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LAND USE LAND COVER CLASSIFICATION AND CHANGE DETECTION USING LANDSAT DATA IN NATHDWARA CITY

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Abstract: The rate of urban growth is very fast in developing countries like India. Nathdwara is a major pilgrimage center in Rajsamand district of Rajasthan and it is a well-respected Peetha of the Vallabh Sampradaya. The main temple in the city is of Shri Krishna, which is famous by the name of Shrinathji. It is visited by devotees from different parts of the country throughout the year. The development of the town is taking place in unplanned and non-systematic manner. Narrow streets in old settlements, Along with the development of unorganized intersections, unplanned and unorganized commercial sites, havelis of ancient importance, as well as lack of basic public facilities in these areas, many problems are arising here. Therefore, it has become necessary to study the LULC, its contribution and importance in relation to the area, before formulating a policy and making a proposal for well-planned and well-organized development of the city in the coming decades. The main objective of this paper is to find change in LULC of the Nathdwara City using Landsat 30 m resolution data with the help of Supervised Classification technique. (1991-2021). For developing Land-use Land-cover map for the study area, two images of Landsat-5 (ETM) and landsat-8 (OLI) have been collected from the USGS (United States Geological Survey) earth explorer website. Each image has resolution of 30m. A Classified map has been prepared in Q-GIS open-source software. Band 1, 2, 3, 4, 5, 6 and 7 were considered for image classification. Supervised classification technique was used with the help of semi-automatic classification plug-in(Q-GIS). The study area has been classified into Four broad category – Vegetation area, Builtup, Barren land area and waterbody. The study reveals that there is a decline in Vegetation in recent years while Builtup has increased during the period. 19.6 percent of total Vegetation area was reduced in thirty years while 66.7 percent builtup area has increased.

Keywords: Nathdwara; Land use land cover; Landsat; Q-GIS; Supervised classification; Urban Expansion

1. INTRODUCTION

Land-use and Land-cover (LULC) change detection information is very important in current time for monitoring, planning, decision making, and socio-economic development of a city. Remote Sensing (RS) is a very advanced technique for change detection in the Surface of the earth without travelling to the place and produces spatial information (in the form of imagery data). The periodical observation of LULC changes is necessary to understand the overall dynamics around the particular place. "The satellite imagery data with RS techniques can show a vital role in the classification and assessment of changes in large-area LULC. The variety of satellite sensors can be used to gather imagery data of the study area, each with unique properties (spatial, spectral, and temporal resolution (Lloyd L. Coulter, 2016))."¹ "Land cover refers to the physical characteristics of Earth's surface, captured in the distribution of vegetation, water, soil and other physical features. Landuse refers to the way in which land has been used by humans and their habitats (such as agriculture, settlements, industry etc.). Although land use is generally inferred based on the cover, yet both the terms land use and land cover being closely related are interchangeable. For example, settlement is cover but if we include buildings

¹ Lloyd L. Coulter, Douglas A. Stow, Yu-Hsin Tsai, Nicholas Ibanez, chien Shih, Andrew Kerr, Magdalena Benza, John R. Weeks, Foster Mensah Classification and assessment of land cover and land use change in southern using dense stacks of Landsat-7 ETM+ imagery Remote Sensing of Environment, 184 (2016), pp. 396-409

whether it is being used for residence or industrial activity, it shows the land use component (Chaudhary et al, 2008).”² Rapid growth in urban areas is an international phenomenon. The rate of urban growth is very fast in developing countries like India. Nathdwara is a major pilgrimage center in Rajsamand district of Rajasthan and it is a well-respected Peetha of the Vallabh Sampradaya. The main temple in the city is of Shri Krishna, which is famous by the name of Shrinathji. It is visited by devotees from different parts of the country throughout the year. Most of the people come from the state of Gujarat. Nathdwara had the status of a city before the year 1901. In the year 1901, the population of the city was only 8594 persons. There was a period of ups and downs in the population of the town. The highest growth rate of 36.02 percent in the town was recorded in the year 1971, which is a record. In this decade, the trend of rural population has been to migrate to cities. If we observe the last 7 decades from the year 1941 to 2011, then by the year 2011, with four times increase, the population was 44523 persons. The area of the city is 18.16 sq km. The population density of the city is 2322 persons per square kilometer. The development of the town is taking place in unplanned and non-systematic manner. Narrow streets in old settlements, Along with the development of unorganized intersections, unplanned and unorganized commercial sites, havelis of ancient importance, as well as lack of basic public facilities in these areas, many problems are arising here. Unplanned residential expansion is taking place on agricultural land in the outskirts of the city. A city is the main center of human activities, which maintains a special relationship with its surrounding area. As a result of these activities, it generates activities of its own. Therefore, it has become necessary to study the LULC, its contribution and importance in relation to the area, before formulating a policy and making a proposal for well-planned and well-organized development of the city in the coming decades. Along with this, its social, economic, cultural and business structure, land use and development trend and progress should also need to be studied.

