NDVI BASED STUDY FOR ASSESSING AGRICULTURAL ACTIVITIES IN VARUNA RIVER BASIN

Ankita Verma[1], Dr. Sudhakar Shukla[2]

[1]*M. tech Student, Remote Sensing Applications Centre – U.P., India*
[2]*Scientist – SE, Head, School of Geoinformatics, Remote Sensing Applications Centre – U.P., India*

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Abstract - *Rivers are natures benefactions to mankind without which life wouldn't have been possible. It sustains life, not only mankind but also flora and fauna. A river is inherently most important commodity in our lives. It carries the essence of a place, its history and its cultural heritage besides sustaining important systems such as agriculture, transportation, pisciculture, industries, recreation and many others. They are crucial economic assets of any country as they aid in the production of electricity, act as a chief transport medium, helps on trading purposes, attract tourism, and also support the ecosystem by providing assistance in the functioning of various natural phenomenon like water cycle. Climate change may have significant impact on life and the natural resources. It poses a significant economic and environment risk worldwide (Setegen et al., 2011). The drought condition prevailing in the basin which has been witnessed by the analysis carried out over a decade (2009-2018) using SOI toposheets and satellite borne data (Landsat 4&5 and Landsat 8). The changes of NDVI in basinal area given an idea of different growth patterns of vegetation over a period of time.*

Key Words*:* Climate Change, NDVI, Satellite Borne Data, Drought

1.INTRODUCTION

A river is inherently most important commodity in our lives. It carries the essence of a place, its history and its cultural heritage besides sustaining important systems such as agriculture, transportation, pisciculture, industries, recreation and many others. Varuna river has been selected for the study as it has undergone severe dryness. The river is currently facing tremendous pressure due to encroachments, discharge of untreated domestic and industrial waste, dumping of solid waste and illegal diversion of water. However, the river remains less examined with regard to important base-line information.

The change detection frameworks use multi-temporal datasets to qualitatively analyze the temporal effects of phenomena and quantify the changes (Singh, 1989). The RS data has become a major source for temporal change detection studies because of its high temporal frequency, digital format suitable for computation, synoptic view, and wider selection of spatial and spectral resolutions (Lunetta, 2004). The classification process aims to group all pixels in a digital image into one of the different classes/themes. This grouped data is used to generate thematic maps of the basin providing NDVI in an image. Multi-spectral data is easiest to use in conducting the classification, as normal. However, the current spectral pattern for each pixel within the data is used as the numerical basis for categorization (Lillesand et al 2000).

The general objectives of change detection in Remote Sensing include identifying the geographical location and type of changes, quantifying the changes, and assessing the accuracy of change detection results (Coppin et al., 2004; Im & Jensen, 2005). According to (Karbassi et,al) rivers are one of the basic resources of surface water and have Ecologic and notable economic value and its hydro chemical composition and the quality of water have always been influenced by natural (Geologic) and unnatural (Pollution) factors (Karbassi and Pazoki, 2015).

2. DESCRIPTION OF THE STUDY AREA

The Varuna river is one of the floodplain tributaries of the river Ganga. It originates at 25°27′N, 82°18′E, near Dain taal and Umran taal, Phulpur in Allahabad district and its flow is in east-to-southeast for about 100 km, and joins the Ganga at 25°19′46″N, 83°02′40″E, just downstream of Varanasi city which is one of the oldest towns of Uttar Pradesh state in India and a prominent industrial, agricultural town, obliging the necessities of several millions of people. River Morwa & River Basuhi meets River Varuna at different locations 25°23'38.25"N & 83°41'36.83"E and 25°23'35.02"N & 82°37'.37"E. Tropical monsoonal climate is knowledgeable about this region. Pre-Monsoon, Monsoon, and post-Monsoon are the major types of seasons in the region. The ambient mean temperature was lowest in December (9.9 to 26.1 °C) and highest in May-June (27.8 to 40.9 °C). The rainy months remained warm and wet, with humidity reaching close to saturation. Location of the study area is shown in Fig – 1.

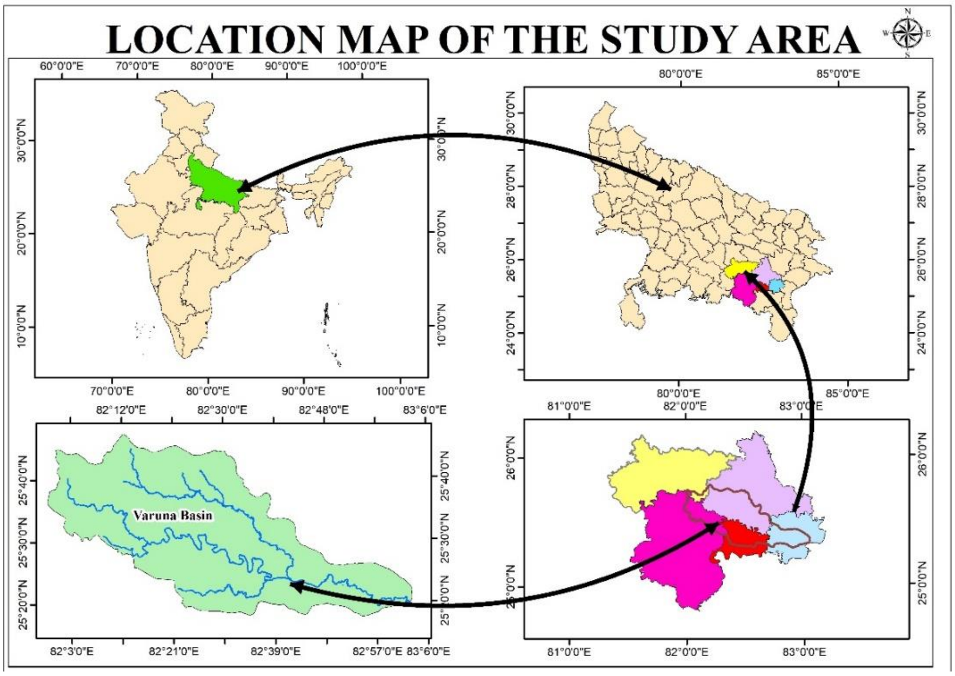


Fig – 1: Location map of Varuna River Basin

Base features of Varuna River basin are depicted in fig – 2.

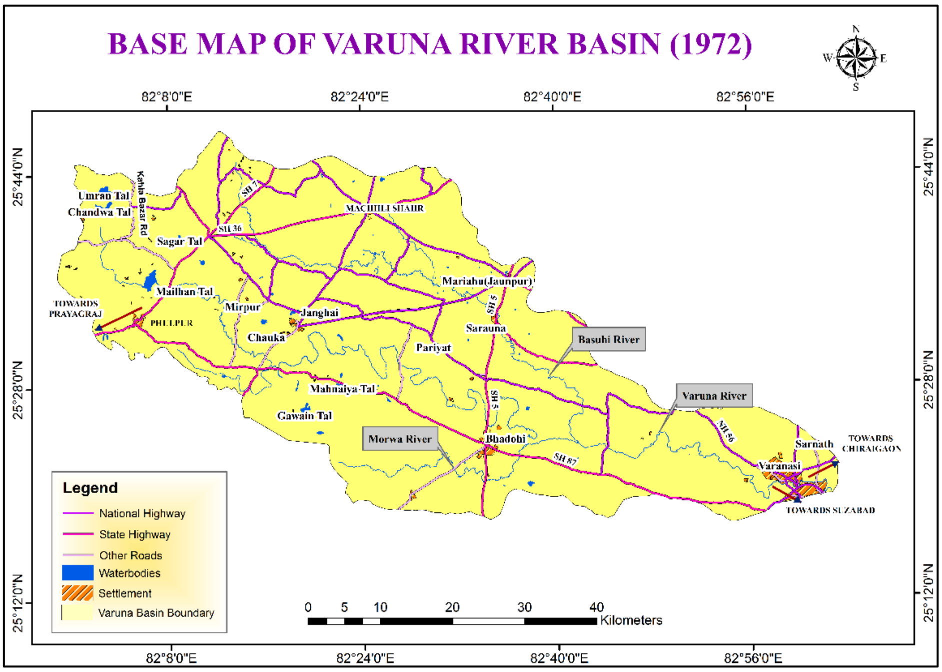


Fig – 2: Base map of Varuna River Basin

Uttar Pradesh has been divided into nine Agro-climatic zones on the basis of soil types and rainfall (Ghosh, 1991). Where of Varuna River basin area is coved under two climatic zone which is shown in fig – 3.

