IIITB-ISRO-AICTE MAPATHON

“Precision Crop Mapping in Chintamani using QGIS”

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About:

Chintamani is a taluk headquarters in the Indian state of Karnataka, located in the heart of Mysore plateau at an average elevation of 865m (2,838 ft). The town lies in the coordinates of 13.40°N 78.06°E, covering an area of 892km^2.

Chintamani falls in the Tropical Semi-Arid type of climatic region of India. The climate here is moderately hot and dry and the taluk mostly consists of Clayey-Loam Soil. Chintamani is famous for its succulent Tomatoes, Groundnuts, Mangoes, Bananas and Silk Production.

Problem Statement:

"Precision Crop mapping in Chintamani using QGIS."

Data used:

1. Resourcesat-1/Resourcesat-2: AWiFS – Toposheets: D43R, D43X, D44M, D44S from Bhuvan for the years 2016, 2017, 2018 for the month of March.
2. District area boundaries – Mapathon website.

Methodology:

The 'normalized difference vegetation index' (**NDVI**) is a simple graphical indicator that can be used to analyze remote sensing measurements, often from a space platform, assessing whether or not the target being observed contains live green vegetation.

Using this indicator, the vegetative index for each pixel is calculated from the following equation;

NDVI = (NIR – Red) / (NIR + Red)   where, NIR = Near Infrared range.

For the AWiFS data used, this would imply:

NDVI = (Band 4 – Band 3) / (Band 4 + Band 3) [Since; Band 4: 0.77 - 0.86µm (NIR range), Band 3: 0.62 – 0.68µm (Red range)]

Thus the maps are created using the above equation and further analysed.

NDVI Difference between the years is computed to better understand the change in vegetation (increase/decrease).

The formula used: (NDVI_2 – NDVI_1) / (NDVI_1) [where; NDVI_2 = current/latest year, NDVI_1 = previous year]

QGIS Steps:

1. Import the bands obtained from the data downloaded from Bhuvan into QGIS.
2. Build a virtual raster for the bands, by creating a separate band for each input file and calculate NDVI for them by applying the formula in the raster calculator.
3. Follow the same procedure for all the toposheets of the years/data considered.

4. Once NDVI files are created for each tile and saved in respective location, open a new QGIS files and import the required tiles into it and build a virtual raster to merge all the tiles.
5. Once the image is processed, change the colour by choosing ‘single band pseudo colour’ from the layer styling option and assigning an apt range to classify and visually observe the NDVI.
6. Once the image is classified, import a vector layer consisting of the district boundary and clip the layer to the merged NDVI so obtained, to get the NDVI for the boundary area. Continue the same process for all the data considered.
7. After, computing and clipping the boundary for the area calculate the NDVI difference for the years 2017, 2016 and for the years 2018, 2017 using raster calculator to get the difference in Vegetation Index between the years.
8. From the processing tool in toolbar choose ‘raster layer unique value’ from ‘raster analysis’ to obtain the number of pixels for each NDVI, to calculate the percentage change in NDVI.
9. Print and compose the maps as per need.

