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Spatio-Temporal Assessment of Vegetation Cover of Jodhpur City and Surrounding Areas

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ABSTRACT: Vegetation cover found in arid zone of Western Rajasthan is a precious resource for environment and livelihood of local habitats. The Vegetation in arid and semi-arid regions experiences a phenomenal change in its growth pattern and is highly dynamic. Various type of seasonal and scattered vegetation like Prosopis cineraria (Khejri), Salvadora oleoides (Meetha jal) Tecomella undulate (Rohida), Acacia senegal (Kumat), Capparis decidua (ker) and Azadirachta indica (neem) are the dominant tree species present in the arid area. Satellite imagery can be very useful in monitoring the vegetation. The main objective of the study is to find out changes among vegetation coverage over the period 2000 to 2010. These Changes are due to increasing population and subsequent anthropogenic activity in the past decades. Satellite data of LANDSAT and IRS L-3 were used for preparation of vegetation density and land use maps of the respective periods. Normalized Difference Vegetation Index (NDVI) supported by GIS was employed to detect vegetation changes. Results revealed significant changes in vegetation cover of the area during the study period. Such studies on temporal analysis of vegetation can help in monitoring the pattern and distribution across the city area for attaining sustainability of natural environment.

KEYWORDS: Satellite Data, NDVI, Vegetation, GIS, Remote Sensing, Change Detection.

I. INTRODUCTION

A geographic Information System (GIS) can be as simple as points plotted on a paper map with some attribute attached to the points.GIS today involves sophisticated software and can be integrated with Remote Sensing (RS) technologies to provide monitoring of vegetation. The key element of GIS is that attributes are related spatial and some system is utilized to process and analyze these relationships. Urban growth and its associated population increase is a major factor which has altered natural vegetation cover. This has resulted in a significant effect on local weather and climate. The use of remote sensing data in recent times has been of immense help in monitoring the changing pattern of vegetation. Change detection, as defined is the temporal effects as variation in spectral response involves situations where the spectral characteristics of the vegetation or other cover type in a given location change over time. The vegetation is one of the invaluable natural resources which changes spatio- temporally in its extent and distribution. Hence, reliable information on the extent and distribution of vegetation types is pre-requisite for natural resource management and planning. As the vegetation types in tropical part of India represents diverse formations, on screen visual image interpretation approach was found to be suitable to delineate various vegetation types. In the present study, Landsat TM and IRS P6 LISS III data which is having spatial resolution 30m & 23.5 m respectively was used to generate baseline information of vegetation types of Jodhpur city and surrounding area. The objective of the present study was to develop detailed vegetation type map using visual image interpretation technique and information collected from Ground Truth surveys.

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II. STUDY AREA

Jodhpur city is located at a latitude of 26º 18' North and longitude of 73º 1' East and is located in the middle of the Thar Desert tract of western Rajasthan (Fig.1a). Its general topography is characterized by the hills located in the North and North-west. Jodhpur city is located at an average altitude of 241 m above Mean Sea Level at railway station with fort and old city being much higher at 367.83 m and between 277.21m to 245.50 m respectively. The city has a natural drainage slope from North-North East to South-South East towards Jojari River. The economy of Jodhpur thrives on industrial goods and cultural heritage.