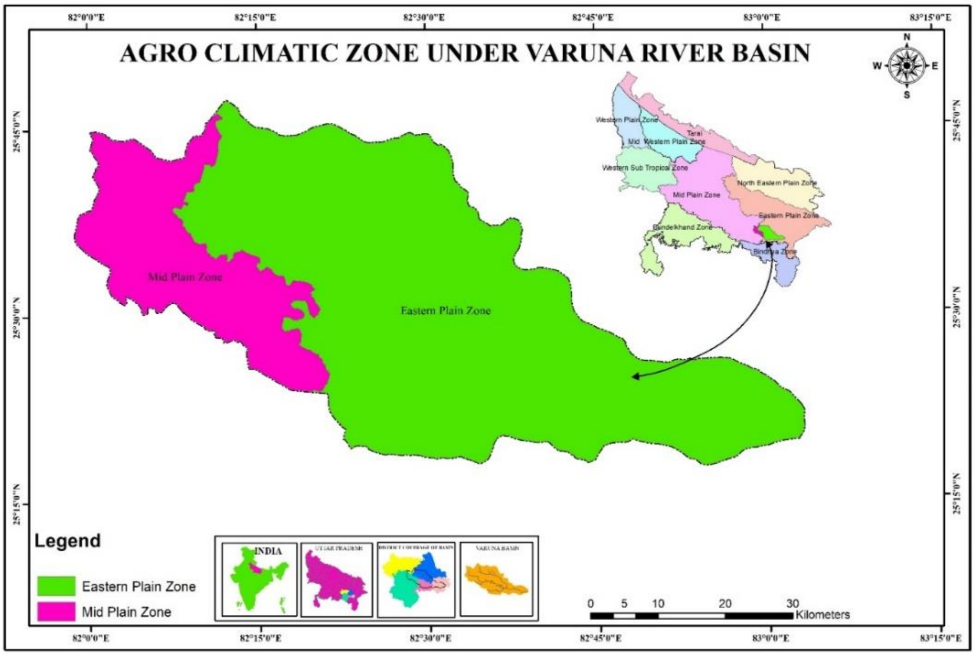


Fig – 3: Agroclimatic zones map of Varuna River Basin

3. DATA USED AND METHODOLOGY

3.1 Data used

For this study, the satellite multi-temporal images of Landsat 4–5 Thematic Mapper (TM), and Landsat 8 Operational Land Imager (OLI)/Thermal Infrared Sensor (TIRS) for years 2009 - 2018.

For the analysis Satellite images free from cloud cover were selected. Basin boundary procured using SOI Toposheet and SRTM DEM with 30-meter resolution. Table - 1 and 2 give details of the Satellite and toposheets data used for NDVI.

Sr.No.	**Satellite-sensor**	**Path-Row**
1	Landsat 4-5-TM	142/42 143/42
2	Landsat 8-OLI TIRS	142/43 143/42

Table – 1 Details of Satellite Data used

S.NO.	TOPOSHEET NUMBER
1	63G/14
2	63K/2
3	63K/6
4	63K/10
5	63K/3
6	63K/7
7	63K/11
8	63K/15
9	63O/3

10	63K/1

Table – 2 Details of Toposheets

3.2 METHODOLOGY

Normalized Difference Vegetation Index (NDVI) is based on the concept that vegetation vigour which is an indicator of water availability or lack thereof. The lowering of the vegetation index will indicate moisture stress in vegetation, resulting to drought like conditions in basin. Following methodology has been adopted to furnish the present study, represented in the flowchart as shown in Chart - 1

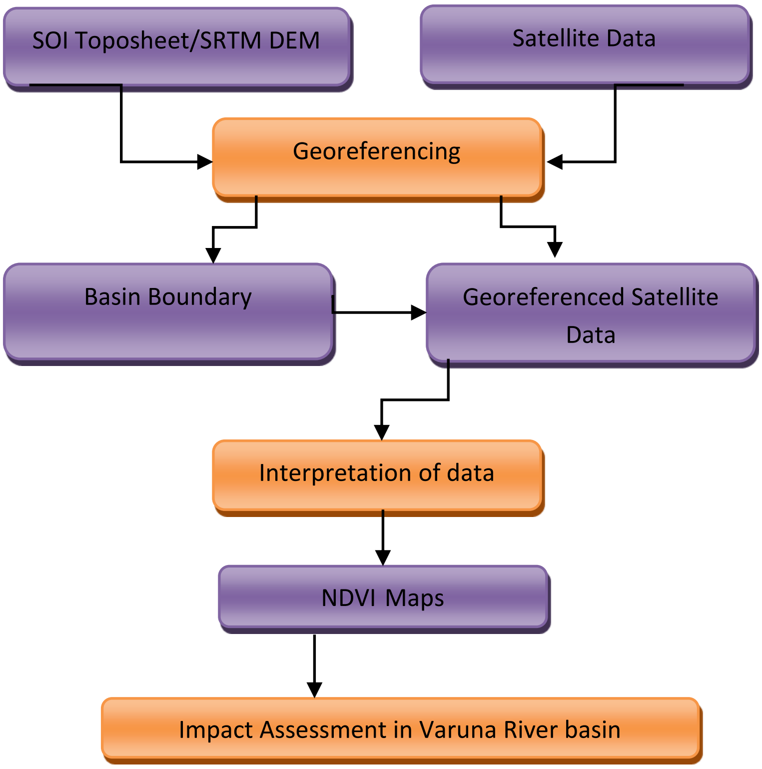
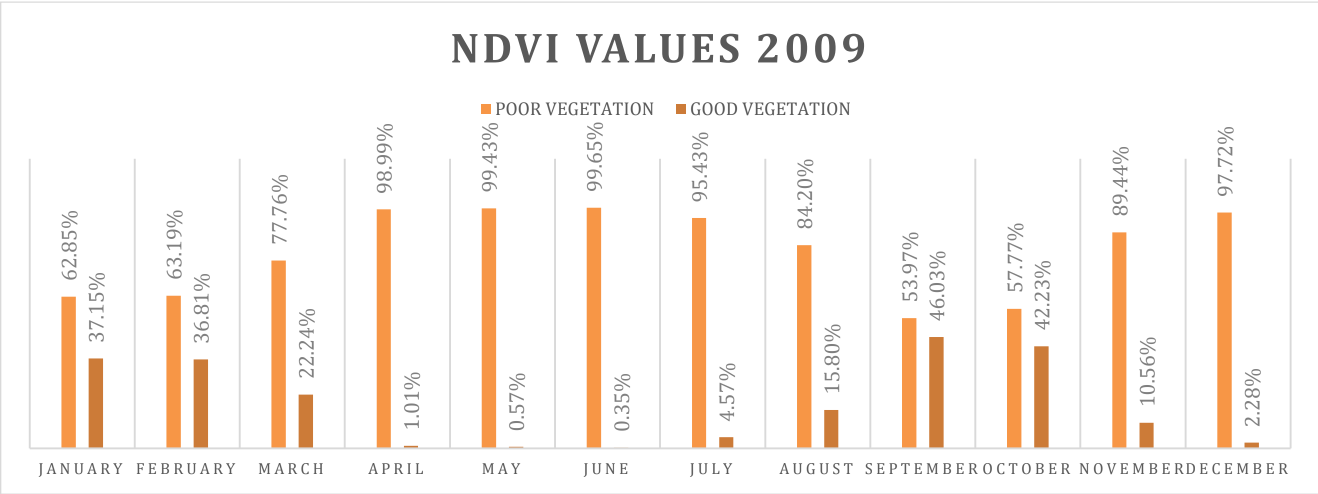


Chart - 1 Research methodology of the study

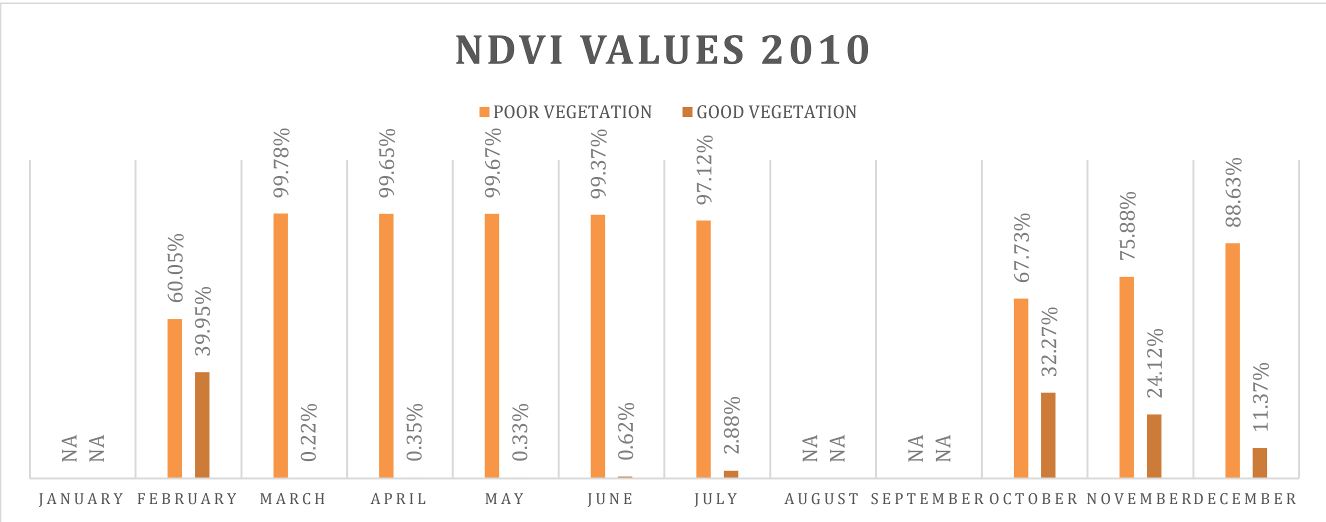
3. RESULTS

In the lower and middle catchment of the river basin, vegetation dynamics is crucial for the ecological stability of the of complete watershed and is indicated by Normalized Difference Vegetation Index. The main vegetation types were grassland and agricultural land. A positive regime of NDVI is seen in the central western part of the basin. While a negative of NDVI values can be seen in eastern part of basin due to the areas covered with industrial waste materials, settlements, industries, agricultural practices, barren lands.