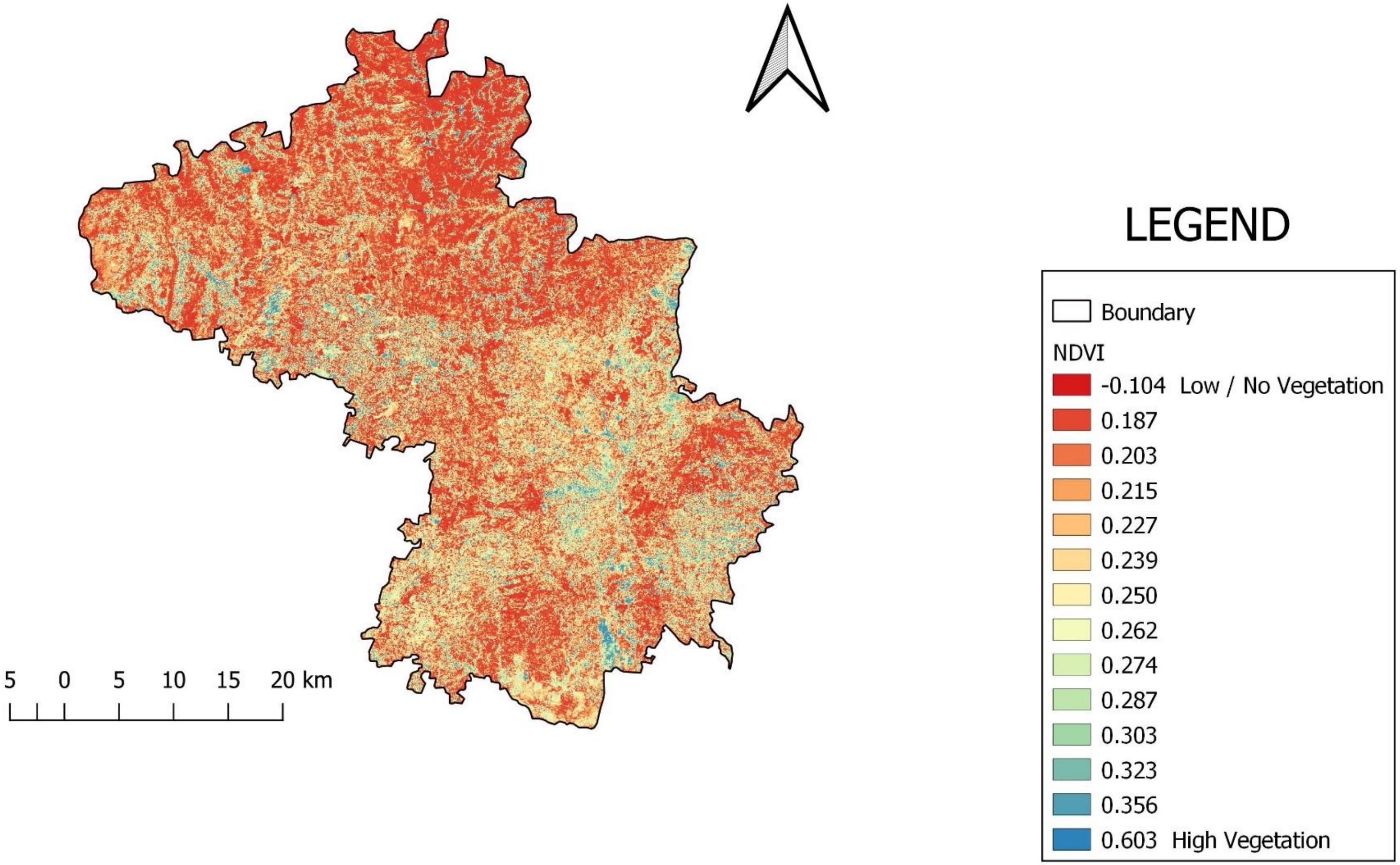
Complexities:

1. Overlapping of tiles when imported into QGIS
2. Missing/ Unavailable data for some portion in few tiles for the year 2018
3. Chintamani is part of Chikballapur district as of 2007, but as per the boundary conditions and the region in Bhuvan, it is under Kolar district. The same region of boundary conditions is used for the maps to match the administrative boundaries provided.

Application and Uses:

