Change Detection of Vegetation Cover by NDVI Technique on Radhangari Wildlife Sanctuary of Kolhapur District in Maharashtra, India

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Abstract*: *The degradation of green cover has been going on since the beginning of human culture in space. The loss of natural forests as a result of progressive activities has become a major environmental concern. The loss of green vegetation is a fact of hydroelectric power generation by impeding the natural flow of a river. It has an influence on both the upper and lower catchment areas' vegetation. Various techniques of Vegetation Index (VI) based on Remote Sensing (RS) and Geographical Information System (GIS) methods are used to analyses this damage. One of the most widely used techniques for assessing vegetation cover is the Normalized Difference Vegetation Index (NDVI. For this study three decade has taken for calculating the NDVI of Radhanagari wildlife Sanctuary. After calculating the NDVI it shows the year 1998 shows 0.71 highest NDVI value and -0.48 was lowest, in the year 2008 highest NDVI was 0.38 and the lowest was -0.46 and for the year 2018 it was 0.49 highest and -0.12 NDVI values. This decreased NDVI represent forest area has degraded rapidly.

Keyword: **NDVI, Remote sensing, wildlife sanctuary, GIS, vegetation coverage.**

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I. INTRODUCTION

The normalized difference vegetation index (NDVI) was developed to determine vegetation cover with satellite data's reflected bands [8] NDVI is a widely used technique for observing the changes in land use and land cover, particularly changes in vegetation cover and pattern [1,9]. It is a measure of the health of the vegetation. The NDVI technique is used to measure forest abolition. It's also a useful tool for extracting data from satellite photographs concerning vegetation [3,5]. The capacity to compare photos from different dates, for different plots on different scenes, is a key step in using satellite data to track change [2,6]. The environment is the primary focus of this study. The cutting down of trees for the Radhangari and Kalmawadi dams has harmed the terrestrial and aquatic forest ecosystems for both the top and bottom catchment areas. The primary goals and purpose of this research are to use the NDVI detection method based on Remotely Sensed data (RS) and Geoinformatics System to classify the temporal variation of vegetation structure, such as related factors, and the gradual decrease of green plant coverage in a temporal scale of view on the Radhangari wildlife sanctuary region of the dam (GIS).

II .THE STUDY AREA AND LOCATION

A. Study Area

First, The study area i.e. the Radhanagari Wildlife Sanctuary (RWS) 351.16 sq. km. is at the crest of the Western Ghats (mean ht. 800 MSL). The study area was once the hunting reserve of Maharaja of erstwhile Kolhapur State. Later in 1952 a small area of 19 Km. was declared as Dajipur Bison Sanctuary by the Government of Maharashtra to conserve the region's biodiversity and animals. It was one of the oldest sanctuaries being declared by the Government of Maharashtra. Few years later forest department of Kolhapur district had put forward a proposed plan for. this 19 Sq.Km area for extension of present Radhanagari Wildlife Sanctuary. Soon after the present research work started in 1984, in September 1985 the area was declared as extended sanctuary. The study area also had significance as the catchment of two major hydroelectric and irrigation dam projects. It was necessary to make a detail study of the area by looking at its geographical importance and biodiversity potential

B. Location

The study area is located in Western Ghats which is well acquainted as one of the most vulnerable and delicate biodiversity hot spot the as the world. This is a natural World Heritage Site notified by UNESCO as Sahyadri sub cluster of Western Ghats. The reserve is located between the latitudes of 16°10 and 16°30 north and the longitudes of 73°52 and 74°14 east. Height from mean sea level is in 185m to 1000m.Itis covering 28,234.70 hectare (351.16.km) of forest area out of which 23,147.50-hectare area reserve forest, 4,728.59-hectare area protected forest whereas, and 358.61-hectare area is occupied by unclassified forest.

