

Urban Expansion and LULC Change in Shahbad City (2000–2020)

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Abstract

Urban expansion is one of the most significant spatial processes impacting land-use structure, environment and the socio-economic nature of developing towns. The present study aims at analyzing the dynamics, spatial distribution, influencing factors and impacts of urban growth in Shahbad City in 2000-2020. The changes occurring in major Land Use/Land Cover categories (built up area, agricultural land, open and fallow land, vegetated cover and green cover, and water bodies) were analyzed by remote sensing data and satellite imagery, and Geographic Information System techniques. The analysis indicates that the urban area has been expanding continuously from the core towards the north, south, east and west. Urban growth occurred along the major transport arteries, in small or leapfrog fashion on the urban fringe, within existing settlements and through intensification of the central area.

The built-up area increased substantially from 64 in 2000 to 132 in 2010 and 218 in 2020. Agricultural land on the other hand decreased from 272 to 204 hectares and then to 148 hectares over the same timeframe. The green cover and vegetation area also reduced from 54 in 2000 to 34 in 2020 and open land and fallow land reduced to 68 in 2020 from 54 in 2000. The key factors of this change were found to be population growth, rural to urban migration, improved transportation, economic diversification, institutional development, and rising land values and real-estate activities. The results show that the rapid and somewhat unplanned urban development has put pressure on agricultural land, the green spaces, the drainage systems and public facilities. The study highlights the importance of GIS based monitoring, small urban development, efficient zoning, preservation of green spaces and water bodies and the integration of urban planning in order to find sustainable growth in the future of Shahbad City.

Keywords: Urban Expansion; Land Use/Land Cover Change; Shahbad City; Remote Sensing; Geographic Information System; Urban Sprawl; Agricultural Land Conversion

Introduction

One of the most important processes shaping the physical, economic, social and environmental characteristics of modern towns and cities is urbanization. Urban sprawl typically includes the transformation of farmland, open spaces, vegetation and other natural surfaces to residential, commercial, institutional, industrial and infrastructural development. Urban expansion brings about opportunities to work, better connectivity within the region, and better access to education, healthcare

and markets; however, unplanned urban expansion can lead to spatial inequality, lack of infrastructure, ecological degradation and conflicts over land uses. Hence, the study of urban expansion and related Land Use/Land Cover change is a must to understand the direction, intensity and impacts of urban development.

There has been significant spatial change in Shahbad City between 2000 and 2020. The urban area of the settlement was relatively compact at the start of the study period, with existing urban development being concentrated in the traditional town centre, the local markets, the administrative buildings, the religious buildings, and the railway station. The surrounding areas continued to be dominated by agricultural areas while open areas, vegetation and water bodies helped to maintain the ecological balance of the city. This demand for residential, commercial and institutional land, however, gradually grew with a rise in population, migration from neighboring villages, economic diversification, infrastructural development and improvement in transport network.

Shahbad has evolved from a tight-knit community to a more spread-out and outward-growing city. The growth has been linear, along the principal roads and highways, nodal, around schools and commercial buildings, and diffuse, on the fringe of the city and in filling in previously developed land. Highways and internal roads are particularly significant as a determinant of urban growth. The commercial establishments, workshops, warehouses, service centres, and residential colonies have begun to grow in the urban corridor, giving it a ribbon-like appearance. At the same time, the price of land has declined and increased availability of land on the urban fringe has facilitated the development of plots for residential and commercial use at the expense of agricultural land.

Spatial change analysis using Land Use/Land Cover analysis is a good tool to measure them. Comparative figures for 2000, 2010 and 2020 show that the built up area is significantly expanded from 64 to 132 and finally to 218. Agricultural land declined from 272 in 2000 to 204 in 2010 and 148 in 2020. The green cover and vegetation also reduced continuously, and open land and fallow land were more and more being covered with construction. The changes show that much of the new urban development has been accomplished at the cost of productive and environmentally valuable land. Degradation of the vegetational cover and open surfaces has also led to an increase in impervious surfaces, which may have led to an increase in surface runoff, localized flooding, surface water retention, and urban heat-island effects. Demographic, economic, infrastructural and institutional elements are interdependent and affect Shahbad's growth. Population growth and rural-urban migration have created the demand for houses and public services. The city of Shahbad has emerged as a local trade and service centre with the improvement of road connectivity with Kurukshetra and other surrounding rural settlements. The construction of schools/colleges, healthcare facilities, small business units and retail markets has brought residents and investments. Meanwhile, land values have increased leading to the conversion of land around the city's urban core into residential and commercial areas. In tandem, agricultural landowners and real-estate developers have also been buying and selling land near the urban core in order to sell in residential and commercial properties.

