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Case Study

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Assessment of Land Use Land Cover Change using Multi-temporal Data and Geospatial Techniques: A Case Study of Shimla City

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ABSTRACT

Shimla City has experienced a wide range of changes in land use and land cover (LULC). This study used Remote Sensing (RS) to detect and quantify LULC changes that occurred in the city throughout a thirty study period, using Landsat and Google earth imageries (960 images) acquired between 1991 and 2021. This study aims to investigate the spatial pattern of land usage in Shimla by ward. A supervised classification method using an Artificial Neural Network (ANN) was used to classify and map LULC types. The compound annual growth rate (CAGR) and instability index used to quantify and estimate the changes in time series data while dealing with land use data. Using the classified images, a post classification comparison approach is use to detect LULC changes between 1991 and 2021. The study revealed that huge population growth has eventually resulted in unprecedented land use change in the built-up category in the city, which has increased from 5.92 percent in 1991 to 13.96 percent in 2021, thus showing a change of 8.04 percent and registering a growth rate of 3.64 percent (2.46 km2). Between 1991 and 2021, the area under forest decreased marginally from -6.96 percent to 4.66 percent, while other fallow land use decreased from 5.86 percent to 4.66 percent. The agricultural land also underwent a decline, from 1.43 percent in 1991 to 1.25 percent in 2021. The findings of this study provide the extensive explanation and spatio-temporal differentiation maps and tables created with geospatial data will undoubtedly aid in understanding the city growth dynamics process and changing form of land-use land cover and aid the decision-making process of local planners, stakeholders, and academicians.

INTRODUCTION

The land is one of the planet's limited resources. Due to a growing population, there are more people who want to use the land for different things. Also, the number of people living in cities is growing quickly. The land resources of a country are important to its economic growth. So, land resources should be kept in decent shape. Every day, people in cities notice changes. Changes in how land is used can cause urgent and difficult problems that cities need to solve. As cities have grown, forests have been cut down, and cities have spread out. As cities have grown, they have used more natural resources and changed how land is used and covered. In 1900, only 15 percent of the world's population lived in cities. Now, more than 50 percent do, and the United Nations predicts that between 1990 and 2050, there will be more than 5 billion people living in cities (Maksimovic and Tucci, 2001). Land use on Earth is changing greatly because of what people do and what happens in nature (Muttitanon 2005). Rapid industrialization and urbanization in an area mean that real land use Maps must be made quickly so that overuse and damage to the landscape that goes beyond the limits of sustainable development can be found and stopped (Guler et al. 2007). Over the last 15 years, changes in land cover and how people use the land have been seen as important global environmental changes (Turner 2002). Geographic Information Systems (GIS) are used a lot in land management and planning, and the demand for land use and land cover scenarios is growing.

The city of Shimla has experienced rapid urbanisation, economic growth, and demographic shifts in recent decades, all of which have had a profound impact on the city's land use patterns. To achieve sustainable development, it is crucial to accurately measure the shift in land use and the shift in ecological carrying capacity, and to understand the unique impact that land use shift has on bio capacity. The researchers set out to learn how changes in land use affect an ecosystem's carrying capacity so that they could better lend technical assistance to regional development plans.

AIMS AND OBJECTIVES

The aim of this research is to assess the transformation of land use and land change in Shimla city. This aim can be achieved through the following objectives;

1. To investigate the spatial pattern of land usage in Shimla by ward.

2. To assess the rate of conversion of open areas to built-up spaces in accordance with existing procedures and regulations governing urban land use.

3. To analyse the instability in land use during the period 1991-2021.

DATA SOURCES AND RESEARCH TECHNIQUES

Topographic maps and IRS LISS-3 FCC images from the study area have been used to get data. The maps have been digitised, and the images have been geo-referenced and analysed on a GIS platform for the purpose of studying land use and land cover.

