Biannual Open Access Journal
Peer-Reviewed/Refereed International Journal
JOURNAL OF GLOBAL RESOURCES
Published by: ISDESR, Jaipur, India

www.isdesr.org

ISSN: 2395-3160 (Print)
ISSN: 2455-2445 (Online)
January 2023, Volume 09 (01)
DOI Prefix: 10.46587/JGR

09

STUDY AND ANALYSIS OF LAND USE/LAND COVER CHANGES OF JODHPUR CITY AND ITS IMPACTS ON ECONOMY AND ENVIRONMENT (1990-2022)

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How to cite this paper:
Prema Ram and Sheikh, M. M. (2023) Study and Analysis of Land use/Land cover of Jodhpur City and its Impacts on Economy and Environment (1990-2020), Journal of Global Resources, Vol. 09 (01)

DOI:
10.46587/JGR.2023.v09i01.009

Received: 07 Nov. 2022
Reviewed: 30 Dec. 2022
Final Accepted: 09 Jan. 2023

OPEN ACCESS
Freely available Online
www.isdesr.org

Abstract: *Urban land use change is a major issue globally. Land cover is a cover that covers any surface and the changes described include urban area land, water body, residential, forest land wasteland, agriculture, and recreation etc. The development of the built-up area separates the city limits.' (PA Khadke & RU Kharat 2017) Land use change plays a major role in the developmental activity of a developing country. Due to the rapid development of urbanization and the dramatically increasing population, fertile agricultural land has been converted into built-up area in relation to the need for housing and the need for infrastructure. The extent of open space and surface water bodies have also been encroached upon. Land use is derived from the human use of land and can be mainly classified into residential, agricultural, commercial use, industrial, etc. Land use and land cover changes are caused by socio-economic and natural factors. The increase in population as well as migration of people from rural to urban is the most important reason for land use change. (P. Sangardas, S. Ishwari, 2019). In the presented research paper, the study and analysis of land use change of Jodhpur city and its impact on economy and environment is to be done.*

Key words: Land-Use, Land Cover, Global, Urbanization, Economy, Environment, Population Migration

Introduction

The Landsat-7, 8 and Sentinal-2 satellite images procured from USGS (United States geological survey) earth explorer portal. The Satellite image were used for image-to-image registration and mosaicking using digital image processing techniques. The classification scheme adopted for the LULC mapping was sourced from the standard classification scheme that has been prepared by NRSC/ISRO, Hyderabad (Error! Reference source not found.). Different kinds of earth surface objects reflect and emit different amounts of the radiant energy and are recorded as tonal/colour or density variations on the satellite image. Built-up area is identified by white blues tones and rough surface, Crop lands are easily identifiable by its red tone, sparse vegetation, gullied or ravenous lands are identified by its yellow to bluish green tone on satellite FCC image with irregular shape and entrenched drainage. Sandy areas appear in bright white with light bluish green tone depending on the moisture content. Reservoir/ tank/ ponds having deep water appears on FCC image as black while having shallow water as blue tone. Mining areas appear in bright white with light bluish green colour and are mostly associated with the hills while Industrial area confined mainly along the roads. The satellite images were visually interpreted separately for the year 1990-2020 period and then integrated to JDA master plan. Final LULC map of that year for the study area on 1:25 K scale through ESRI ArcGIS software. Similar steps were performed for generating LULC for the different year. Once the interpretation was complete in the lab, ground verification was carried out and various information including geotagged field photographs were collected from the study area. The ground verification information and data collected in the field. Preparation of GIS layers viz. settlement, nala/drainage, road, and rail network in the study area was carried out using the satellite data. These layers were overlaid in the map compositions along with administrative boundaries.

Objectives

1. Analysis of urban land use change in Jodhpur city, (1990-2020).
2. To study and analysis the impacts of urban land change on economy and environmental.

