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Land use land cover change detection in Jalgaon district, Maharashtra: A geographical study (2005-2015)

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Abstract

One of a nation's most valuable natural resources is its land. Both land use and land cover refer to human activities, such as built-up (Residential, Commercial, Agricultural land, and Recreation areas) land. In contrast, natural vegetation, water bodies, and hilly areas comprise the land cover. Jalgaon district as the study region used data and the map extracted from the Bhuvan website. Available data is divided as per requirements such as LULC class as well as Rural and Urban Categories. With the aid of computer programs, including MS Excel, the analytical approach was applied for the current study to generate several graphical presentations. Including the mapping methods used in cartography data analysis data on land use and land cover of the Jalgaon district reveals a sharp rise in the amount of developed land and a sharp decline in the amount of agricultural and vegetative cover inside the study region limits.

Keywords: Land use, land cover, urbanization, urban area, rural area, urban sprawl

1. Introduction

Stamp first introduced the concept of land use in 1962. All of the country's legitimate and necessary needs should be met by the land (Stamp, 1930) ^[17]. According to Nanavati, land usage and conservation are related (1951). To use land resource that is accessible requires strong scientific, rational, and economic preparedness. On the other hand, we also need to maintain the ecological and socioeconomic balance (Mohammad, 1980) ^[18]. For human development, land use and land cover are essential (Doke, 2017) ^[3]. One of each nation's most valuable natural resources is its land. A common phrase is the human modification of the Earth's surface is "land use/land cover change." A significant portion of supervision of natural resources is also used to actualize the outcome of the man-made action in the surrounding environment.

Change detection is the practice of spotting alterations in an object or phenomenon's state through repeated observation. The ability to measure temporal impacts utilizing multi-temporal data sets is essentially involved. Change detection is one of the primary uses for remotely sensed data from Earth-orbiting satellites due to the repeating coverage at frequent intervals and consistent image quality (Anderson, 1976) ^[19]. The rapid changes in Land Use and Land Cover (LULC) that are linked to the city's growth may be mostly due to the growth. Over the past few decades, the Earth's terrestrial surfaces have seen significant changes as a result of the global trend of economic expansion and population growth. When a big number of people were residing in cities in the 19th and 20th centuries urbanized societies were developed. The ratio of villagers moving to cities depends on the area's desire for a higher quality of life and new employment opportunities (Davis, 1955) ^[20]. Urbanization is closely linked to modernization, industrialization, and the sociological process of rationalization.

Though people have been altering the land for thousands of years to obtain food and other necessities, the current rates, extents, and intensities of land use/land cover change are much greater than at any other time in human history, leading to unprecedented changes in ecosystems and environmental processes at local, regional, and global scales. The biggest environmental issues facing the human population today, such as climate change, biodiversity loss, and water, soil, and air pollution, are all impacted by land use and cover changes. Researchers and policymakers worldwide now place a high premium on monitoring and mitigating the negative effects of land use and land cover change while maintaining the production of key resources (Erle and Pontius, 2007) ^[21].

In Present study elaborates on LULC change detection and analyses the impact of urbanization on land resources and its use changes in the Jalgaon district from 2005 to 2015. The present article has shown changes in urban–rural residential-industrial (Built-up) areas, agriculture, forest, etc. Hence, land use and land cover change have become an important component for research because the demand for land resources increasing continuously within the proportion of the population at the local to global level. So that in current strategies for managing natural land resources and monitoring environmental changes for sustainable environmental planning and management LULC change detection study become the need of time for sustainable human being survival.

1.1 Objectives

The proposed research study has the following objectives-

1. Discuss the relationship between the population and Urban sprawl in the study region.
2. To assess land use land cover changes from 2005 to 2015 in Jalgaon District.
3. To examine comparatively the Land use Land cover changes of the rural and urban areas in Jalgaon District.

1.2 Methodology

The proposed research work is fully dependent on secondary data. Data was collected from various secondary sources as per requirement. Population data was collected from the Census Handbook of the year 1981, 2001, and 2011. Data related to urban land use and land cover are collected from the Bhuvan portal in form of statistics and maps. Google Earth and Bhuvan software's also used for the actual and current status of the urban land use Land cover of Jalgaon District.