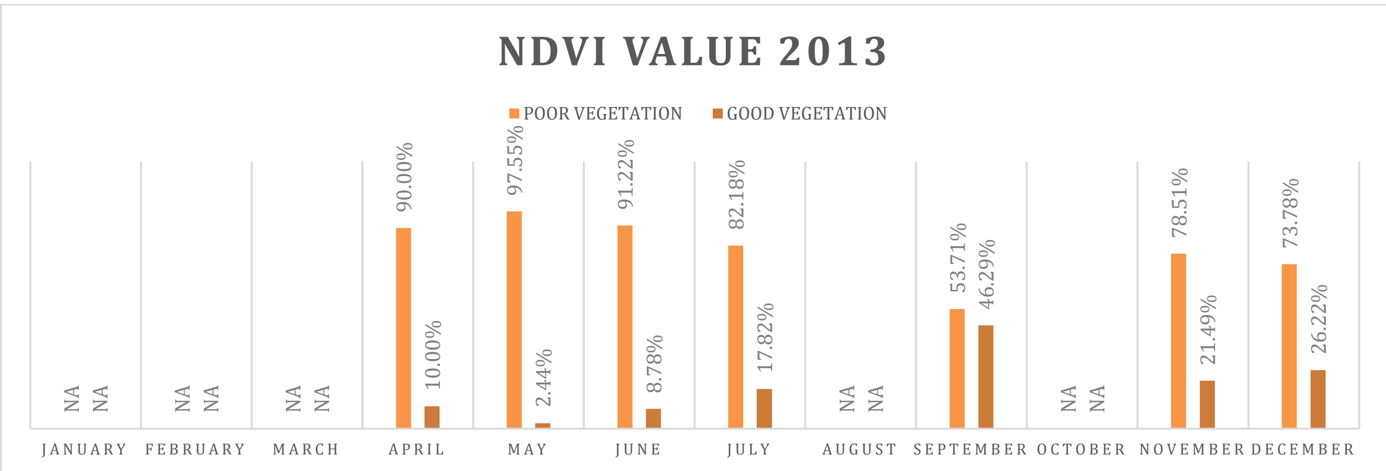
The graphical representation and NDVI maps on monthly basis in Varuna river basin can be seen in fig 4 and fig 5 between 2009 - 2018 where an increasing fashion of poor vegetation can be seen before monsoon arrives.


NDVI VALUES 2009
POOR VEGETATION
GOOD VEGETATION
62.85%
37.15%
63.19%
36.81%
77.76%
22.24%
98.99%
1.01%
99.43%
0.57%
99.65%
0.35%
95.43%
4.57%
84.20%
15.80%
53.97%
46.03%
57.77%
42.23%
89.44%
10.56%
97.72%
2.28%
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

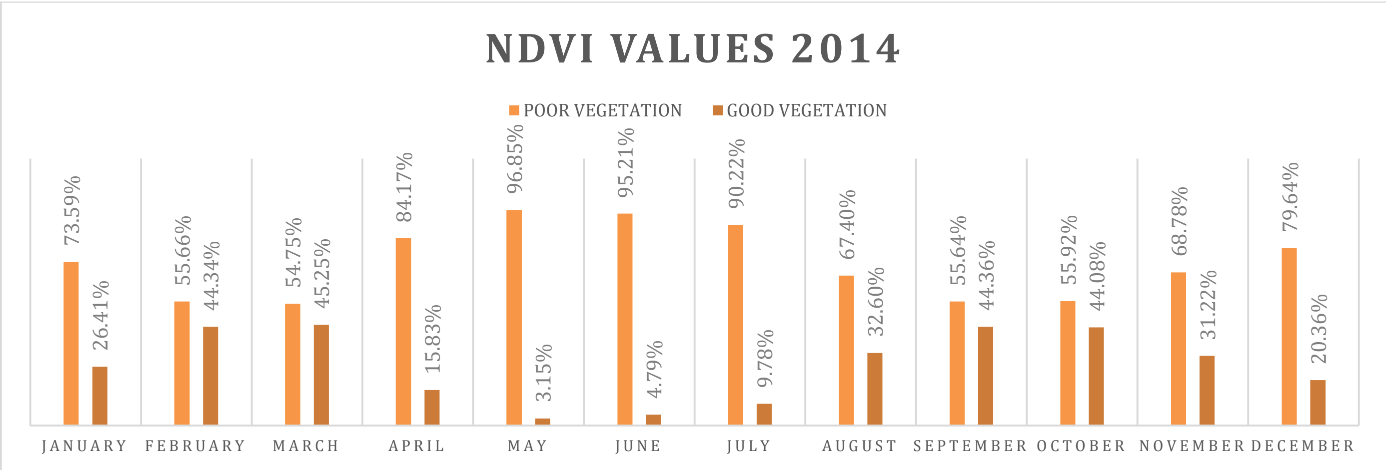
(a)


NDVI VALUES 2010
POOR VEGETATION
GOOD VEGETATION
NA
NA
60.05%
39.95%
99.78%
0.22%
99.65%
0.35%
99.67%
0.33%
99.37%
0.62%
97.12%
2.88%
NA
NA
NA
NA
67.73%
32.27%
75.88%
24.12%
88.63%
11.37%
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

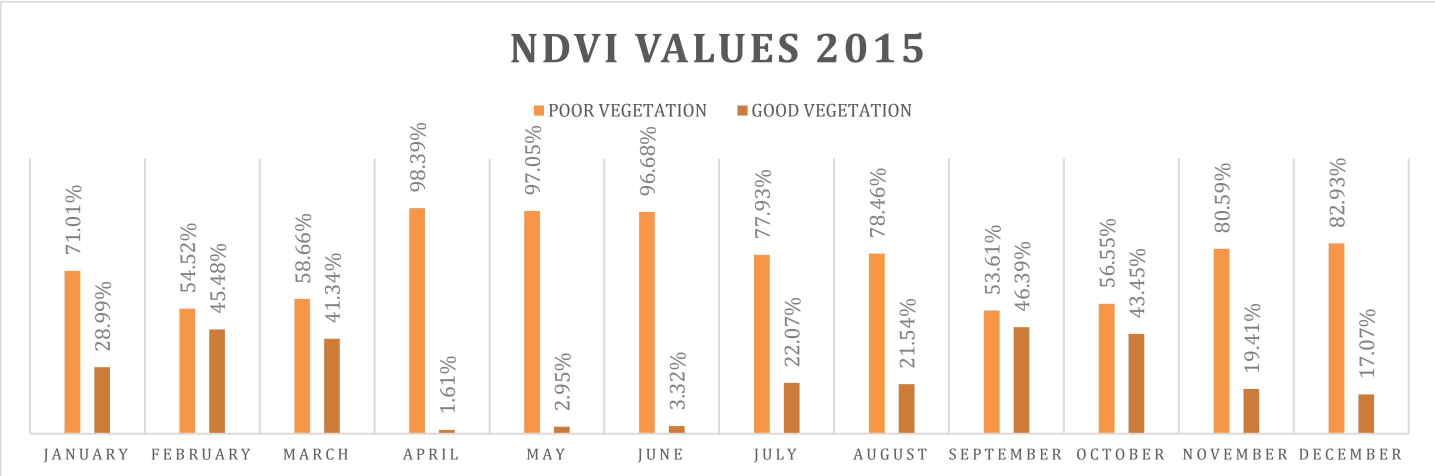
(b)


NDVI VALUE 2013
POOR VEGETATION
GOOD VEGETATION
NA
NA
NA
NA
NA
NA
90.00%
10.00%
97.55%
2.44%
91.22%
8.78%
82.18%
17.82%
NA
NA
53.71%
46.29%
NA
NA
78.51%
21.49%
73.78%
26.22%
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

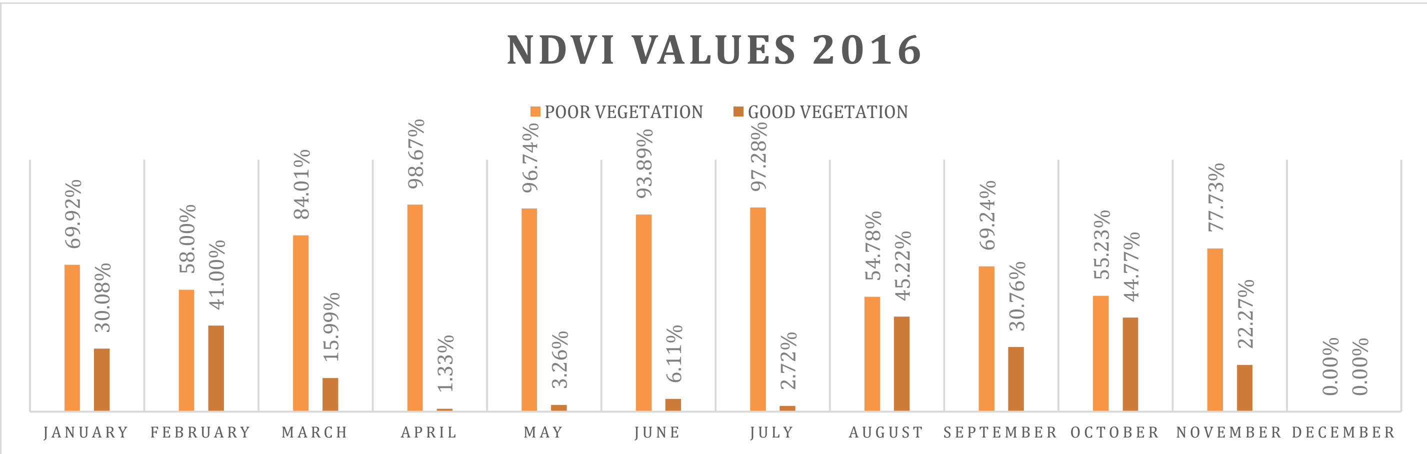
(c)


NDVI VALUES 2014
POOR VEGETATION
GOOD VEGETATION
73.59%
26.41%
55.66%
44.34%
54.75%
45.25%
84.17%
15.83%
96.85%
3.15%
95.21%
4.79%
90.22%
9.78%
67.40%
32.60%
55.64%
44.36%
55.92%
44.08%
68.78%
31.22%
79.64%
20.36%
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