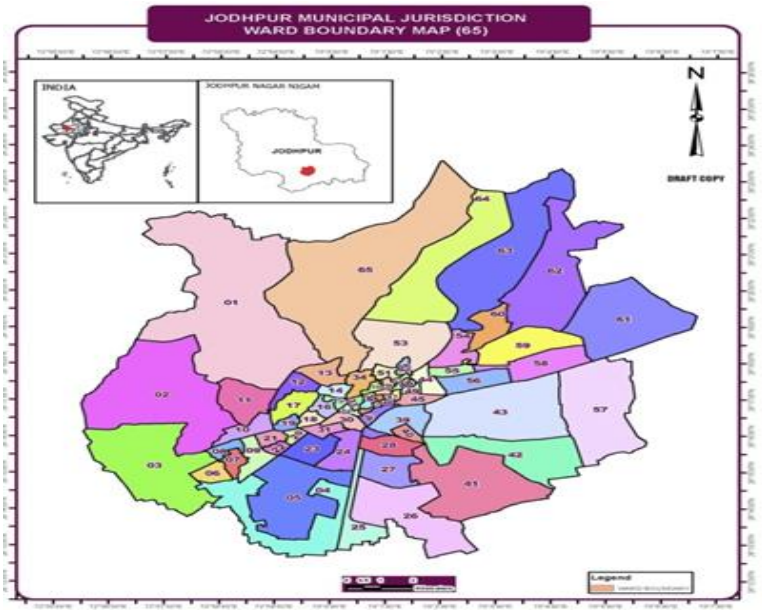
Study Area

Jodhpur city is in the west of Rajasthan at 26°18′ north latitude and 73°10′ east longitude on the eastern end of Thar desert and it is situated at an altitude of 241 meters above sea level. Jodhpur is the largest metropolis of the Thar Desert located in the west of India, and is also the second largest metropolis of Rajasthan after Jaipur. Which is 250 km from the Pak International Border in the west. The distance of is settled. The city of Jodhpur is 340 km south-west from Jaipur, the capital of Rajasthan. Is situated at this distance.

Urban Land Use Change from 1990-2020

Between 1990 and 2020, a comparative study of land use and land cover data in Jodhpur city has been done in a span of 30 years. After studying the intervals of ten years, now looking at the data of population and land use between the years 1990 to 2020 shows that in the census year 1991, the total urban population of Jodhpur city was 6,66,279, which was 8 in the year 2001. 56,034 and increased to 11,37,815 in the latest census year 2011, this ever-increasing population reflects the increasing urbanization of Jodhpur city. In the year 1990, the total urbanized area of Jodhpur city was 23,299, 43 hectares, in which the developed built-up area of the city was 7,665.77 hectares, which was 32.90 percent of the total urbanized area, which in the year 2020 is the highest increase of 16.91 percent in these 30 years. With this, it has become 11607.52 hectares, which has become 49.81 percent of the total urbanized area. This

growth, the increasing population pressure on the city due to the increasing urban population and external immigration has converted the urban vacant land and agricultural land into residential and non-residential areas, due to which there has been a considerable decline in agricultural land.



In the year 1990, agricultural land was 7515.18 hectares, which was almost equal to the built-up land area, but by 2020, with a decline of 16.54 percent, this increasing population limited the agricultural land of urban fringe areas to 3760.99 hectares. At the same time, the increasing external migrant population and internal lower-class population in the city have also encroached on the forest land and hilly areas and set up residential slums. In 1990, there was forest area on 20.73 percent of the total urbanized area, which has decreased by 1.15 percent in the year 2020. In 1990, the mining area was 109292 hectares, which increased to 1179.44 hectares with an increase of 0.37 percent in 30 years. The main reason for this is the increasing internal demand and external exports of Jodhpuri Timber Chitar stone. In other land use categories, there has been 1.52 percent increase in barren land, 0.10 percent increase in water body and 1.21 percent decline in grass and pasture land.

Table 01: Land Use & land cover changes in Jodhpur City, 1990-2020

#	Classes of land use/ sub-classes	Area in Hect. (1990)	Area (%) (1990)	Area in Hect. (2020)	Area (%) (2020)	Changes (1990-2020)
1.	Built-up land	7,665.77	32.90	11607.52	49.81	16.91
2.	Agriculture land	7515.18	32.68	3760.99	16.14	-16.54
3.	Forest land	4831.28	20.73	4563.17	19.58	-1.15
4.	Waste-land	1179.2	5.06	1533.88	6.58	1.52
5.	Water-Bodies	330.69	1.41	351.92	1.51	0.10
6.	Mining land	1092.92	4.69	1179.44	5.06	0.37
7.	Grassland/ Grazingland	584.26	2.50	302.52	1.29	-1.21
	Total	23,299.43	100	23,299.43	100	