The analytical method was used for the present study with the help of computer applications i.e. MS Excel was used for the tabulation and prepared various graphical

presentations. As well as the cartographic techniques use for mapping. Percentile, and mean were used to analyze and interpret the concerned data related to the land use land cover area of the study region.

1.3 Description of Study area

The Khandesh region's significant district of Jalgaon is located in northwestern Maharashtra. Jalgaon District is part of the Nashik division. The growing of bananas is well-recognized in the area. Its entire area is 117670.48 square kilometers. The area is bounded by latitudes 20°15' and 21°25' north and east. Longitudes 74°55' and 76°28' are located in the state's northernmost region, which borders Madhya Pradesh to the north. 11,762.70 sq. km is the total area of the district, and it is located in the Survey of India degree sheets 46 K, 46 L, 46 P, 55 C, 55 D, and 56 O. Madhya Pradesh borders the district on the north, Buldhana district to the east, Nashik and Dhule districts to the west, and South of the district of Aurangabad. According to the 2011 census, it has a total population of 4,224,442. There are 15 towns and 1519 villages in the area. According to the 2011 Census, there are 359 people per square kilometer. The district can be divided into three main physiographic divisions: the alluvial plain of Tapi Valley in the center of the district; the Satpuda Hill Ranges, which flank the hill ridges and small valleys in the district's northern part; and the Ajanta Hill Ranges, which are located in the district's southern part. Tapi basin covers the majority of the district. The primary river in the region is called Tapi, and its important tributaries include the Bhokar, Aner, Suki, Morna, Harki, Manki, and Gul rivers in the north and the Purna, Girna, Bahul, Bori, and Vaghur rivers in the south less than 500 mm of rainfall occurs annually. The range for the maximum summer temperature is 39-43 °C, and the range for the lowest winter temperature is 12-15 °C. The relative humidity ranges from 12% to 87%. (Kaul & Ingle, 2012) [7].



Map 1: Maharashtra State



Map 2: Jalgaon District (Location of the Study Area)

2. Results and Discussion

2.1 Urban Sprawl in the Study Region

The term "urbanization" (or "urbanization") describes the process by which individuals move from rural to urban regions, the concomitant decline in the number of people living in rural areas, and how societies adjust to this transition. It is primarily the process by which towns and cities are created and enlarged as more people move into urban centers to live and work. The percentage of the population living in urban areas is referred to as urbanization. The process of urbanization promoted urban sprawl, also known as sprawl or suburban sprawl, which is the fast rise in the geographic size of cities and towns. It is frequently characterized by single-use zoning, low-density residential housing, and an increased reliance on private automobiles. Urban sprawl is a result of a demand for more living space and other residential amenities, though it is also a result of the necessity to accommodate a growing urban population in many metropolitan areas.

In Jalgaon district, not a different scenario of urban sprawl in comparison to state, national, and global levels. The population has increased due to natural as well as migration factors. Migration flow is mainly set in the study region from rural to urban areas due to the attractions of urban living standards. Table no. 1 shows the population of all towns of Jalgaon district increasing continuously from 1981

to 2011. Jalgaon city has the constant on the first rank in the case of population growth. Then Bhusawal and Chalisgaon randomly have second and third ranks followed by Jalgaon. Muktainagar, Bodwad, and Savda have recorded continuously the lowest population growth in Jalgaon District. On the other hand, the total population growth of towns and cities in the Jalgaon district has 6, 73,493 from 1981 to 2011. Table. No.2 shows that the above-discussed towns have the same ranking in the percentage of population growth out of the total population growth from 1981 to 2011 of towns and cities in the Jalgaon district. So growing population in the study regions migrated from rural and urban areas creates pressure on existing land for the fulfillment of their requirements like housing, commercial, industrial, and recreation, etc. That is why the geographical areas of each town extended in course of time resulting in unplanned urbanization as well as urban sprawl. Also, the issue results in the degradation of wildlife habitat and the fragmentation of remaining natural regions by increasing the physical and environmental "footprints" of town areas. Jalgaon, Bhusawal, and Chalisgaon have faced various problems are stated above in present as well as in the future these problems becoming serious for human beings. So we need sustainable development planning for these towns in the study regions.