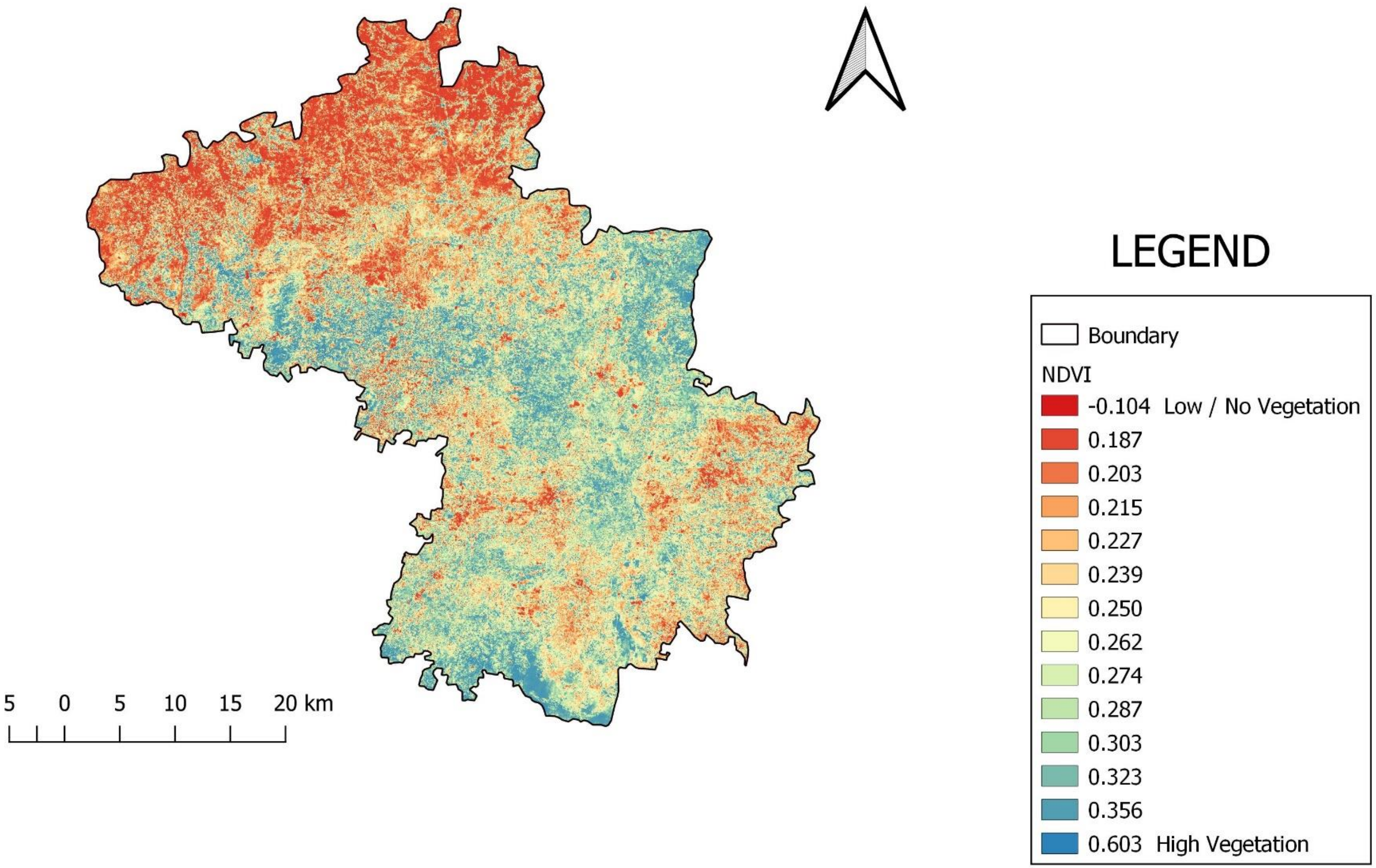
1. Precision mapping can be used to obtain better information on crop moisture level, soil nutrients levels, crop yield and much more.
2. The maps created can be used to analysed with other climate factors such as Temperature, rainfall, soil type to better understand the effects of climate change on agriculture.
3. Precision maps and techniques made available to farmers can help in better crop monitoring and maximised crop yield.
4. Exact location of stress in the field can be pin-pointed, resulting in sooner problem identification.
5. It is beneficial to both small-scale and large-scale farmers for real time monitoring of crop.