Figure 02: Land Use & Land Cover Changes in Jodhpur City, 1990-2020 (Hectare area in Percentage)

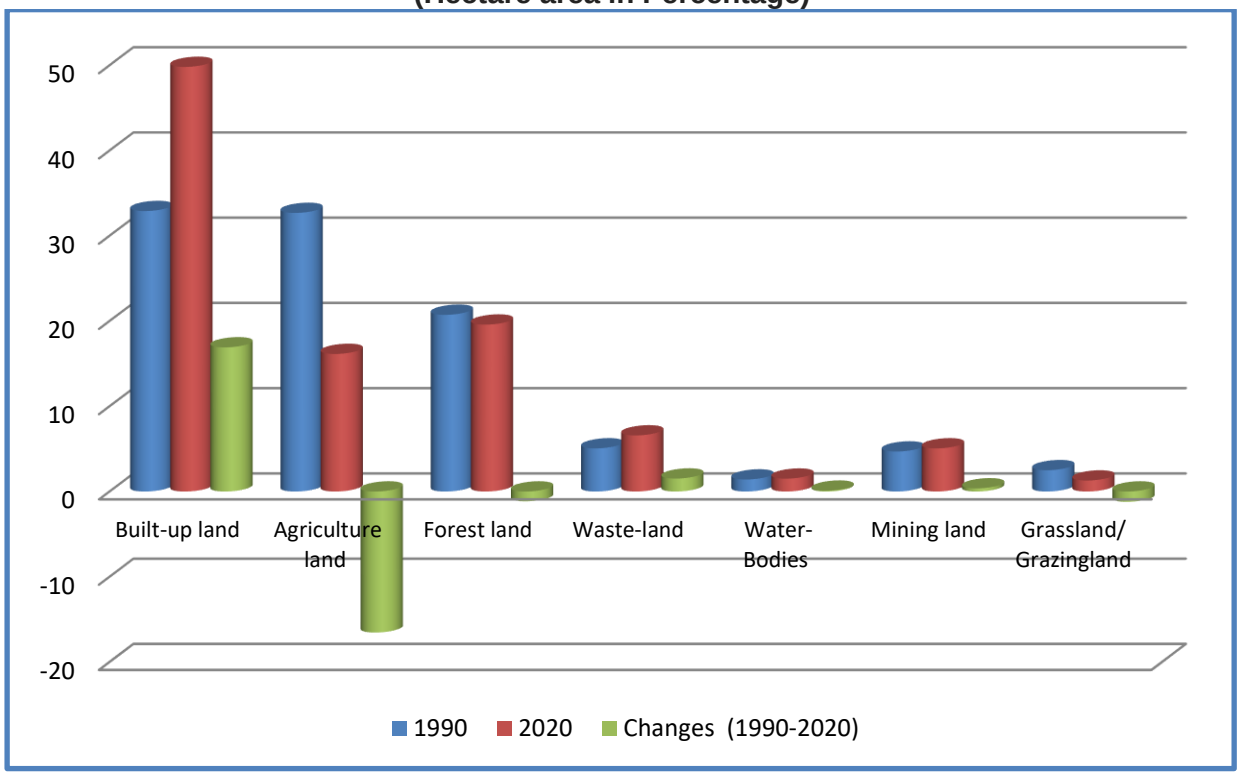


Figure 03: Land Use & Land Cover Changes in Jodhpur City, 1990-2020 (Hectare area in Percentage)