A set of 1:50,000 scale toposheets covering the Shimla Municipal Corporation study area were obtained from the Survey of India with the reference numbers 53 F/1/SW, 53 F/1/SE, 53 F/1/NE, and 53 F/1/NW. The scanned toposheets were georeferenced using known latitude and longitude values in the ArcGIS 10 platform. The Shimla city corporation's boundary has been digitized and converted from ArcGIS shape file format (.shp) to Google Earth compatible format (.kml). A total of 960 images acquired between 1991 and 2021, covering the entire study area, were downloaded. The individual images were then mosaicked to form one single image and converted from geographic coordinate systems (latitude and longitude) to projected coordinate systems (northing and easting) using the Universal Transverse Mercator (UTM) projection in ArcGIS 10. Finally, on-screen digitization of various land use classes was performed to prepare the land use map. The land use classes that were considered in the study were built-up areas, forestland, fallow land, open land, and agricultural areas.

To analyze the relationship between land use and topographic factors, the land use map was combined with the Digital Elevation Model (DEM) or slope gradient map through the grid extensions of ArcInfo 10 and ArcInfo 10.3. The map (2021) was extracted and used for subsequent transformation matrix analysis. It was in grid format, and the cell size was 30 meters by 30 meters.

Statistical Techniques

The growth rate of land use in Shimla city was quantified using the compound annual growth rate (CAGR) formula as devised by Nassar et al. (2014). It is given as follows:

CAGR = (tn1)(tn−t01)−1

Where:

to is the initial area of city land use,

tn is the area at the end of the analysis period,

tn-to is the number of years covered by the analysis period.

This approach was used to characterize the rate of Shimla's growth over the time periods as well as the entire period of study.

The Instability Index

The Instability Index was also used to estimate the changes in time series data while dealing with land use data. It is estimated as follows:

a) Estimate the parameters of a log-linear trend line for the variable (Yt) for which instability is to be estimated.

b) If the estimated parameter is statistically significant, then the instability index (IIN) is defined as

$$IIN = CV \times \sqrt{(1 - R^2)}$$

Where CV= Coefficient of Variation for the time-series calculation as

Where, S.D. = Standard Deviation

c) If the estimated parameter in the regression equation of compound growth rate is not significant, then the CV itself is the instability index

GEOGRAPHICAL PERSONALITY OF THE STUDY AREA

Shimla is situated in the Central Himalayas at 31°4′ to 31°10′ north latitude and 77°5′ to 77°15′ east longitude, and its mean elevation is 2,130 m above mean sea level.

The topography of Shimla is characterized by rugged mountains, steep slopes and deep valleys. It experiences cold winters during December–February, with temperatures ranging from 0°C to 13°C. Shimla receives snowfall around Christmas or the last week of December. The summers (May–June) are mild with temperatures varying from 20°C to 30°C. The monsoon period extends from June to September and records moderate rainfall.

The average rainfall recorded for the last 25 years (1980–2005) in Shimla is 1,437 mm. The Shimla region consists of a thin soil layer (0.15 m on ridges to 7 m deep in valleys), an intervening layer of detritus (mix of soil and fragments of weathered bedrock) and hard bedrock (Tandon, 2008; Altaf et al., 2013, 2014; Meraj et al., 2021, 2016).

Shimla city was discovered in 1819 by the British and has evolved from a small hill settlement to one of the popular tourist destinations in India. Part of Himachal Pradesh was carved out of erstwhile the Punjab state in 1966, and Shimla became the capital of newly formed state of Himachal Pradesh in 1971. As per Census (2011), Shimla is the only Class I City in the State of Himachal Pradesh with a total population of 169,758 persons.

Consequently, the population of the city has grown by 12 times (from 14,000 in 1901 to 169,758 in 2011) during the century.

The total area under the jurisdiction of MC Shimla also has increased after merger of New Shimla, Totu (including some parts of Jutog) and Dhalli areas to 3,500 sq. km. According to 2011, the Municipal Corporation of Shimla (Shimla city) was divided into 25 wards and 34 in present, covering urban core and urban fringes.

RESULTS AND DISCUSSION

The Land Use Trend in Shimla City

The study area was divided into five types of land use: agriculture, forest, fallow land, open land, and built-up areas. Land use changes during the study period, 1991–2021, have been examined. The reported geographical area of the city was 34.54 km2.

