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Analysis of population growth and land use change in Anantnag town of South Kashmir using remote sensing and geographical information system

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Abstract
The Himalayan region is currently experiencing unplanned and unregulated urban growth. The fast expansion of road linkages, emergence and growth of rural service centers and increased access to markets has facilitated urbanization in Himalayas. The growth in human population is considered not only one of the important causes of urban expansion but also a key driving force of land use land cover (LULC) change. The present study analyses the urban growth of Anantnag town which acts as district headquarter of Anantnag district in South Kashmir Region. The response of various LULC categories to growing population of the town was analyzed using integrated technologies of remote sensing and geographic information system. The results have revealed that the town has registered an increase by 4.37 fold in population and 7.5 fold in area from 1981 to 2011. The arable land has been converted into built-up area and is devoted to various urban land uses. It is therefore highly imperative to analyze and interpret the steering factors of fast urban growth and assess its environmental impacts.

Keywords: Urbanization, Remote sensing, Land use, Anantnag

INTRODUCTION

Land use denotes the human employment of the land and is a synthesis of physical, chemical and biological systems and processes on the one hand and human/social processes and behavior on the other [1] while land cover denotes the physical and biotic character of the land surface [2, 3]. LULC change is a dynamic, widespread, continuous and accelerating process driven by natural phenomena and anthropogenic activities [4] which in turn impel changes that would impact natural ecosystems [5, 6]. Inventory, assessment and monitoring of LULC change provides vital input to environmental decision-making [7] and are crucial for further understanding and modeling of change mechanism at different scales [8]. Over the last few decades LULC change has resulted in unproductive or less productive uses in Himalayan region and is of focal concern for its sustainable development [9]. Satellite remote sensing and geographical information system (GIS) is a strong tool for providing accurate and timely geospatial information describing most types of land use [10, 11] and its assessment at global [12, 13, 14] as well as regional level [15] While GIS provides a flexible environment for collecting, storing, displaying and analyzing digital data [16] remote sensing imagery forms its most important data resource [17].

The process of urbanization is considered as one of the most prominent human induced land transformation. The major cause of most urban environmental problems is the rapidly growing human population. Many reasons have been given for the rapid growth of urban population in developing countries. One of the chief causes has been unbridled influx of rural population into urban areas, either due to some push factors or due to pull factors. The proportion of the world's population living in urban areas, which was less than 5 percent in 1800 AD increased to 47 percent in 2000 and is expected to reach 65 percent in 2030 [18]. During the last fifty years the population of India has grown 2.5 times, but urban India has grown nearly five times [19]. About 60 percent of this urban population growth is attributable to natural growth, and the remaining 40 percent is due to migration and spatial expansion [20]. As urban areas grow, the proportion of land use for different activities also undergoes changes to meet the socio-economic and demographic challenges. The study of these changes is essential from the point of view of urban planning.

STUDY AREA

Anantnag town is located in the heart of the district which encompasses three tehsils of Anantnag, Bijbiara and Pahalgam in its Jurisdiction. The township is situated between 75^0 05' 19" to 75^0 11' 18" East longitude and 33^0 42' 31" to 33^0 46' 27" North latitude (fig.1) at an altitude of 1600 meters above mean sea level and at a distance of 53 km in the Southeast of Srinagar city. The total area of the town is 38.03 km^2. The town has originated closer to the confluence of two important tributaries of Jhelum river - Lidder and Arapat which contribute substantially to the discharge of river Jhelum. The town being the administrative headquarter of one of the major districts on the Kashmir valley has attained enormous significance due to the disposition of number of Tourist resorts espicially Amarnath cave and Martand Temple.

Initially, the town grew in the form of a Necklace, Ribboning along the Fatehgarh plateau and Kadipora to Sheerpora-Bala but mostly above the highest flood levels of Arapat and Lidder streams. But the increasing pressure of population has resulted in unplanned colonies in low lying areas of Donipaw, Zadipora, Ashajipora, Dabrun etc. which have experienced high growth during recent years along the Khanabal – Pahalgam and Dooru – Verinag roads.