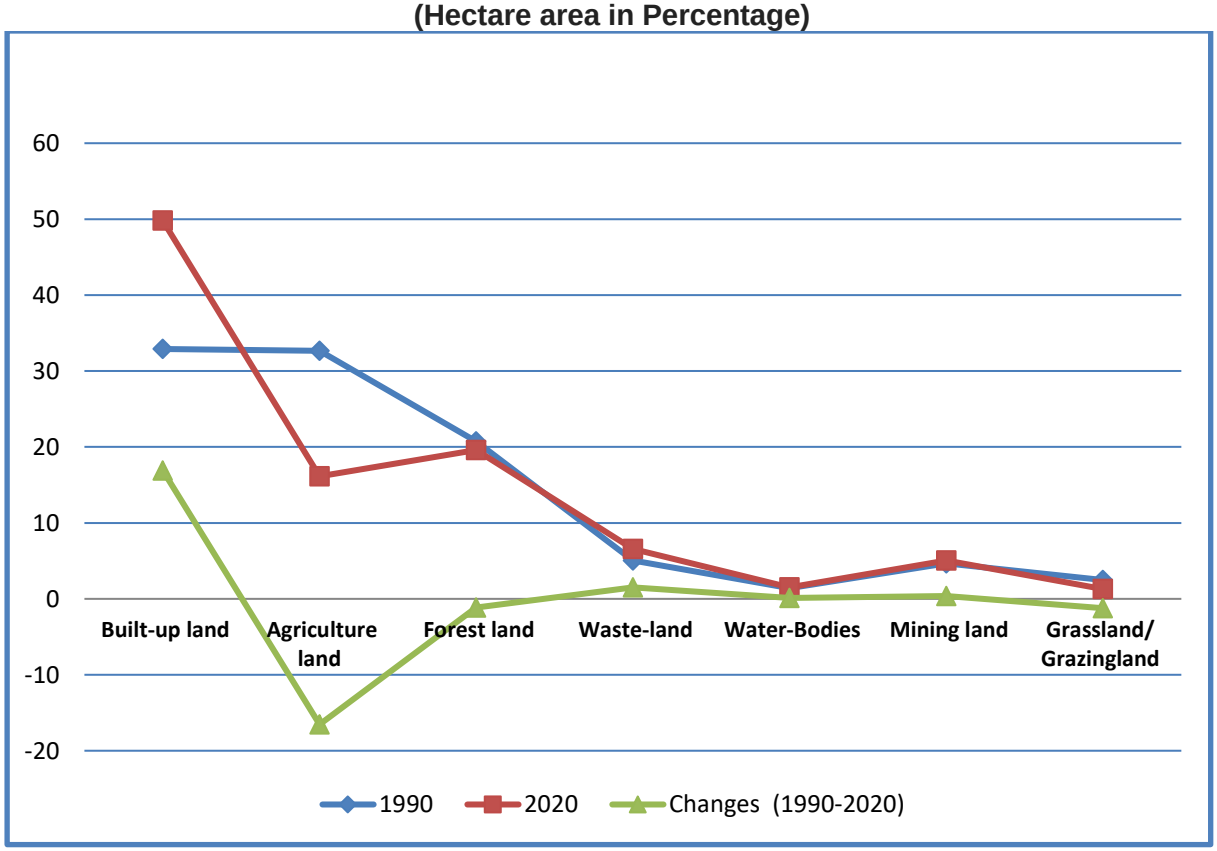
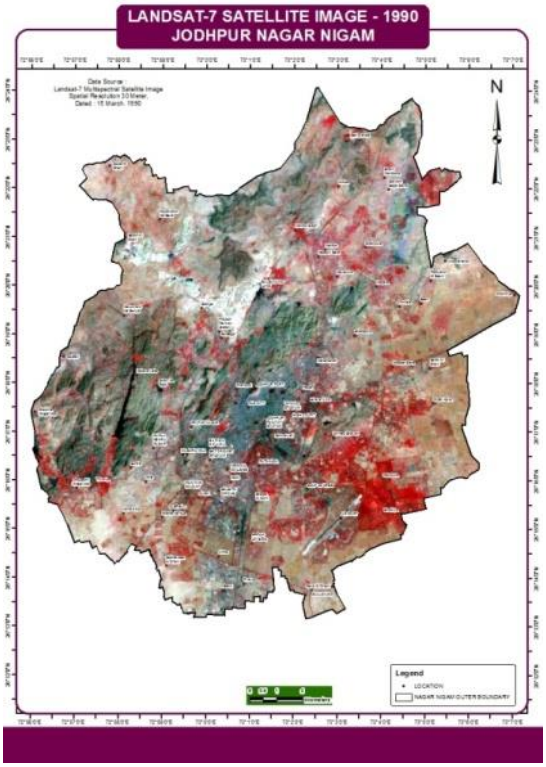
