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Changing Land Use Pattern in Bhagwanpur Tahsil (Haridwar District): A Geographical Study

Netrapal [1], Jyoti Prakash Gupta[2]
1 Research Scholar, Department of Geography, Hemavati Nandan Bahuguna Garhwal University, Srinagar (Garhwal) Uttarakhand.
2 Professor, Department of Geography, D.B.S (PG) College Dehradun.

Abstract:

This paper analyses the spatio-temporal dynamics of land use and land cover (LULC) of Bhagwanpur Tahsil, Haridwar District, in terms of remote sensing and GIS in a twenty-year time period (20012021). The analysis is done relying on the Landsat satellite data acquired by United States Geological Survey (USGS) to determine the nature, extent and pattern of land use change. The paper shows that there has been a great way of transformation in the major categories of land use, especially the built-up area has increased significantly signaling about the fast urbanization and the infrastructural growth in the area. Simultaneously, the agricultural land has experienced a commendable decrease indicating the growing demand of non-agricultural activities and alteration of the socio-economic state of affairs. The vegetation cover has also been increasing moderately, largely through the plantation and natural regeneration and the water bodies have not been changing drastically with slight changes. The decreasing number of unused and barren (fallow) land also points to the increased use of land in the course of time. The results indicate the increasing influence of anthropogenic factor on land resources and the necessity of planning land-use systematically, sustainability of development policies, and proper management of available resources. The research gives important geographical information to the policymakers and planners so that land use may be balanced and environmentally sustainable development attained in Bhagwanpur Tahsil.

Keywords: Land Use and Land Cover (LULC)**,** Remote Sensing and GIS**,** Urban Expansion**,** Agricultural Land Transformation**,** Bhagwanpur Tahsil**.**

Introduction:

The change of Land Use and Land Cover (LULC) is one of the most crucial indicators of the interaction between humans and the environment and demonstrates the changing relationship between natural resources and socio-economic growth. The high rates of population increase, urbanization, agrarianization, and infrastructural construction have significantly changed the land utilization pattern in India over the past few decades. These changes need to be understood in order to have a sustainable land management, environmental conservation and regional planning. Geographical research on land use change, in this regard, offers sound information about the way human activities and the process of nature transform landscapes across time.

Bhanwanpur Tahsil, in Haridwar district of Uttarakhand, is one such area that has undergone significant changes in land use pattern related to soaring population growth, agricultural growth, urban encroachment by adjacent towns and development. The region is typified by the combination of agricultural fields, settlements, forest patches, and water bodies hence it is ideal

in examining the spatial and temporal changes in the land utilization. This has been made possible by the availability of satellite-based data and geospatial techniques to provide a more accurate evaluation of these changes, especially to conduct comparative analysis of changes across time.

This research paper has been dubbed as Changing Land Use Pattern in Bhanwanpur Tahsil (Haridwar District): A Geographical Study to analyze the nature and degree of land change in the period between 2001 and 2021. Using LULC data of these two periods of time, the study will determine the key trends and spatial changes as well as the factors that contributed to the transformation of the land. This analysis is important in comprehending the sustainability of the environment, future land use planning and bolstering of policy formulation towards a balanced regional development in Bhanwanpur Tahsil.

Review of Literature:

One of the early researchers to underscore the systematic classification and interpretation of the land use patterns was Stamp (1960), who underscored the fact that land was dynamic and was constantly altered by human actions. His work formed the conceptual basis of the land use research by giving an account of the impact of agricultural growth, settlement development, and socio-economic aspects on land use. The approach used by stamp is still applicable in explaining the process of land transformation particularly in the developing world whereby population pressure and economic growth has a strong influence on the structure of land use.

Sah (2017) investigated the land use pattern of the Uttarakhand that is changing and noted that almost 90 percent of the area of the state is mountainous and most of the state agricultural activities are reliant on rain fall and conventional methodology. The paper has pointed out the steady reduction in agricultural area and forest cover, and the rise of wasteland and built-up areas. Sah also highlighted that the fast growth of population, shortage of irrigation equipment, and unstable soil, have increased land degradation and transformed the conventional land use practises. Her results are of great relevance to the current study since Bhagwanpur Tahsil also experiences the same movements of agricultural land to non-agricultural ones.

