001	0.58
6.	Deoli	1225.89	0.141	0.28	53.02	0.002	0.52
7.	Ashti	551.67	4.44	2.29	87.06	0.041	0.52
8.	Arvi	1063.48	0.755	1.419	97.76	0.043	0.50

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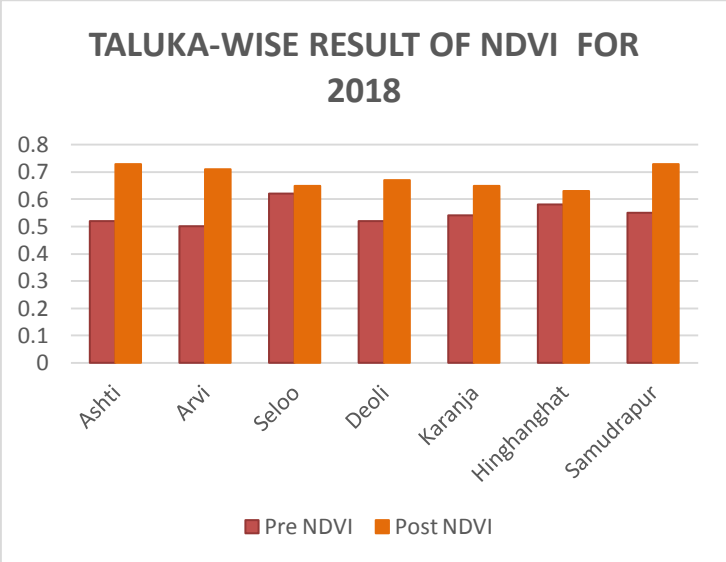
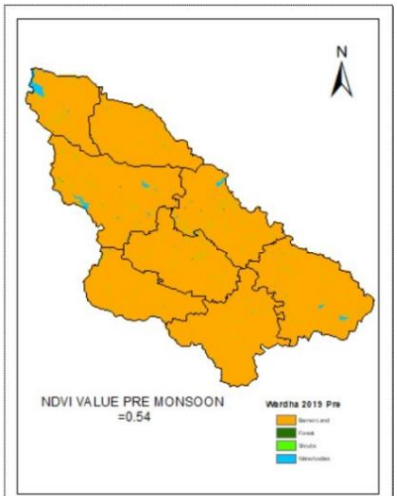
2018 Post Monsoon

Sr. no	Tehsil	Area (sqkm)	Water bodies (%)	Shrubs/ Agriculture (%)	Barren land/Settlement (%)	Forest (%)	NDVI value
1.	Wardha	761	0.095	48.74	48.174	2.84	0.68
2.	Seloo	765.13	0.844	49.55	48.24	2.65	0.65
3.	Samudrapur	1109.69	1.351	47.76	45.23	2.21	0.73
4.	Karanja	823.50	0.280	26.63	50.49	1.21	0.65
5.	Hinganghat	1058.63	0.166	44.71	37.79	1.31	0.63
6.	Deoli	1225.89	0.112	27.64	24.81	0.87	0.67
7.	Ashti	551.67	4.31	32.37	55.63	1.50	0.73
8.	Arvi	1063.48	2.51	42.19	53.44	1.82	0.71



NDVI Results for year 2019 pre-monsoon: -



International Journal of Advances in Engineering and Management (IJAEM)
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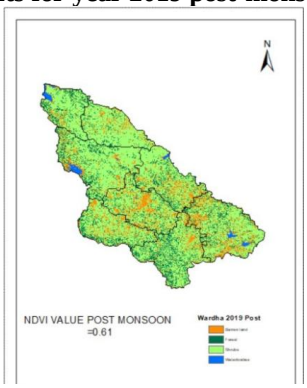
NDVI Results for year 2019 post-monsoon: -



NDVI value for the year 2019 has been calculated for Wardha District and based upon it the particular land type i.e.,Forest Land, Barren Land/Settlements, Shrubs/Agricultural land and Water Body has been identified and classified as given in the above image.

TALUKA-WISE RESULT OF NDVI FOR 2019 PRE AND POST MONSOON: -

2019 Pre-Monsoon

r. no	Tehsil	Area (sqkm)	Water bodies (%)	Shrubs/ Agricultu re (%)	Barren land/Settl ement (%)	Forest (%)	NDVI value
1.	Wardha	761	0.021	0.821	99.02	0.023	0.54
2.	Seloo	765.13	0.6695	1.281	99.27	0.085	0.53
3.	Samudrapur	1109.69	0.54	0.327	90.71	0.001	0.51
4.	Karanja	823.50	0.12	0.43	78.07	0.0109	0.56
5.	Hinganghat	1058.63	0.071	0.27	83.66	0.004	0.54
6.	Deoli	1225.89	0.028	0.26	53.16	0.005	0.55
7.	Ashti	551.67	3.69	1.26	88.87	0.011	0.49
8.	Arvi	1063.48	1.24	0.93	97.78	0.035	0.50