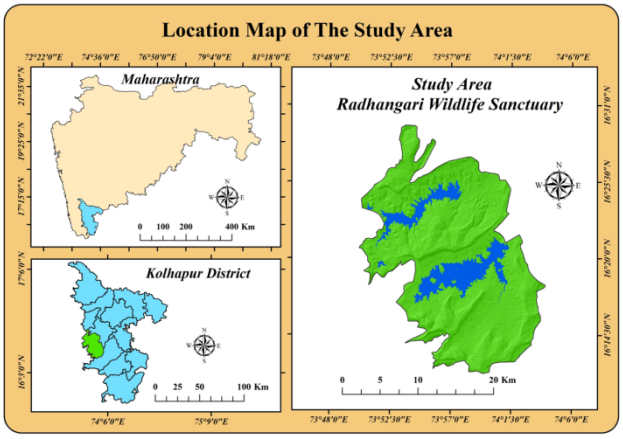

Fig. 1. Location map of study area

III. Dataset and Methodology

Table no I shows the detailed dataset which have used for this research work.

TABLE I. SHOWS THE DETAILED DATASET

Data Acquired Date	*Satellite*	*Sensor*	*Projection*	*Datum*	*UTM Zone*	*Spatial Resolution*	*Band used*
30 Dec 1998	Landsat 5	TM	UTM	WGS 84	45N	30m	4/3/2
30 Dec 2008	Landsat 5	TM	UTM	WGS 84	45N	30m	4/3/2
30 Dec 2018	Landsat 8	OLI	UTM	WGS 84	45N	30m	4/3/2

The following Figure number 2 shows the detailed methodology of current research work

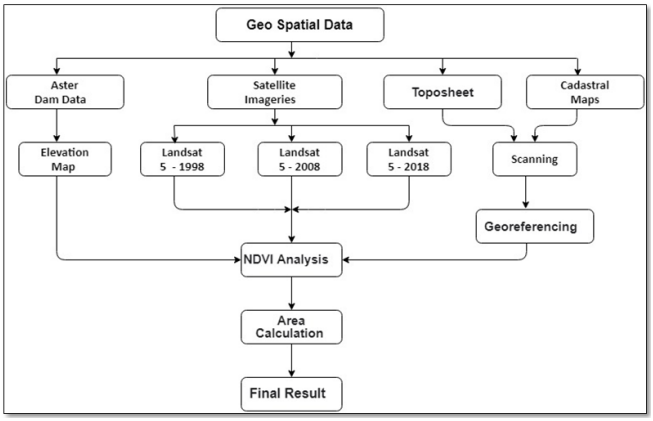

Fig. 2. Flowchart of methodology

A. Calculation of NDVI

Vegetation Index (VI) is an imitation image overlay produced from an FCC image's existing bands. This new layer frequently gives unique and important information that cannot be obtained from any of the previous layers. Plant growth, overall productivity, leaf and stem, and/or vegetation land cover have all proven to be extremely quantified or predicted using vegetation indices the paper [4]. Solar light in the Picture Synthetically Active Radiation (PAR) spectral range is absorbed by live green plants and used as a source of power in the process of photosynthesis [7,10]. The NDVI is calculated using the following formula.

$$NDVI = (NIR - Red)/ (NIR + Red) \quad (1)$$

The spectral reflectance measurements in the red and near-infrared sections, respectively, are denoted by RED and Near Infrared. As a result, the NDVI ranges from -1.0 to +1.0.

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B. Characteristic of NDVI Signatures

The NDVI (Normalized Difference Vegetation Index) of densely vegetated canopy will have a tendency to be positive (say 0.3 to 0.8) Negative values of this index will characterize clouds and snow fields. Oceans, seas, lakes, and rivers, for example, exhibit poor transmittance in both spectral bands (at particular away from coastlines), resulting in very low positive or even slightly negative NDVI values. Soils typically have a near-infrared spectral reflectance that is slightly bigger than red, resulting in small positive NDVI values (say 0.1 to 0.2). Low NDVI values (0.1 and lower) indicate barren areas of rock, sand, or snow. High levels imply temperate and tropical rainforests, whereas medium values indicate shrub and grassland (0.2 to 0.3). (0.6 to 0.8).