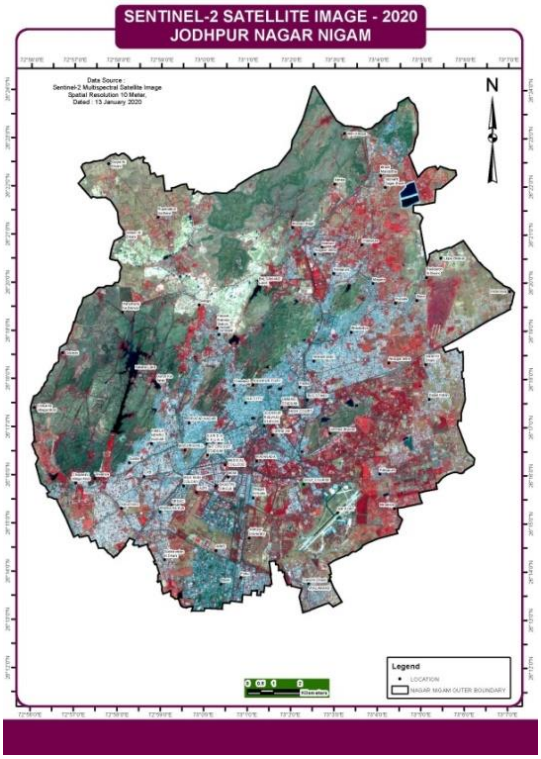
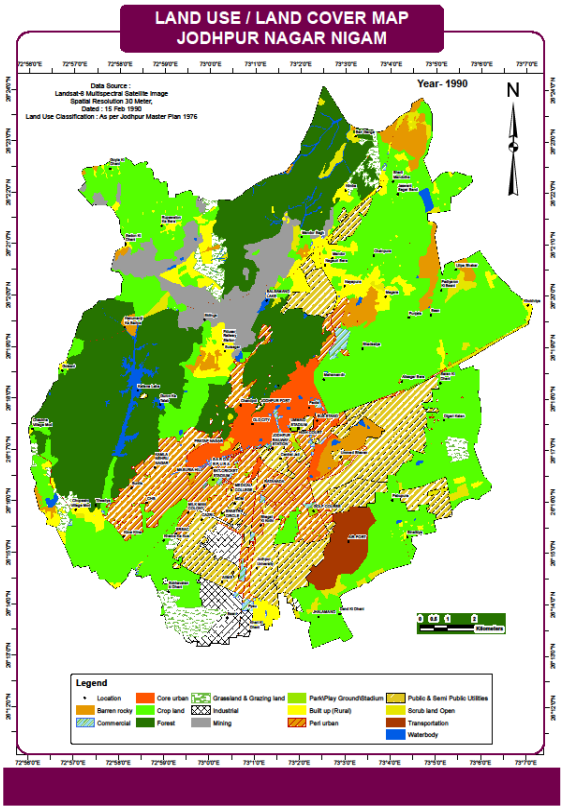