NDVI 2016

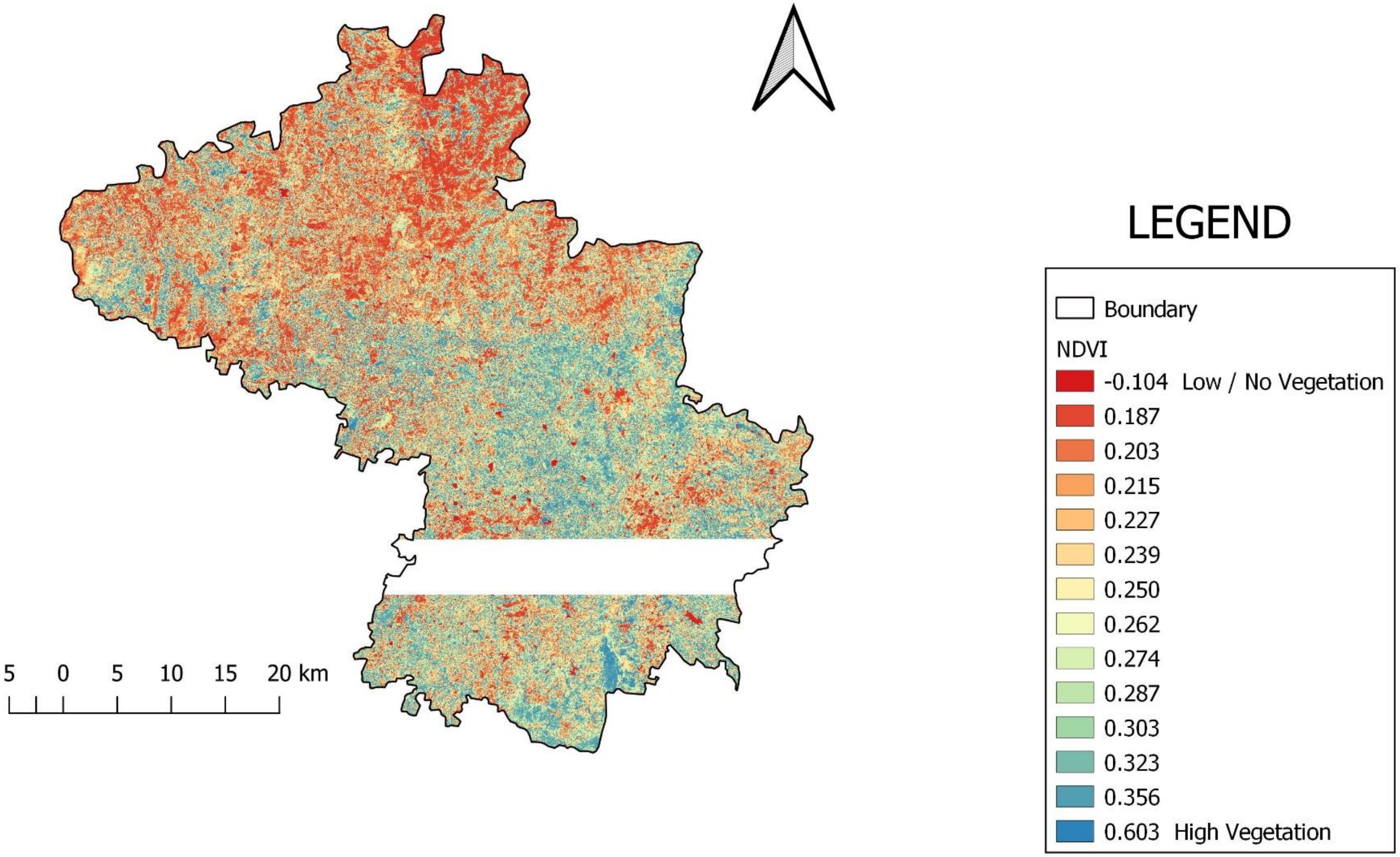


5 0 5 10 15 20 km
LEGEND
Boundary
NDVI
-0.104 Low / No Vegetation
0.187
0.203
0.215
0.227
0.239
0.250
0.262
0.274
0.287
0.303
0.323
0.356
0.603 High Vegetation

NDVI 2017


LEGEND
Boundary
NDVI
-0.104 Low / No Vegetation
0.187
0.203
0.215
0.227
0.239
0.250
0.262
0.274
0.287
0.303
0.323
0.356
0.603 High Vegetation
5 0 5 10 15 20 km