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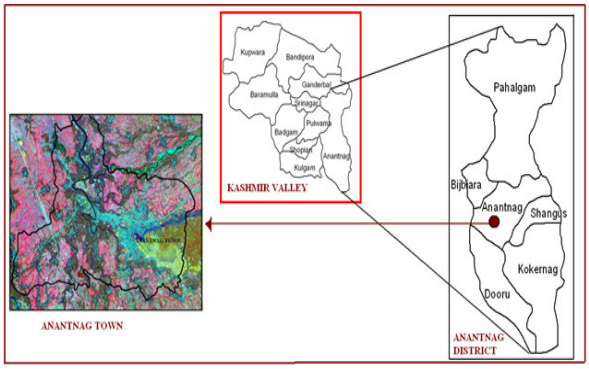

Fig 1. Location map of the Study area

METHODOLOGY

The present study was carried out using both primary as well as secondary data. The analysis of population growth of the town as well as its expansion was carried out using secondary data obtained from Census of India and Town Planning Organization, Srinagar. The LULC change analysis was carried out from the year 1981 to 2011. The present study have adopted the land use classification of Jammu and Kashmir Town Planning Organization, Srinagar; which have broadly classified the land use of Anantnag town into two categories i.e., developed and undeveloped land. The developed land has been sub-divided into dense built-up and mixed built-up. The undeveloped land has been sub-divided into six categories viz., agricultural, water-bodies, dense forests, sparse forests, waste lands and plantations. LULC information for the year 1981 was obtained from Town Planning Organization, Anantnag. The recent (year 2011) LULC map was generated by digital image processing of the satellite data (IRS P6 LISS III, September 2010 with 23 meter resolution). The LULC map for 2011 was validated through field survey. A differential Global Positioning System (GPS) was used to collect the accurate locations of the reference points for all LULC categories. These points were used for the validation of classified data.The necessary changes resulting from ground truthing were incorporated into the final classified image.

RESULTS AND DISCUSSION

Spatio – temporal growth of Anantnag town

Anantnag was declared town in 1901 when the population of the town was only nine thousand and was predominantly confined in and around Fatehgarh Plateau. The town has shown slow and steady growth in areal expansion in the first half of the twentieth century. The slow growth and areal expansion of Anantnag town was mainly due to migration of people to main urban centre i.e., Srinagar city which dominates the urban scene in the Valley. However from 1981 onwards, the town showed tremendous areal expansion from 5.07 km^2 in 1981 to 38.03 km^2 in 2011. The direction of the urban expansion was controlled by the topographical factors. The city's eastward expansion was limited by the presence of a hill which substantially limited the expansion of the city to the east and hence the expansion was on west, south east and northeast.

Table 1. Population growth profile of Anantnag Town, (1901-2011)

S. No.	Year	Population (Persons)	Absolute variation (Persons)	Average annual Growth rate
1	1901	9019	-	-
2	1941	11985	2966	1.1
3	1951	16536	4551	3.8
4	1961	21087	4551	2.8
5	1971	27643	6556	3.1
6	1981	33978	6335	2.3
7	1991*	52000	18022	5.3
8	2001	97896	45896	8.8
9	2011	148586	50690	5.2

Source: Census of India; * Projected Population

The town experienced slow but steady growth of population till 1951 when it had a population of 16536 persons with the average annual growth of 3.8 percent (table 1). However, from 1951 onwards, the population growth alternatively decreased and then increased in the successive decades except for 2001 when the population growth continued the increasing trend. The highest population growth (8.8 percent) was recorded in the decade of 1990 – 2001 which decreased to 5.2 percent during 2001 to 2011 (fig. 2). Due to accelerated growth in Population and anticipated territorial annexation, Housing and Urban Development Department of Jammu and Kashmir Government has declared Town Area Committee (TAC) of Anantnag as Municipal Council of Anantnag (MCA). The town crossed the population of one lakh mark in 2011 and has attained the status of city which is now next to the only city of Srinagar in the region. Besides the town ship of Mattan which is situated in close proximity of Anantnag is expected to merge in its territorial limits and make it lower level urban agglomeration and a potential counter magnet to Srinagar city. Anantnag town is rapidly emerging as an important agro-industry centre in South-Kashmir; it acts as the major terminating centre for export of fruits outside the valley. Considering all these aspects, it becomes imperative that appropriate and timely measures are taken to make it a sustainable second order urban settlement of Kashmir valley.