Figure 04: Land Use & land cover changes in Jodhpur City, 1990-2020







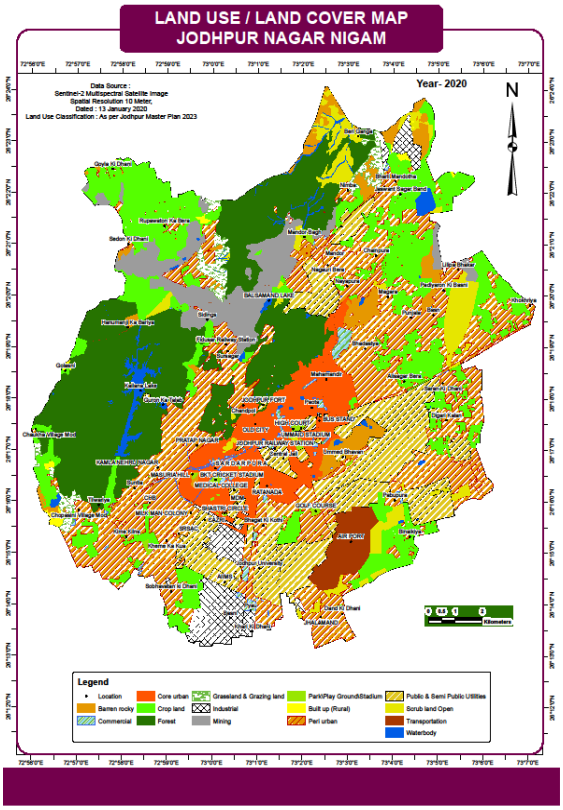


Table 02: Land Use & land cover changes in Jodhpur City, 1990-2020

#	Classes of land use/ sub-classes		Area in Hect. (1990)	Area (%)	Area in Hect. (2020)	Area (%)	Changes (1990-2020)
	LEVEL-I	**LEVEL-II**	**(in Hect.)**	**(%)**	**(in Hect.)**	**(%)**	**(%)**
1	Built-up Land	1 (core urban)	719.39	3.09	1761.97	7.56	+4.48
		2 (Peri urban)	2087.67	8.96	5635.53	24.18	+15.22
		Total Built-up Land	**2807.06**	**12.05**	**7,397.5**	**31.74**	**+19.69**
		3 (Industrial)	472.96	2.03	705.64	3.03	+0.99
		4 (Commercial)	186.87	0.8	211.51	0.90	+0.1
		5 (public & semi-public)	2569.92	11.03	2678.14	11.49	+0.46
		6 (transportation)	442.33	1.9	444.33	1.90	00
		7 Park/playground/stadium	74.17	0.32	101.81	0.43	+0.11
		Built-up rural)	1112.53	4.77	68.59	0.29	-4.48
		Total Development Area	**7,665.77**	**32.90**	**11,607.52**	**49.82**	**+16.91**
2	Agricultural Land		7615.18	32.68	3760.99	16.14	-16.54
3	Forest Land		4831.28	20.73	4563.17	19.58	-1.15
4	Waste-land	**(ii)** Barren rocky	794.54	3.41	714.89	3.06	-0.35
		(ii) Scurb land open	384.66	1.65	818.99	3.51	+1.86
		Total Waste-land	**1179.28**	**5.06**	**1533.88**	**6.58**	+1.56
5	Water-Bodies		330.69	1.41	351.92	1.51	+0.10
6	Mining		1092.98	4.69	1179.44	5.06	+0.37
7	Grassland/ Grazingland		584.26	2.5O	302.52	1.29	-1.21
		Total Development	**15,633.67**	**67.07**	**11,691.52**	**50.18**	**-16.89**
		Vacant Land	**23,299.44**	**100**	**23,299.43**	**100**	

Study and Analysis of Impacts on Economy and Environment due to Land Use Change of Jodhpur City

Changes in land use and land cover affect not only socioeconomic activities but also a city's environmental quality and quality of life, both aspects that affect human well-being. Changes in habitat, water and air quality, and quality of life are some of the environmental, social, and economic concerns associated with land use and land cover change.

Effect on the economy due to change in land use of Jodhpur city Due to change in land use in Jodhpur city: the following positive and negative effects are visible on the economy.

Positive Impacts

1. Development of New Residential Settlements: As the city of Jodhpur has developed and grown, urban vacant land and marginal agricultural land have been transformed into built-up land, such as outdoor open and clean environment, open roads, less congestion. New residential settlements with facilities are being constructed. Due to which the problems like overcrowding, narrow streets, traffic inconvenience, dilapidated old buildings in the inner part of the city were also reduced.

2. Promotion of urbanization: Both urbanization and land use change complement each other. Increasing urbanization is the biggest factor in land use change. On the one hand, as urban land use changes, so does the degree of urbanization. The total urban population of Jodhpur city was 6,66,279 in the census year 1991, which increased to 8,56,034 in the year 2001 and 11,37,815 in the latest census year 2011, this continuous increasing population reflects the increasing urbanization of Jodhpur city. Whereas in the year 1990, the total urbanized area of Jodhpur city was 23,299.43 hectares, in which the developed built-up land area of the city was 7,665.77 hectares, which was 32.90 percent of the total urbanized area. Which increased to 11607.52 hectares with the highest increase of 16.91 percent in a span of 30 years in the year 2020, which became 49.81 percent of some urbanized area.

3. Increase in the land revenue of the city: Due to increasing urbanization, there will also be an increase in the built-up areas (residential, commercial, business and industrial areas), due to which local urban bodies like Municipal Corporation and Jodhpur Urban Development Authority will issue building permission, name transfer, Issuance of patta, sale permission and also for non-residential areas, by collecting city tax separately, will get its land revenue income. Which can be used in other urban development works.

4. Utilization of vacant, barren land for residential purpose: In urbanization another encroachment on rural agricultural land and forest land has resulted in construction of new residential settlements, but vacant and uncultivated land in the city has also been utilized for residential construction works.