Table 1: Towns/ City Population of Jalgaon District

| Sr. No | Town/City | Population 1981 to 2011 | | | Population Growth 1981-2011 |
|--------|-------------|-------------------------|----------|----------|--------------------------------|
| | | 1931 | 2001 | 2011 | |
| 1 | Amalner | 67,516 | 91,490 | 95,994 | 28,478 |
| 2 | Bhadgaon | 16099 | 16443 | 37,214 | 21,115 |
| 3 | Bhusawal | 1,32,142 | 1,87,564 | 211575 | 79,433 |
| 4 | Bodvad | 13274 | 19513 | 24221 | 10,947 |
| 5 | Chalisgaon | 59,342 | 91,110 | 1,08,181 | 48,839 |
| 6 | Chopda | 40,931 | 60,865 | 72,783 | 31,852 |
| 7 | Dharangaon | 28,736 | 33,625 | 35,375 | 6,639 |
| 8 | Erandol | 22,797 | 30120 | 31,071 | 8,274 |
| 9 | Faizpur | 17,629 | 23,694 | 26,602 | 8,973 |
| 10 | Jalgaon | 1,45,335 | 3,68,618 | 4,60,228 | 3,14,893 |
| 11 | Jamner | 19932 | 36386 | 46,762 | 26,830 |
| 12 | Muktainagar | 10144 | 18408 | 23970 | 13,826 |
| 13 | Pachora | 31,564 | 45,333 | 59,817 | 28,253 |
| 14 | Parola | 24,328 | 34,799 | 37,666 | 13,338 |
| 15 | Raver | 20,346 | 25,993 | 27,039 | 6,693 |
| 16 | Savda | 15,989 | 19,332 | 20,584 | 4,595 |
| 17 | Varangaon | 26,553 | 35279 | 35,411 | 8,858 |
| 18 | Yawal | 25,049 | 31,803 | 36,706 | 11,657 |

Source: Census Handbook 1981, 2001, 2011

Table 2: Towns/ City Population Change in Jalgaon District

| Percentage (%) of Population growth out of the total population growth of towns and cities in Jalgaon District from 1931 to 2011 | | | | | |
|----------------------------------------------------------------------------------------------------------------------------------|---------------------|------------|---------------------|-----------|--------------------|
| Town/City | Population Growth % | Town/city | Population Growth % | Town/City | Population Growth% |
| Amalner | 4.23 | Chopda | 4.73 | Jamner | 3.98 |
| Bhadgaon | 3.14 | Dharangaon | 0.99 | Bodvad | 1.63 |
| Bhusawal | 11.79 | Erandol | 1.23 | Savda | 0.68 |
| Muktainagar | 2.05 | Faizpur | 1.33 | Parola | 1.98 |
| Chalisgaon | 7.25 | Jalgaon | 46.36 | Raver | 0.99 |
| Varangaon | L32 | Pachora | 4.19 | Yawal | 1.33 |

Source: Census Handbook 1981, 2001, 2011

2.2 Land use Land Cover of Jalgaon District (2005-06)

Table 3: LULC of Jalgaon District (2005-06)

| LULC: information for Jalgaon District for 2005-06 | | | |
|--------------------------------------------------------------------------------------------|---------------|-----------------------------------------------------------------|----------------|
| Urban | | Rural | |
| LEL C Class | Arm (M. Tim.) | LULC Class | Area (Sq.K.m.) |
| Built-Up. | 82.33 | Built-up. | 91.96 |
| Built-Up, Mining | 0.89 | Agriculture, Cropland | 7577.82 |
| Agriculture, Plantation | 666.48 | Agriculture, Fallow | 615.96 |
| Forest. Deciduous | 1233.95 | Forest. Saul) Forest Barrcn/unculturable/ Wastelands, Sent land | 505.33 |
| Barren/unculturable/ Wastelands, Gullied/Ravinous Land | 143.79 | Wed ands/Wales Bodes. River/Stream/canals | 400.72 |
| Barren/unculturable! Wastelands_ Barren rocky Wetlands/Water bodies. Reservoir/Lakes/Ponds | 29.74 | | 250.25 |
| | 105.67 | | |
| Total Urban Area - | 2322.9 | Total Rural Area- | 9442.09 |
| Total Geographical Area of Jalgaon District (Urban A-Rural) =11765 Area Sq. Km. | | | |

