INTER COMPARISON OF NDVI WITH A NEW ANGLE-BASED SPECTRAL INDEX (ABDI) FOR CROP GROWTH MONITERING AND DROUGHT ASSESSMENT

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Abstract - *In the present study, the New Angle Based Drought Index (ABDI) was derived from near infrared (NIR), shortwave infrared 1 (SWIR1) and shortwave infrared 2 (SWIR2) bands of Landsat8 (OLI) for study are SUB WATERSHED OF GINGEE BASIN, India. The ABDI, sensitive to surface wetness, and greenish values were found to be strongly correlated with NDVI. Comparison between normalized difference vegetation index (NDVI) with New Angle Based Drought Index ABDI and ABDI 1 showed that during the beginning of the crop season, ABDI was relatively better in discriminating the surface dryness and vegetation conditions prevailing in different years of 2017and 2018. ABDI and ABDI-I were equal to the NDVI. A very high coefficient of regression value ($R^2 = 0.867$) was observed while analyzing the agreement between derived ABDI and NDVI. The same low coefficient of regression value ($R^2 = 0.3087$) was observed while analyzing the agreement between derived ABDI –I and NDVI. And the proposed ABDI had a stronger response to regional drought than NDVI which can be an ideal method of vegetation monitoring in both precise and effective.*

Key Words: Remote Sensing, GIS, Normalized Difference Vegetation Index, Angle Based Drought Index (ABDI), Drought.

1. INTRODUCTION

A Drought is a natural disaster of below average rain in a given area resulting in prolonged shortages in the water supply, whether atmospheric, surface water or ground water.[1] The ideas of spatial-temporal Changes of surface moisture is of key importance in the detection of early season drought. In the condition of the crop season, the surface moisture plays an important role. As the crop season progresses, the contribution of canopy surface moisture increases and at the peak vegetation stage, it becomes the key contributor of surface moisture [1][2]. The spatiotemporal variation of soil moisture is also reflected in the spatial patterns of plant growth and crop yield. There is a necessity to prepare new indices with a set of multispectral bands to provide a more realistic indication on moisture in vegetation and soil that is normalized multi-band drought index with spectral bands of SWIR and NIR[3][4]. However, little research had been done for drought monitoring and vegetation cover monitoring with an angle-based spectral index with the reflectance in the SWIR region is primarily for moisture analysis. The spectral angle index based on RED and NIR can be used to estimate the NDVI and soil moisture. This paper objective in crop monitoring, with an ABDI and NDVI. ABDI and ABDI-I were created and analyzed to evaluate the Relationship between NDVI and severe drought analysis.

2. DATASET AND METHODOLOGY

2.1 Study area

Study area sub water basin Gingee river basin cover with 900 sq.km with part of Villupuram District of Tamil Nadu and Puducherry district along Gingee stream bowl is arranged on the Coromandel drift between 11.9416° N, 79.8083° E. Is represented in Figure no: 1 and comes under the UTM zone 42N. The climate of the district is sub-tropical, which is characterized by a very hot dry summer from April to early June. The average maximum temperature is 36 °C and a cold winter lows to around 18–20 °C. And in the following figure no:2 is a representation of drainage pattern in the study area.
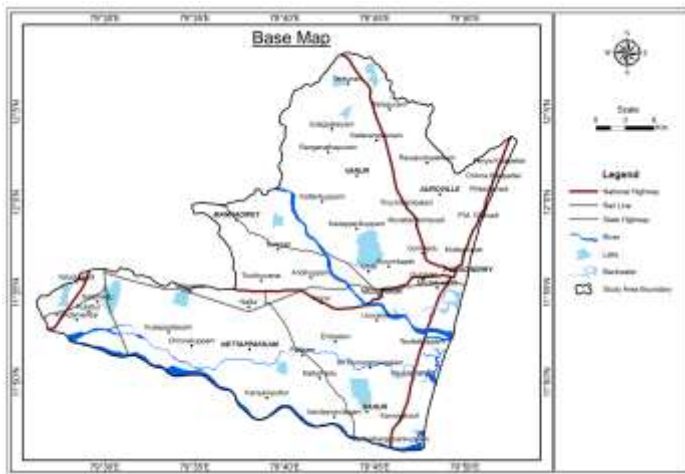
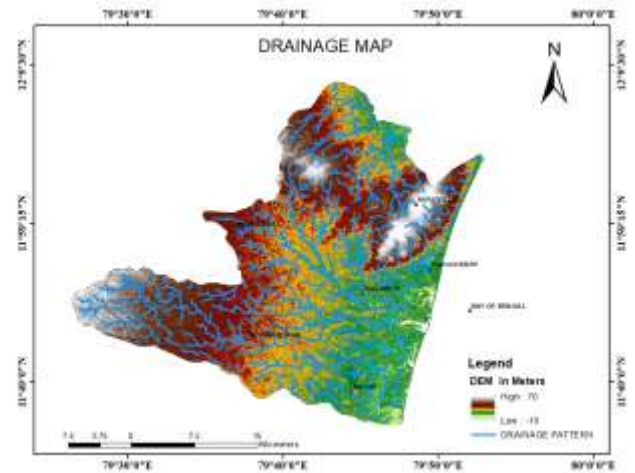**Figure no: 1** Base map of study area