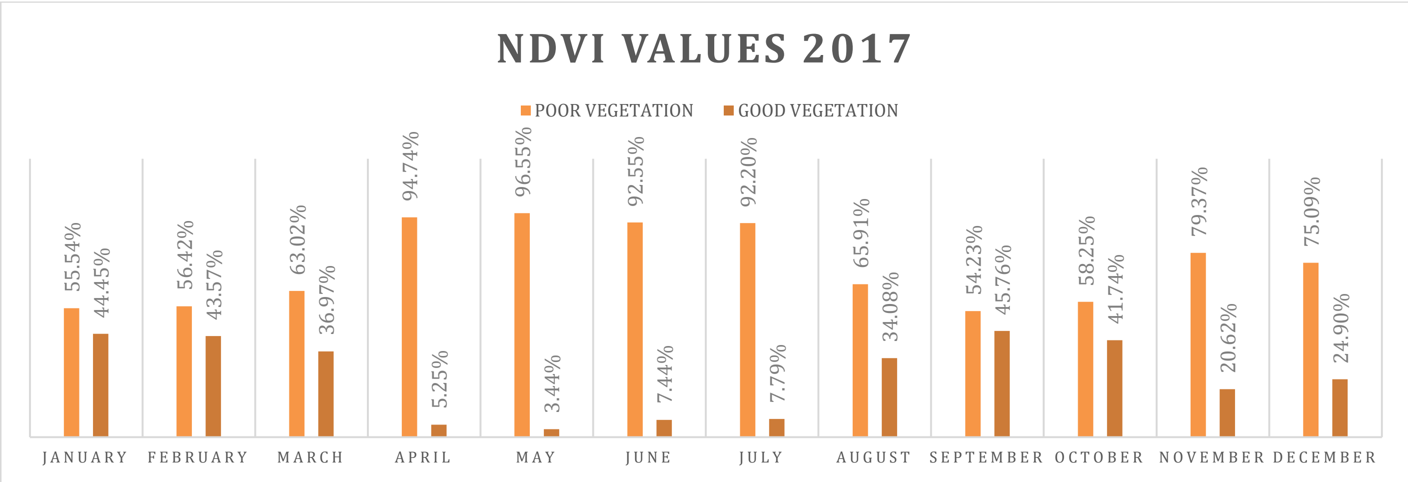
(d)


NDVI VALUES 2015
POOR VEGETATION
GOOD VEGETATION
71.01%
28.99%
54.52%
45.48%
58.66%
41.34%
98.39%
1.61%
97.05%
2.95%
96.68%
3.32%
77.93%
22.07%
78.46%
21.54%
53.61%
46.39%
56.55%
43.45%
80.59%
19.41%
82.93%
17.07%
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

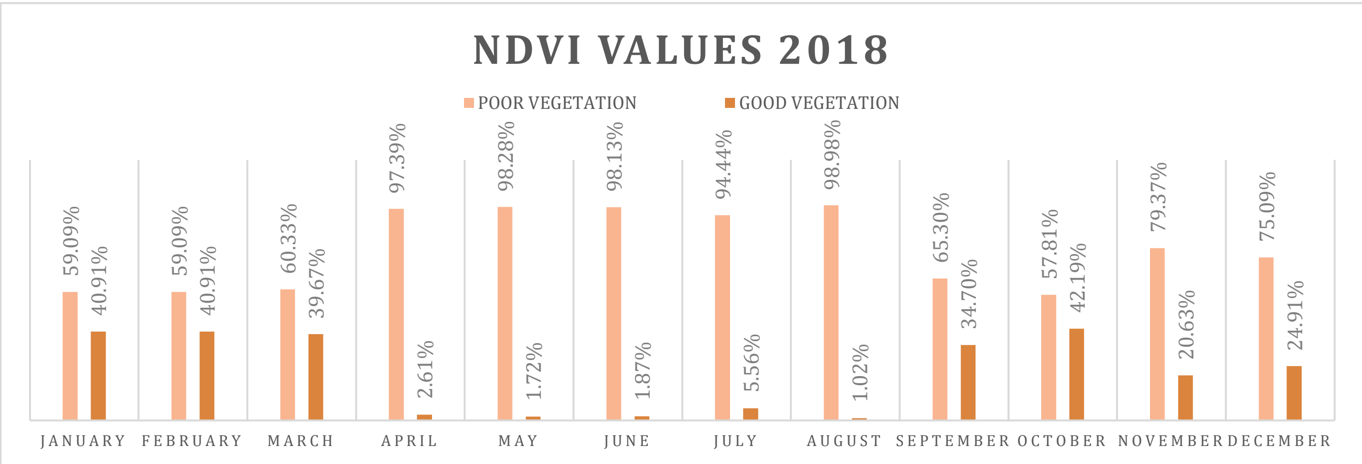
(e)


NDVI VALUES 2016
POOR VEGETATION
GOOD VEGETATION
69.92%
30.08%
58.00%
41.00%
84.01%
15.99%
98.67%
1.33%
96.74%
3.26%
93.89%
6.11%
97.28%
2.72%
54.78%
45.22%
69.24%
30.76%
55.23%
44.77%
77.73%
22.27%
0.00%
0.00%
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

(f)



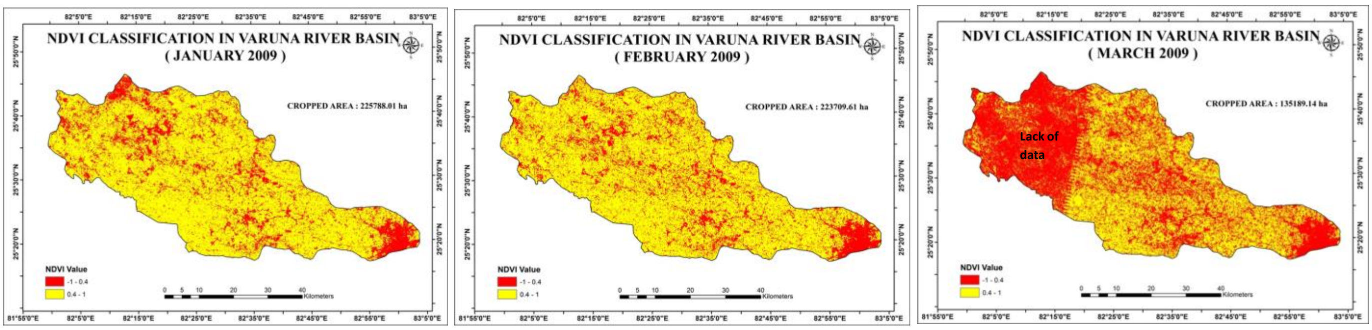
(g)



(h)

Fig – 4 Graphical representations of area of NDVI (a) (b) (c) (d) (e) (f) (g) (h)

NDVI maps of Varuna river for year 2009 to 2018 can be seen in fig - 5 (a) (b) (c) (d) (e) (f) (g) (h) (i)



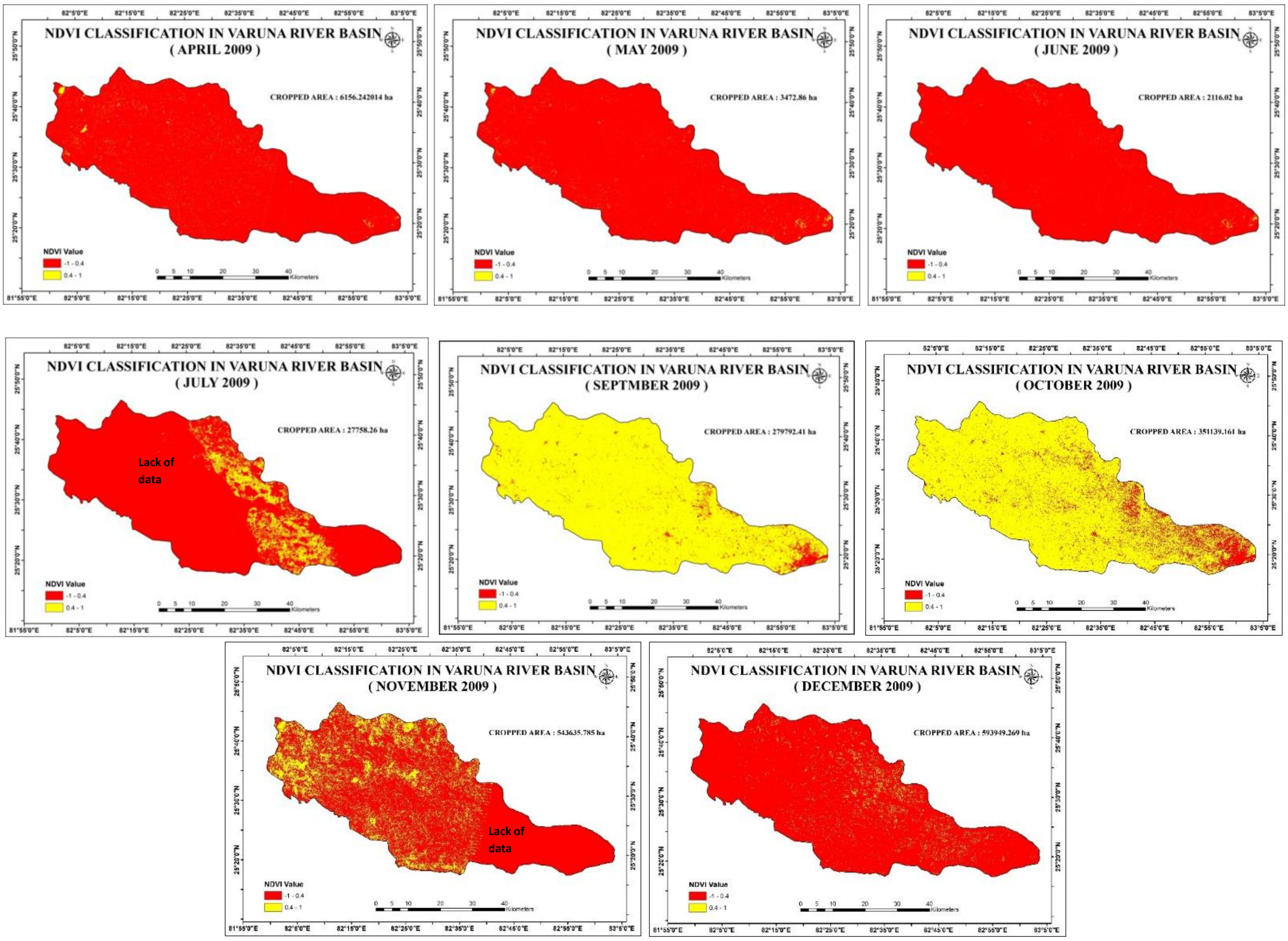


Fig – 5 (a) NDVI of Varuna river basin (2009)