2. THE STUDY AREA

Nathdwara town is situated on the bank of river Banas, between the picturesque hills of Aravalli in southern Rajasthan, at the confluence of National Highway-8 and State Highway 49 with 24° 56' north latitude and 74°50' east longitude and 585 meters above mean sea level. Nathdwara is surrounded by Banas river on one side and hills on the other. It is situated on uneven stony land. Banas, a tributary of the Chambal, originating from the mountain ranges of Kumbhalgarh, moves near Nathdwara. Nand Samand dam on Banas river is situated 12 km west of Nathdwara, due to which the production of agriculture has increased a lot. The maximum temperature here in summer is 45 °C and the minimum temperature in winter is 4.8 °C. Nathdwara Municipality area is 18.6 sq km. The city is spread over 4487.16 acres of land, which includes hills, reservoirs, barren land and gardens etc. Out of the mentioned urban area, only 1093.54 acres is actually developed urban area and the remaining area includes vacant land and hills. Apart from being an important commercial center of Nathdwara subdivision headquarters, it is also a major pilgrimage site. Commercial activities have developed rapidly due to the systematic economic development here only after independence. Due to the increasing number of pilgrims in the last decades, there is a continuous increase in the working population in the field of trade and business. Marble Industry is also developing in Nathdwara on Rajsamand road.

² Chaudhary, B.S., Saroha, G.P., and Yadav, M. (2008) Human Induced Land Use Land Cover Changes in Northern Part of Gurgaon District, Haryana, India: Natural Resources Census Concept. Journal of Human Ecology, 23(3), pp. 243-252.

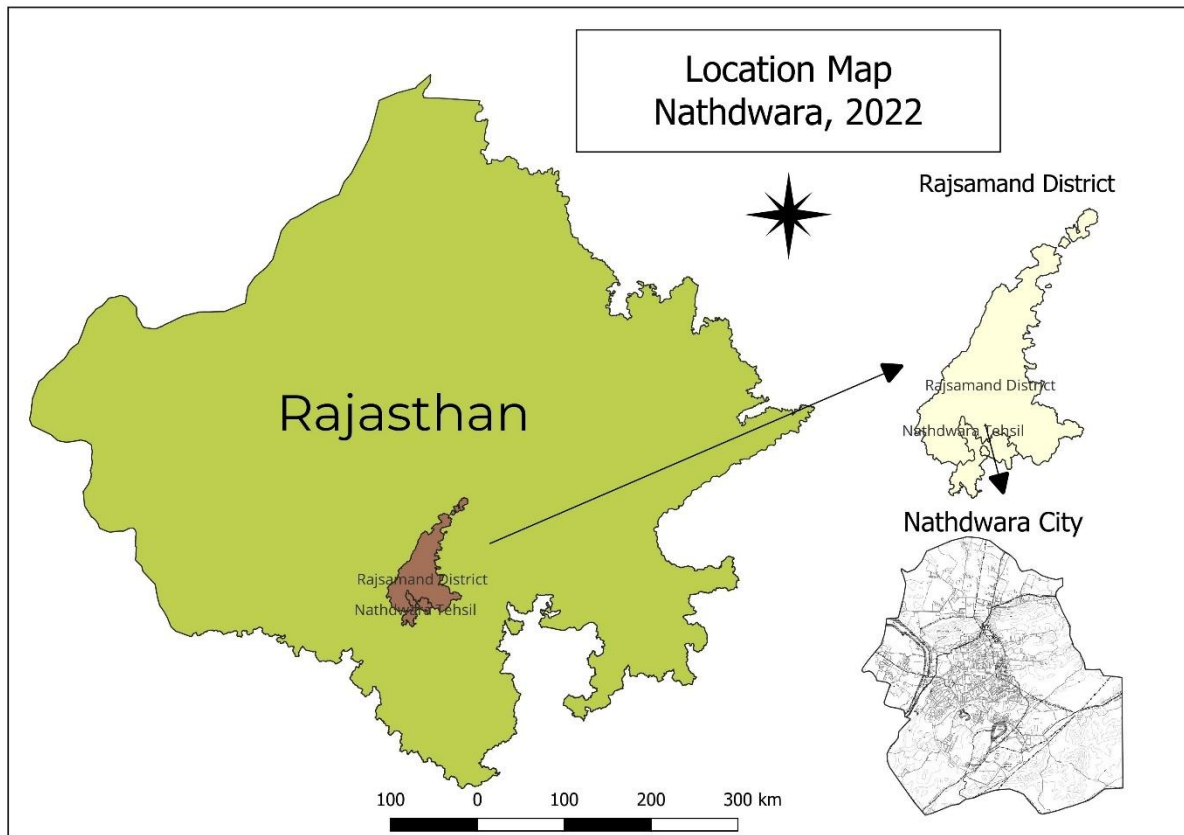


Figure 1.1 Location map of the study area.