IV. Result and Discussion

TABLE II. RANGES OF NDVI VALUE FOR LULC

NDVI value range	*Class Name*	*Description*
< - 0.1 to 0.5	Water	Rivers, streams, lakes, and dams are examples of water-covered areas.
-0.5 to 0.18	Fallow land/ Irrigated land	Cropping and cultivated regions that are irrigated by rain Cropping that has been planted and irrigated
0.05 to 0.34	Barren land	Unvegetated areas, degraded terrain, and any unused land or settlement areas
0.23 to 0.5	Agriculture Grassland Open forest	Agriculture refers to land that is primarily planted with crops, Herbaceous vegetation with bushes was included in the grassland. Woody vegetation, shrubby plants, and other species grew sparsely in the open forest.

TABLE III. DECADEWISE NDVI VALUE OF THE STUDY REGION

Year	*Low*	*High*
1998	-0.48	0.71
2008	-0.46	0.38
2018	-0.12	0.49

Source: Based on USGS Data

A. NDVI 1998

Fig. Number 3 and Table .2 show the Normal Difference Vegetation Index (NDVI) spatial distribution for the year of 1998, in which values of the NDVI are in between to the 0.71 to -0.48 (Table.3) North West and south east side of the study area having more positive values which are showing dense forest area at the crust line of the hilly areas of the Radhanagari wildlife sanctuary. Likewise adjacent area of the top is also showing the positive values including inner parts of the Radhanagari wildlife sanctuary this area is moderately dense forest.

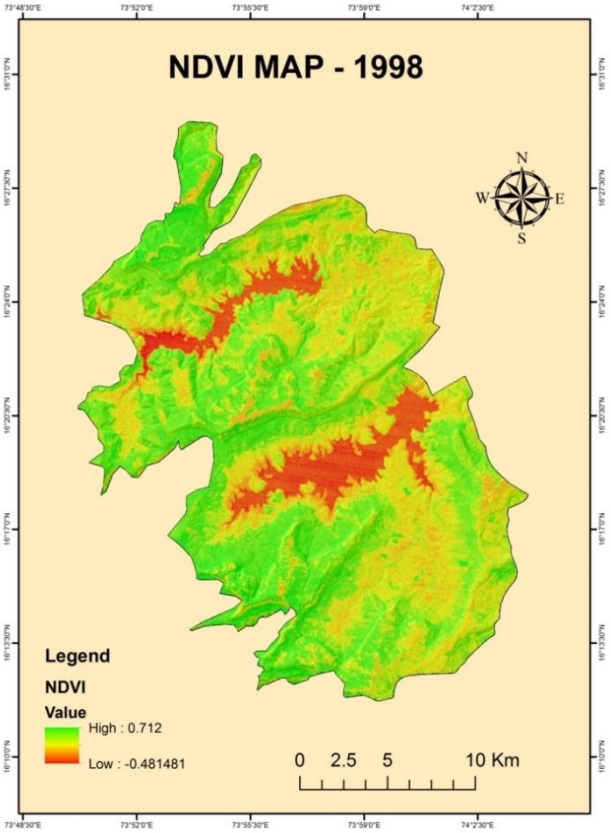

Fig. 3. NDVI Map of study area (1998).

The other part of forest area shows the positive value a including the open forest had woody vegetation. Water bodies are showing negative values which are storage for the water. In the above map of the study region there is big dam reservoirs are there of Kalammawadi and Radhanagari, which are showing in dark Blue colour having with negative values. Also, there is north eastern part is showing more negative values comparably with the south area of the study region which is part of northern flowing in the river area and south eastern part of the study region is showing moderate negative values which sanctuary. are showing barren land of the Radhanagari wildlife

B. NDVI 2008

Fig. number 4 and table no.2 show the Normal Difference Vegetation Index (NDVI) spatial distribution for the year of 2008, in which values of the NDVI are in between to the 0.38 to -0.46((Table no.3)). Which is showing decrease in the greenery of the area with past years. A value of NDVI varies between 0.3 to -0.4 which are showing the area is changed with respect to the previous year's situation.