Built-up Area

The pattern of land use has been significantly impacted as a direct result of the expansion of Shimla city, both in terms of population and area. This enormous increase in population has led to an unparalleled land use change in the built-up category inside the city, which has increased from 5.92 percent in 1991 to 13.96 percent in 2021, displaying a change of 8.04 percent and registering a growth rate of 3.64 percent (Table 1).

However, in absolute terms, the built-up area witnessed an increase of 8.04 km2 during the overall period, with the increase being exceedingly high between 1991 and 2021. During this time, there has been a significant increase in the number of residential colonies as well as commercial flats that have been constructed in the city. Most of these developments have taken place on land within the city that is suitable for agricultural purposes.

The built-up area was found to be concentrated in the central and eastern areas of the city, covering parts of Shimla's Lower Bazar, Ram Bazar, Sanjauli, and Engine Ghar wards. This information was discovered through an investigation. The inhabitants of Totu, Annadale, Tutikandi, and Chamyana were dispersed across the city, apart from a loose group that was located on the outskirts of Summerhill. The vast bulk of these wards were in the southern, eastern, central, and northern regions of the city, and they encompassed portions of the neighbourhoods of Kasumpti, Pateyog, Chotta Shimla, Chamyana, Dhalli, Sanjauli, Engine Ghar, and Lower Bazar, as well as Kainthu. The highly compact layout that can be seen in these wards can be explained by the presence of commercial and administrative hubs, as well as ongoing development operations that have pushed up building infrastructure.

The total coverage of the built-up area was 2.10 km2 in 1991 (5.92 percent). But in 2021, the same area was 4.96 km2 larger than it had been (13.96 percent). When compared to the other land use categories, this land use category was the one that benefited the most. During this time (1991–2021), this climbed to 2.86 km2 (8.04 percent) (Table 1). This was the result of a combination of fast urbanisation and massive migration from rural to urban areas. The majority of the other land use categories were negatively affected, and their contributions were mostly focused on the built-up land use groups.

Table: 1

Share of Different Land Use Categories to Total Geographical Area in Shimla City,1991 to 2021(average for the respective period)

Sr. No.	Land Use Categories	1991		2001		2011		2021	
		Area Per Km2	Percent Reporting Area	Area Per Km2	Percent Reporting Area	Area Per Km2	Percent Reporting Area	Area Per Km2	Percent Reporting Area
1	**Agriculture**	1.44	4.04	1.35	3.80	1.28	3.60	1.25	3.51
2	**Forest**	18.91	53.23	17.63	49.61	17.07	48.02	16.45	46.27
3	**Fallow**	2.08	5.86	2.03	5.71	2.00	5.63	1.66	4.66
4	**Open land**	11.57	32.57	11.27	31.72	11.23	31.59	11.01	30.97
5	**Built-up Land**	2.10	5.92	2.96	8.32	3.93	11.04	4.96	13.96
6	**Reporting Area**	**35.54**	**100**	**35.54**	**100**	**35.54**	**100**	**35.54**	**100**

Source: Google Earth Satellite Imageries and ArcGIS 10 and 10.3, 1991 to 2021

Agricultural Land

The pattern of agricultural land use in Shimla city from 1991 to 2021 has been portrayed in Table 1. Agricultural land in Shimla city shrank continuously from 4.04 percent in 1991 to 3.51 percent in 2021, which showed a decrease of about 0.53 percent points during this period. Agricultural lands were prominently spread over 19 of the 25 wards of the study area except in the central and northern parts, and a continuous ablation is observed in all the agriculturally covered parts. The amount of agricultural land decreased by 1.44 km2 (4.04 percent), 1.35 km2 (3.80 percent), 1.28 km2 (3.60 percent), and 1.25 km2 (3.51 percent) for the years 1991, 2001, 2001, and 2021, respectively. In six wards, viz. RulduBhatta, Ram Bazar, Lower Bazar, Jakhoo, Benmore, and Nabha, there was no agricultural land in Shimla city (Map1–4 and Table 1).