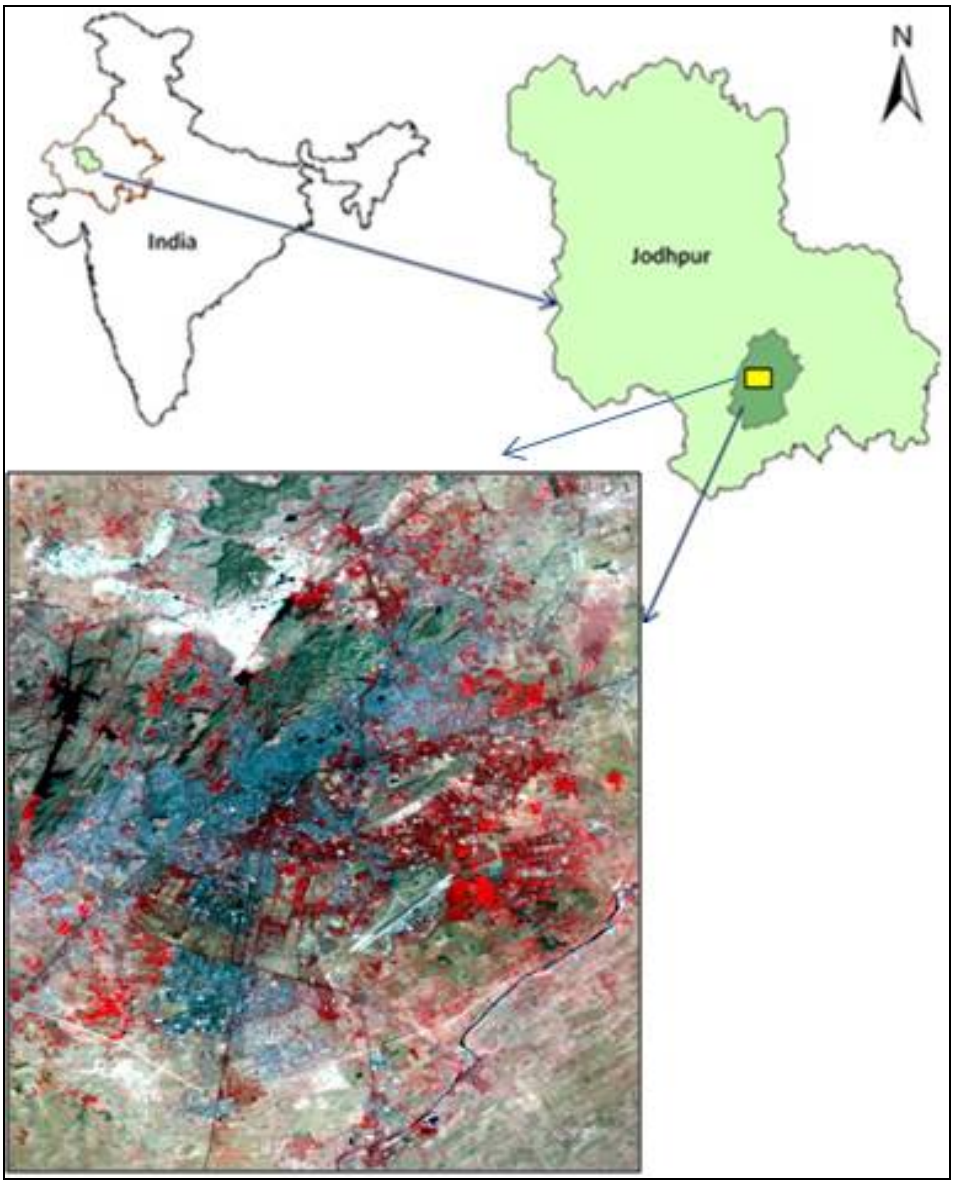

Fig.1(a). Location Map of the Study Area.

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III. METHODS AND MATERIAL

False Colour Images of LANDSAT data on scale 1:50,000 for last one decade with Survey of India (SoI) maps were used in the present study (Table No-1). The LANDSAT satellite Image is used to image processing for estimation of NDVI. The software ERDAS-9.2 and ARCGIS-9.3 is used for data acquisition and processing. The detailed methodology adopted for this work is given in Fig-1(b).

Table No-1 The Satellite Data used in the Study Area.