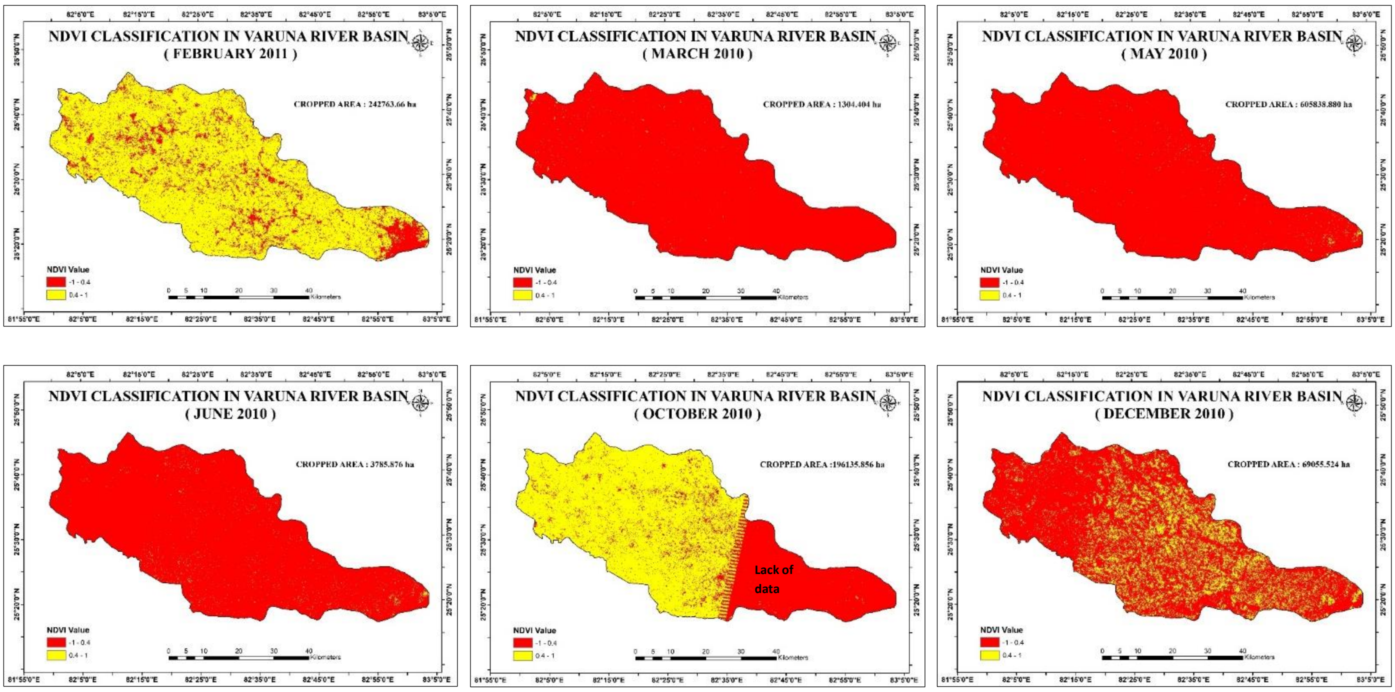


Fig – 5 (b) NDVI of Varuna river basin (2010)

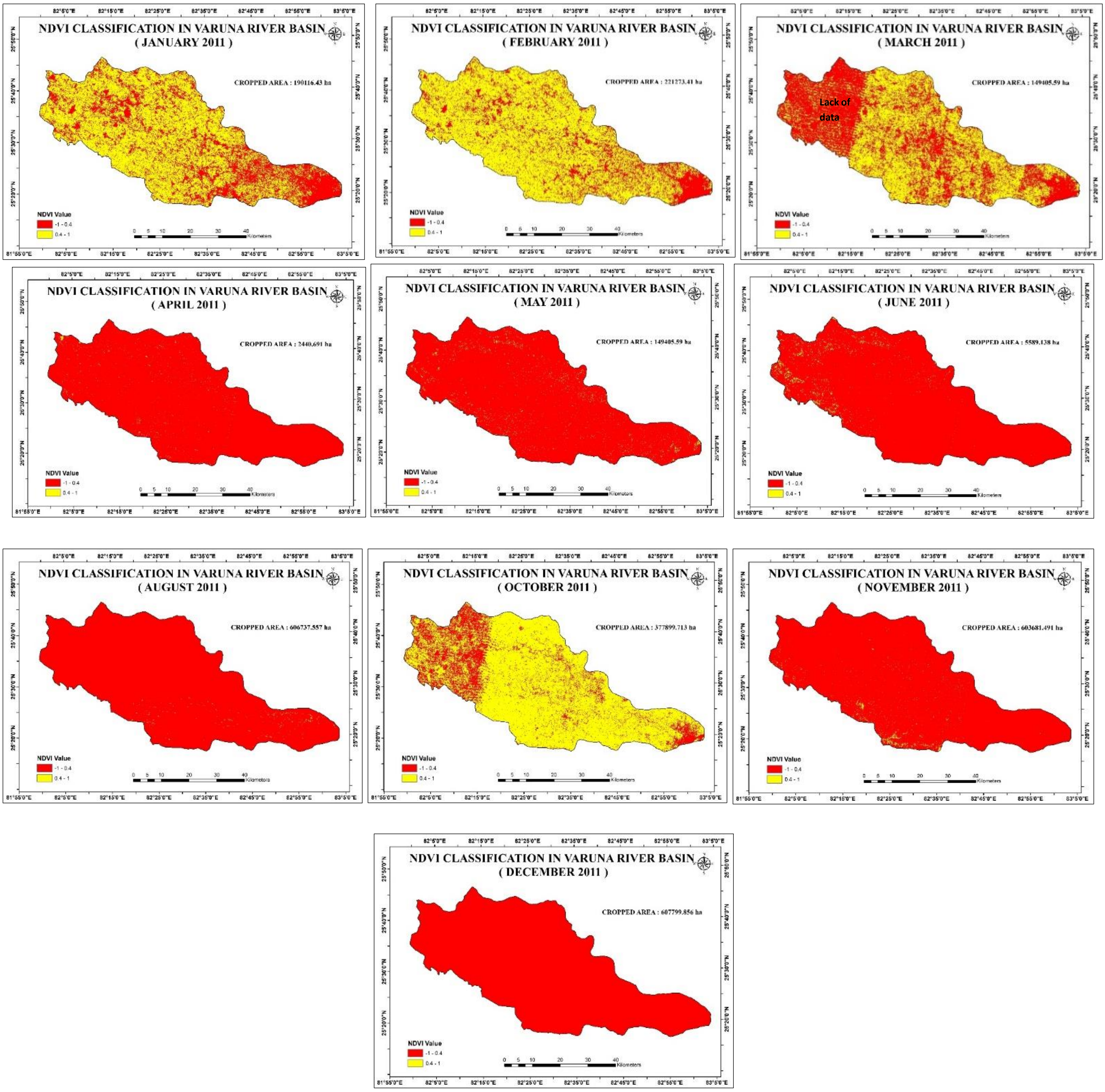
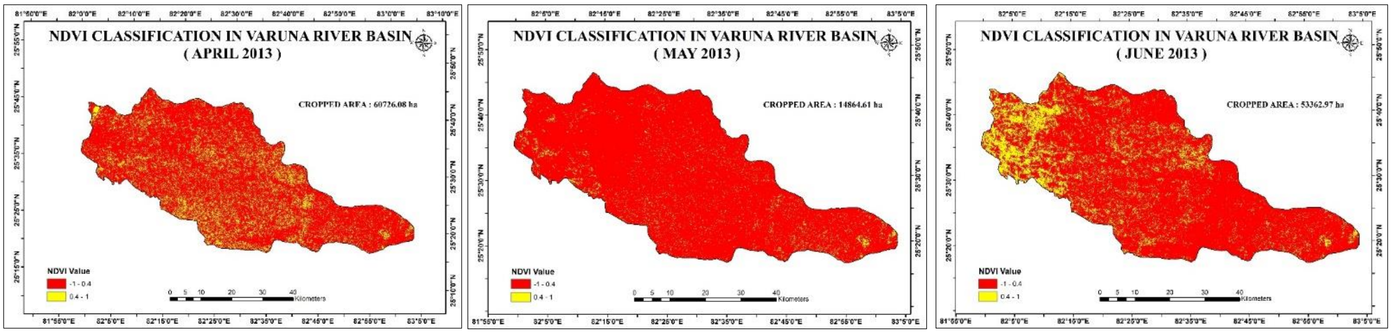