Vishleshwar and Chanyal (2024) used the changes in the land use in Uttarakhand with particular emphasis on the agricultural transformation in the Himalayan region. In a research they carried on, land use patterns have a direct effect on agricultural productivity and rural livelihood. The authors have pointed out the fact that the growing urbanisation, infrastructural growth, and the decreasing reliance upon traditional agriculture has contributed to the high rate of conversion of agricultural acreage to built-up and non-agricultural purposes. Another important aspect of the study that was identified to help determine the presence or absence of spatial and temporal changes is the use of satellite data and GIS techniques which validate the methodological framework used in the current study.

Mishra and Kumar (2015) examined the effects of land use change on ground water in the Haridwar district by remote sensing and GIS analysis. Their research found out that urban sprawl and greater ground surface cover have severely diminished the groundwater recharge zones. It was found that land use transformation is strongly correlated with environmental degradation that is predominant in fast developing areas such as Haridwar. This research is

directly applicable to Bhagwanpur Tahsil because the same patterns of urban development have been followed in the region between 2001 and 2021.

Devi and Panwar (2018) reviewed the land use, trade and transport patterns of the Haridwar district and highlighted the importance of economic activities in changing the land use structure. Their research indicated that growth in the transport network and commerce has increased the rate of agricultural land turning into built-up space. They have concluded that socio-economic development and urban growth are highly attributed to land use change, which is valid in accordance with the current study that is carried out in Bhagwanpur Tahsil.

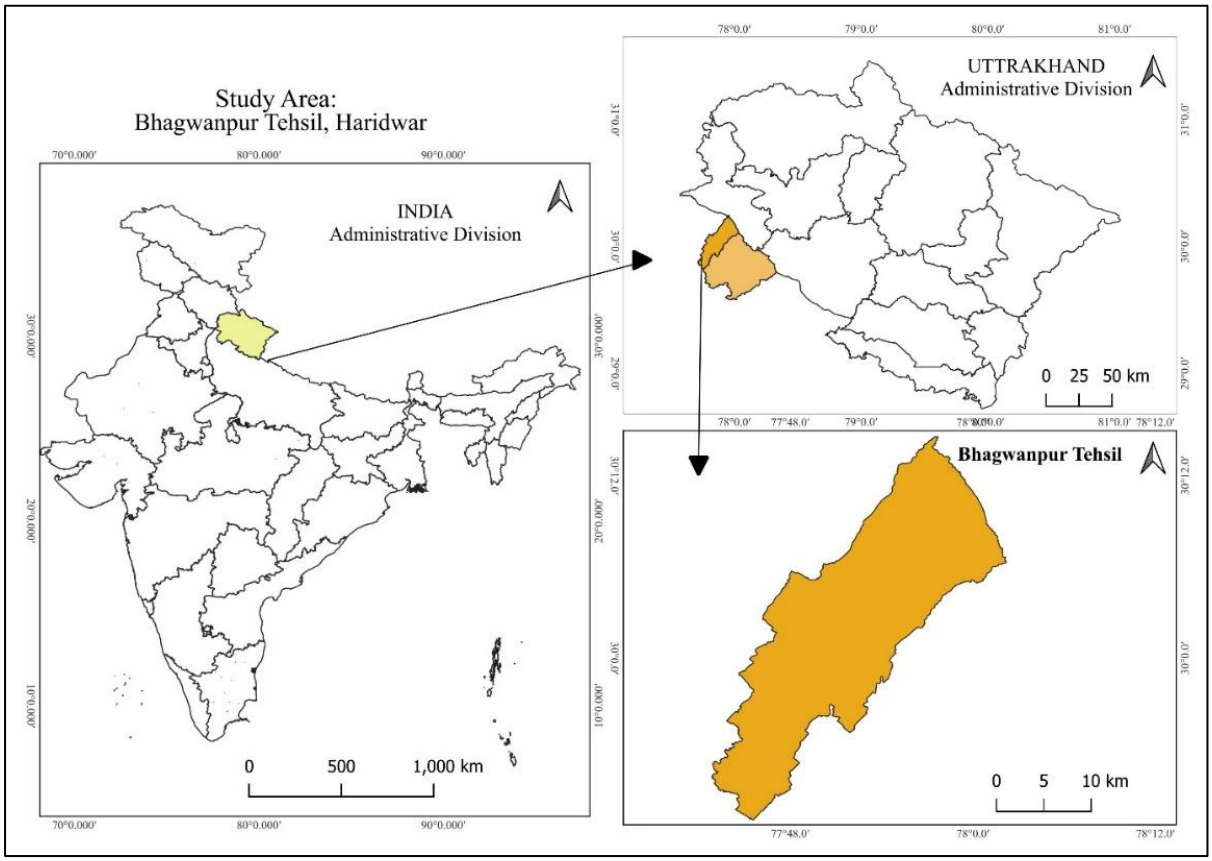
Rani (2020) carried out a comparative analysis of land use change in India and underscored the fact that the development policies in the country have had notable impacts on the land use patterns of the nation, post-independence. The research found out that there were more built-up and cultivated lands at the expense of the fallow and forest areas. The author highlighted that population increase, industrialization as well as evolving economic priorities are the key contributors of land use change. These trends on the national level give a wider perspective on the issue of land transformation at the tahsil level.