RS Data	Resolution	Path/Row	Date of Acquisition
Landsat TM	30 m	149/42	Oct 2000
Landsat TM	30m	149/42	Oct 2010
IRS L-3	23.5m	92/53	Oct 2010

Table No-2. Band Combination

LANDSAT Imageries	Band Combination		
	Blue	Green	Red
True Colour Composite	1	2	3
False Colour Composite	2	3	4
NDVI Data	(Band 4- Band 3)/ (Band 4+ Band 3)		

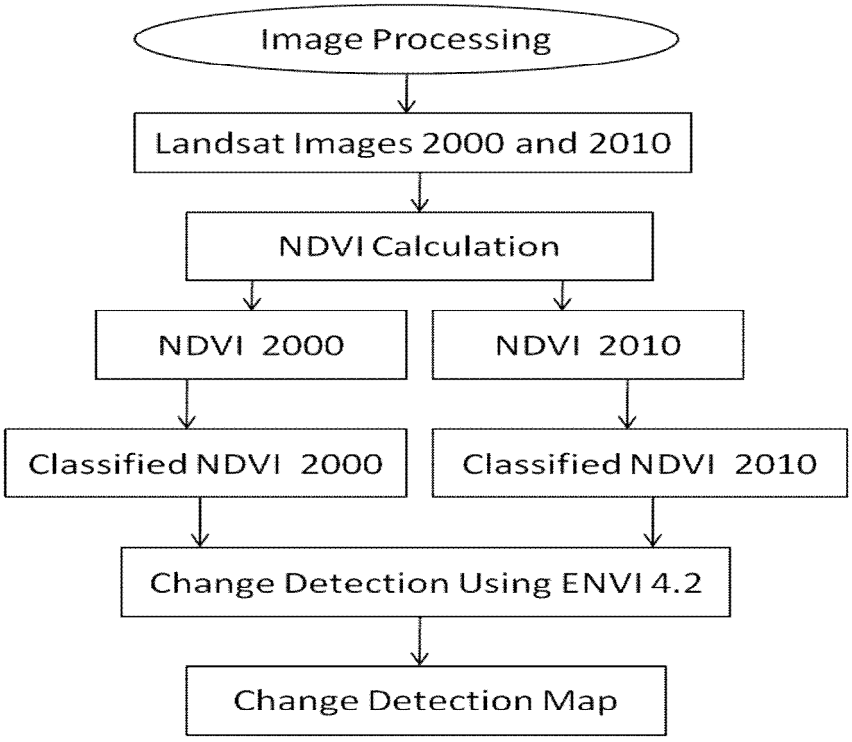

Fig.1(b) Methodology Flow Chart

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IV. RESULTS AND DISCUSSION

The objective of present study was to generate a LU/LC features and change detection using remote sensing and Geological Information System (GIS). The observation for the highly declining of vegetation cover, limited availability and extinction of trees is also reported. The NDVI maps of Jodhpur city for both the years reveal four classes viz- water bodies, mining area, vegetation/ forest and other land. NDVI values for each class of vegetation cover are detected. The geospatial data generated on vegetation type maps are prime input for landscape ecological analysis.

(A) NDVI MAPPING OF THE STUDY AREA

The Normalized Difference Vegetation Index (NDVI) values for study area varied mostly from -0.56 to 0.63. As it can be seen clearly the forest area has maximum NDVI values then comes the non forest area followed by the habitation, mines and finally water body shows the least. From Fig.2 it is clear that most area in 2000 was covered by forest. In the 2010 NDVI maps, there is decrease in the forest area and the increase in mining area can be clearly seen. The area occupied by the mines and settlements has low NDVI values nearer to zero. Table-1 shows the variation of NDVI values for different classes in the year 2010.