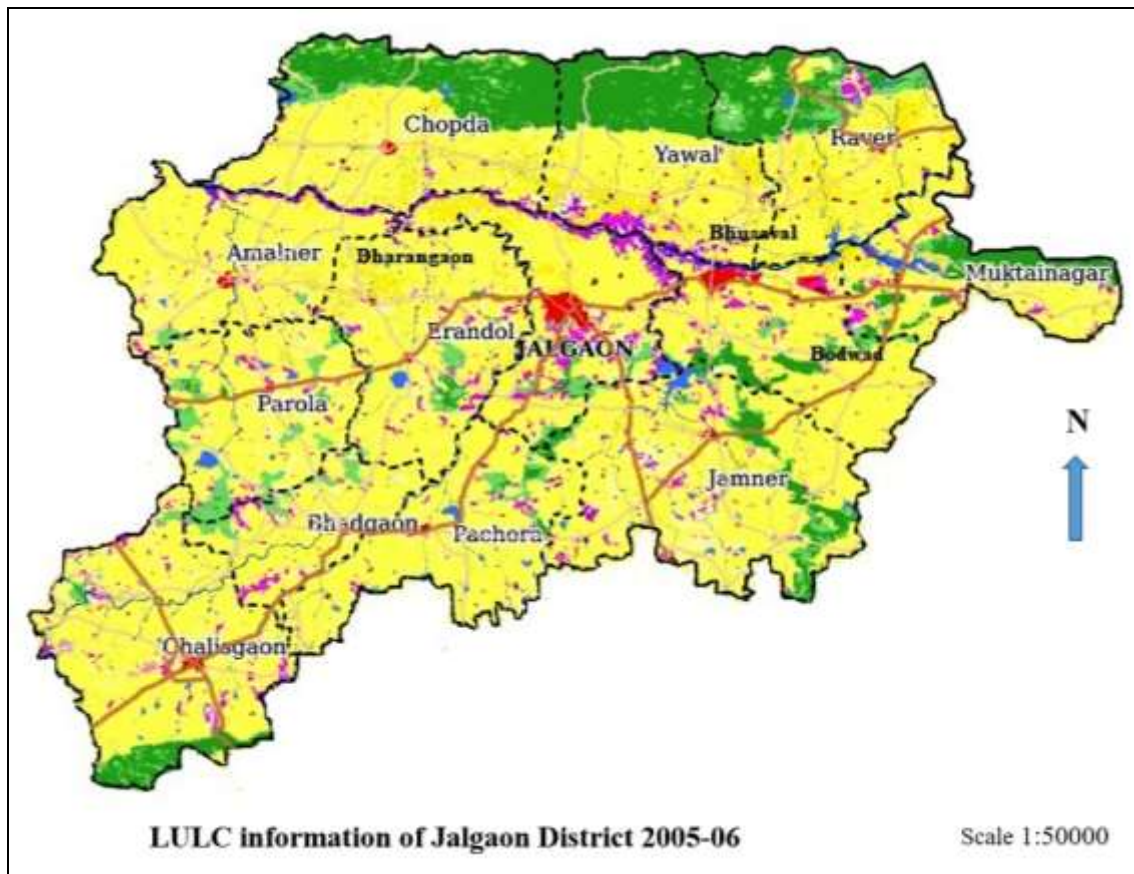
Source: <https://bhuvan-app1.nrsc.gov.in>

The above Table no. 3 shows the LULC of the Jalgaon district of 2005-06 Agricultural land, forest/vegetation, built-up areas, water bodies, and fallow land are all included in the categories or class of land use and land cover with rural and urban area comparison in the study region. The total research area is approximately 11756 square kilometers. Which falls under Jalgaon District. This total study region area is considered in rural and urban broad categories. A total of 175.23 sq. km area, is built-up land in the Jalgaon district. All land uses, including residential, commercial, industrial, public, and semi-public land utilities

and services, are regarded as built-up areas in this context, it is crucial to remember. Out of the total built-up area 83.27sq.km.is urban and 91.96 sq. km. is rural. In the study region, 8244.3 sq. km. area came under the agricultural cropland categories which are divided into 666.48 sq. km. for urban and 7577.82 sq. km. for rural areas. Here, 615.96 sq. km. area is available as agriculture fallow land in the Jalgaon district. Out of the total study area, 1794.33 sq. km. area is under the forest LULC class. The study region 1288.95 sq. km. share is an urban Forest area and 505.38 in the rural forest area. Barren or unculturable LULC class covered 178.53sq. Km. area in the urban sector and 400.72

sq. km. ravenous in the rural sector. Total 355.92 sq. km. area occupied by water bodies. Out of this, 105.67 Sq. km.

the area belongs to the urban zone and 250.25 sq. km. area to the rural zone.