Map1 to 4 show that from 1991 to 2021, agricultural land in 10 wards, including Totu, Summerhill, Kaithu, Bharari, Phagli, Tuttikandi, Pateyog, Malyana, Engine Ghar, Chamyana, and Dhalli, has been used for other things. As much as 0.53 percent (-0.19 km2) of agricultural land was lost during the period 1991–2021 (Table 1), and these were mostly converted to built-up area infrastructure. One characteristic feature that was common to all these wards was that they were all located in administrative and commercial centres.

Forest Land

An area of 16.45 km2 is under forest use, which accounts for 46.27 percent of the total area (Table 1). It may be observed that the extent of forest area was far higher when compared to other land uses. Most of the forest land is concentrated in all wards of the city.

The dense concentration of this category is mostly found in the north and central parts of the city. Extremely thick forest land was found in the eight wards, namely Engine Ghar, Sanjauli, Chamyana, Malyana, Dhalli, Kasumpti, Pateyog, Ram Bazar, and Lower Bazar, of the study area (Map 1). There are seven wards, viz. Chotta Shimla, Kanlog, Benmore, Boileauganj, Summerhill, Kaithu, and Bharari, that observed a high degree of decrease in forest area and conversion into the built-up area during the study period from 1991 to 2021 (Map 2 and 5).

The Map is extracted in tabular form, as shown in Table 1about 18.91 km2 (53.23 percent), 17.63 km2 (49.61 percent), 17.07 km2 (48.78 percent), and 16.45 km2 (46.27 percent) during 1991, 2001, 2011 and 2021 of the total administrative area of the Shimla city comprised the forest space. Over the period of 25 years of forest land, continuous losses were accounted for during urbanization. Approximately 6.96 percent of forest land was lost during the study period.

A study showed that the forest resource depletion in the city was attributed to ownership arrangements and the growing demand for wood for construction and domestic purposes. The expansion of built-up area is at the expense of forest and agricultural land area, and this shows anthropogenic factors of deforestation due to the need to build houses and practice urban agriculture.

Fallow Land

Land lying fallow is noticed in the eastern, western, and southern parts of the city, covering the parts of Dhalli, Chamyana, Malyana, Kasumpti, Pateyog, Phagli, Tutikandi, Boileauganj, and Totu wards of the study area. Fallow land was widely dispersed throughout the city, forming no regular pattern (Map 2– 5).

It covers an area of about 2.08 km2 (5.86 percent), 2.03 km2 (5.71 percent), 2.00 km2 (5.73 percent), and 1.66 km2 (4.66 percent) during the years 1991, 2001, 2011, and 2021, respectively (Table 1). An area of about 0.15 km2 (0.05 percent) decreased during the period 1995–2000. A perusal of Table 1 leads one to see that the decline rate of this category varied between the study period of 1991 and 2021. It covered an area of about 2.08 km2 (5.86 percent) and 1.66 km2 (4.66 percent) for the years 1991 and 2021. There was a decrease in area of about 0.43 km2 (1.20 percent). The reduced areas of fallow land were gradually converted into built-up and agricultural land.

Open spaces

The pattern of open spaces in Shimla has evolved over time because of the city's changing land usage. Decreases in open space have been steady, going from 32.57 percent in 1991 to 31.72 percent in 2001 to 30.97 percent in 2021 (Table 1). In a quarter century, dilapidated and abandoned land has shrunk. This group included a sizable portion of the city, as shown in Map 3.1 to 3.4. All the desk space was replaced by an open floor plan. Dhalli, Chamyana, Malyana, Sanjauli, Engine Ghar, Kasumpti, and Pateyog are just some of the neighbourhoods in the city's southeast and east where it might be spotted. Nabha, Phagli, Khalini, Tuttikandi, Boileauganj, Totu, and some areas of Summerhill, as well as the central and western regions of the study area, contained another cluster of similar type. In contrast to the typical suburban sprawl, the city's traditional land use pattern is quite dense.