5. Benefits to Property Dealers and Builders: Due to increasing urbanization of Jodhpur city, residential, commercial, business and industrial activities have also increased, due to There has also been an increase in construction work. The builders also get the means of earning their income to meet the residential needs of the growing population in the city.

6. Employment opportunities are also promoted: Urban expansion promotes urban land use change due to increasing residential, industrial, commercial, and business activities in the city. At the same time, with the increase in urban construction work, employment opportunities for skilled and semi-skilled labourers and **other categories of people are also promoted.**

7. Encouragement to the construction works of various schemes of the Centre and the State: With increasing urbanisation, the increasing urban land use change has encouraged the construction works of various schemes of the Centre and the State in the city.

8. Establishment of new institutions and offices: Along with the increasing trend of urbanization, the changing land use of the city has also encouraged the establishment of new development works and institutions. In the inner part of Jodhpur city, due to paucity of land and increasing population pressure, new institutions have been established in the open and peaceful environment of the city. Ayurveda University, National Law University, Indian Institute of Technology (IIT), Rajasthan High Court, Sardar Patel Police, and Dandita Vishwavidyalaya are prominent among the institutions established in the outskirts of the city.

(b) Negative Impacts:

1. Continuous decline in agricultural land: In the city of Jodhpur, between 1990 and 2020, the maximum change in land use and land cover data has been seen in urban built-up land area and agricultural land. In this too, the maximum increase was 12.22 percent in the built-up area between 1990 and 2000, which increased from 7,665,77 hectares to 10,513.43 hectares. The maximum decline is also seen in 11.69 percent of agricultural land during these ten years.

2. Unemployment: Due to the increasing urbanization of Jodhpur city, while the urban area is expanding on the one hand, on the other hand, due to the increasing urban pressure on the border rural land, agricultural land is becoming limited, and agricultural land is continuously being converted into residential settlements. Due to which the farmers engaged in agriculture

are becoming landless. Due to which the farmers have become in the categories of agricultural unemployed. The rate at which agricultural land is being destroyed needs serious consideration by planners and policy makers.

3. Emergence of Slums: The increasing use of land also affects the cost of land. Due to the increasing cost of land, common people are not able to buy expensive land in the city, due to which a special category emerges in the city. The lower categories of people who have come to the city from villages and other outlying areas in search of employment can neither buy nor pay the rent, so they live on the side of the main roads of the cities, vacant land, or forest land and by cleaning the hill lands, slums are made which later develop into new slums. Which is currently the biggest problem of cities.

4. Decreasing Forest Area: Bad land use due to increasing urbanization in Jodhpur has not only reduced agriculture, but has also changed forest land. The growing population of outside migrants and internal low-class population in the city has also encroached on forest land and hilly areas and set up residential slums. In the year 1990, the forest area was 4831 28-hectare, which was 20.73 percent of the total urbanized area, but after 30 years, it decreased by 115 percent in the year 2020 to 4563 17 hectare.

5. Urban encroachment on rural land: The increasing built-up land use of the city of Jodhpur has led to expansion in the urban fringe areas as well. As the population of the city has increased, the spread of the city has gradually increased towards the nearby villages, due to which the encroachment on the rural agricultural land is increasing and the agricultural land is being converted into residential settlements. In the year 1990, 1112.53 hectares of rural land under the municipal corporation area, which was 477 percent of the total city built-up area, but by the year 2020, with a decline of 4:48 percent in 30 years, it has remained only 68.59 hectares, which is the total built-up area. 0:29 percent remained. This is becoming clear from the situation (5.1 from the land use map).

6. Emergence of upper and lower classes: Due to increasing urbanization, on the one hand, economic disparity has led to the emergence of upper- and lower-class categories in cities, due to which differences are seen in urban residential settlements. On one hand the people of upper and rich classes live in multi-storied buildings, on the other hand the people of lower and middle class live in low and slums.

7. Urban Sprawls has resulted in loss of productive agricultural land, loss of open green spaces and surface water bodies.

Impact on Environment Due to Change in Land Use of Jodhpur City

1. Degradation of natural green areas: Any construction work not only changes the natural form, but also affects the local ecosystem there. Due to the increasing construction activities in the city (such as construction of buildings, road construction, construction of big bridges, establishment of new institutions, etc.), natural agricultural land area, grass land area, forest area is being destroyed by cutting and cleaning. These forest areas and grasslands, which are the shelter of wild animals, are being destroyed, due to which the entire local ecosystem is also being affected.