Source: <https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php>

Map 3: LULC of Jalgaon District (2005-06)



2.3 The Land Use Land Cover of Jalgaon District (2015-16)

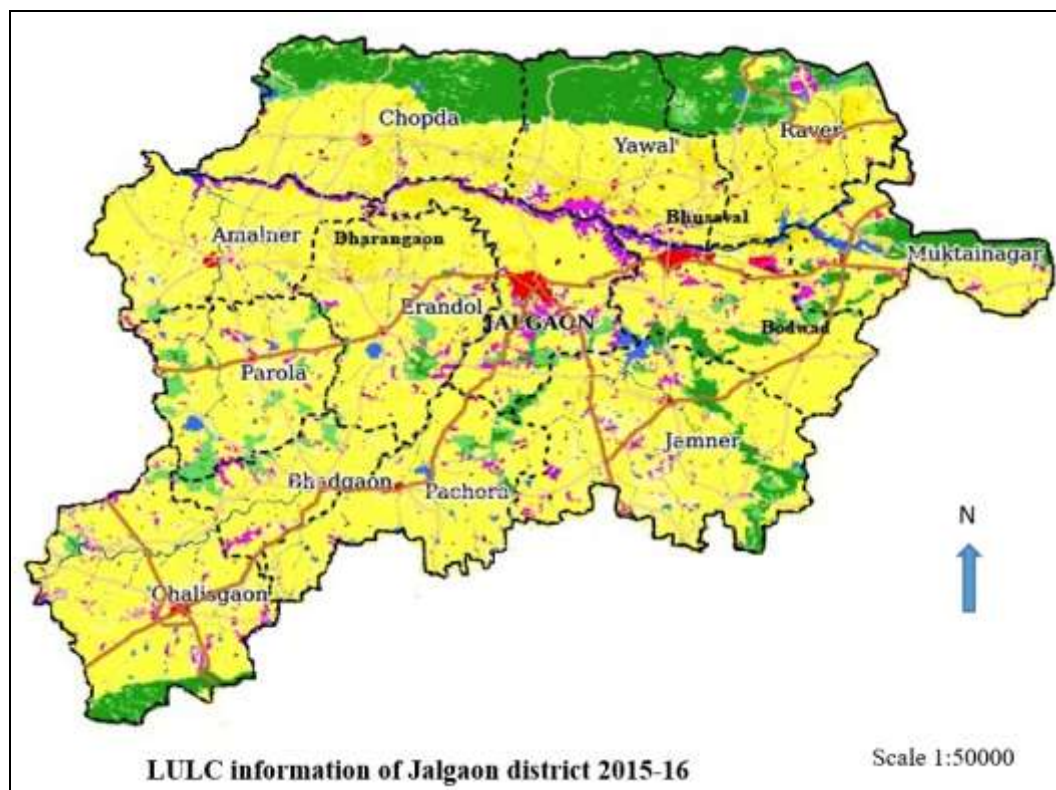
Table 4: LULC of Jalgaon District (2015-2016)

| LULC Information for Jalgaon District for 20015-16 | | | |
|-------------------------------------------------------------------------|----------------|--------------------------------------------|----------------|
| Urban | | Rural | |
| LULC Class | Area (Sq. Km.) | LULC Class | Area (Sq. Km.) |
| Built-up, | 125.6 | Built-up, | 176.45 |
| Built-up, Mining | 3.97 | Agriculture, Cropland | 6975.51 |
| Agriculture, Plantation | 557.78 | Agriculture, Fallow | 1146.31 |
| Forest, Deciduous | 1282.33 | Forest, Scrub Forest | 500.36 |
| Barren/unculturable/ Wastelands, Gullied/Ravinous Land | 154.25 | Barren/unculturable/ Wastelands, Scrubland | 381.71 |
| Barren/unculturable/ Wastelands, Barren rocky | 27.87 | Wetlands/Water Bodies, River/Stream/canals | 255.82 |
| Wetlands/Water Bodes: Reservoir Lakes Ponds | 177.04 | | |
| Total Urban Area - | 2328.84 | Total Rural Area- | 1 9436.16 |
| Total Geographical Area of Jalgaon District (Urban +Rural) = 11765 Area | | | |