According to reports by the Government of Uttarakhand (2017; 2022) through the State Agriculture Plan and Integrated Horticulture Development Project, the tendency of land use in the state was shifting toward the decrease in agricultural land, land fragmentation, and strain on the natural resources. These reports emphasised on the necessity to have sustainable land management, scientific planning and balanced regional development. The results are very much positive to the current study which notes the same land use changes in Bhagwanpur Tahsil as a result of urbanisation and infrastructural development.

Study Area:

The Bhagwanpur Tahsil of the Haridwar district of Uttarakhand is the area of great agricultural and socio-economic value, with a powerful subject of urban and rural residents. In 2011 Census, the tahsil had a population of 228,583, and the population density of the tahsil has been rising, since 2001 (where it was 4,953 people per square kilometer), which is evidence of rapid urbanization. The area has been experiencing a slow urbanization and agricultural production is still the major activity even as industrial activities have increased since the neighboring city of Haridwar. Agricultural sector of the tahsil relies extensively on the use of traditional farming methods and rain-fed irrigation practices, which dominates the 90 percent mountainous region, and the rest 10 percent of the land area is the Tarai plains where commercial agriculture is also practiced at a greater scale. The phenomenon of urbanization has however resulted in agricultural lands being converted into built in regions which has made the traditional agricultural activities to be difficult to sustain. Population is heterogeneous, and both the male population and the female population are engaged in agricultural and industrial development, whereas the gender ratio stands on 880 per 1,000 males, which means that the socio-economic processes continue to be active in the region. Rural settlements of the region are in the process of profound change, where demographic pressures are placing more pressure on the land, infrastructure, and services, which leads to the additional land-use change.

Figure 01: Study Area Map



Source: Prepare by QGIS Using SOI Data.

Objectives:

1. To analyze the spatio-temporal changes in land use and land cover pattern of Bhagwanpur Tahsil between 2001 and 2021.
2. To assess the nature and extent of land use transformation.

Material and Methodology:

The given work relies on secondary data and geospatial methods to examine the land use and land cover (LULC) dynamics in Bhagwanpur Tahsil of Haridwar District that occurred during the last two decades (20012021). To achieve this, Landsat 7 (2001) and Landsat 8 (2021) satellite imageries were accessed at the United States Geological Survey (USGS). These data sets were chosen because they have appropriate spatial resolution and it can be used to analyze temporal land use. Geographic Information System (GIS) and Remote Sensing were used to process and analyze the satellite images. The classification of the images was done to determine the dominant land use/land cover items including built-up area, vegetation, agricultural land, water bodies and fallow/barren land. Controlled classification processes were used to make sure that land cover identification is more accurate. The land area of each land use was calculated in square kilometers and comparative analysis undertaken to determine the spatio-temporal changes in the 2001-2021. The interpretation of the results was based on thematic maps and statistical tables to comprehend the nature, extent and pattern of land use

transformation. This research methodology assisted in achieving the aims of the research project because it offered a scientific and methodical evaluation of the land use transformation in Bhagwanpur Tahsil.