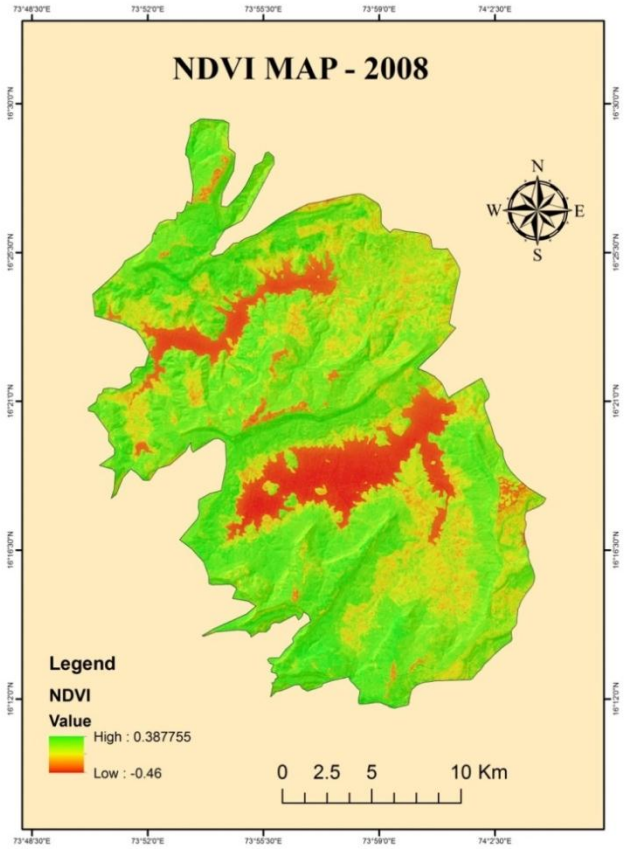

Fig. 4. NDVI Map of study area (2008).

Fig. number 4 shows core part of Radhangari sanctuary having dense forest area and also on and around to the crust line of the Radhanagari wildlife sanctuary area is moderately dense forest. The study area moderate positive value this area including the open forest had woody vegetation, greener area having surrounding patch of negative values which are showing non green area. North middle part and south middle part is showing high negative values because this area is under Kalammawadi and Radhanagari is huge dam area. Also, eastern part of Radhanagari dam and Southern part of Kalammawadi dam are showing much negative values, showing barren land and area under agriculture area.

C. NDVI 2018

Fig. number 5 shows the Normal Difference Vegetation Index (NDVI) spatial distribution for the year of 2018, in which values of the NDVI are in between to the 0.49 to -0.12. (Table no.3) This is showing decrease in the greenery of the area with compare to past two decades. There is NDVI values distribution has been showing green and non-green area of the Radhanagari wildlife sanctuary for the year of 2018.

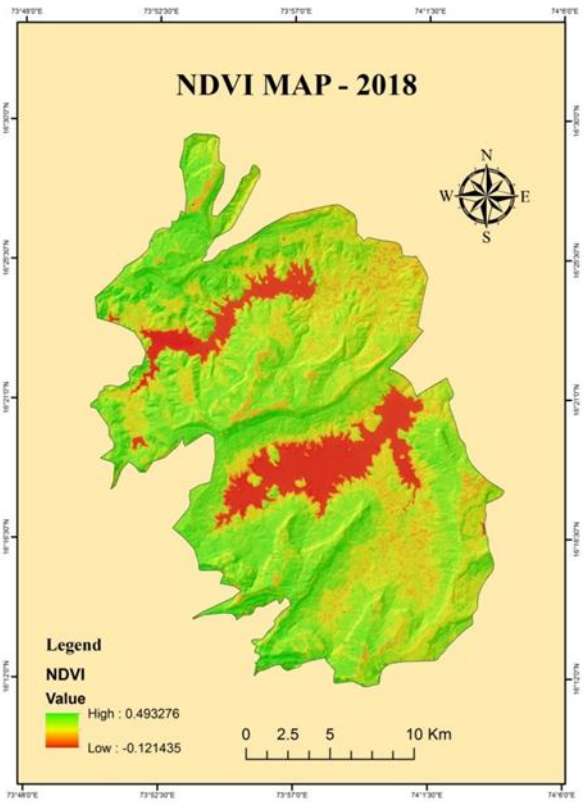

Fig. 5. NDVI Map of study area (2018).