NDVI 2018



5 0 5 10 15 20 km
LEGEND
Boundary
NDVI
-0.104 Low / No Vegetation
0.187
0.203
0.215
0.227
0.239
0.250
0.262
0.274
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0.323
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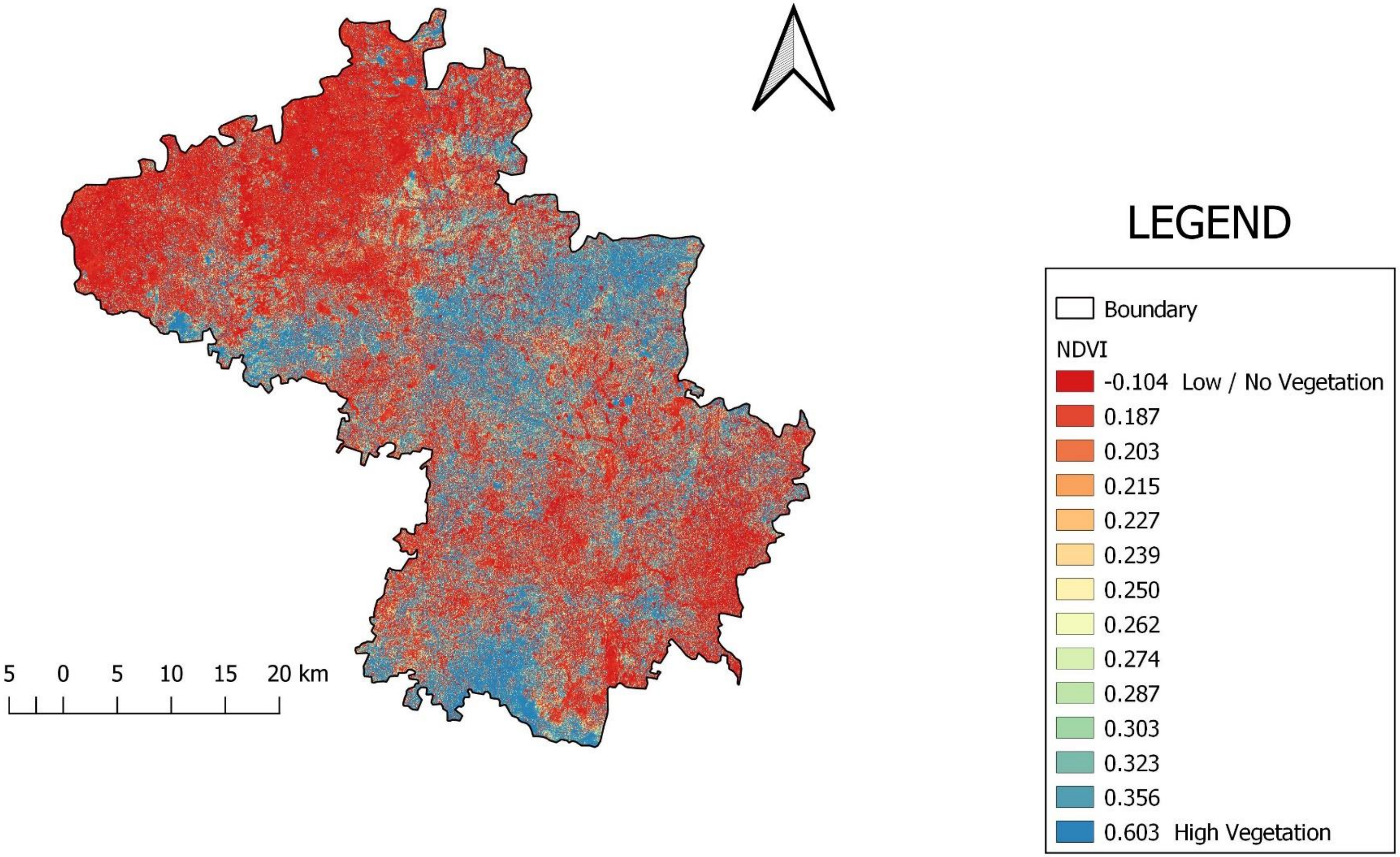
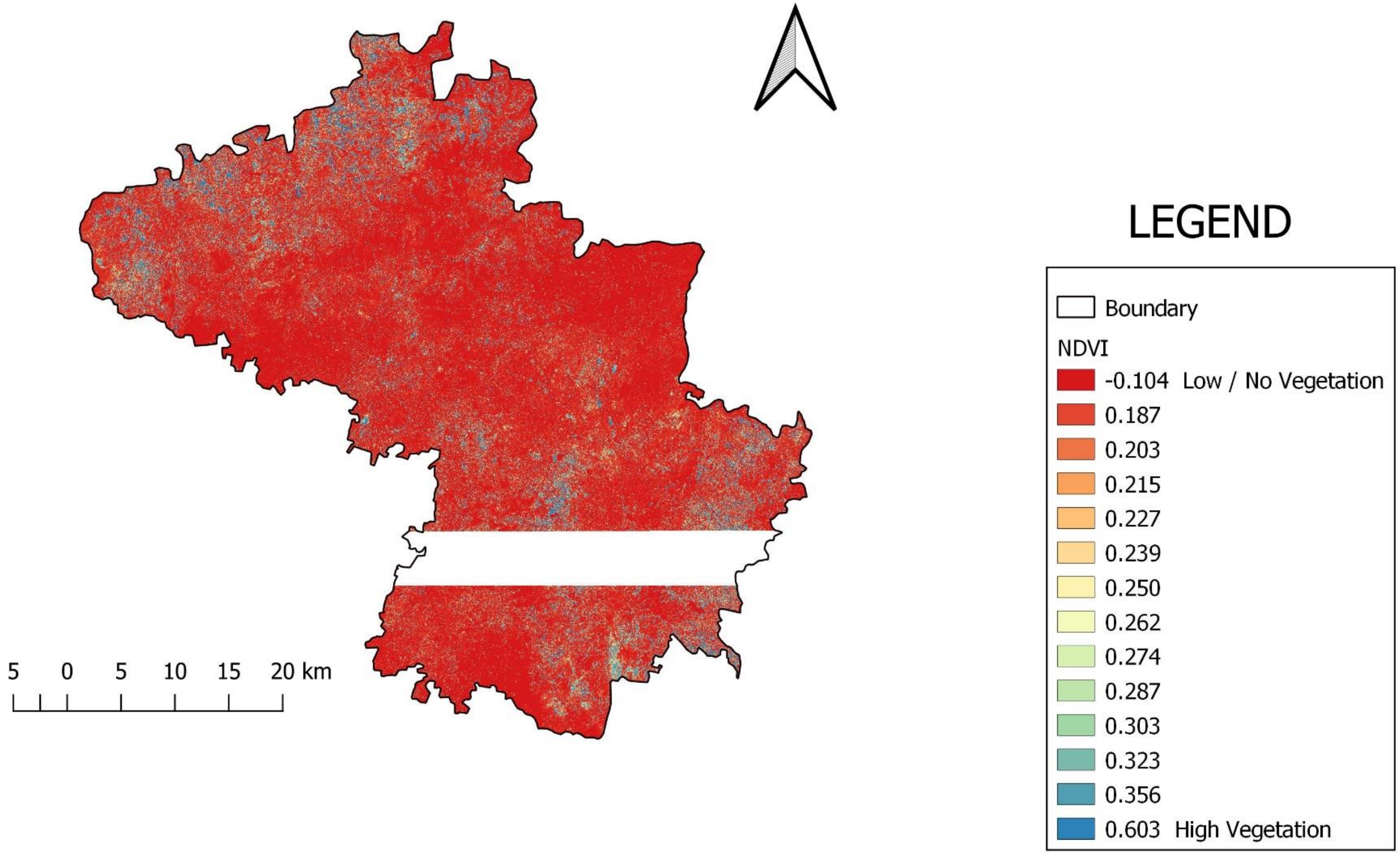
NDVI DIFFERENCE (2017 - 2016)