Table: 01

LULC data of Bhagwanpur Tahsil (2001)		
Sr. No.	**LULC Class**	**Area_Sq Km**
1	Built-up Area	7.9299
2	Vegetation	168.8544
3	Agricultural Land	238.2192
4	Water Body	4.5072
5	Fellow Land/Barren land	102.825
Source: *Landsat 7 Collection 2 Level 1 from USGS*		

Table: 02

LULC data of Bhagwanpur Tahsil (2021)		
Sr. No.		**Area_Sq Km**
1	Built-up Area	34.2693
2	Vegetation	218.295
3	Agricultural Land	165.681
4	Water Body	4.7403
5	Fellow Land/Barren land	99.3501
Source: *Landsat 8 Collection 2 Level 1 from USGS*		

Result and Discussion:

The current paper discusses the changes in the spatio-temporal development of land use and land cover (LULC) of Bhagwanpur Tahsil between years 2001 and 2021 with the help of satellite-based data acquired with the help of Landsat images. It was observed that there has been much change in the land utilization pattern within the last twenty years depending on the factors of population growth, urbanization, infrastructural growth and the socio-economic activity in the area. The discussion of Figures 02 to 06 and Tables 01 and 02 shows significant changes in all significant land use categories, i.e. built-up area, vegetation, agricultural land, water bodies, and fallow/barren land.

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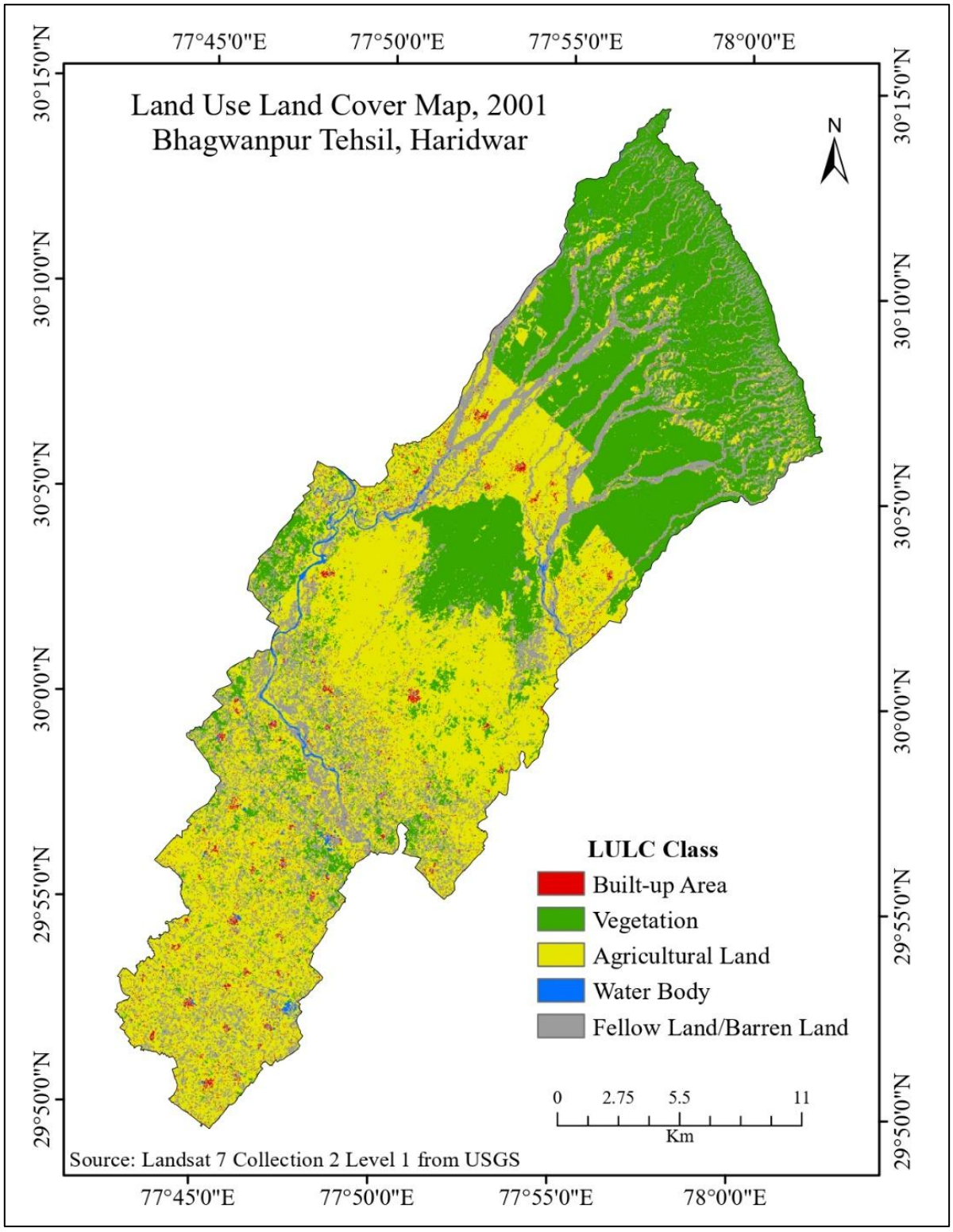
Figure: 02