NDVI values are varies between 0.12 to -0.49, as usual there is crust line of the Radhanagari wildlife sanctuary are having dense evergreen type of forest area having high positive values. North eastern art of the study region having couple of green patches and most of the area is showing moderately dense forest area and the study area moderate positive value this area including the open forest had woody vegetation. The study area high negative values which are having much area under non green region and also area under various human economical activities. The eastern part of the study area is showing most negative values which are showing increase negative values, is the sign of economic activities are increasing in the concern area like agriculture, mining etc.

D. Green and Non - Green Area in Radhanagari Wildlife Sanctuary

The Radhangari Wildlife Sanctuary studied the green and non-green forest area using GIS and Remote sensing techniques calculate NDVI sheeting the forest area in marge into non forest area during 1998 to 2018.

TABLE IV. GREEN AND NON - GREEN AREA OF RWS (AREA IN %)

Sr. No	Year	Green	Non - Green
1	1998	81.14	18.86
2	2008	69.08	30.92
3	2018	60.31	39.69

Above table no. IV shows the NDVI analysis results from the year of 1998 to 2018 in Percent. At the temporal year of 1998, there is high green area has been observed i.e. 81.14% and remaining is a non-green area i.e. 18.86 %. This year is having more area below vegetation as compare all other years. At that time there is human disturbance is very less that is why there is natural area is more which is showing in the area under green.

Second data base is of 2008, in that respective year green patch is showing high decline in the area. In that year 69.08 % area is under the green patch and remaining area is under non green area which is 30.92% which is increased by 12.06 % in those 10 years of 1998 to 2008. This temporal year is showing high decline in the greenery of the study region.

Third data base is of 2018, in that respective year green patch is showing high decline in the area. In that year 60.31 % area is under the green patch and remaining area is under non green area which is 39.69 % which is increased by 08.77 % in those 10 years of 2008 to 2018. This temporal year is showing high decline in the greenery of the study region. These 3 decades are showing continuous decline in the green area of Radhanagari wildlife sanctuary.

Fig. number 6 shows the area under green and non-green area of the Radhanagari wildlife sanctuary. That shows the three decades are continuous decrease in the greenery of the Radhanagari wildlife sanctuary in the year of 1998 to 2018. Because day by day increasing human population as well as related human activity. At that time there is human disturbance is very high that is why there is natural area is more which is showing in the area under non green.

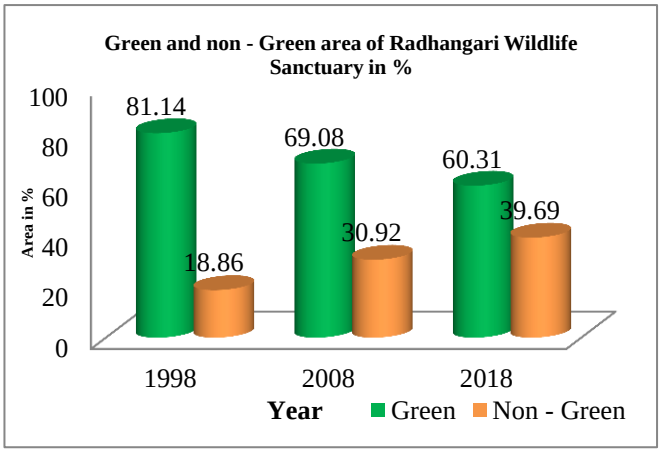

Fig. 6. Green and non-Green area of RWS in %

V. CONCLUSION

In this study the forest degradation of Radhangari wildlife sanctuary has been assessed using Normalized Difference Vegetation Index (NDVI) technique through GIS environment. Three decades have taken for calculating the NDVI of study area. After calculating the NDVI it shows the year 1998 shows 0.71 highest NDVI value and -0.48 was lowest, in the year 2008 highest NDVI was 0.38 and the lowest was -0.46 and for the year 2018 it was 0.49 highest and -0.12 NDVI values. Finally, it is concluded that the forest area of Radhanagari wildlife Sanctuary it has been decreased very rapidly. It has suggested that there is need of the forest conservation and management plan.

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