The current study thus examines the urban expanse in the city of Shahbad from 2000 to 2020 in terms of its temporal and spatial aspects. It explores LULC changes, discusses key drivers of urban expansion and reviews environmental and planning issues of fast pace of change. The study also emphasizes the concept of sustainable growth-management approaches such as efficient zoning, safeguarding agricultural and ecological land, enhancing civic infrastructure, preserving green spaces and bodies of water and periodic GIS-based monitoring. This is useful in determining the future planning decisions and to make sure that urban development in Shahbad is economically productive, socially inclusive and environmentally sustainable.

Trends and Spatial Patterns of Urban Expansion

The urbanization of Shahbad city is an evolving phenomenon influenced by population growth, economic development, transportation and land use. In the last 30 years the city has evolved from a concentrated settlement pattern to a more spread out and outward-growing city. Satellite images and GIS-based analyses show clear temporal trends, with a gradual rise in urbanization, and a decline in agricultural land and an open space at the edges of the urban sprawl. It is evident that the spatial manifestation of this expansion follows a linear development in major transportation corridors, a nodal development in major commercial and institutional centres and a scattered residential expansion to the northern and southern fringe. The immediate connections to the main highways and the added connectivity have promoted ribbon development, while the core area has become increasingly congested because of commercial intensification. The spatial transformations reflect a shift from a rural-urban mixed landscape towards more urban characteristics, which can be considered as sign of both planned and unplanned growth patterns. Knowing these trends and patterns is very important to forecast future expansion and find the vulnerable areas and formulate suitable strategies for sustainable land use management in Shahbad city.

• Temporal Analysis of Urban Expansion from 2000–2020

The temporal study of urbanization process in Shahbad city between 2000 and 2020 shows a significant change in the land-use structure, urban settlement pattern and built-up growth direction of Shahbad city. During these past 40 years, Shahbad has evolved from a predominantly rural and agrarian community to the establishment of a new urban settlement with rising densities of urban fabric, enlarging residential and commercial centres and the development of infrastructural networks. This timeframe (1980-2020) can be broken up into four distinct periods, 2000, 2000-2010 and 2010-2020, which each exhibit different demographic, economic, infrastructural, transportation, and socio-economic patterns. The topographical mapping, satellite imagery and GIS-based spatial analysis of the temporal assessment shows a continuous and gradual spreading of urban land, and marked transformation of agricultural fields, fallow land and open spaces to built-up areas. The changes are not only physical, but social and economic changes that redefined the urban identity of the City over time. In the period 2000-2020, Shahbad remained in the initial phase of urban transition, with a compact structure of the town center mostly around the old town core, administrative buildings, local markets, religious buildings, and the railway station. During this timeframe, the built-up area was

relatively small, and the economic infrastructure fairly agrarian, with both a small degree of agricultural activity and of small scale trading and services. Demand for more residential areas was limited and growth pressures were low because population growth was not as high and job diversification and infrastructure development were not as rapid as in the old town centre. Although the major roads were there, they were non-commercial, and ribbon development had not yet become prominent. Outside of the core, agricultural fields were predominant and open fields were the main land cover. The change over this decade was not sudden but instead paved the way for the following decades when the economy and demographics started to drive increasing urbanization.

There was a noticeable spatial and structural change in Shahbad starting from the year 2000. Urban expansion had been catalysed by several important socio-economic changes like accelerated population growth, increased rural to urban migration, enhanced transportation connectivity and the emergence of educational and small industrial units. The built-up area started to grow beyond the historic core, especially in the north-west and south-east, where land values were relatively low, and roads were becoming more accessible. Small businesses like shops, dhabas, small industries, warehouses and service centres along the highway started to grow, leading to ribbon development along the main transportation routes. Most importantly, the proximity of the town to Kurukshetra and Ambala facilitated the movement of labour and trade and facilitated the growth of new residential settlements which started putting strain on the town. There were no planned large colonies, but there were residential areas scattered across the connecting roads, which were unplanned. The decade was a turning point for Shahbad from being a rural market town to a semi-urban area in the early stages of land-use fragmentation and non-uniform spatial growth. The years from 2000 to 2010 were the most dynamic in the urban development of Shahbad. Economic liberalization, freedom of movement, increased land values and increased infrastructural investment were prominent features of the post-2000 years. The built-up area of Shahbad grew considerably during the last 10 years as compared to the previous decades when high resolution satellite images were captured. The residential colonies started to grow in all directions, particularly to the north, south and west. The morphology of the city was drastically altered as a result of the rapid construction of houses, commercial buildings, coaching centres, schools, and transport-related buildings. The National Highway near the city became a hub of urban activities and urban growth. In addition, greater connectivity to other cities provided commuting opportunities, leading to an increase in population density and housing demand. Conversion of agriculture land to residential land particularly near existing residential areas and transportation corridors occurred at a rapid pace. The beginning of the decade also saw the emergence of isolated residential and commercial buildings, known as scattered or leapfrog development, in the area beyond the contiguous urban area. New institutions, shops, service centres and small industries helped to bring about a lively urban economy, with noticeable shifts in land-use. The city evolved in space, as mixed use zones, fragmented open spaces and more and more dense pockets of built-up areas, became characteristic. The trends here highlight how Shahbad is morphing into a medium sized urban node with a range of diverse functions and increased regional connectivity.