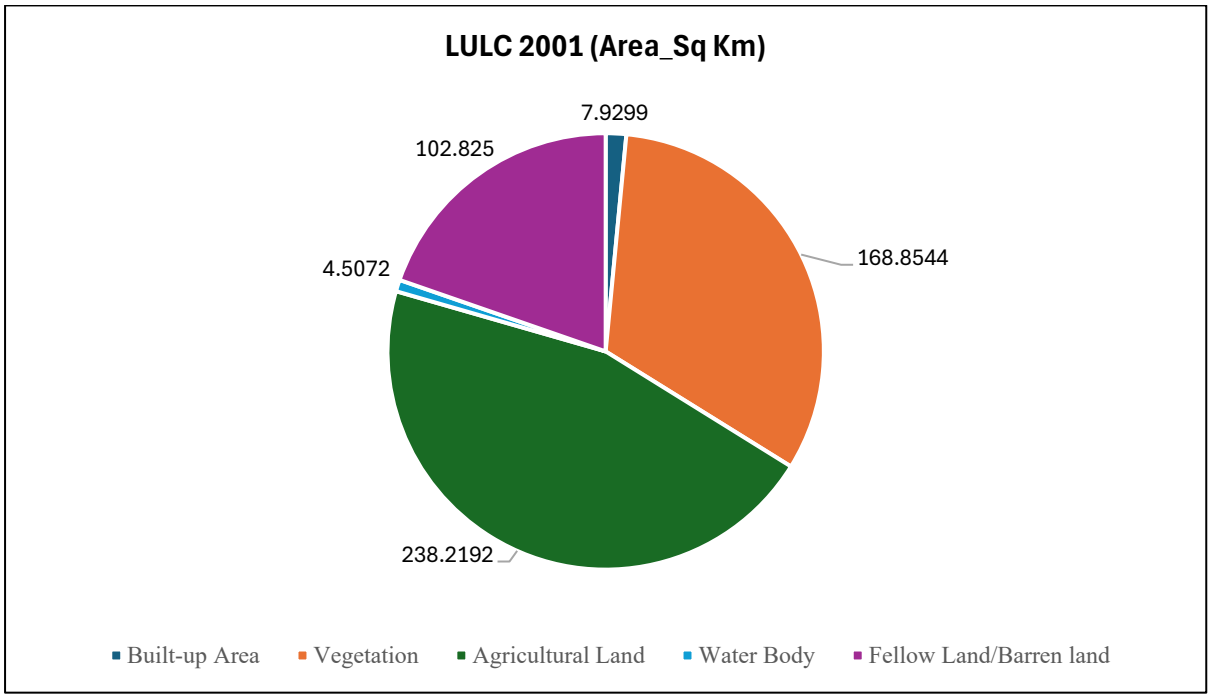


Source: Prepared by QGIS Using Landsat 8 Collection 2 Level 1 data from USGS.