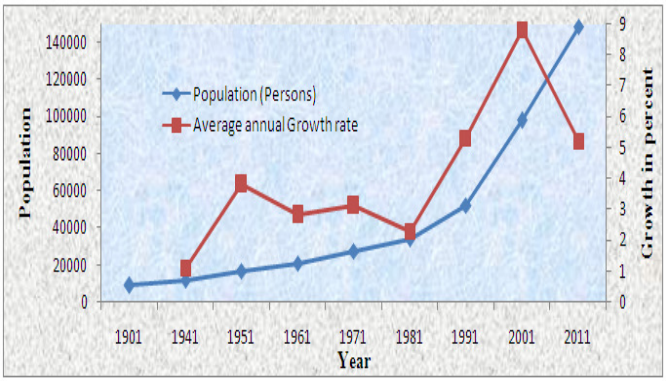

Fig 2. Decadal population and its growth in Anantnag town

Analysis of land use land cover change

Land is one of the greatest resources of an area. It provides room for human dwellings, communication lines, factories, cultivation, grazing, orchards and forests, etc. These are the bases for the foundation of economic development. The proper utilization of land resources offers a chance to accelerate economic growth and the formation of capital. Proper utilization, however, depends on socio-economic and techno-economic status of a particular region. It is, thus important to note various uses to which land is put in the region under study.

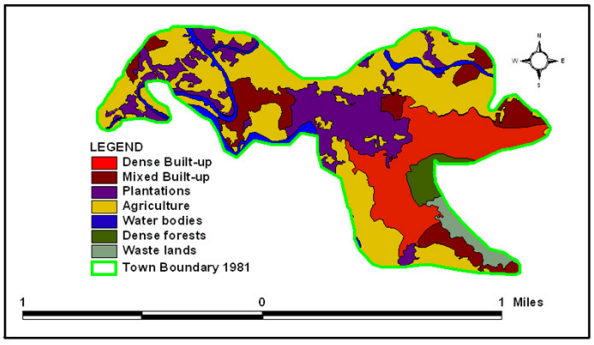

Fig 3. Map showing land use land cover of Anantnag town for the year 1981

The land use pattern of a city is the product of two sets of forces. One is centrifugal which tend to cause functions to migrate from the centre of the city towards periphery, and the other centripetal one which tend to work in opposite directions [21]. Among economic factors, land values are the major determinant of urban land use. In the present study, seven LULC categories were identified in Anantnag town for 1981 (fig.3) while eight LULC categories were identified for 2011 (fig. 4) because the areal expansion of the town resulted in the inclusion of sparse forest area under town limits. The town has itself registered an areal expansion of 3296 hectares from just 507 hectares in 1981 to 3803 hectares in 2011 which amounts to the annual average growth of 21.7 percent. Such a rapid growth could be attributed to the natural population increase of the town on one hand and to the increasing migration from rural areas to Anantnag town for better facilities and job opportunities on the other hand. The area under dense built-up has increased from 102 hectares in 1981 to 341 hectares in 2011. However the share of dense built-up area to total area of the town has decreased by 11.15 percent on account of the areal expansion of the town where many rural areas with the dominance of agriculture have been included in the town. This is in fact the reason that the area under mixed built-up has increased from 57 hectares in 1981 to 337 hectares in 2011 (fig. 5). The percentage share of agriculture in the town has increased from only 39.45 percent in 1981 to 57.22 percent in 2011, the reason being the same as stated above. The percentage share of water bodies, dense forests and waste lands has also decreased from 1981 to 2011. However the share of sparse forests has increased by 5.15 percent because sparse forests were not present in the area demarcated as town in 1981.

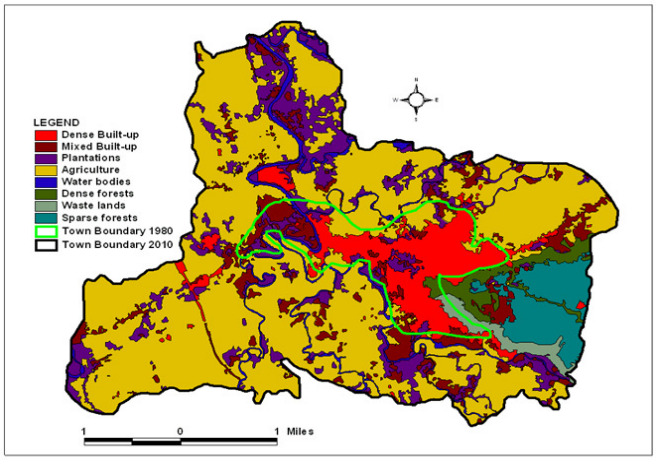

Fig 4. Map showing land use land cover of Anantnag town for the year 2011

Table 2. Land use land cover change of Anantnag town, 1981-2011

S. No.	LULC category	Area (hectares)			Change in percentage share (1981-2011)
		1981	2011(As per 1981 town boundary)	2011 (As per 2011 town boundary)	
1.	Dense built-up	102 (20.12)	261 (51.48)	341 (8.97)	-11.15
2.	Mixed Built-up	57 (11.24)	67 (13.21)	337 (8.86)	-2.38
3.	Agriculture	200 (39.45)	88 (17.36)	2176 (57.22)	17.77
4.	Plantation	90 (17.75)	57 (11.24)	480 (12.62)	-5.13
5.	Water bodies	25 (4.93)	12 (2.37)	118 (3.1)	-1.83
6.	Wastelands	16 (3.16)	14 (2.76)	60 (1.58)	-1.58
7.	Sparse forests	0 (0)	0 (0)	196 (5.15)	5.15
8.	Dense forests	17 (3.35)	8 (1.58)	95 (2.5)	-0.85
Total		507 (100)	507 (100)	3803 (100)	0