The 10-year period 2010–2020 is the most critical and the most widespread period of urban growth in Shahbad. The satellite data reveals high rate of conversion of non-urban land into built-up land during this period, and a large increase in the number of educational institutions, commercial buildings, health facilities, service-based enterprises and residential colonies. The urban footprint grew rapidly in all directions, especially in the southern and eastern corridors, where land was available and connectivity allowed for the growth of real estate. Urban expansion was fueled by the population growth, migration from adjacent rural areas, better employment prospects in the service sector and better infrastructure especially road widening and transport facilities and digital infrastructure. In this decade, planned residential colonies began to also emerge, but in some peripheral areas weak land management and administration allowed for continued unplanned construction. Growth pattern between 2010 and 2020 is a mix of sprawl and ribbon development and infilling. Sprawling was found in areas where development moved outwards in isolated fragments, ribbon development along transportation corridors was increased and infilling was seen as the use of empty space within built-up areas. The urban entropy values are an indicator of increasing spatial dispersion, signifying that the city was not only growing outward but also in a dispersed manner. The north and west sides, which were largely agricultural, became the sites of rapid urban growth, and the central region of the city was undergoing vertical growth and commercial proliferation. In some parts of the region, land-use efficiency has been reduced by the dispersion of development, and in other parts, by the appearance of planned layouts. In all, the decade is characterized by a faster pace of urbanization as a result of socio-economic aspirations, better regional connectivity and an increase in household incomes.

• **Land Use/Land Cover (LULC) Change Detection and Land Use Change Pattern Analysis**

Land Use/Land Cover (LULC) change detection is valuable analytical tool for clarifying the spatial, functional and environmental transformation of Shahbad city from 2000 to 2020. Land Use/Land Cover Change Pattern Analysis is a major geospatial technique used in the present study to identify and analyse the changes in various LULC categories such as built-up area, agricultural area, open land, vegetation, water bodies, roads and others. The analysis also sheds light on the evolution of Shahbad city and the impact of urban development on the natural and environmental fabric of the area. GIS techniques and comparison of satellite images from various years provide a detailed and quantifiable visualization of the land use and land cover changes that occurred over the course of the study. The study demonstrates the impact of population growth, infrastructure development, transport connectivity, economic activity and urbanization pressure on the agricultural fields, open spaces, vegetation, water bodies, and roads and built-up structures. Previously predominantly a city of agriculture and open rural areas, Shahbad has now evolved to become a growing urban settlement with the growing prevalence of residential, commercial, institutional and infrastructure land uses.

Agricultural use of land was the major land utilization category in the year 2000 in and around the Shahbad city. Built-up areas were primarily concentrated in the central part of the city, such as the main market, the administrative area, the railway station, religious buildings, and older residential areas. The open space, vegetation and water bodies were also found in various parts of the city and

played a role in maintaining ecological balance. Roads and other urban surfaces were relatively scarce, and primarily linked to the center of the city. In the year 2000 urban growth began to radiate outwards from the urban centre to the fringes of the urban area. The agricultural fields opposite roads and highways slowly transformed into residential colonies, commercial buildings, businesses, warehouses, workshops and institutional buildings. Between 2000 and 2010 there is a gradual land use change. The decade saw the growth of built-up area along major roads and close to the city centre, and agricultural land was beginning to be lost where new areas of residential and commercial development emerged. The LULC change pattern indicates linear growth along transport routes and scattered development in outer areas. It is the beginning stage in urbanization, where rural lands start to develop into the urban land as a result of improved connectivity, rise in land values, and increase in demand for houses and services.