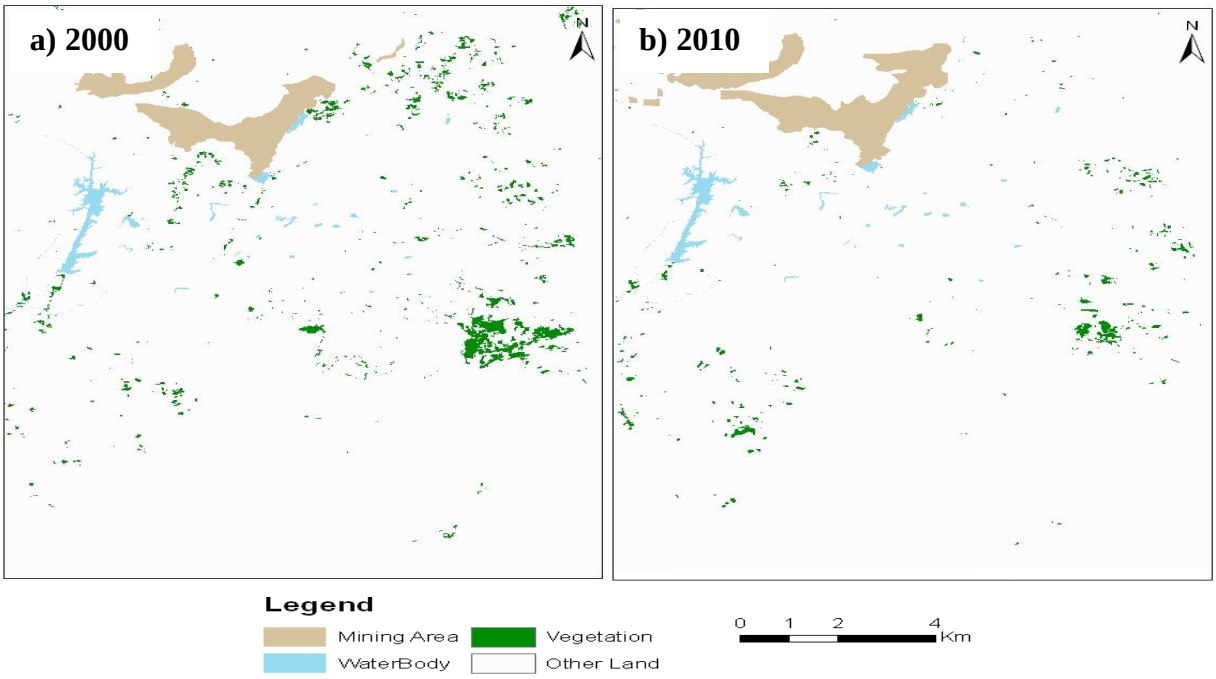

Fig.2. NDVI map based on the Landsat Satellite Data.

Table No-3: NDVI values and Class Types

S.No.	Class Type	NDVI
1	Forest/Vegetation	0.29 to 0.63
2	Mining Area	-0.27 to 0.00
3	Water body	-0.56 to -0.44
4	Other Land	0.10 to 0.29

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Table No-4. LU/LC Change statistics for the Decade (2000-2010)

NDVI Classes	Area% 2000	Area % 2010	(%) change 2000-2010
Mining Area	18.18	22.91	4.73
Water Body	0.601	0.684	0.083
Vegetation/ Forest	24.369	21.282	-3.087
Other Land	56.849	75.721	18.872
Total Area	100	100	--

(B) NDVI ASSESSMENT OF THE STUDY AREA

During 2000-10 decade the NDVI value is lies between -0.56 and +0.63 (Table No-3 and 4). The lower most NDVI value in 2000 is –0.56. This value is close to -1 shows NDVI for no vegetation. The lower value of - 0.56 indicates the presence aquatic plants in extremely low proportion. The NDVI value above zero to one indicates the terrestrial vegetation with increase in their maximum proportion. The maximum NDVI value is 0.63 indicates comparative dense vegetation cover. The overall highest value dense vegetation cover is +1. The maximum area of the Jodhpur city belongs to the scrub and grasslands. The minimum area lies under water bodies. The NDVI is unable to separate cropland from forest area. However, overall change of vegetation may be detected from substring NDVI map of year 2000 from year 2010 (Figure-3a&b). The final change detection map shows that water body is increases (0.083%) and mining area also increases (4.73%) from 2000 to 2010 (Figure-4). The vegetation cover decrease (3.087%) and other land is increases (18.872%) due to increase of population pressure on land.