2019 Post Monsoon

Sr. no	Tehsil	Area (sqkm)	Water bodies (%)	Shrubs/ Agricultu re (%)	Barren land/Settl ement (%)	Forest (%)	NDVI value
1.	Wardha	761	0.144	63.92	23.92	11.892	0.58
2.	Seloo	765.13	0.752	70.266	17.7	12.58	0.57
3.	Samudrapur	1109.69	1.61	57.41	21.09	11.425	0.55
4.	Karanja	823.50	0.127	63.49	8.09	6.91	0.58
5.	Hinganghat	1058.63	0.01	53.56	10.8	19.58	0.60
6.	Deoli	1225.89	0.008	35.20	9.6	8.62	0.61
7.	Ashti	551.67	4.422	64.83	7.781	16.79	0.53
8.	Arvi	1063.48	2.43	71.59	10.76	15.20	0.54

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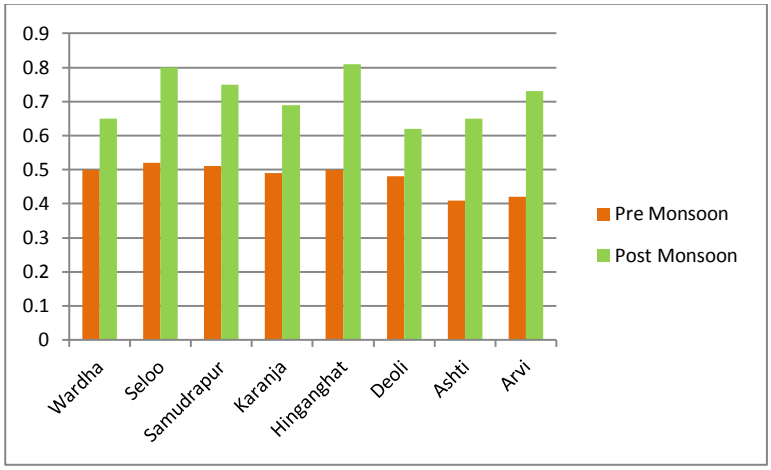
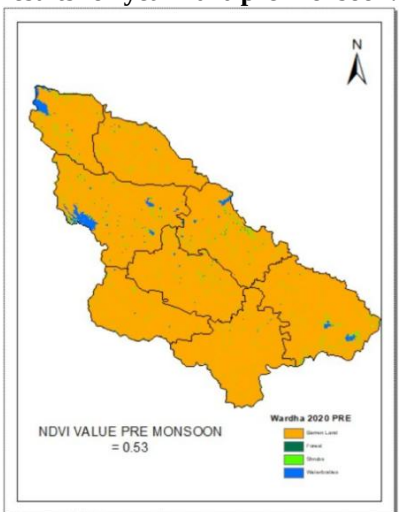
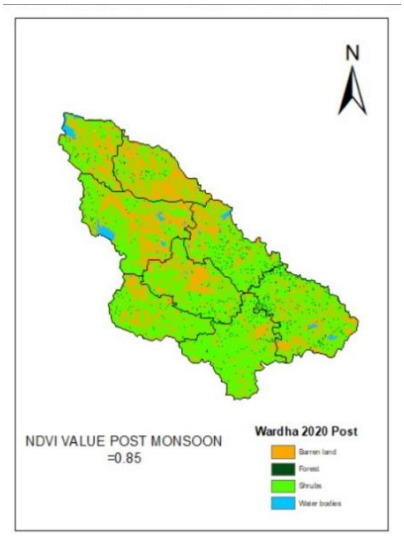


NDVI Results for year 2020 pre-monsoon: -





NDVI Results for year 2020 post-monsoon: -

NDVI value for the year 2020 has been calculated for Wardha District and based upon it the particular land type i.e.,Forest Land, Barren Land/Settlements, Shrubs/Agricultural land and Water Body has been identified and classified as given in the above image.