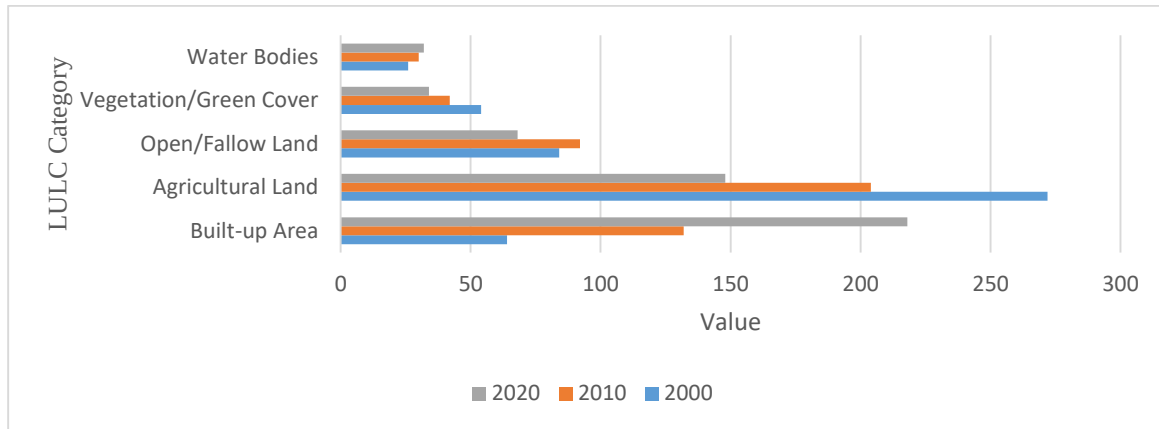
The rate and clearly visible extent of LULC change increased between 2010 and 2020. There was considerable growth in built-up land in virtually all directions, particularly to the south, east and west of Shahbad city. Displacement of agricultural and open land due to new residential colonies, plotted developments, shops, educational institutions, health care facilities and commercial complexes. The densification of the city core was also gradual, with the filling of empty land parcels by residential and/or commercial buildings. During this time more intense urban sprawl can be observed: with leapfrog development in the vicinity of larger road corridors, and continuous built-up expansion. It is evident from the pattern of change in the land-use that agriculture was in a continuous decline over the years and the built-up area was in a continuous rise. The reduction of open spaces and vegetation cover is also a result of construction activities and increase in impervious surfaces (concrete road, rooftops, parking areas and paved commercial surfaces). Natural areas of low elevation and water bodies have been subject to encroachment and land alteration pressures. These modifications have upset the natural drainage of the site and decreased its groundwater recharge potential. Consequently, Shahbad city is experiencing environmental issues like surface water run-off, localized flooding, reduction of green cover, urban heat islands and natural resources pressure.

Table 4.1: *Land Use/Land Cover Comparison of Shahbad City in 2000, 2010 and 2020*

LULC Category	2000	2010	2020
Built-up Area	64	132	218
Agricultural Land	272	204	148
Open/Fallow Land	84	92	68
Vegetation/Green Cover	54	42	34
Water Bodies	26	30	32