Note: Figures in parenthesis indicate percentage area
Source: Jammu and Kashmir Town Planning Organization Srinagar and Generated from Satellite data 2011

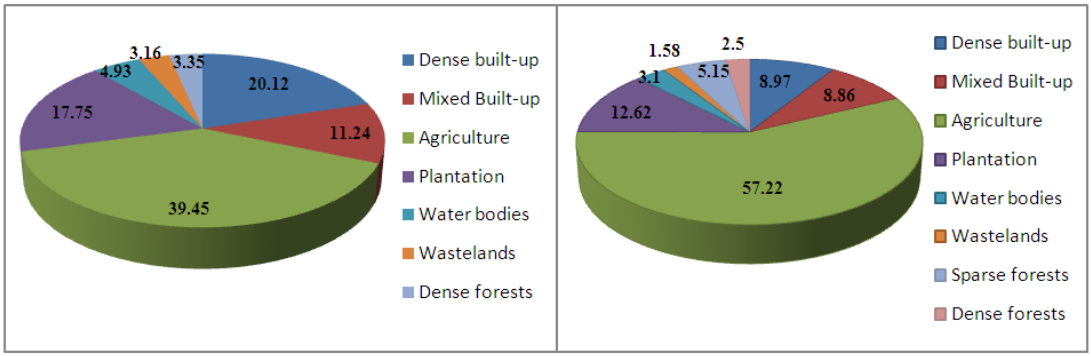

Fig 5. Percentage share of LULC categories in Anantnag town for 1981 (left) and 2011 (right)

The analysis of land use change in the area demarcated as town in 1981 has revealed that the area under dense built-up and mixed built-up has increased and together cover more than 65 percent of the total area at the cost of the other land uses which have considerably reduced (table 2). Thus it could be inferred that not only has the area under dense built-up increased in the town limits of 1981 but also the area under other land uses has been constantly been changed into built-up area. The spatial analysis has revealed that the built-up area of the town is expanding along the major transport routes towards the southwest, northwest, southeast and northeast resembling more or less to a star pattern of settlement growth. In 1981 the percentage area of the town used for urban land uses was 31.36 percent which has reduced to less than 18 percent in 2011 as the town has expanded to surrounding rural area where agriculture land is the dominant category. The town has grown so far without any proper planning and haphazard expansion has resulted into mixed land uses which is resulting into many urban environmental problems especially that of congestion, waste accumulation and degradation of water quality. Since the town has attained the status of city and non-urban land uses constitute more than 82 percent of the total town area, the prospects for proper planning are very bright and land use in the town can be regulated in order to provide better civic amenities to the inhabitants while maintaining the environmental quality at the same time.

CONCLUSION

The study of urban land use is of considerable significance as it provides base for urban planning. Urban land use change is an inevitable phenomenon as it is a part and parcel of the overall dynamics of urbanization. Although, land use changes cannot be avoided, yet its direction can be regulated in a controlled manner. The control over land use changes is essential; otherwise it leads to a haphazard and unplanned growth of cities and towns. The Anantnag town has experienced rapid growth of urban population which has resulted into vast areal expansion of the town. The main reason is the continuous inflow of rural population into urban areas motivated by the availability of better living conditions and job opportunity. With the growth of population and infrastructure, particularly increasing road connectivity, the town has experienced fast urban growth during the past three decades. As a result of this, the town has witnessed a radical change in the socio-economic and demographic as well as physical built-up character. Agricultural land use not only continued to dominate the land use pattern, but also experienced the largest amount of change with an increase of 14 percent of the total area of the town. The vast expansion of agricultural land use could be attributed to the inclusion of new areas within the municipal limits of Anantnag town. Thus, at present the land use pattern of Anantnag Town is dominated by agricultural and residential land use. However, the built-up area is expanding in an unplanned manner resulting into many urban environmental problems. Managing solid waste and waste water, which is the main reason of deteriorating water quality, is a daunting task, as urban areas have grown haphazardly without provisions or plans for appropriate infrastructure and services.

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