The most noticeable transformation noticed throughout the research period is the high rate of built-up area growth, which went up to 7.93 sq. km in 2001 and 34.27 sq. km in 2021. Such high growth that is almost fivefold is a clear sign of high urbanization and settlement

development in Bhagwanpur Tahsil. The close location of the area to industrial areas, easy access through roads and development of residential colony regions have been major causes to this trend. The space distribution as illustrated in Figure 03 reveals that the area that has been built up has largely been along transportation highways and around the already established settlements, which signifies unplanned urban sprawl. This change is a direct result of the stress of population increase and re-organization of livelihood, achieving the initial goal of land use change which is a spatio-temporal analysis.

Figure:03



Source: Data extracted from table No. 01.

There is also a significant growth in vegetation cover which has increased to 218.30 sq. km in 2021 but was 168.85 sq. km in 2001. This favorable development could be credited to plantation activities and regeneration of natural vegetation and better land management practices. In certain regions, the currently fallow agricultural land seems to have changed to vegetated land cover. The vegetation growth indicates a partial reclaiming of the ecology and a more environmentally conscious atmosphere but it is also an indication of a conversion of land-use instead of the natural expansion of forests since a majority of the vegetation is scattered and agro-based.

On the contrary, the agricultural area has experienced a huge reduction and has changed to 165.68 sq. km in 2021 against 238.22 sq. km in 2001. This loss of over 70 sq. km is one of the most crucial results of the research. The degradation is a clear indication of agricultural land being converted to built up areas, infrastructure and other non agricultural purposes. The fragmentation of landholdings, decline in profitability of agricultural activities, rural population shifting to non-farm jobs and the rising land value are some of the factors that have played a determining role in this change. This development has dire consequences to food security and sustainable land management in the tahsil.