The size of open spaces diminished because of conventional land development practices that prioritised filling in already developed areas. Recently, though, municipal planning initiatives have begun to shape the pattern of urban growth. It is up to the current owners of these land parcels to decide whether to develop them (private citizens or the municipality). Now, the frontier is open to everyone. The city is responsible for maintaining these spaces, but budget cuts have left them looking run down.

There is considerable potential for environmental and social enrichment in the city's man-made patches of public open spaces, such as cemeteries, hospital gardens, government office campuses, etc. One way to measure how a city's social, economic, and cultural landscape has shifted over time is to look at how its open spaces have evolved from natural and agricultural to manufacture. Since urbanisation places a premium on amenities that are tailored to the demands of city dwellers, the sorts of open space available to them are also evolving.

CHANGES IN LAND USE PATTERN (COMPOUND GROWTH RATE)

Transformations in land use patterns have been computed by the compound growth formula to get a more in-depth view of the dynamics of land use patterns in the city on the spatial and temporal dimensions. These changes have been broken down by decade and analyse for the period of 1991 to 2021 (Table 2). The compound annual growth rates for various land uses over the entire period have been presented in (Table 2). This was done so that a more accurate picture of the trends in the various land-use categories could be obtained and was further divided into three sub periods: the first one lasted from 1991 to 2001, the second one from 2001 to 2011, and the third one lasted from 2011 to 2021. The main period lasted from 1991 to 2021 overall. It should come as no surprise that the entire land area of the city is 34.54 km2.

Table: 2

Compound Growth Rate of Different Land Use Categories in Shimla City, 1991-2001 to 2011-2021(*Per cent per annum*)

Sr. No.	Land Use Categories	1991-2001 (First Period) CAGR	2001-2011 (Second Period) CAGR	2011-2021 (Third Period) CAGR	1991-2021 (Over All) CAGR
1	Agriculture	**-0.62**** (-0.24)	**-0.55**** (-0.20)	**-0.59**** (-0.08)	**-0.58**** (-0.53)
2	Forest	**-0.70*** (-3.62)	**-0.33*** (-1.59)	**-0.92*** (-1.75)	**-0.58*** (-6.96)
3	Fallow	**-0.25*** (-0.15)	**-0.15*** (-0.09)	**-4.60*** (-0.97)	**-0.95**** (-1.20)
4	Open land	**0.50*** (1.61)	**-0.26*** (-0.86)	**-0.10*** (-0.13)	**0.08*** (0.63)
5	Built-up Land	**3.46*** (2.40)	**2.87*** (2.72)	**6.04*** (2.92)	**3.64*** (8.04)

Note: (**) and (*) Indicate significance of growth rates at 5 and 1 percent level, respectively.
Source: Google Earth Satellite Imageries and ArcGIS 10 and 10.3, 1991 to 2021

An analysis of the growth rate in the land use categories, specifically agricultural land, forest land, and fallow land, revealed that it dropped during the first period at the rates of -0.62, -0.70, and -0.25 percent, respectively. This was the case throughout the first period. During the first period, the percentage of open land is increasing at a pace of 0.50

percent per year, while the percentage of built-up areas is growing at a rate of 3.43 percent per year.

The growth rates of agricultural land, forest land, and fallow land continued to deteriorate during the second period at the rates of -0.55, -0.33, and -0.15 percent, respectively, while the growth rates of open land also turned out to be negative during this era at the rate of -0.26 percent. But in the end, the growth rate of built-up areas was significantly quicker in the second decade (2001–2011), with a rate of 2.87 percent for that period.

A study of growth rates in agricultural land, forest land, open land, and fallow land demonstrates that growth rates in all four types of land use during the third period were negative (-0.08, -1.75, -0.97, and -0.13) (2011-2021). However, during the third quarter, the growth rate of the built-up area increased at a rate of 6.04 percent (Table 2).