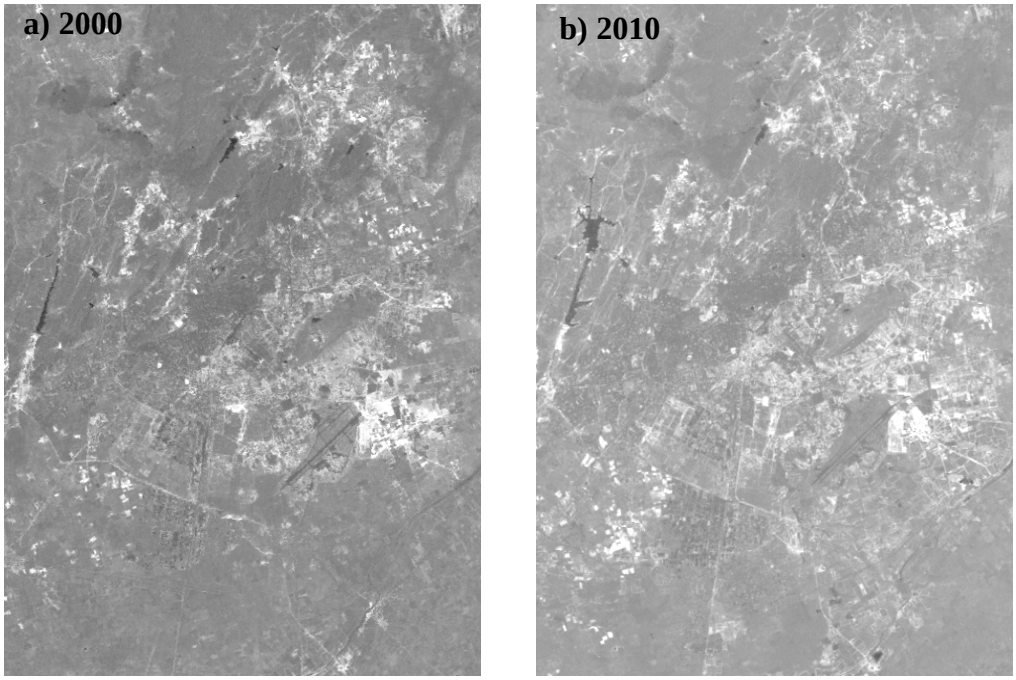

Fig.3(a & b). Temporal NDVI Maps of the Study Area.

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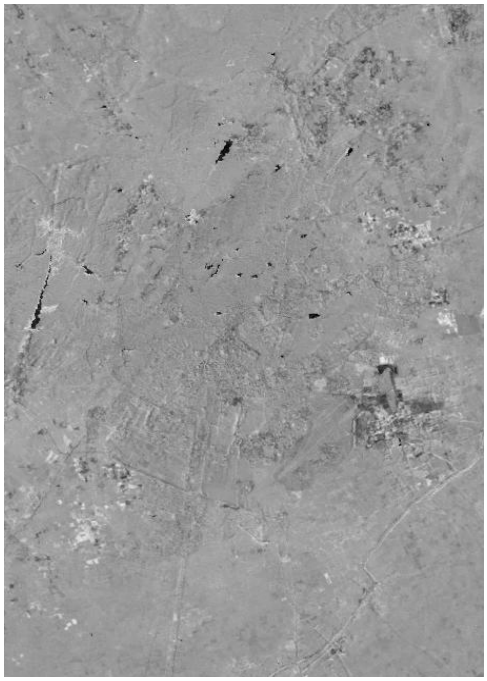

Fig.4. Final NDVI Change Detection Map of the Study Area.

V. CONCLUSION

NDVI is an emerging technique from Remote Sensing and GIS technology to detect spatio-temporal change of vegetation cover. The NDVI method gives superior results for vegetation varying in densities and also for scattered vegetation from a multispectral remote sensing image. The vegetation analysis can be used in the events of natural disasters to provide humanitarian aid and damage assessment.

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