3. OBJECTIVE

1. To find change in LULC of the Nathdwara City using Landsat 30 m resolution data with the help of Supervised Classification technique. (1991-2021).

4. DATA SOURCES AND RESEARCH METHODOLOGY

For developing Land-use Land-cover map for the study area, two images of Landsat-5 (ETM) and landsat-8 (OLI) have been collected from the USGS (United States Geological Survey) earth explorer website. Each image has resolution of 30m, first image is from Landsat-5 taken on 20 September 1991 with three percent cloud cover. Second image is from landsat-8 (OLI) taken on 19 November 2021 with Zero percent cloud cover. Both images have been captured after Monsoon period. To see the difference in Land use Land cover, A Classified map has been prepared in Q-GIS open-source software. Band 1, 2, 3, 4, 5, 6 and 7 were considered for image classification. Supervised classification technique was used with the help of semi-automatic classification plug-in(Q-GIS). The study area has been classified into Four broad category – Vegetation area, Builtup, Barren land area and waterbody. In pre-processing of the image geometric rectification or image registration, radiometric calibration and atmospheric correction has been applied. Accuracy assessment of the classification has also been done.

5. RESULT AND DISCUSSION

True-color composites of the study area are shown in figure (1.3); Image A reflects the Urban area (Builtup) in 1991 while Image B of the 2021 time period. These two Images very much clarify the scenario, as one can see the difference of Urban expansion in both the images. The city expanded in both northward and southward direction.

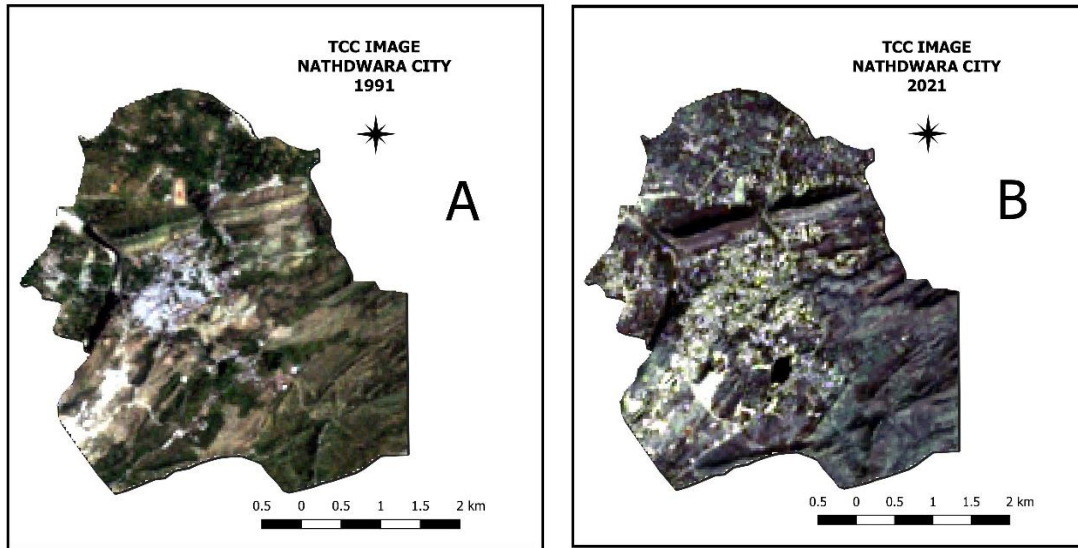


Figure 1.2 (True-color composites of Nathdwara city A. (1991) B. (2021))

