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Assessment of Land Use and Land Cover Dynamics in Adampur Block Using Geospatial Techniques

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ABSTRACT

The present research reviews land-use/land-cover (LULC) changes in the Adampur block from 1991 to 2021, driven by rapid unplanned socio-economic development and demographic change. The accelerating demographic change, which is leading to the expansion of not only cities but also villages, is also altering human land use patterns, profoundly impacting the landscape. USGS Landsat-5 (1991, 2001, and 2011) and Sentinel-2 (2021) data were used to measure land use and cover change in the study area. Supervised classification was then used to create five categories: i) built-up; ii) cropland; iii) lowland; iv) green cover; and v) waterbodies. The result clearly demonstrates that the maximum change has occurred in cropland area (37.97 percent to 70.54 percent), as well as built-up land and waterbodies. On the other hand, the maximum decrease has been recorded in fallow land (43.47 percent to 16.19 percent), followed by green cover. The overall classification average accuracy from 1991 to 2021 was recorded at 81.62 percent.

Introduction: Land is a precious resource provided by nature on Earth, which is the foundation for the progress of all ecosystems and biodiversity, including humans. Humans use land for various activities –

agriculture, housing, industry, transportation and other economic purposes – to meet their basic needs. While the natural or artificial physical environment – forests and grasslands, water bodies, agricultural and built-up areas – represent land cover. Changes in land use and land cover (LULC) reflect multi-dimensional influences (natural processes and human interventions) over space and time **(Kamraju M. 2025)**.

Traditional methods of measuring changes in land use and land cover were time-consuming, cost-effective, and laborious; therefore, the study of land use and land cover was limited. In recent years, revolutionary advances in remote sensing have enabled more reliable spatio-temporal observations of the Earth's surface cover **(Eric et al. 2003)**. Remote sensing captures the land cover of a specific location at a specific time, while geographic information systems analyse these images and play a key role in data collection, management, modeling, and mapping. This data has made it possible to identify changes in land use, understand spatio-temporal patterns of change, and predict future land use trends.

Over the years, land use and land cover have undergone radical changes not only locally but also globally. The primary causes of these changes include rapidly changing demographic trends, shifting industrial and economic dynamics, infrastructure growth, agricultural expansion, and climate change. The impact of these changes is not limited to land use and land cover, but also impacts on overexploitation of natural resources, biodiversity loss, soil conservation, water quality and availability, and regional environmental imbalances **(Chidananda et al. 2025)**.

Currently, the scope of geospatial technology has become very wide, it has proved to be effective in strategies in areas like natural resource management and conservation, urban development, agricultural planning and disaster risk reduction (**Sedat et al. 2009)**.

India, the most populous and developing superpower, with over sixty percent of its population directly dependent on land, has not only increased pressure on agricultural land, but also transformed land use patterns, especially in rural areas. It’s devastating impacts have given rise to numerous natural and human challenges. Therefore, continuous monitoring of land use and land cover is essential to develop timely strategies to address these challenges.

Thus, this research shows that through the analysis of land use and land cover of the present study area for thirty years (1991 to 2021), the trend of change in land use and land cover in rural areas has increased, hence continuous monitoring and sustainable planning based on geo-spatial technology is necessary, and spatial planners need to pay more attention to this.

Objective: to investigate the land use and land cover dynamics in Adampur block.

Study Area: Adampur Block is located on the Haryana-Rajasthan border, west of Hisar district. This block, with its blended culture of the two states, lies roughly between 29°7'38" N and 29°23'21" N latitude and 75°19'39" E and 75°37'20" E longitude. The total geographical area of Adampur Block is 32,189.00 hectares, out of which 30199 hectares area is rural area while 1990 hectares area covers urban area. According to the 2011 census, Adampur block had a population of 111,542, of which 59,015 were males and 52,527 were females. According to the 2011 census, Adampur block had a total population of 111,542, of which 59,015 were males and 52,527 were females. Of the total population of Adampur block, 86,011 persons represented the rural population, while 25,531 persons were found to be urban. Total number of households in Adampur Block was 21,782, out of which 16761 households were located in rural area while 5021 households were located in urban area.