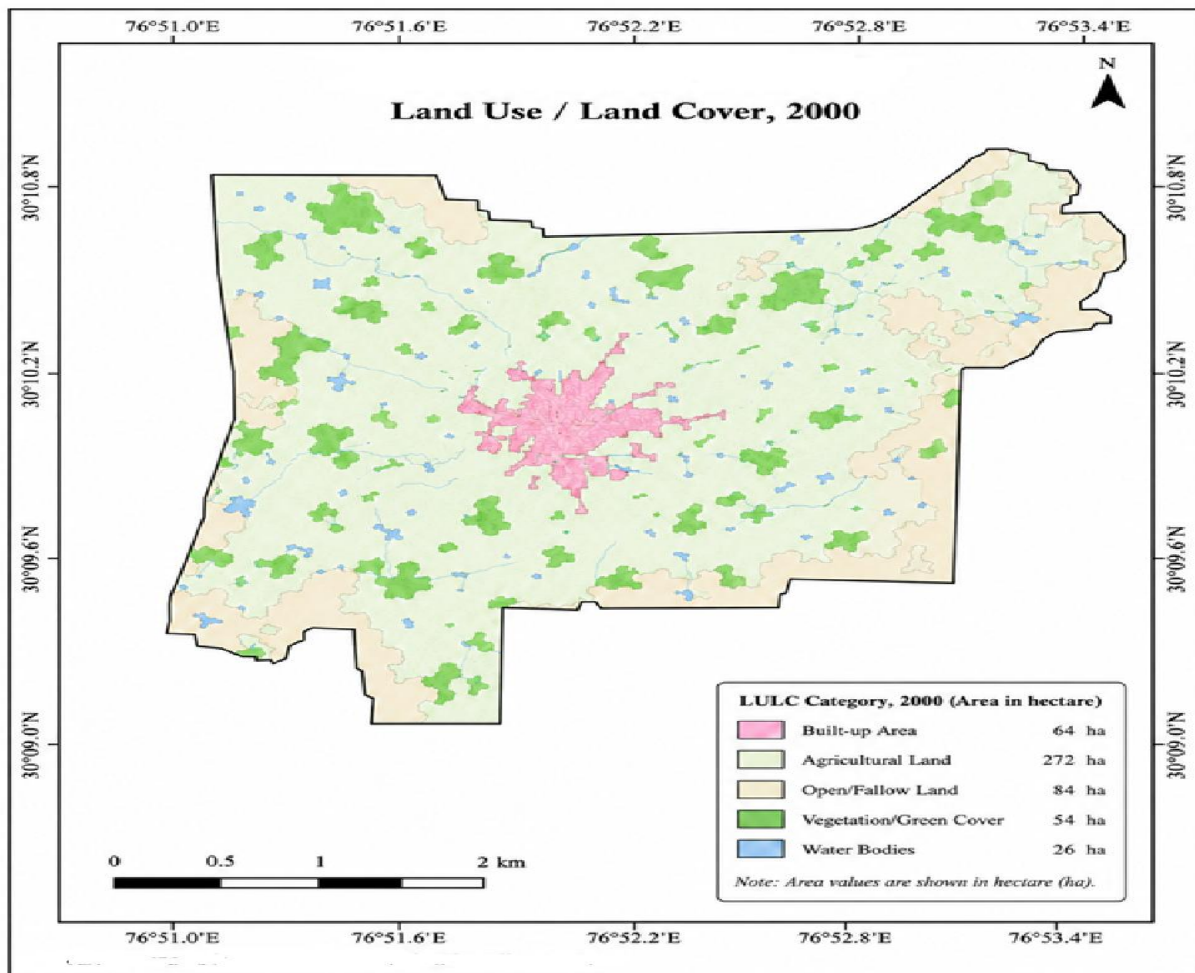
Source: Primary data

Figure 4.1: Land Use/Land Cover Comparison of Shahbad City in 2000, 2010 and 2020