Source: <https://bhuvan-app1.nrsc.gov.in>

The distribution of various types of land use and cover, such as built-up areas, water features, vegetation, fallow land, wasteland, etc., is shown in Table No. 4. The Jalgaon District's entire research area is about 11756 sq. km. as the whole, the entire research region is divided into two major categories: rural and urban. The district of Jalgaon has built-up land covering a total area of 306.02 sq. km. Including residential, commercial, industrial, public, and semi-public utilities and services, all land uses fall under the built-up LULC class. 129.57 square kilometers of the total built-up area are urban, and 176.45 square kilometers are rural. 7533.29 sq. km of land in the research area fell under the

category of agriculture, which is further broken down into 557.78 sq. km of urban and 6975.51 sq. km of rural regions. Moreover, there is 1146.31 sq. km. of agricultural fallow land in rural areas. 1782.69 sq. km. of land fall under the forest LULC class in the Jalgaon district. The study region's forest area is made up of 500.36 sq. km. of rural land and 1282.33 sq. km. of urban land. Uncultivable or wastelands LULC class occupied 381.71 square kilometers in the rural sector and 182.12 square kilometers in the urban sector. Water bodies have a total area of 355.92 square kilometers. Of this, 105.67 square kilometers are in the urban zone and 250.25 square kilometers are in the rural zone.



Source: <https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php>

Map 4: LULC of Jalgaon District (2015-16)

| LEGENDS | |
|--------------------------------------------|-------------------------------------------------------|
| ■ | Builtup, Urban |
| ■ | Builtup, Rural |
| ■ | Builtup, Mining |
| ■ | Agriculture, Crop land |
| ■ | Agriculture, Plantation |
| ■ | Agriculture, Fallow |
| ■ | Agriculture, Current Shifting Cultivation |
| ■ | Forest, Evergreen / Semi evergreen |
| ■ | Forest, Deciduous |
| ■ | Forest, Forest Plantation |
| ■ | Forest, Scrub Forest |
| ■ | Forest, Swamp/Mangroves |
| ■ | Grass/Grazing |
| ■ | Barren/unculturable/Wastelands, Salt Affected Land |
| ■ | Barren/unculturable/Wastelands, Gullied/Ravinous Land |
| ■ | Barren/unculturable/Wastelands, Scrub land |
| ■ | Barren/unculturable/Wastelands, Sandy area |
| ■ | Barren/unculturable/Wastelands, Barren rocky |
| ■ | Rann |
| ■ | Wetlands/Water Bodies, Inland Wetland |
| ■ | Wetlands/Water Bodies, Coastal Wetland |
| ■ | Wetlands/Water Bodies, River/Stream/Canals |
| ■ | Wetlands/Water Bodies, Reservoir/Lakes/Ponds |
| ■ | Snow and Glacier |

2.4 LULC change in Jalgaon District (2005-06 to 2015-16)

Table 5: LULC change of Jalgaon District (2005-06 to 2015-16)