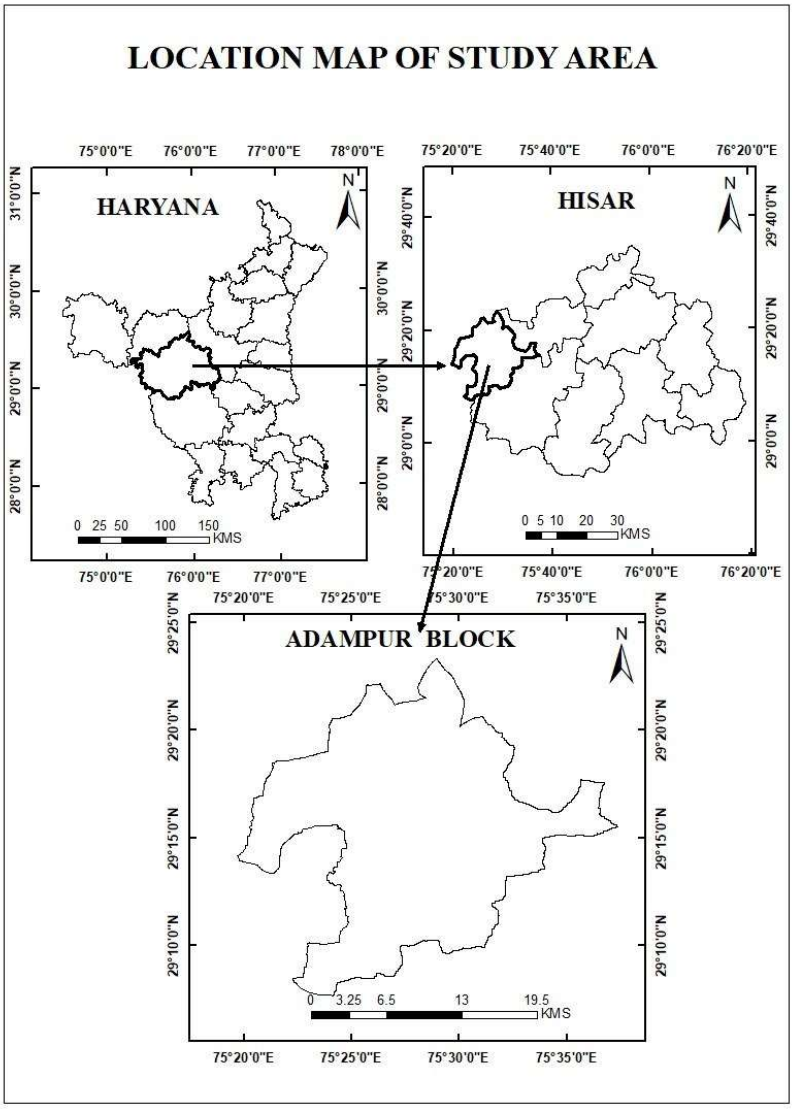

Figure 1

Methodology: The analysis in the current study used secondary data sources, including the 2011 census data and satellite data (1991, 2001, 2011, and 2021). Supervised classification was used to measure land use and land cover change, identifying five categories: cropland, built-up areas, green cover, water bodies, and fallow land. The analysis and classification of census data, thematic maps, and satellite images and Village-wise boundary digitization involved the use of ArcMap 10.8 software. Microsoft Excel was used to create graphs, tables, and calculate land cover change.

Table 1
List of Variables & Data Base

Secondary data base		**Variables**
• 2011		Geographical Setting
		Demographic Strata
		Cultural Zone
		Administration Setup
Satellite Data		**Sensor**
• 1991		Landsat-5 (TM)
• 2001		Landsat-5 (TM)
• 2011		Landsat-5 (TM)
• 2021		Sentinel-2

Result & Discussion:

Built-up Land: No significant change is evident in the built-up class of land use and land cover between 1991 to 2021, as this class covered 4.04 percent of the area in 1991, which increased marginally to 6.43 percent observed in 2021. The built-up class observed an increase of only 2.39 percent.

Cropland: In terms of land use and land cover change, cropland is the dominant class, a pattern evident on the map, as the area covered by this class increased from 37.97 percent in 1991 to 70.54 percent in 2021. During this time period, the cropland class recorded an increase of 32.57 percent. However, a decrease in this category was recorded between 2001 to 2021.