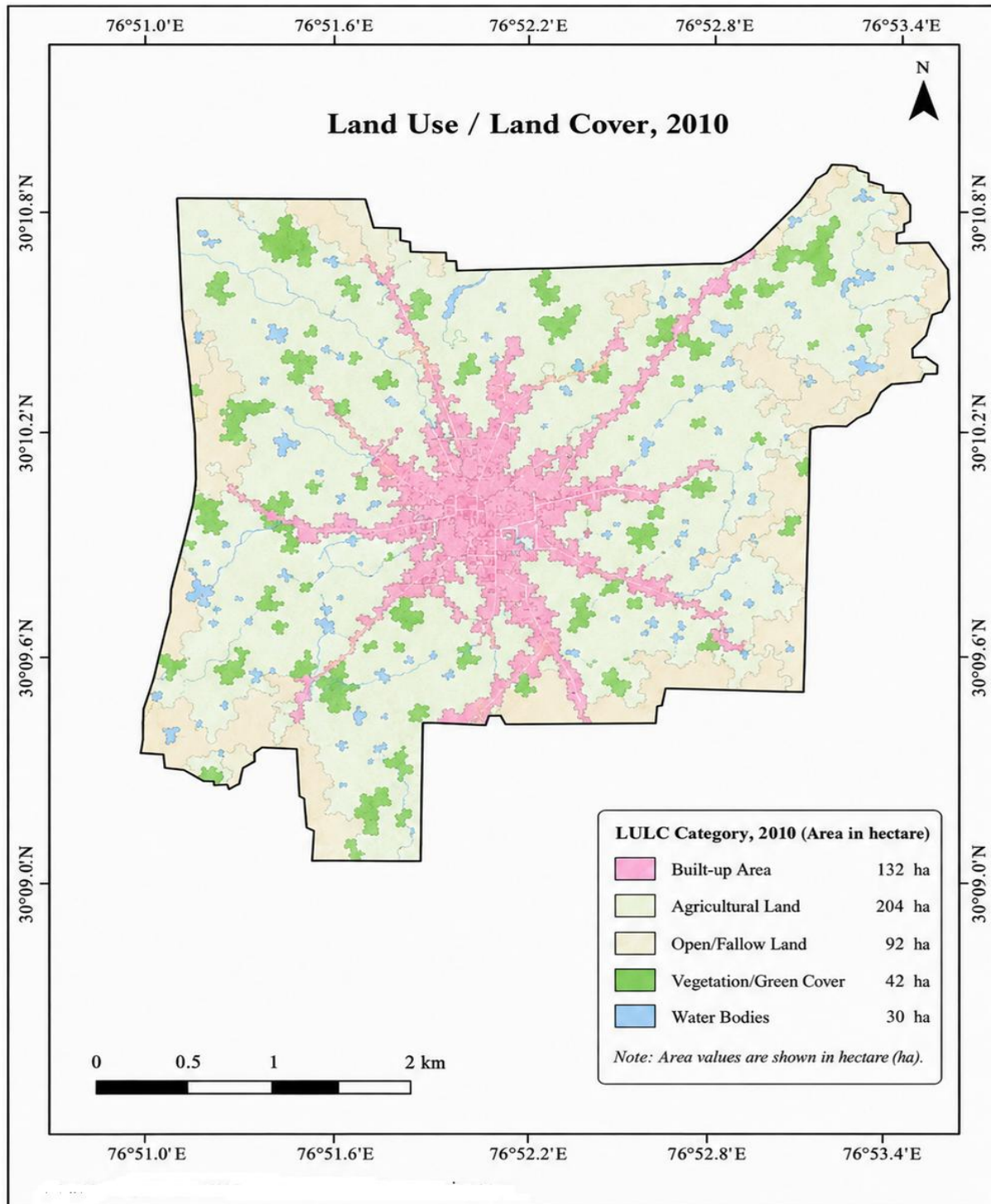
Source: Table 4.1

Map 4.1: Land Use/Land Cover Comparison of Shahbad City in 2000



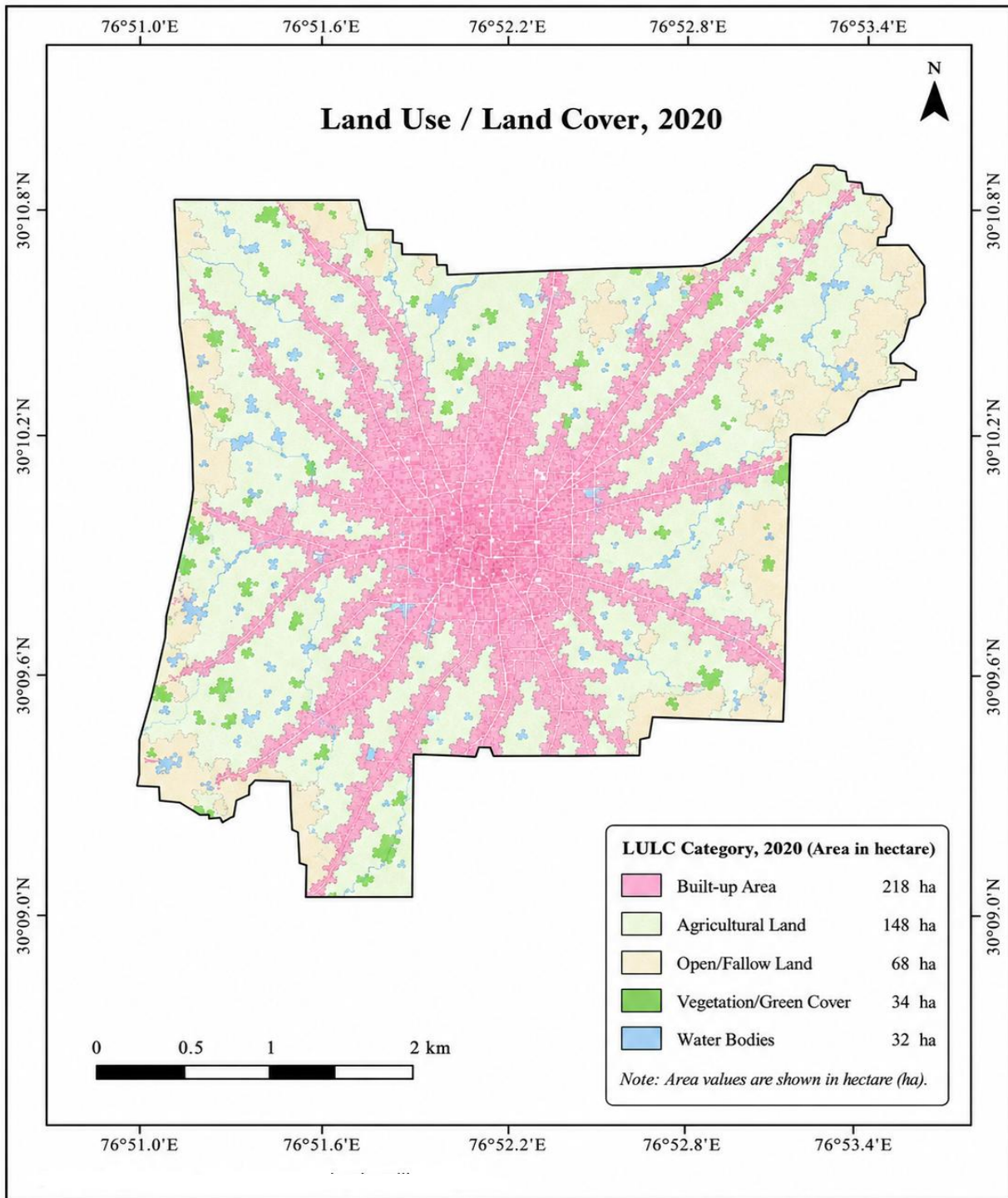
Source: The researcher has done this research work with the help of QGIS.

Map 4.2: Land Use/Land Cover Comparison of Shahbad City in 2010



Source: The researcher has done this research work with the help of QGIS.

Map 4.3: Land Use/Land Cover Comparison of Shahbad City in 2020



Source: The researcher has done this research work with the help of QGIS.