Figure no: 2 Drainage map of the study area

2.2 Data Available

2.2.1 Spatial data.

LANDSAT-8 OLI Operational Land Imager with the optical region of 30m spatial resolution. The Path/Row of Landsat-8 OLI satellite was found 142/52. The data of satellite image acquisition is represented in Table- 1.

Table: 1 satellite data and data of acquisition.

| Data type	Date of acquisition
Landsat8(OLI)	17-Sep-2017
	10-Jan-2018
	19-Aug-2018
	25-Dec-2018

2.2.2 Crop data

The study area contains both wetland area and dry land area. The major growing crops are Cashew, Sugarcane, Coconut, Maize, Rice, Groundnut, Sunflower, Minor crops like Bajara, Jowar (cholam), Mango, Amla, Sapota, etc., GPS point location are taken in the study are for different 10 crops is denoted in Table- 2

Table-2 GPS observation points for Crops

S.No	Crop	Latitude	Longitude
1	CASHEW	11.99131	79.82201
2	AMLA	11.93879	79.76512
3	SAPOTA	11.93846	79.66502
4	MANGO	11.93827	79.76537
5	GROUNDNUT	11.93769	79.76799
6	RICE	11.93227	79.76921
7	SUGARCANE	11.95345	79.70761
8	FODDER	11.93682	79.76249
9	CASUARINA	11.94988	79.72557
10	COCONUT	11.95292	79.74084

3. METHODOLOGY

In this section, the satellite image is extracted to the study area. Land Use land cover classification is with 12 variable point data which are collected from the ground. Monitoring the agriculture area with Landsat time serious data for the post and pre-monsoon, with 30m spatial resolution. The crop monitoring by NDVI ABDI, and ABDI-I.
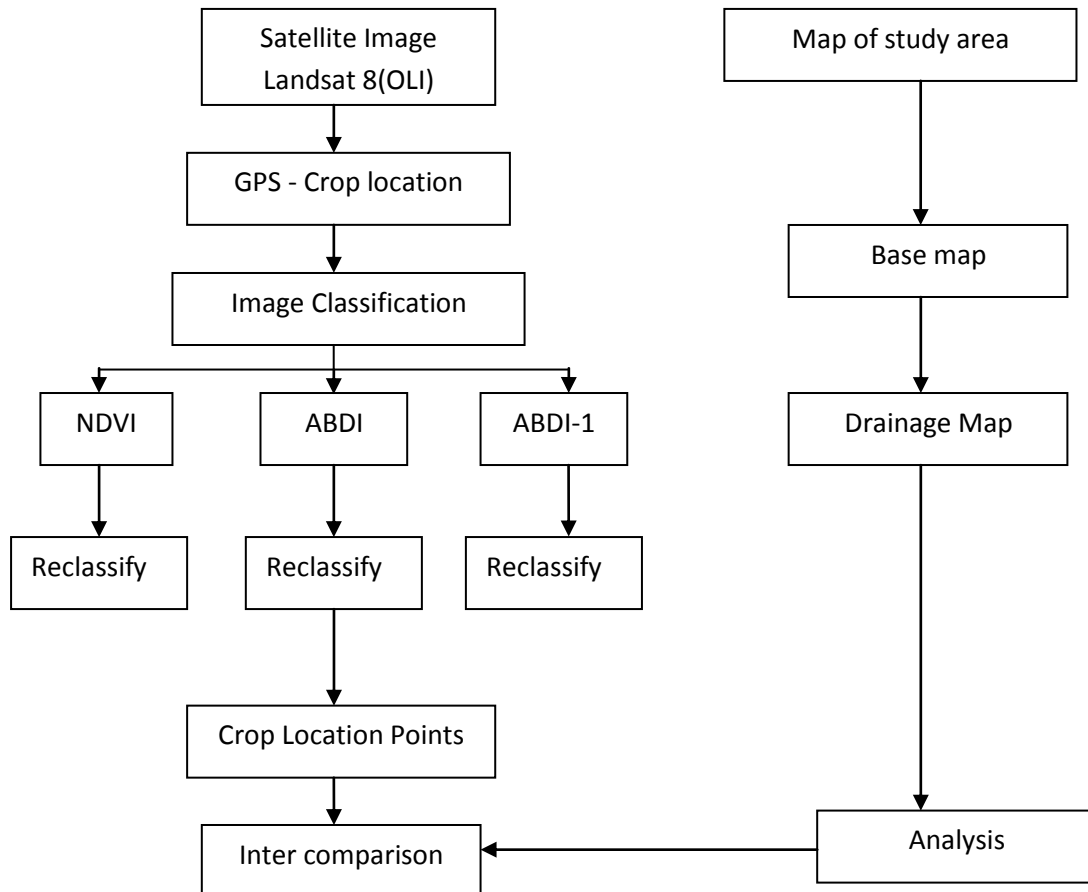
Flow chart: 1 Methodology of the study area