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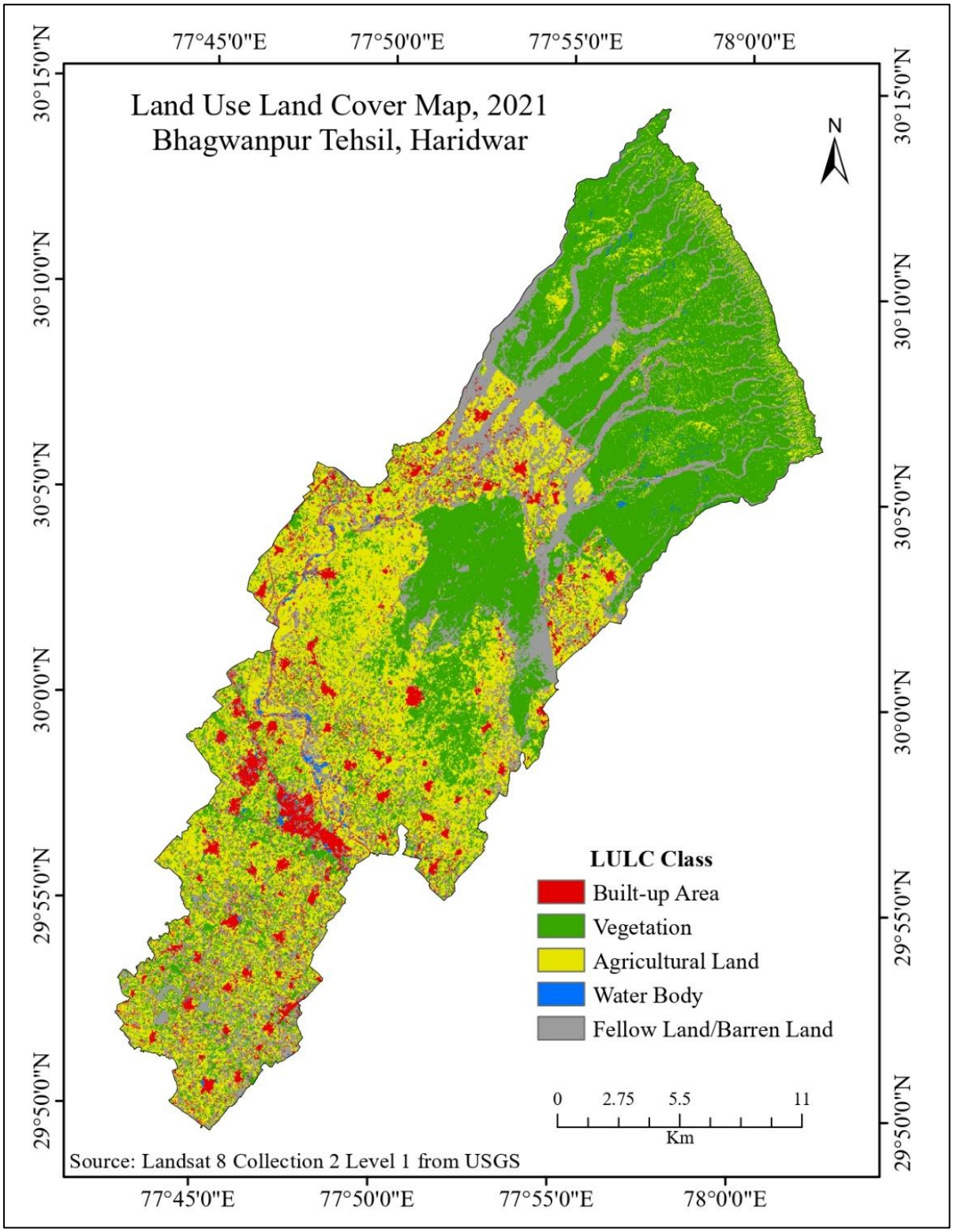
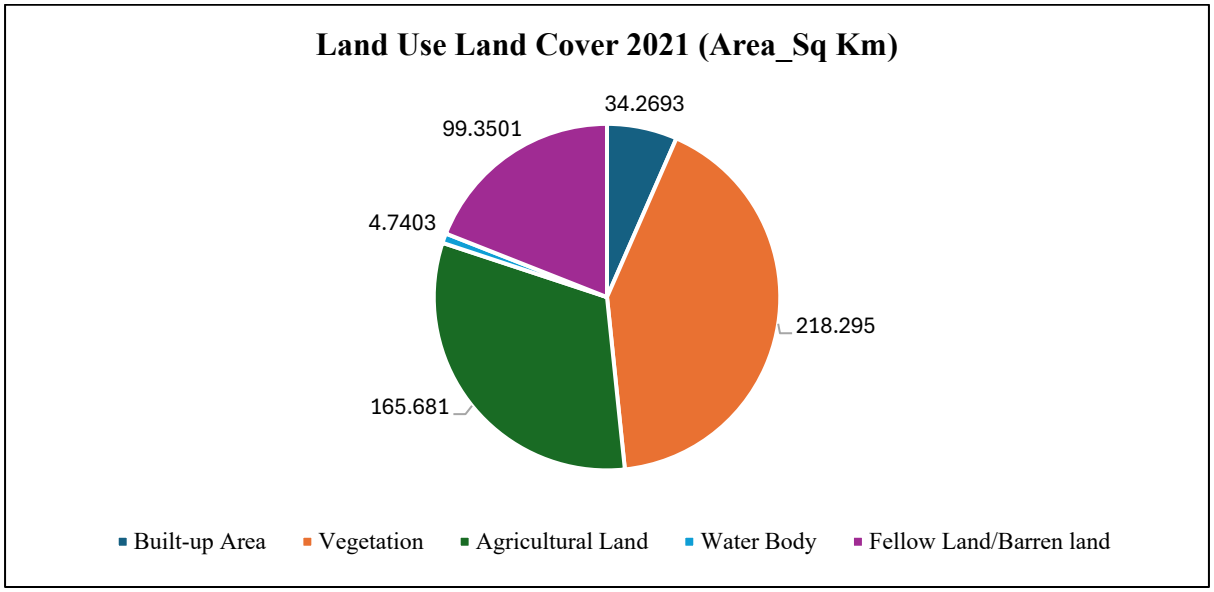
Figure: 04



Source: Prepared by QGIS Using Landsat 8 Collection 2 Level 1 data from USGS.