Fig – 5 (c) NDVI of Varuna river basin (2011)



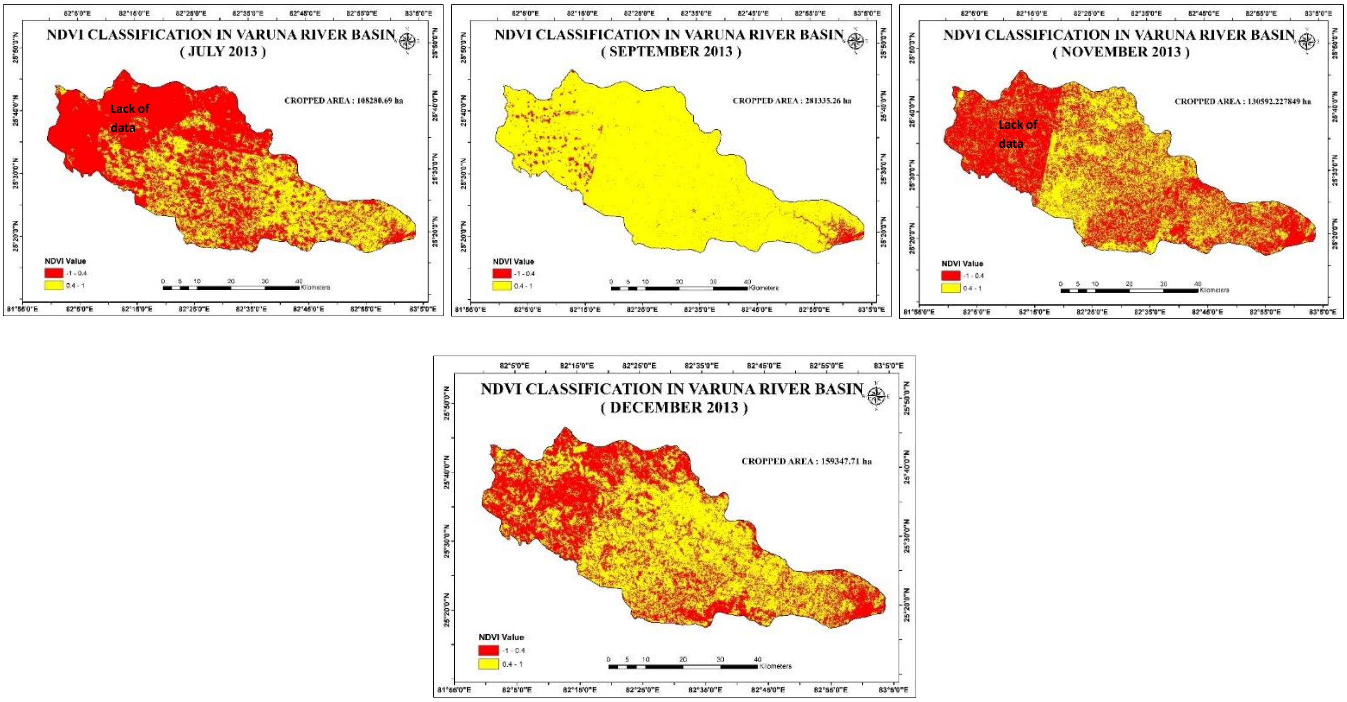
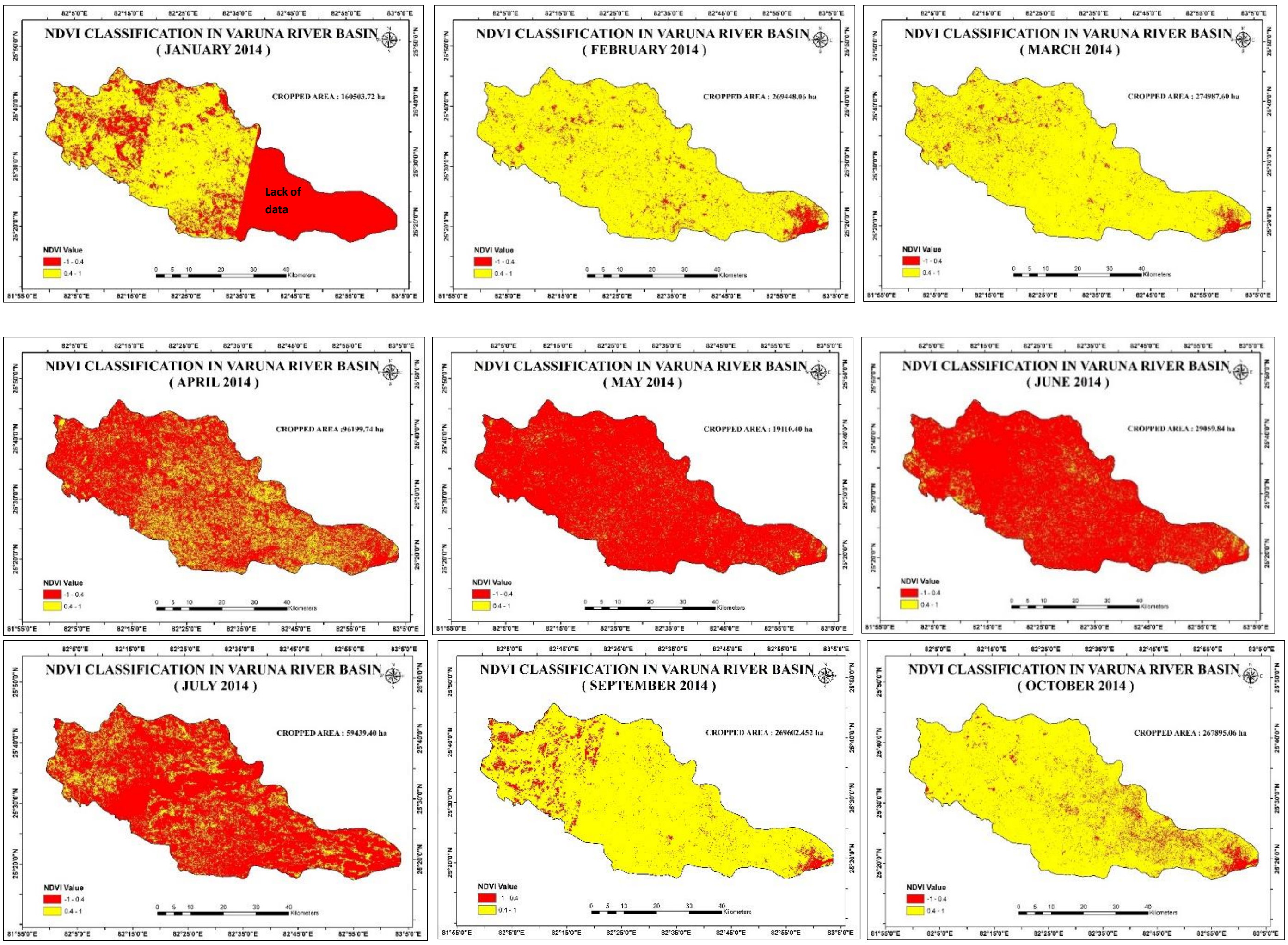


Fig – 5 (d) NDVI of Varuna river basin (2013)



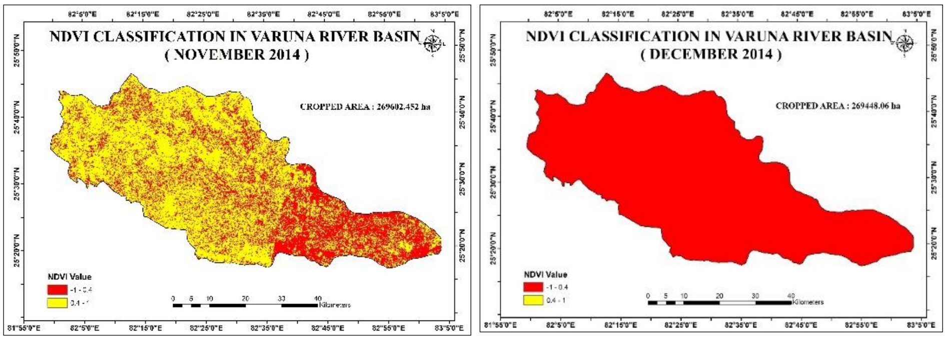
CC


Fig – 5 (e) NDVI of Varuna river basin (2014)