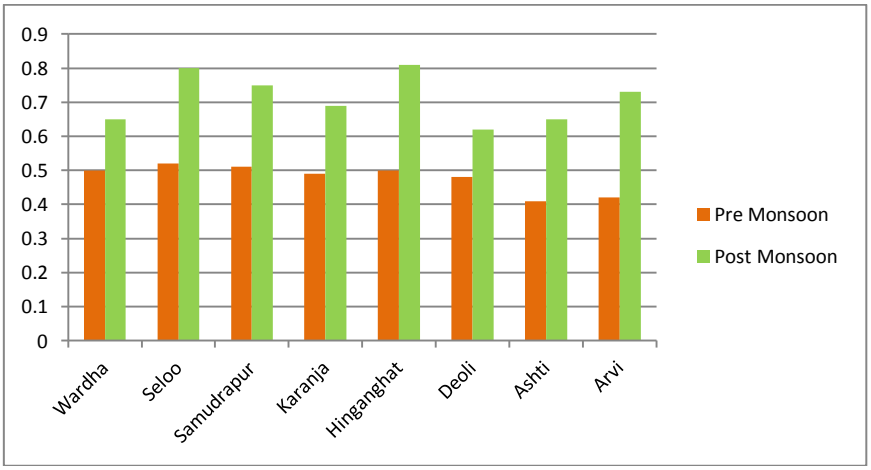
International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 12, pp: 370-379 www.ijaem.net ISSN: 2395-5252

TALUKA-WISE RESULT OF NDVI FOR 2020 PRE AND POST MONSOON: -
2020 Pre-Monsoon

Sr. no	Tehsil	Area (sqkm)	Water bodies (%)	Shrubs/Agriculture (%)	Barren land/Settlement (%)	Forest (%)	NDVI value
1.	Wardha	761	0.12	7.03	92.29	0.06	0.5
2.	Seloo	765.13	1.057	4.10	94.03	0.27	0.52
3.	Samudrapur	1109.69	0.91	6.21	87.40	0.38	0.51
4.	Karanja	823.50	0.165	6.3	76.86	0.063	0.49
5.	Hinganghat	1058.63	0.18	7.71	83.03	0.012	0.5
6.	Deoli	1225.89	0.153	7.4	82.53	0.07	0.48
7.	Ashti	551.67	4.905	7.15	85.707	0.07	0.41
8.	Arvi	1063.48	4.28	6.64	88.96	0.104	0.42

2020 Pre-Monsoon

Sr. no	Tehsil	Area (sqkm)	Water bodies (%)	Shrubs/Agriculture (%)	Barren land/Settlement (%)	Forest (%)	NDVI value
1.	Wardha	761	0.162	63.12	37.85	1.37	0.65
2.	Seloo	765.13	1.343	65.34	32.24	2.30	0.8
3.	Samudrapur	1109.69	0.875	63.11	24.43	3.14	0.75
4.	Karanja	823.50	0.31	32.69	45.06	0.561	0.69
5.	Hinganghat	1058.63	0.025	67.21	15.24	1.51	0.81
6.	Deoli	1225.89	0.08	36.90	16.04	0.43	0.62
7.	Ashti	551.67	5.335	47.98	39.79	0.719	0.65
8.	Arvi	1063.48	3.63	53.84	41.89	0.611	0.73



NDVI RESULTS ACCORDING TO THE YEAR WISE COMPARISON FOR 2018, 2019&2020: -

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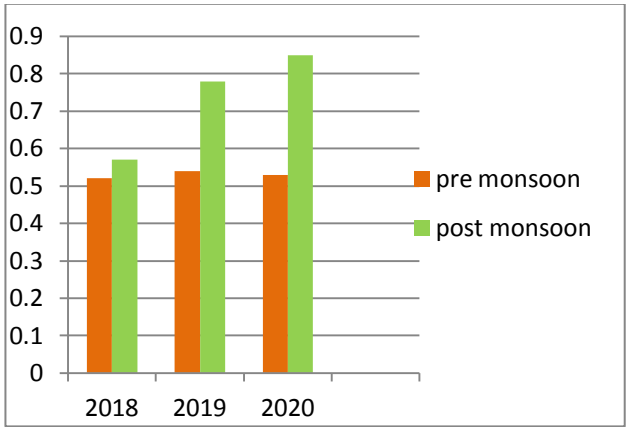

This bar graph indicates comparison between NDVI value in pre and post monsoon period of Wardha District for Year 2018, 2019& 2020. Here the increase in the NDVI values can be observed from 2018 to 2020 due to increase in rainfall amount from 2018 to 2020 and hence the NDVI value for year 2020 is highest in Wardha district.

VI. CONCLUSION

The potential of NDVI to differentiate between the different types of land covers present in particular area was demonstrated. The NDVI was able to differentiate between the Forest land, Barren land/Settlements, Shrubs/Agricultural land, water bodies and shown the NDVI values of the above four types of classes within the range. NDVI values can be used as predictors in determination of the type of land cover in a particular area; NDVI value is directly proportional to the green land cover and also to the rainfall. Higher the value of NDVI higher will be the chances of green land cover in particular area, and if the area is having green land cover it implies that the rainfall in that area will be more. Also, the NDVI value is inversely proportional to the soil erosion. As we have seen that soil erosion is more in barren land and NDVI value for barren land is less as compared to the green land or forest land. Therefore, lesser will be the value of NDVI more chances of barren land will be there and more will be the soil erosion on such type of land.

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