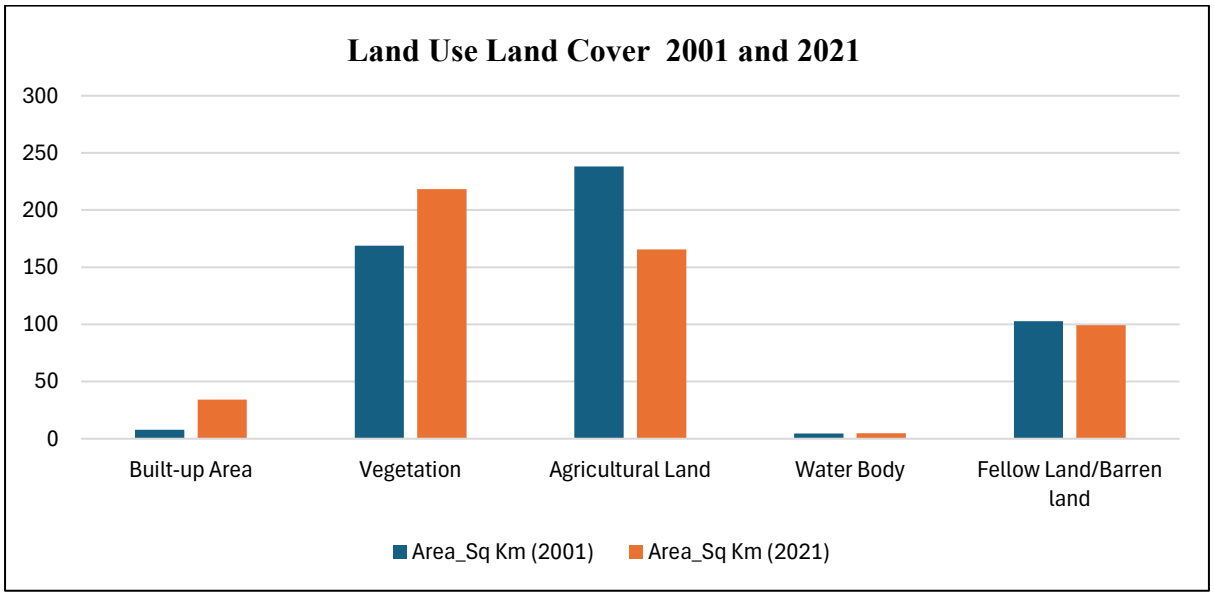
Figure: 05



Source: Data extracted from table No. 02.

The water bodies category has been relatively intact with a slight rise in the years 4.51 sq. km in 2001 to 4.74 sq. km in 2021. This minor increase can be explained by the fact that small ponds, reservoirs, or seasonal water storage facilities can be built. Nevertheless, the total percentage of water bodies is very small which implies that there is minimal availability of surface waters. This shows a necessity to have water conservation and sustainable management practises, particularly in the face of rising urban and agricultural demand.

Figure: 06



Source: Data extracted from table No. 01 and 02

Fallow or barren land category declined marginally in terms of 102.83 sq. km in 2001 to 99.35 sq. km in 2021. This decline is a pointer to the slow exploitation of idle land whether in

vegetation cover or urban development. The shrinkage in barren land though insignificant, indicates the growing anthropogenic pressure and conversion to land use within the tahsil.

In general, the land use characteristics of Bhagwanpur Tahsil during 2001-2021 clearly show that there has been a change in land use in the region towards the dominance of urban and vegetation-based land use. The findings are very strong in the study objectives as they capture the extent and the direction of the land use transformation. The spatial patterns in Figures 01 to 05 also established the fact that the key forces of change are human activities and infrastructure development and population pressure. These results highlight the necessity of scientific land-use planning, sustainable urban development policies, and conservation-focused agriculture in order to balance regional development in the future.

Conclusion:

In the current research, it is apparent that Tahsil Bhagwanpur has experienced a substantial change in land use and land cover in the time range of 2001 up to 2021. The analysis indicates the dramatic growth in the built-up area which is indicative of accelerated urbanization, population growth, and growing infrastructural activities and the agricultural land has recorded a significant decrease as it has been converted into residential and commercial services. Despite the moderate increase in vegetation cover, much of the vegetation cover is secondary growth and plantation, and does not reflect natural forest cover expansion. The change in water bodies marginally is an indication that there is no big change in the availability of water resources which can be a challenge in the sustainable development in the future. In general, the emerging trend in land use indicates the increasing anthropogenic stress on the land resources and the necessity of the planned land management, regulated urban development, and sustainable agriculture. The research results will be helpful to the planners and policymakers to develop proper land-use planning policies that will result into a balanced regional development and environmental sustainability in Bhagwanpur Tahsil.

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