3.1 Processing of Satellite data

The software package like ENVI5.1 for Image processing and QGIS Desktop 2.18.27 for data analysis and map generation.

3.2.1 NDVI Analysis

The NDVI (Normalized Difference Vegetation Index) is a vegetation quality index to quantify the dynamic vegetation cover change.[4] This index is popular and examined with many earth observer over the years. The main objective to calculate NDVI is to analysis the healthy green vegetation (Green Cover, Grassland, vegetation)[5]

$NDVI = (R_{NIR} — R_{RED}) / (R_{NIR} + R_{RED})$,

Where, RED is visible Red region, and NIR is near infrared region. The wavelength range of NIR band is (750-1300 nm), Red band is (600-700 nm), and the Green band is (550 nm).[5] Red and Near Infrared values are used for the observation of greenish values. The values of NDVI is from -1 to 1. The fewer values like 0. And <0.1 are denoted as barren lands likes, rocky area, sand, and uncultivable area. Moderate values (0.2 to 0.3) are denoted as low shrubs and grassland, the high values (0.6 to 0.8) denoted high vegetation cover is like a rain forest, temperate rainforest[6][7][8].

3.3 Angle Based Drought Indexes

The SWIR is the band strongly observed in water vapor and water content areas, and water bodies. The surface moisture content is well reflected in spectral bands of NIR-SWIR and RED.[9][10] Considering the absorption of the soil particles has a pattern of increment with the enlargement of water content, not have a frequent change in spectral bands. The Angle framed by absorption spectral curve band. The curve reflection of dry soil is larger compare to wet soil. [11]

$ABDI = R_{NIR} \times \tan^{-1}((R_{NIR} - R_{SWIR\,1})/ (\lambda_{SWIR\,1} - \lambda_{nir}))$

$ABDI\text{-}I = R_{NIR} \times \tan^{-1}((R_{NIR} - R_{SWIR\,2})/ (\lambda_{SWIR\,2} - \lambda_{nir}))$

Where, λ_{SWIR} is the wavelength of specific bands, that is 1.566 nm where λ_{nir} with a wavelength of 0.851, in the case of Landsat8 (OLI) has two SWIR bands so, in second New Angle Based drought index is formed with SWIR-2[12] For vegetation, the value of ABDI's is positive, and the value of green vegetation values are higher than that of low dry vegetation. For negative values are for soils, day soil with lower value compare to wet soil. [13][14]

4 RESULTS

4.1 Monitoring of vegetation Quality by different indexes.

4.1.1 Monitoring by NDVI.

For monitoring the chlorophyll content in an ecosystem like green cover vegetation areas, in both spatial and temporal resolution by main domain in NDVI, other so many indexes are there for analysis of vegetation quality but it has specific outcomes. Because there is insufficient evidence to enable this ill-health Vegetation, so it used as a vegetation monitoring tool. [15] This study contains both pre-monsoon and post-monsoon of the continuous year of 2017 and 2018.

In the year 2017, the pre-monsoon values of all crops in low vegetation especially crop casuarina, mango and pre-monsoon rice crop have high vegetation, due to backwater cultivation of rice makes to cultivated in pre-monsoon. In the post-monsoon season, the vegetation quality is well compared to pre-monsoon, the northeast monsoon brings a huge rain due to along the seashore. The crop is less vegetation because they are in the stage of harvesting so the greenish values are changed to yellowish color. The post-monsoon season of sugarcane is good due to the sugarcane is annual crop stars from January. The following Figure no: 2 (a) representation of the graph.