| LULC Change of Jalgaon district During 2005-06 to 2015-16 | | | | |
|-----------------------------------------------------------|---------------------------|---------|-------------|--------------------------------------------------------------|
| Urban | | | | |
| LULC Class | Area (sq. Km) Change area | | | Percentage out of total LULC LULC Change% |
| | 2005-06 | 2015-16 | LULC Change | |
| Built-up, | 82.38 | 125.6 | 43.22 | 52.46 |
| Built-up, Mining | 0.89 | 3.97 | 3.08 | 346.07 |
| Agriculture, Plantation | 666.48 | 557.78 | -108.7 | -16.31 |
| Forest, Deciduous | 1288.95 | 1232.33 | -6.62 | -0.51 |
| Barren/unculturable Wastelands, Gullied/Ravenous Land | 148.79 | 154.25 | - 05.46 | -3.67 |
| Barren/unculturable Wastelands, Barren rocky | 29.74 | 27.37 | -1.37 | -6.29 |
| Wetlands/Water Bodies, Reservoir/Lakes/Ponds | 105.67 | 177.04 | 71.37 | 67.54 |
| Total Urban Area = | 2322.9 | 2323.34 | 5.94 | 0.26 |
| Rural | | | | |
| LULC Class | Area (sq. Km) | | | Percentage out of total LULC change area LULC Change % |
| | 2005-06 | 2015-16 | LULC Change | |
| Built-up, | 91.96 | 176.45 | 84.49 | 91.33 |
| Agriculture, Cropland | 7577.82 | 6975.51 | -602.31 | -7.95 |
| Agriculture, Fall ow | 615.96 | 1146.31 | 530.35 | 36.10 |
| Forest, Scrub Forest | 505.38 | 500.36 | -05.02 | - 0.99 |
| Barren unculturable, Wastelands. Scrub land | 400.72 | 381.71 | -19.01 | -4.74 |
| Wetlands/Water Bodies, River/Stream/canals | 250.25 | 255.82 | 05.57 | 2.23 |
| Total Rural Area = | 9442.09 | 9436.16 | -5.93 | -0.06 |