The comparison of Land Use/Land Cover (LULC) changes in Shahbad City between 2000 and 2010 and 2020 years is shown in Table 4.1, which reveals a notable change in urban area over a span of 20 years. The data clearly presents an increase in the built-up area from 64 units in 2000 to 132 units in 2010 and 218 units in 2020. This significant development is in line with the fast development of residential colonies, commercial establishments, institutional buildings and transportation infrastructure as a result of population growth, real-estate development and increase in economic activities. Consequently, agricultural land continues to decrease from 272 units in 2000 to 204 units in 2010, down to 148 units in 2020. This dimension signals a significant shift of arable land into the urban, and is an expression of spatial growth and increasing land needs towards settlement and development. There is also a declining trend in open and fallow land from 84 units in 2000 to 92 units in 2010 and down to 68 units in 2020. This decrease is due to the gradual encroachment of built-up expansion that is taking up and occupying unused and empty properties within the city, thereby leaving less open space. In a similar downward trend, the vegetation and green cover also dropped, from 54 units in 2000 to 42 units in 2010 and 34 units in 2020. This decrease indicates a growing environmental pressure associated with the destruction of natural vegetation, trees and the ecological spaces in the city, which impact the micro-climate and environmental quality. There are slight fluctuations in the number of water bodies, with a rise from 26 units in 2000 to 30 in 2010 and 32 in 2020, which could be due to canal improvements, pond renovation and better water management practices. In general, the LULC comparison showed that the city of Shahbad is experiencing a process of rapid urbanization, with the expansion of urban built-up areas at the expense of agricultural areas, green space and open land, which reflects the significant effects of urbanization on the environment of the city during 2000-2020.

Factors Influencing Urban Growth

Urban growth in Shahbad city is the result of the interplay of a number of factors such as demographic, economic, infrastructural, social and spatial factors, which have collectively combined to create a rapidly expanding urban centre in Shahbad city over last four decades. Population growth is one of the main reasons for this change as it has been on the rise over time from the natural increase and migration from nearby villages. With limited employment opportunities, restricted agricultural incomes and aspirations for improved living standards in rural communities, Shahbad has become an attractive place for people to move to provide them with better access to services, markets and employment. This population growth has led to the growing need for housing, commercial facilities and public services, which have put pressure on the conversion of land use and the built-up area. Expansion of economic activities has been closely related to demographic changes, and has greatly contributed to the urban development. Being a strategic position on the roadways, Shahbad has the advantage of having trade, services, retail markets, small industries and educational institutions to grow due to its proximity to the key towns like Kurukshetra and Ambala. The shift from agricultural based economy to service and small scale industry has created new income opportunities in the economy and investments have been made in real estate, commercial complexes and supporting

infrastructure. Enhanced transport and connectivity has also been one of the key drivers of the development of the city in Shahbad. The presence of national and state highways within the vicinity of the city has created a better regional connection and mobility. Improved transportation facilities has enabled people to commute, trade and be accessible to one another making the city a transit hub and services hub for surrounding rural areas. This increased connectivity has also fostered linear or ribbon growth along key corridors, helping to drive outwards growth in built-up areas. Commercial and service-oriented activity shops, repair facilities, warehouses, fuel stations, educational facilities, etc., have attracted to transportation corridors, creating a stimulus for residential development in nearby areas. Therefore, better transportation has not only transformed spatial shape, but also influenced the spatial pattern of land use.

The changing dynamics of real estate and an increase in land values have also altered the cityscape of Shahbad. Growth of population and economic activities led to a sudden surge in the demand for land, especially around institutional clusters, markets and highways. The farmers were encouraged to turn their land into residential or commercial property and a lot of real estate development took place, in addition to the fragmentation of farmland. Real estate developers indicated that there was a demand for the development of plotted colonies and housing projects in peripheral areas, thus speeding up the process of conversion from rural land to urban land. This market use of land has driven the city expansion, and encouraged speculative and unplanned development in some areas. Rapid expansion of social infrastructure like schools, colleges, coaching centres, hospitals and community facilities also has contributed significantly to urbanisation. As Shahbad became an educational and service centre for nearby villages, more families came to the city for better quality education and health services. Educational institutions attract students, provide jobs, need hostels, rental units and commercial services. Hospitals also draw patients and households from the suburbs, fueling the demographic and spatial development of the city. There are good opportunities to provide social infrastructure in clusters, which attracts areas of residential growth.

The other major improvement is the enhancement of the basic infrastructure and civic amenities such as water supply, electricity, sanitation, and telecommunication. Service provision grew and improved, and it became possible to live in the peripheral areas that were not built up; this led to a migration away from the crowded central areas to new residential colonies. The advantages of better utilities are lower living expenses, better quality of life and greater settlement and commercial potential of peripheral zones. Urban expansion has therefore been directly affected by the public investment in infrastructure. Urban growth is also significantly influenced by migration. There is not only rural-urban migration from villages to Shahbad but also seasonal migration from far away villages. Migrants are also part of the workforce in markets, industries and service centres, contributing to the growth of local economic activities. More migration leads to more people seeking affordable housing, rentals, transportation, and day to day services, which further drives up construction and commercial development. As the result of migration, migrants may eventually establish permanent settlements and make a positive long-term impact on the demographic of the area, leading to the growth of urban