In the year 2018, the pre-monsoon values of all crops in low vegetation especially rice crop In the post-monsoon season the vegetation quality are well compared to pre-monsoon, the northeast monsoon brings a huge rain due to along the seashore. The following Figure no: 2 (b) representation of the graph.
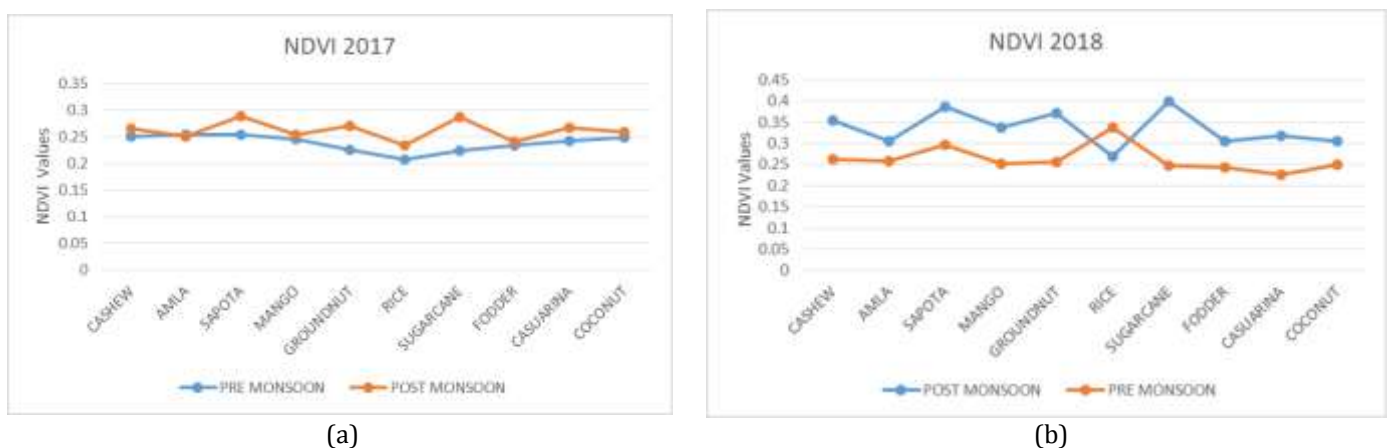

(a)　　　　　　　　　　　　　　　　　　　　(b)

Figure no: 2 (a) Graphical representation of NDVI values in 2017 **(b)** Graphical representation of NDVI values in 2018

4.1.1 Monitoring by ABDI.

The ABDI and ABDI-I analysis are done in the year 2017, the pre-monsoon values of all crops in low vegetation especially crop fodder with a range of 0.2 pre-monsoon rice crop has less vegetation, even in post monsoon

In the year 2018, the pre-monsoon values of all crops in low vegetation especially rice crop in the post-monsoon season the vegetation quality goes well compared to pre-monsoon, the northeast monsoon brings a huge rain due to along the seashore. During the early Pre-monsoon and post-monsoon, similar observations were seen where fractional at NDVI had maximum equal with fractional of ABDI, followed by ABDI-2. In that case, the dry phase is not following the low positive values. The following Figure no: 3(a)(b)(c)(d) representation of a graph of ABDI and ABDI-I values in the respective year of 2017 and 2018.

(a)

(b)

(c)

(d)

Figure no: 3 (**a**) Graphical representation of ABDI values in 2018   **(b)** Graphical representation of ABDI values in 2017
(c) Graphical representation of ABDI-I values in 2018   **(d)** Graphical representation of ABDI-I values in 2017

4.2 Inter computation with NDVI, ABDI, and ABDI-I

The relationship between seasonal time serious data of ABDI, ABDI-I, and NDVI, derived from the the same satellite for the year 2011 and 2018. The data of all year was observed to consider the maximum working range of both the vegetation indices, i.e. ABDI, ABDI-I, and NDVI. The scatterplot in Figure no: 4(a) with a very high coefficient of regression and low bias that is about R^2 values of 0.867 with the high positive values and in scatterplot Figure no: 4(b) of ABDI-I with NDVI with low regression factor compare to ABDI coefficient of regression, R^2 is 0.3087 Indexes start decreasing when soil moisture becomes insufficient for crop planting. ABDI values were increasing in a positive direction, representing a good soil or vegetation