According to Table 2, the reduction in fallow, forest, and agricultural land was the biggest during the entire period. This decline may have been caused by population pressures as well as an increasing demand for residential and commercial infrastructure. Across all categories of land use, the rate of expansion of built-up area over the past quarter-century has been the fastest. The most worrisome pattern is the observation that built-up areas have the highest yearly growth rate, which comes in at 8.04 percent. Over the course of the previous 25 years, researchers found that this growth rate averaged 3.64 percent. The rapid expansion of built-up area was brought about by the loss of regions that were once agricultural, forest, open space, and fallow land.

INSTABILITY IN LAND USE

Instability index is a measure of extent of variability or the absence of stability in time-series data and hence the instability indices for various land use categories were worked out by the formula as mentioned in research technique section, and these are presented in Table 3. It could be observed from the Table that the instability index during the period 1991-2021 was the highest for the area under built-up area followed by the area under fallow lands. The decadal instability was also found to be higher for built-up areas as compared to other categories of land use in all the three decades during the period between 1991 and 2021. However, open land of land use categories showed the stability, which recorded the 0.47 instability during the 1991-2021 (Table 3).

Table: 3

Instability Index for Land Use Pattern in Shimla City

Sr. No.	Land Use Categories	1991-2001	2001-2011	2011-2021	1991-2021
1	Agriculture	3.40	2.87	0.69	8.97
2	Forest	3.95	1.31	1.63	8.90
3	Fallow	0.78	0.09	12.29	15.17
4	Open land	2.53	0.83	-0.71	0.47
5	Built-up Land	22.84	18.88	15.52	56.24

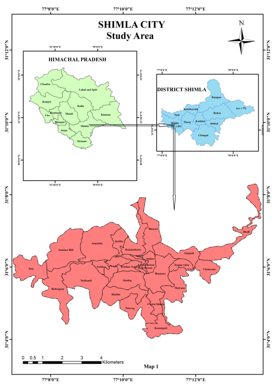
Source: Google Earth Satellite Imageries and ArcGIS Software 10 and 10.3, 1991 to 2021

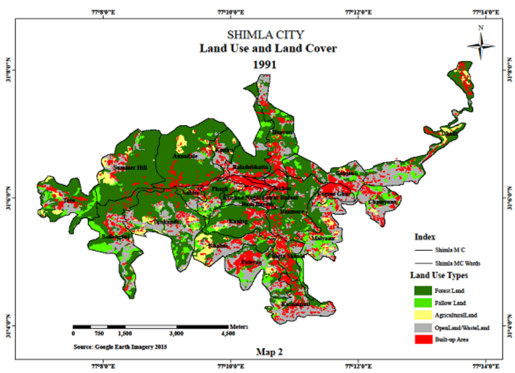
Between the years 1991 and 2001, the rate of instability of patterns of land use varied depending on the category of land use being examined. The category of built-up land had the highest level of instability during this time with a score of 22.84, followed by the categories of forest land (3.95), agricultural land (3.40), open land (2.53), and fallow land (0.78). Built-up land had the highest level of instability (18.88) during the second period 2001-2011, followed by agricultural land (2.87), forest land (1.31), open land (0.83), and fallow land (0.83) (Table 3). According to the findings of the study, the degree of instability in the categories of land use was consistently variable between the years 2011 and 2021. In the area under study, the built-up land category showed the greatest amount of change in land use (15.52), whilst the open land category showed the least amount of change (-0.71). The area under built-up shows extremely high year-to-year fluctuation due to the commercial and administrative centre as well as ongoing developmental activities that pushed up building infrastructure, which led to the highest level of instability in built-up land during the overall period. This was the cause of the greatest amount of land instability.