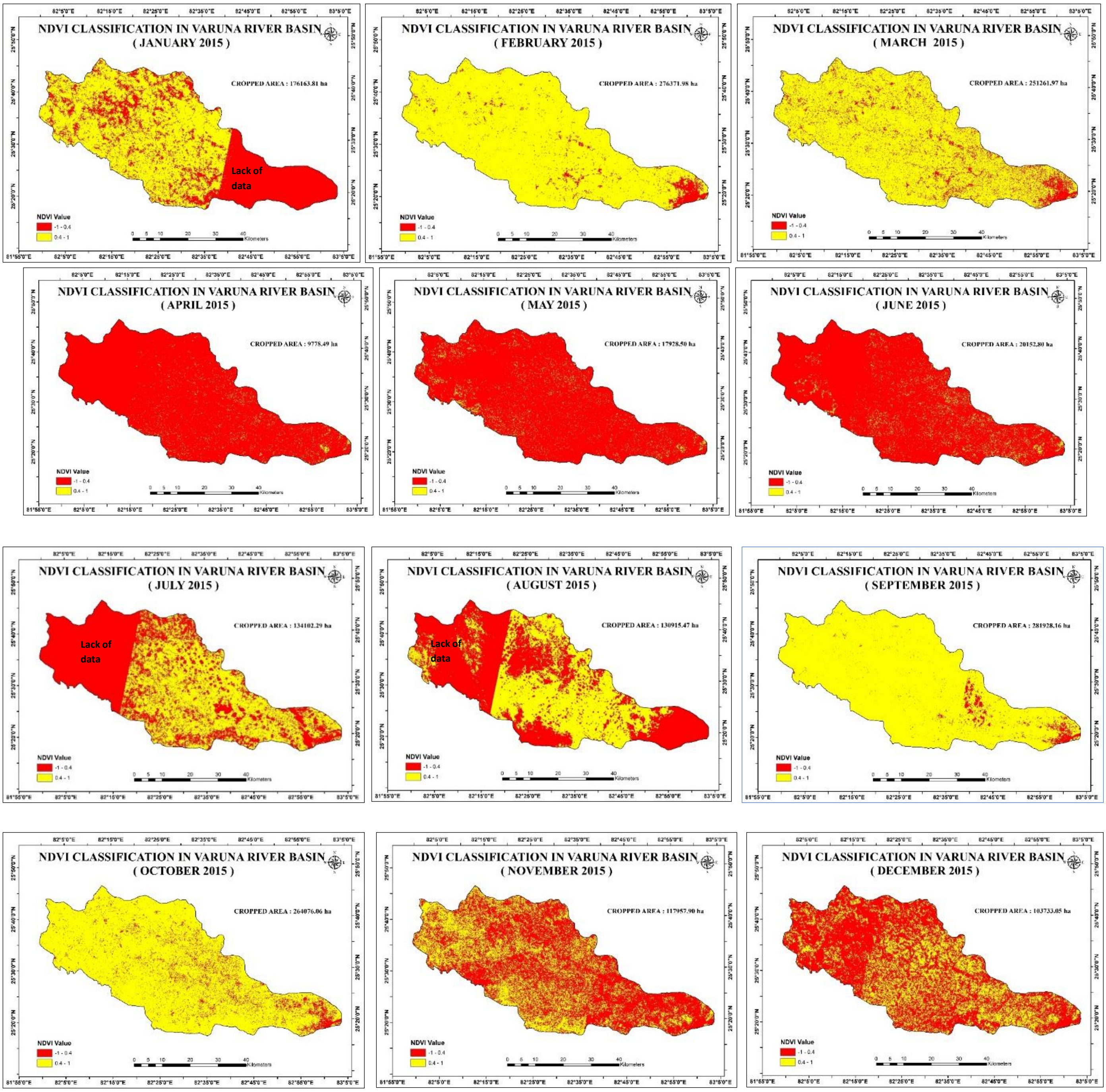


Fig – 5 (f) NDVI of Varuna river basin (2015)

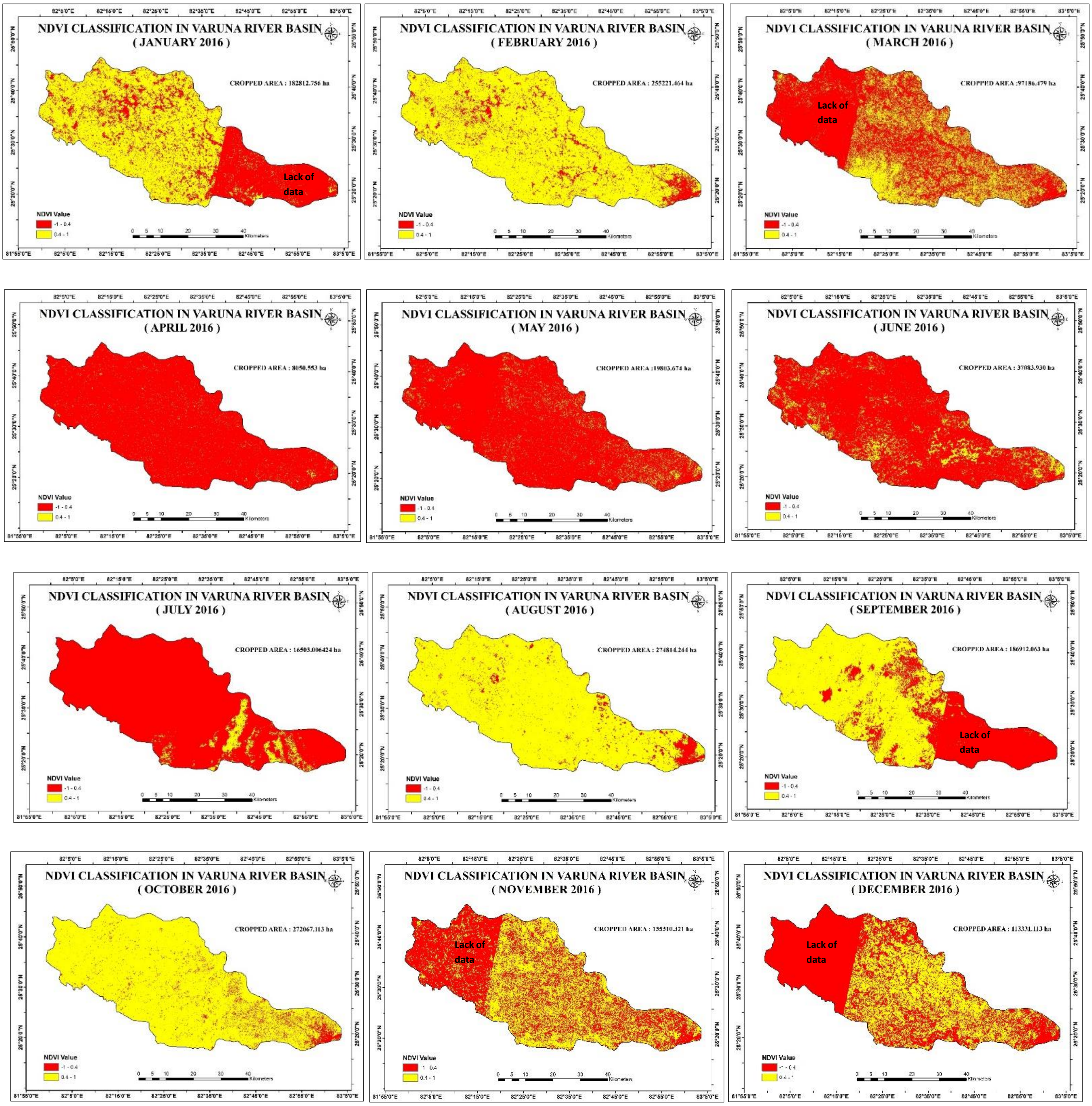
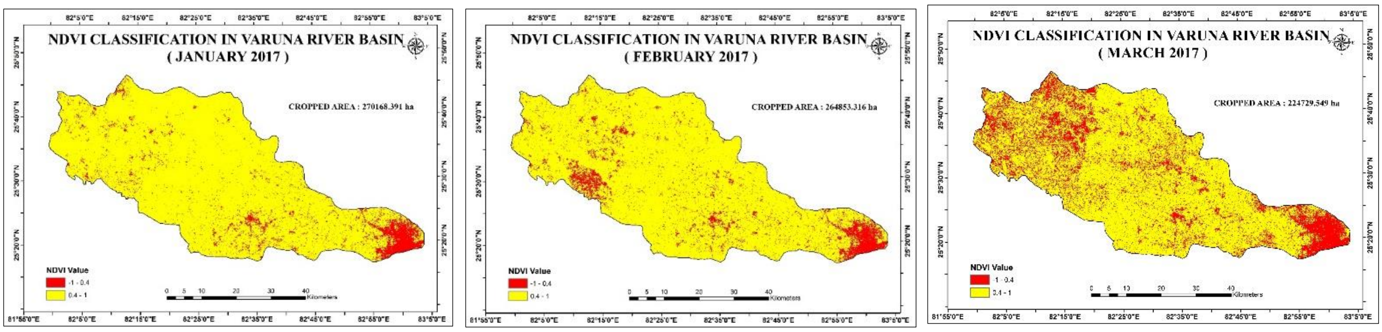


Fig – 5 (g) NDVI of Varuna river basin (2016)