condition. On the conflicting, positive values of NDVI were coexist with negative or very low positive ABDI values, indicating dry soil condition. ABDI closely followed the trend of NDVI
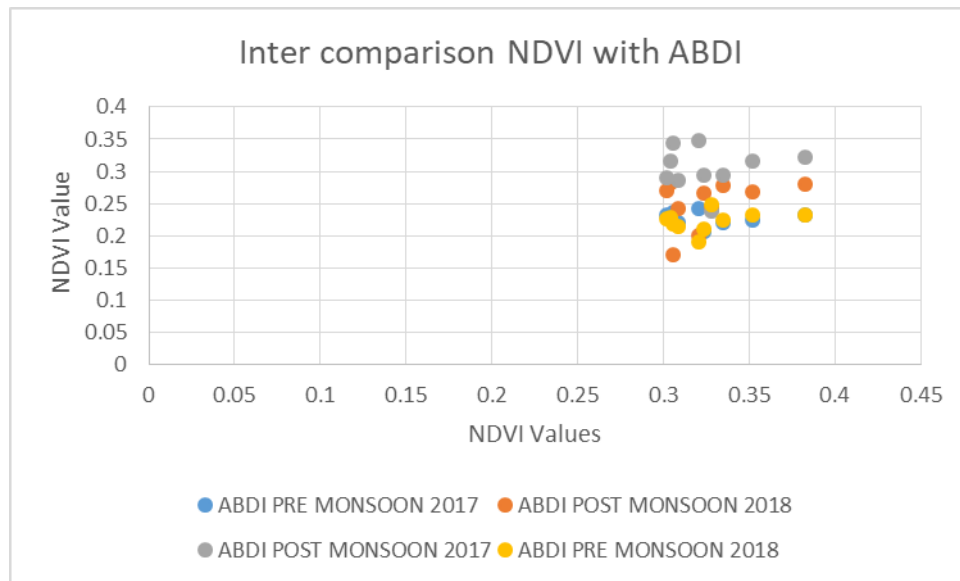

Figure no: 4 (a) Graphical representation of inter comparison NDVI with ABDI
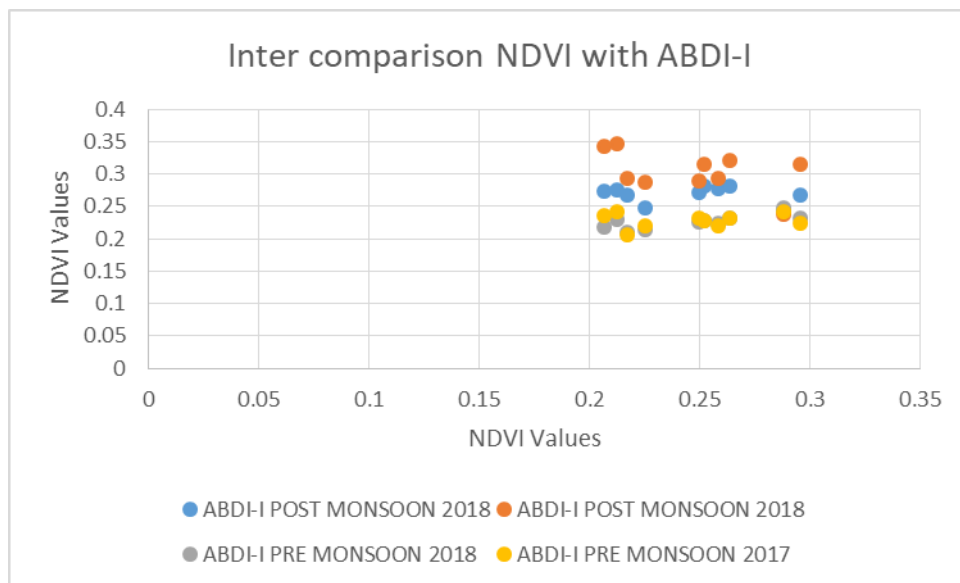

Figure no: 4 (b) Graphical representation of inter comparison NDVI with ABDI-I

5. CONCLUSION

The objective of this research is to identify the potential indices from several spectral indices for monitoring the ecological environment and their capability in drought monitoring. And an angle-based spectral index (ABDI) which works of the SWIR and NIR bands was proposed in this study. With two different wave length in SWIR region of Landsat 8(OLI). ABDI and ABDI –I indicate that a strong relationship exists among NDVI. ABDI-I will be significantly lower than that of non-drought years compare to ABDI, NDVI also decreased, but the performance is better with ABDI. Preliminary results show that NDAI and ABDI can be applied effectively for drought. Further validation studies need to be performed to determine whether the ABDI is effective in drought monitoring for different land cover types.

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