Classified LULC map (Figure 1.3) shows that, Vegetation category which includes agriculture as well has decreased extremely as area under vegetation reduced to 6.78 km² (2021) from 8.44 km² in 1991. -19.6 percent area decreased under vegetation category which is very vital in environment degradation. Difference can be seen clearly in figure 1.3, where in 1991 image green area is very much higher compare to 2021 image. While Barren area has been increased to 0.40 km². Barren Land has no major affect as total area under Barren land remain Little surplus compare to year of 1991. Builtup has become more than double in study area, In 1991 total area under this category was 2.65 sq km, which increased to 4.42 sq km in 2021. This is called urban expansion. According to Master Plan of Nathdwara 2011, the population of Nathdwara is projected to increase from 44,523 in year 2011 to 72,800 in the year of 2031. There will be an increase of about 28,277 persons during the plan period. An increase of 1413 persons is estimated in the city every year. The city will expand more in near future but compare to last 30 years the vegetation needs to be protected. Keeping in view the availability of land and the present development, the expansion of the city is estimated to be around National Highway-8 and State Highway-49. Nathdwara is connected to Udaipur in the south and Ajmer city in the north. Vehicular traffic is continuously increasing on Nathdwara-Udaipur and Nathdwara-Rajsamand National Highway No.8. The bus stand is located near Lalbagh on Rajsamand road, which has been developed as a complex under the Integrated Development Scheme of centrally promoted small and medium towns. This area will be more expand along with the National highway.

Kappa accuracy assessment of both images has been also done, in which overall accuaracy was found 96.19 percent in 1991 image classification and for 2021 image classification overall acuuracy was found 95.11 percent. User accuracy and indivisual producer accuracy in both the images were also above 95 percent in vegetation class and barren land class.

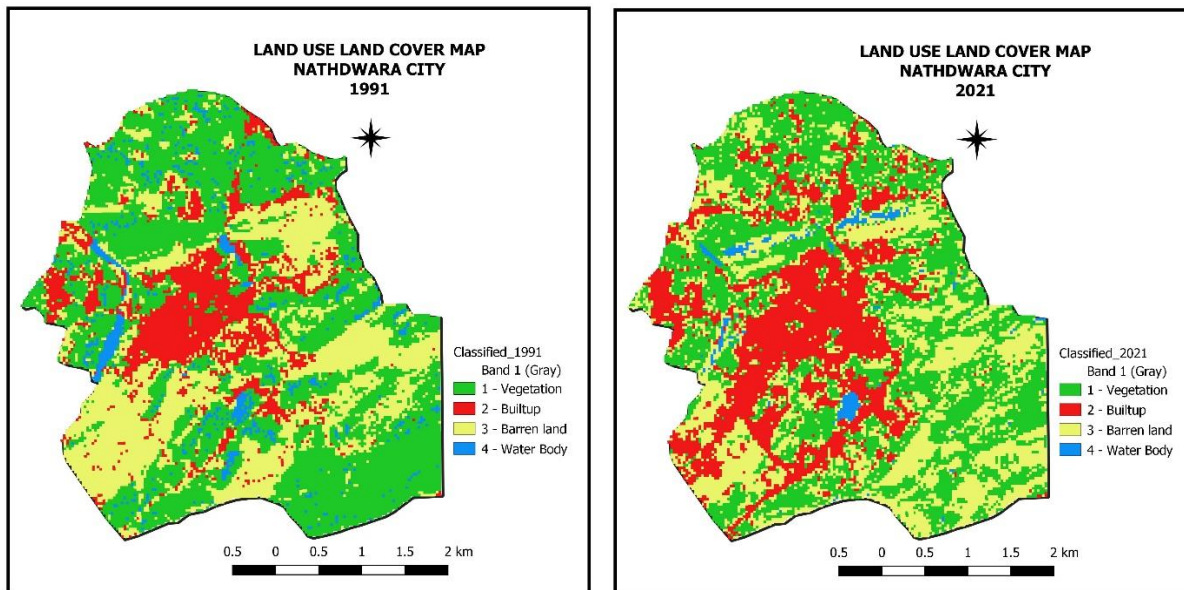


Figure 1.3 (LULC change during years 1991-2021 in Nathdwara City)

Table 1.2 LULC distribution in Nathdwara City

LULC Class	1991 Area in km ²	2021 Area in km ²	Change Between 1991 and 2021 km ²	Average Rate of Change %
Vegetation	8.44	6.78	-1.66	-19.69
Builtup	2.65	4.42	1.77	66.77
Barren Land	5.43	5.82	0.40	7.28
Waterbody	0.76	0.26	-0.50	-65.88
Total (Area in Sq Km)	17.28	17.28		

6. CONCLUSION

This study analyzed the change in Urban area during 2015-2021 in the Nathdwara city using Landsat-5 and 8 data. The study reveals that there is a decline in Vegetation in recent years while Builtup has increased during the period. 19.6 percent of total Vegetation area was reduced in thirty years while 66.7 percent builtup area has increased. LULC mapping is a significant technique to measure the growth of land use land cover (LULC) especially change detection of Urban pattern and its area. So it can be said that this technique is very effective and useful for the decision-making process and future planning concerned with Urban change.

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