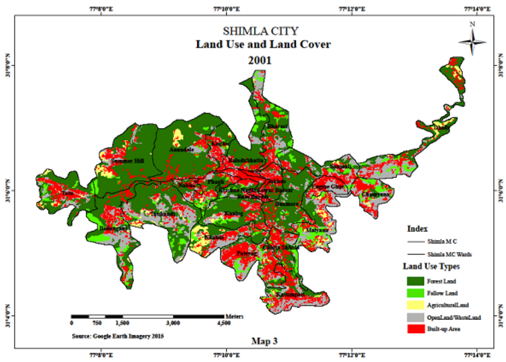
CONCLUSION

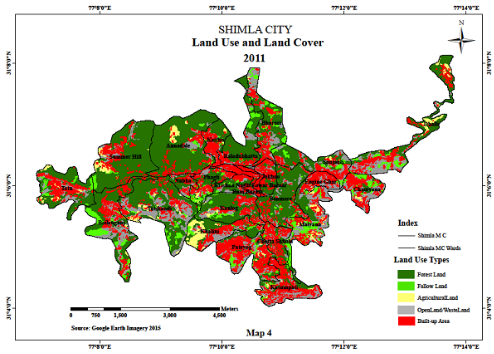
The examination of time-series data on land use trends revealed that the steep increasing trend in built-up land that really occurred in Shimla city between 2001 and 2021 is the most alarming trend in land use pattern, likely because of the instability in the forest and open space. Shimla's built-up areas are more densely concentrated in the city's eastern, central, and southern regions than in the city's northern and western regions, according to an analysis of the city's geographical distribution of built-up areas. Rapid urbanisation and large-scale migration from rural to urban areas are likely to blame for this trend. The economic and administrative hub as well as continuous development efforts may have accelerated infrastructure development. The category of land use that had the most change was built up land (15.52) and the group that experienced the least change was open land (-0.71). The commercial, administrative centre and ongoing developmental operations that pushed up building infrastructure caused the greatest year-to-year variability in built-up area over the whole period.

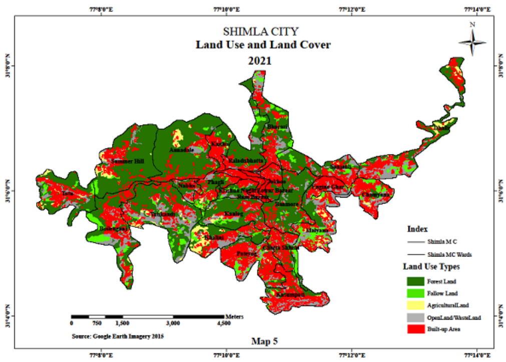
The study concluded that Shimla's population had significantly surpassed the city's safe limit. Over the past few decades, unchecked and improper building practices have made Shimla's building environment particularly hazardous for workers. The death toll would be unprecedented, the government would be paralysed, and the entire economy, especially the tourism industry, would be thrown into chaos. As the population and the number of buildings both rise and become denser, the potential for harm multiplies dramatically. A few rastic measures, such as the removal or retrofitting of some of the city's most susceptible buildings, are required to bring Shimla's population density down to a more manageable level.











REFERENCES

Balasubramanian, A. (2017). *India: Topography and slope*. Centre for Advanced Studies in Earth Science, University of Mysore.

Basawaraja, R., et al. (2011). Analysis of the impact of urban sprawl in altering the land-use and land-cover pattern of Raichur City, India, using geospatial technologies. *Journal of Geography and Regional Planning, 4*(8), 455–462.

Kafi, K. M., et al. (2014). An analysis of LULC change detection using remotely sensed data: A case study of Bauchi City. *Earth and Environmental Science, 20*, 1–10.

Malarvizhi, K., et al. (2016). Use of high-resolution Google Earth satellite imagery in land-use map preparation for urban-related applications. *Procedia Technology, 24*, 1835–1842.

Moss, M. L., & Neill, H. O. (2012). *Urban mobility in the 21st century*. NYU Rudin Center for Transportation Policy.

Nassar, A. K., et al. (2014). Developing the desert: The pace and process of urban growth in Dubai. *Computers, Environment and Urban Systems, 45*, 50–62.

Poudel, K. P. (1996). Geographic information system-based hill-slope instability analysis for land-use planning perspective: The case of Upper Madi Watershed, Kaski, Nepal. *Tribhuvan University Journal, 19*(2), 25–42.

Shandas, V., et al. (2017). Rapid urban growth and land use patterns in Doha, Qatar: Opportunities for sustainability. *European Journal of Sustainable Development, 11*, 2542–4742.

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