neighbourhoods from peripheral settlements over time. Further, geographical conditions like relatively flat land, fertile agricultural land and accessibility have helped the built-up areas of the country spread outwards. Traditionally fertile land is used for farming however, land that is close to a transport route and towards urban consumption is more appealing for residential and commercial development. Its geographical location on the connecting roads between main towns has facilitated it to develop into a service and trading centre, which has led to urbanisation beyond its limits. Government policies, planning frameworks and administrative decisions may also have an impact on the direction of urban development, but their impact is variable. The aim of the development of Master Plans, zoning regulation and building guidelines is to direct growth in an organized fashion but enforcement issues frequently cause unplanned development in the periphery. Indirect stimulation of private development is achieved through periodic upgrading of infrastructure, road widening projects and public investment initiatives which improve accessibility and land values. However, there have been several settlement developments and the presence of mixed use areas have resulted in spatial fragmentation, due to lack of regulatory control. In areas with effective planning, growth seems more coherent; in areas with less effective regulation, unplanned sprawl is more evident. Last but not least, urban growth is now shaped by changes in lifestyle aspirations and socio-cultural change. As incomes increase and tastes change, many households want to increase the size of their home, the quality of the neighbourhood and the quality of the amenities, and thus move out of dense central locations. This suburban lifestyle preference abets suburban residential growth. The construction of modern retail spaces, restaurants, coaching centres and health clubs further fuels the commercial development of the city and leads to an even greater future expansion. To sum up the above discussion, population, economical diversification, improved connectivity, real estate, social infrastructure, migration, geography, and policy interventions all influence the development of urban growth in Shahbad. All these elements together lead to a polyvalent and poly-directional trend of expansion, which is still reshaping the spatial and functional nature of the city.

Urban Growth Management for Sustainable Development

Rapid urbanisation, population growth and the ongoing process of land use change in Shahbad city has accentuated the importance of urban growth management, which is facing severe challenges from these. Good urban growth management should be orderly, efficient and in keeping with Sustainable Development Goals (SDGs), specifically SDG-11: Make cities and human settlements inclusive, safe, resilient and sustainable. The control of land-use patterns in Shahbad using zoning, enforcement of master plan guidelines, protection of environmentally sensitive areas and the promotion of compact development to mitigate urban sprawl are all aspects of managing growth. Preserving green spaces, enhancing public transport, encouraging mixed-use development, and providing proper water and sanitation infrastructure and waste management solutions are all important strategic measures to help buffer the impacts of urban sprawl. Furthermore, to support sustainable urban development, renewable energy, rainwater harvesting and eco-friendly construction practices are integrated to minimize ecological impacts. Institutional capacity building, strengthening governance mechanisms and

ensuring community participation in planning and construction is also crucial to reduce unplanned construction, encroachment and waste of resources. The use of smart planning instruments such as land monitoring via GIS and environmental impact assessment and growth forecasting models can be used to tackle future challenges and to plan development in a balanced way as Shahbad expands. In short, sustainable urban growth management aims to balance economic development with environmental protection and social inclusion and infrastructure development to ensure Shahbad is developed into a modern urban centre while being environmentally responsible and socio-economically rewarding.

Conclusion

A comparative study on urban expansion of Shahbad City in 2000 and 2020 shows a significant change in the physical aspects, functional nature and land-use composition of the city. Over the past twenty years, Shahbad has transformed from a small, rural and agriculture-based community to a growing urban centre, featuring residential development, commercialisation, institutional growth, and enhanced transport infrastructure. The city has grown from its historic center in several ways: ribbon development, peripheral sprawl, scattered or leapfrog development, infilling, and by densifying the central areas. Land Use/Land Cover data vividly identifies the extent of this change. The built-up area increased from 64 in 2000 to 132 in 2010 and 218 in 2020. Meanwhile agricultural land shrank dramatically from 272 to 204 and then to 148. Vegetation and green cover fell from 54 to 34 and open and fallow land fell to 68 at the end of the study period, respectively. The urbanisation trend is directly reflected in these changes as it has led to the pressure on natural or productive land. Population growth, migration, transportation connectivity, economic diversification, institutional expansion, real-estate development and rising land values were the main forces responsible for Shahbad's urban growth. The key role of spatial corridors was played by major roads and highways to which commercial establishments, services, warehouses, institutions and residential colonies were attracted. Greater access to neighbouring villages and towns made Shahbad more important in the region, and educational and health facilities led to additional demand for housing, rental accommodation and the provision of additional commercial activities. The speed of development has however resulted in some environmental and planning issues. Loss of farmlands and vegetation, reduction in available open space, encroachment on natural drainage and impervious surfaces can lead to surface runoff, flooding on impervious surfaces, lowered groundwater recharge, elevated temperatures and degraded environmental quality. Inappropriate and uncontrolled fringe growth has also stressed the roads, water supply, sanitation, drainage and waste management and other civic services. Mixed land-use development has facilitated economic activities but at the same time has added to the traffic congestion, pollution and infrastructure pressure.

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