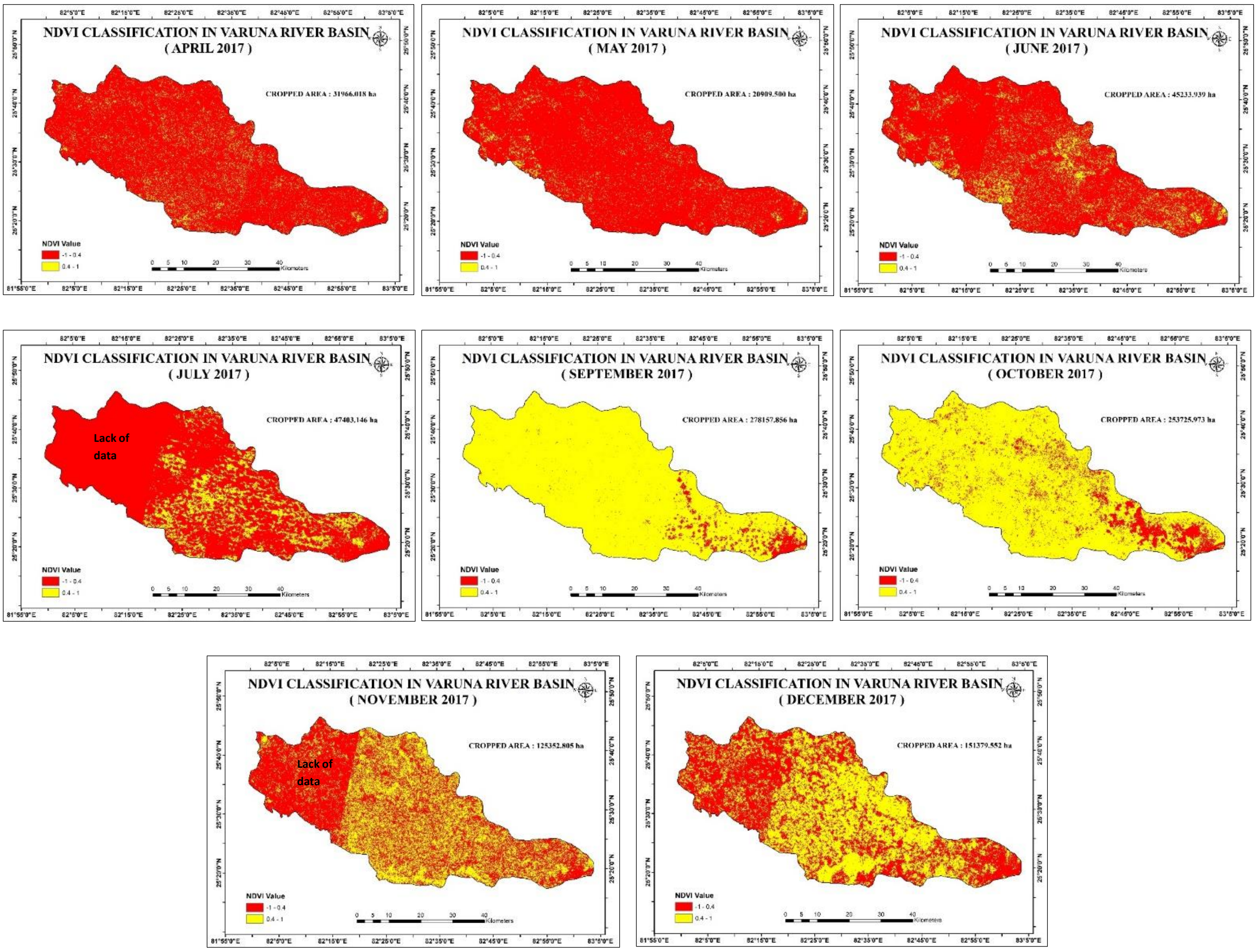
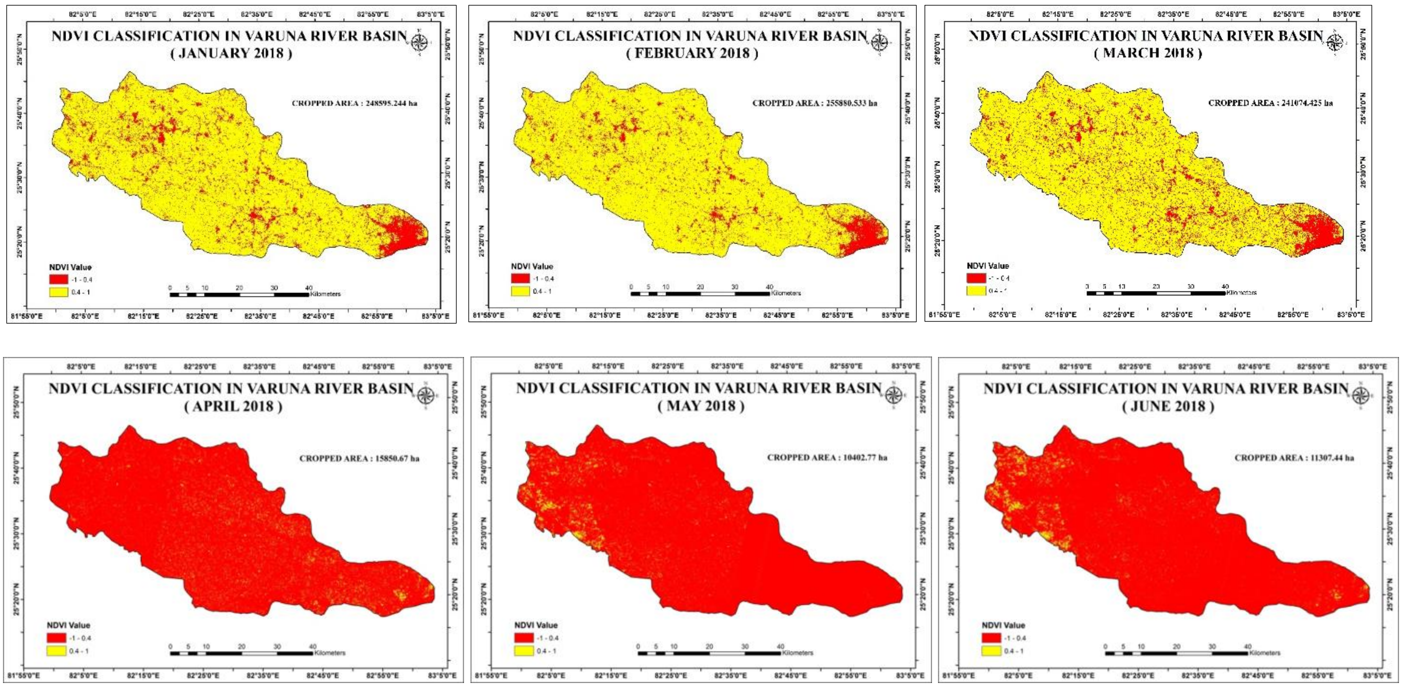


Fig – 5 (h) NDVI of Varuna river basin (2017)



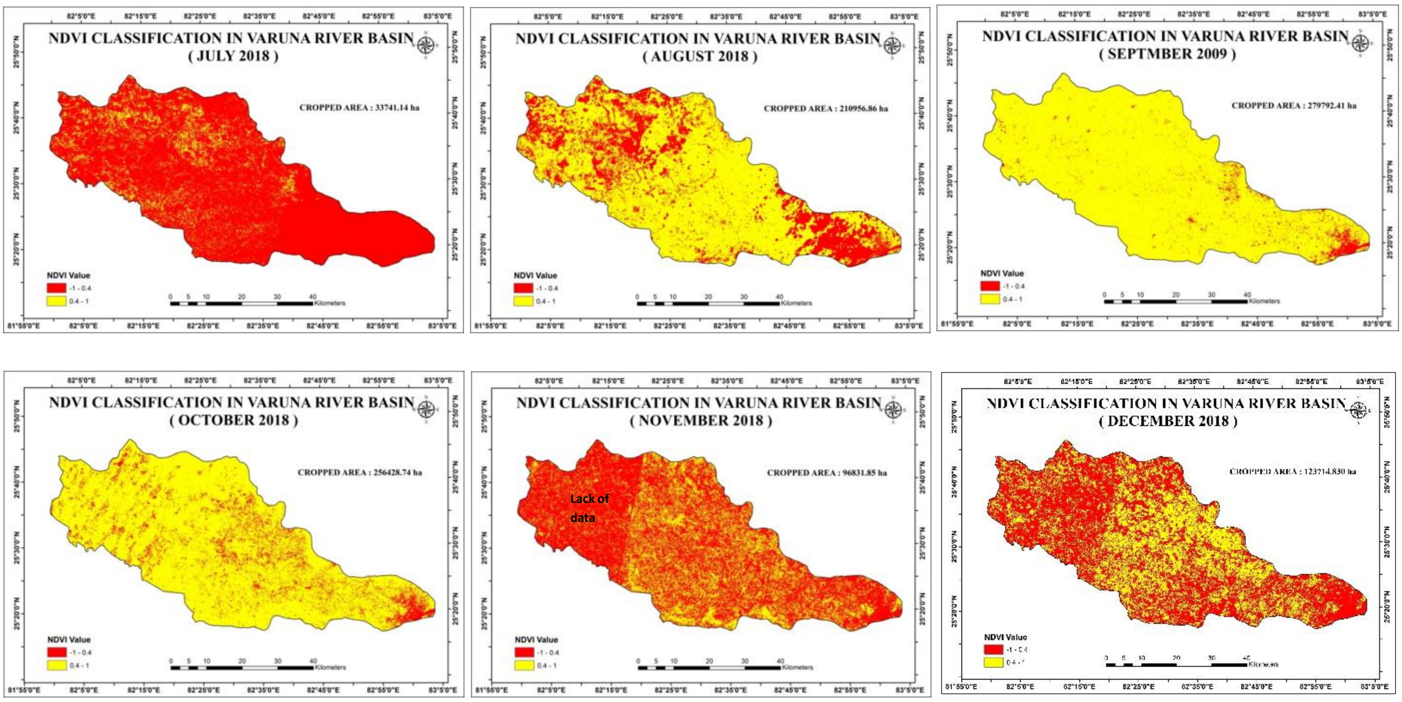


Fig – 5 (i) NDVI of Varuna river basin (2018)

5. CONCLUSIONS

The present study which is based on NDVI values, which is based on NDVI values, which is changing rapidly from 2009 – 2018. In general, very high NDVI values which are found in north western part of the basin are decreasing towards south eastern part of the basin as rainfall during the month April, May, June, July over the period 2009 – 2018 is decreasing in the same way NDVI values are increasing.

For the months April, May, June and July in 2009 to 2018 the values of NDVI are pretty high which indicates the maximum of the vegetation is under stunning growth as the rainfall starts from the month of august the scenario gets changed. Where a healthier growth of vegetation has been observed.

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