Source: Computed by researcher

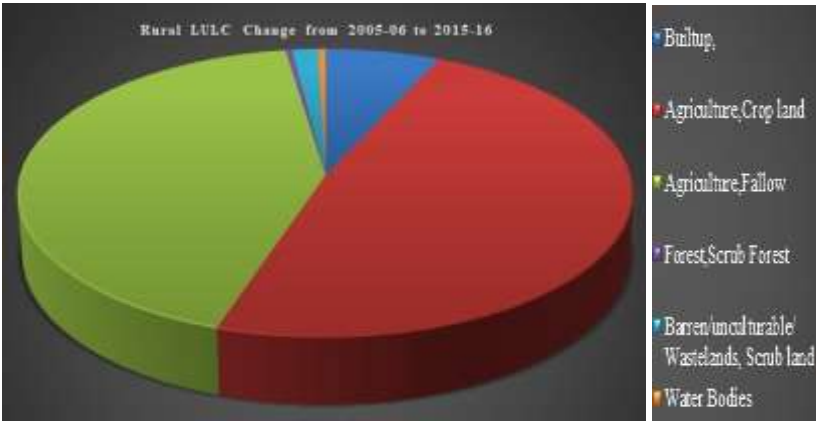


Fig 1: Rural LULC change from 2005-06 to 2015-16

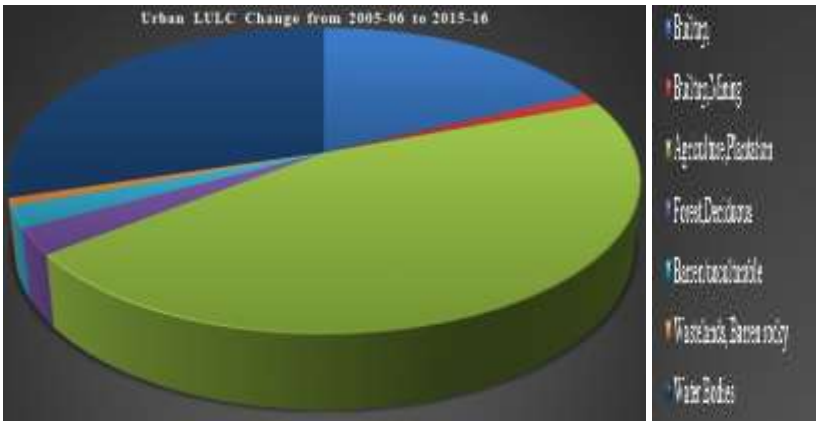


Fig 2: Urban LULC change from 2005-06 to 2015-16

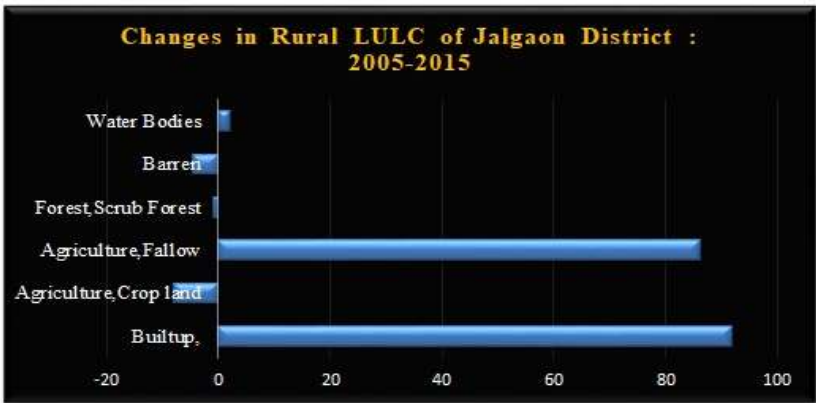


Fig 3: Changes in Rural LULC of Jalgaon District 2005-2015



Fig 4: Changes in urban LULC of Jalgaon district: 2005-2015

With help of table no. 5 researchers have analyzed that there were noticeable LULC changes have been taken in the study region during 2005-06 to 2015-16. Total LULC changes take place in 5.94 sq. km. area in urban as well as in -5.93 sq. km. area in rural areas in the study region. In Jalgaon district, there are detected LULC changes in each class in the rural area as well as the urban area. The total built-up area increased by 127.71 sq. km., Because of population growth during study periods in the Jalgaon district. At the same time, the 3.08 (346.07%) sq. km. built-up stone mining area also increased around the towns and cities. The growing population needs more construction materials, increasing such demands which promoted built-up stone mining. Out of this total built-up area increased in urban areas by 43.22 sq. km. (52.46%) and in rural areas by 84.49 sq. km. (91.88%). Pressure creates on towns, cities, and villages surrounding land due to increased population size in the study region. Most of the land requirements for settlements and other fundamental services development. That's why the built-up area increases on large scale. At the same time, the total agricultural cropland and plantation area decreased by 711.01 sq. km., out of which 108.70 sq. km. (16.31%) in the urban area and 602.31 sq. km. (7.95%) in rural areas. It means the surrounding agricultural land of towns, cities, and villages is destroyed by built-up activities. Here most of the settlement's peripheral agricultural land transfers to the residential, industrial, and other basic needs fulfilment of the growing population. The forest land has also been negatively affected by various human activities. In urban areas 6.62 sq. km. (0.51%) and in rural areas 5.02 sq. km. (0.99%) forest land has been destroyed during study periods in Jalgaon district. During study periods agricultural fallow land class increased by 530.35 sq. km. (86.10%) in rural areas. On the other hand, barren land decreased by 5.46 sq. km. (3.67%) and unculturable land decreased by 1.87 sq. km. (6.29%) in urban areas which indicate that barren and unculturable land also converted into built-up lands. In rural areas, in the case of wasteland negative change has taken place on 19.01 sq. km. (4.74%) which shows that wastelands are also utilized for other purposes. The most positive scenario has been seen in the case of water bodies in the Jalgaon district. There were water bodies increased by 71.37 sq. km. (67.54%) in urban areas and in rural areas wetlands increased by 5.57 sq. km. (2.23%).

3. Conclusion

With the help of all the above discussion, here researcher concluded that on a large scale agricultural and forest land degraded due to urban sprawl. It means maximum LULC change has taken place in an agricultural area out of the total LULC change area in the Jalgaon district. It means agricultural and forest land transformed into built-up and fallow land in the study region. Green land cover is transmitted into the concrete land which has dangerous for every organism on the earth's surface. Such type of scenario in the study region as well as overall creates numerous problems in the path of the sustainable development of the human being. Increasing water bodies in the study region is a positive sign for everyone. So full proof planning, as well as implementation, will have strongly necessary for a better future of the study region, which of responsibility of the administration, urban planner, society, and citizens.

4. Recommendation

In India, urbanization has rapid growth. Due to rapid urbanization, arising red alarming issues related to agricultural land use. Hence recommend here doing systematic planning for land use. Need well design policy planning programs on such issues for the long term.

5. Acknowledgment

We thank the Bhuvan team for providing data related to LULC from their website. We also acknowledge towards those their references are helpful for the present study.

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