NDVI DIFFERENCE (2018 - 2017)



THE INTERPRETATION:

The NDVI maps above for the years 2016, 2017, 2018 and the NDVI difference between the years 2017 – 2016 and the years 2018 – 2017 are created using the ISRO data obtained from Bhuvan's free open data base from the Resourcesat-1/Resourcesat-2 AWiFS data for the tile numbers: D43X, D43R, D44M, D44S using the standard NDVI formula as mentioned in the methodology. On performance of raster calculation and for NDVI and obtained pixel count for NDVI of each year, the following percentage of NDVI was obtained for the range.

NDVI Range (%) → Year ↓	Less than -0.104	-0.104 to 0.250	0.250 to 0.603	More than 0.603
March, 2016	0.068	74.233	25.69	0.00044
March, 2017	0.0039	45.91	54.07	0.0095
March, 2018	0.19	49.51	50.24	0.051

These percentages for the NDVI indicate a significant change between the years.
For instance when taken for the years 2017 and 2016, for the NDVI range of 0.250 to 0.603 there is an increase of around 28% indicating improvement in vegetation of the area. At, the same time for the NDVI range of -0.104 to 0.250 there is a decrease of 28% which is reflected in the range of 0.250 to 0.603 tallying the claim of increased vegetation. Similarly, the same is reflected for the ranges less than -0.104 and more than 0.603 by a decrease of 0.06% and increase of 0.009% respectively.
In the same manner, for the years 2018 and 2017, for the NDVI range of -0.104 to 0.250, there is an increase of around 3%, indicating decrease in vegetated areas, as compared to 2017 and increase in the range of less than -0.104 by 0.18% displaying more no vegetation/ barren zones. Similarly, there's a decrease of 3% in 0.250 to 0.603 range and increase of around 0.042% for more than 0.603 range displaying dense vegetation in the same year as compared to 2017.
These changes can help in analysing a lot of factors influencing agriculture and help in understanding the various factors influencing it. For instance when considering the increase in vegetation in 2017, as compared to 2016 could indicate more suitable climate for growth, better circumstances to farmers, availability of water due to better monsoon's (chintamani being water stressed region) etc. Whereas, decrease in vegetation in 2018(ignoring the unavailability of data) could indicate delayed monsoon, bad climate leading to bad crop growth, high temperatures (2018 being one of warmest years in history) unavailability of water and so on.

Thus, this way Precision mapping could help in better analysis of agriculture and the planet by helping in better understanding of various factors otherwise not noticeable and provide in better solutions to meet the needs and improve the overall situation.