2. Changes in Urban surface energy: After the construction of urban infrastructure, there have been changes in the surface energy, where on the one hand there has been a decrease in the underground seepage of rain water, on the other hand there has been an increase in solar radiation due to the hard roads of asphalt and cement and tall buildings. Due to absorption, temperature difference is seen in the inner parts as compared to the open areas. In summer, the inner parts of the city become the city's heat island.

3. Decline in Urban Ground Water Level: With increasing urbanization, continuous changes are taking place in the land use configuration. Due to increasing construction works in cities, increasing network of hard roads, footpaths, parking etc., the runoff rain water does not seep into the land during the rainy season. This water flows in vain through urban drains, due to which there has been a continuous decline in the underground water level in the inner and nearby areas of the city.

Conclusion

It is clear from the above analysis that in 30 years from the year 1990 to the present 2020, the increasing natural population growth of the city and the out-rural and other nearby small urban immigrants have changed the land use situation of the city. Where in the year 1990, the total urbanized area of the city was 23:299:44 hectares and the total population was 6,66,279, in which the total urban developed built-up land area was 7,665.77 hectares and agricultural land area was 7615.18 hectares, which constituted 32.90 percent of the total urbanized area- Land area and 32.68 percent of the area is agricultural land, while in the year 2000, the total built-up land area increased by 12.5 percent to 10513.43 hectare.

With an increase of 22 percent - 1051343 hectares (45.12%). With an increase of 4.75 percent in the year 2010, it has increased to 11,500.84 hectares (40.75%) and in 2020 with an increase of 0.07 percent, it has increased to 11,607.52 hectares. At the same time, in the year 1990, the agricultural land was 7.665.77 hectares, which was 32.08 percent of the total urbanized area, while in the year 2020, with a decline of 16.1654 percent, it is 3.760.99 hectares, which remained only 16.54 percent of the total urbanized area. The maximum land use change has occurred in built up land area and agricultural land. This change is due to increasing urbanisation, population growth rate, out-migration, urban congestion, congested streets, worse traffic, old dilapidated buildings, lack of cleanliness, etc. difficulties in outer fringe areas of the city and open and calm environment of rural land. attracted people.

Between 1990 and 2020, not only there has been a change in urban built-up area, rural built-up area, and agricultural land, but also fluctuations have been seen in forest land mining, barge, and pass and pasture land. Where the total forest area in the year 1990 was 4831.28 hectares, which is 20.74 percent of the total urbanized area, but it remained 19.72 percent in the year 2000, 20.0 percent in 2010 and 19.58 percent in 2020. Thus, from 1990 to 2020, there has been a decline of 1.16 percent in forest land. The mining area was 1092.92 hectares in 1990, which increased to 1179.44 hectares in 30 years with an increase of 0.37 percent, the main reason for this is the increasing internal demand and external exports of Jodhpuri building ash.

Thus, it can be said that in Jodhpur city between 1990 and 2020, maximum change in land use and land cover data has been observed in urban built-up area and agricultural land. In

this too, the maximum increase was 12.22 percent in the built-up area between 1990 and 2000, which increased from 7,665.77 hectares to 10,51343 hectares. At the same time, maximum decline is also seen in 11.69 percent agricultural land during these ten years. However, since 1990, this north-up and down is seen in all the land use categories at an interval of ten years, while the maximum increase has been in the built-up area and the decline has been in agricultural land.

This change is the gradual conversion of agricultural land to built-up land such as industrial, residential, commercial, and other urban uses without any systematic development planning. Similarly, forest area, barren land, and grass land and pasture land have been converted into agriculture and built-up area. These problems require the immediate attention of planners and administrators. The sprawl of the city leaves a significant impact on the land use pattern, which shows a tendency towards built-up areas, growing in an unplanned manner along main roadways. The rate at which agricultural land and forest land is being destroyed needs serious consideration by the planners and policy makers. Thus, the increasing population growth of the city has changed the internal geomorphology of the city itself. Thus, there is an urgent need to check unplanned urban expansion not only within the city but also in the surrounding areas. This study proves that the integration of GIS and remote sensing technologies is an effective tool for urban planning and management.

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