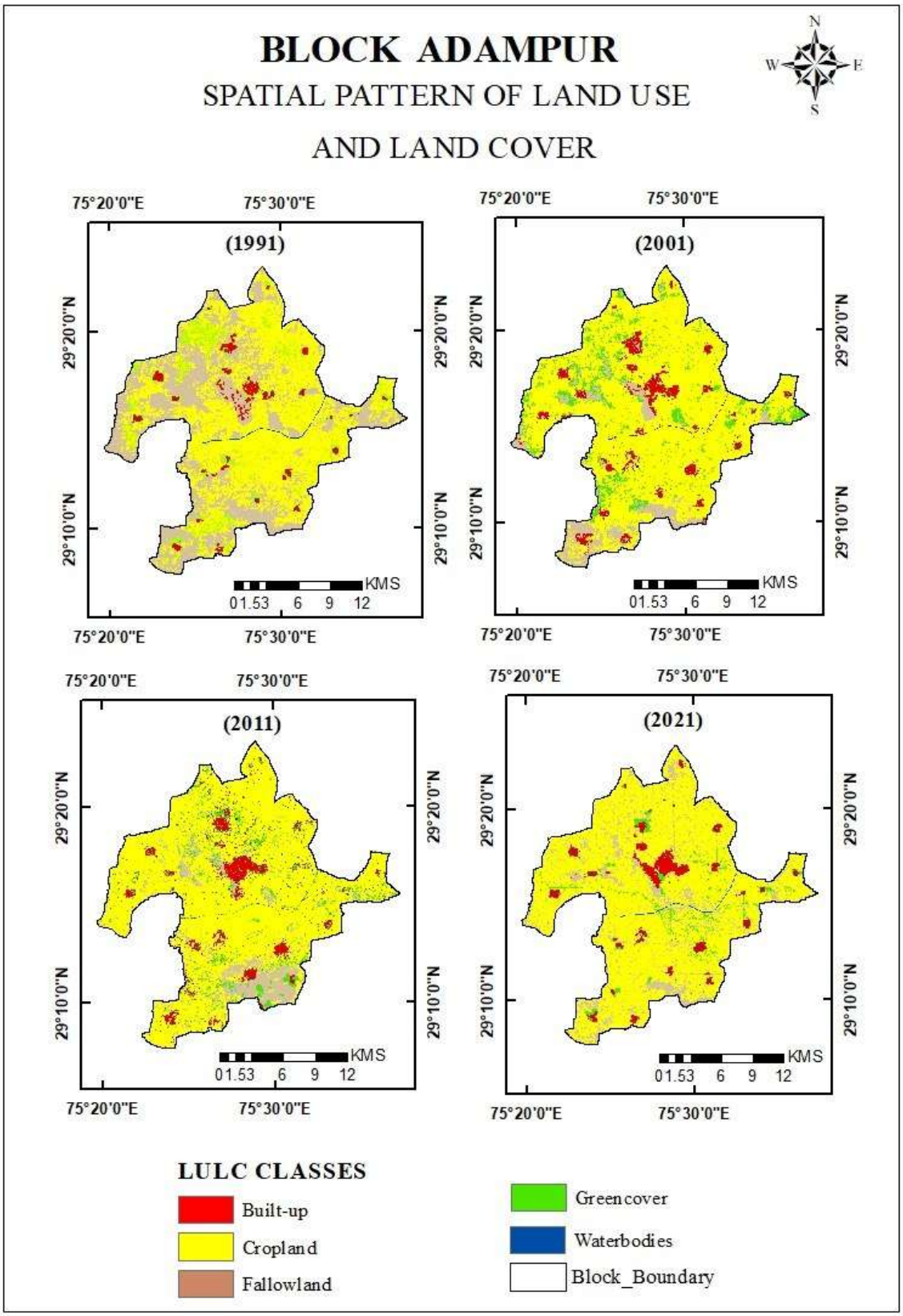
BLOCK ADAMPUR
SPATIAL PATTERN OF LAND USE
AND LAND COVER
N
W
E
S
(1991)
(2001)
(2011)
(2021)
75°20'0"E
75°30'0"E
29°20'0"N
29°10'0"N
KMS
01.53 6 9 12
LULC CLASSES
Built-up
Cropland
Fallowland
Greencover
Waterbodies
Block_Boundary

Figure 2

Water Bodies: In terms of land use and land cover change, the water bodies class saw a negligible increase. In 1991, this class covered only 0.54 percent of the area, which increased marginally to 1.01 percent in 2021. During this time period, the water bodies class recorded an increase of only 0.47 percent.

Table 2

Area Statistics of Land Use Land Cover from 1991 to 2021

Classes	Years			
	1991 Area in %	2001 Area in %	2011 Area in %	2021 Area in %
Built-up	4.04	4.82	5.29	6.43
Cropland	37.97	76.31	77.01	70.54
Fallow land	43.47	9.05	9.96	16.19
Green-cover	13.98	9.3	6.98	5.83
Water bodies	0.54	0.52	0.76	1.01

Fallow Land: The second major change in land use and land cover was noted in the fallow land class. In 1991, this class covered 43.47 percent of the area listed, which decreased to 16.19 percent in 2021. The fallow land class recorded a decline of -27.28 percent during this period.

Green Cover: Regarding land use and land cover changes, there has been a significant decline in the green cover class. In 1991, this class covered 13.98 percent of the area, which declined to 5.83 percent in 2021. A decline of -8.15 percent in the green cover class was observed during this time period.

Conclusion: The current research attempts to quantify the temporal changes in land use and land cover in the Adampur block using geospatial techniques. The results clearly indicate that the land use and land cover changes in the Adampur block have been dynamic, driven by natural and human influences. These dynamics can be attributed to factors such as population growth, improved transportation networks, availability of agricultural machinery, expansion of irrigation facilities, the introduction of urban features in villages, and greater access to resources. The current results reveal a significant reduction in fallow land. In 1991, this category covered 43.47 percent of the Adampur block, which declined to just 16.19 percent in 2021. A significant reduction in the green cover category was also observed in the study area. In 1991, this category covered 13.98 percent of the area, which was recorded at just 5.83 percent in 2021, which is a matter of concern. On the other hand, a significant increase was observed in the cropland category, which

indicates the current agricultural character of the study area. The results also suggest that unplanned changes in land use and land cover could lead to several environmental challenges in the future.

Suggestions:

- Although the rate of change in built-up areas is slow, it could lead to future disasters, requiring continuous monitoring using geospatial techniques.
- Water conservation methods such as micro-irrigation, rainwater harvesting, etc. are essential to improve the health of water bodies in the study area.

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