International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 9, Issue 6 (December 2013), PP. 50-55

Urban Land Use Dynamics And Its Future Prospectus (A Case Study Of Jammu City)

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Abstract:- India is poised to have nearly 50% of population living in urban areas in next decade and that poses a challenge for the urban development and renewal task. With large scale urbanization, comes the need to plan and develop urban areas in a logical manner, invest in infrastructure and improve the quality of life in our cities. There is an urgent need to address the downside of proliferating slums, increasing homelessness, growing urban poverty, of relentless march of pollution and ecological damage. One of the major requirements for urban development is to have the accurate and timely information – information in geo-spatial forms that allows generation and use of different maps, GIS data and applications. Every urban area needs GIS – a comprehensive map-based Geographical Information Systems (GIS) that powers urban planning and urban management. This project examines the use of Geospatial approach in mapping of urban sprawl between 1972-2011 (a period of 40 years) and temporal land use /land cover change detection (A case study of Jammu City, 2011-2012) so as to detect changes that has been taken place between these periods. Subsequently, an attempt was made at projecting the observed urban built-up in between 2011 to 2041.

Keywords:- GIS, Sprawl, Landsat, Land use, Regression, Trend line

I. INTRODUCTION

In India, urban sprawl coupled with unplanned developmental activities has led to urbanization, which lacks infrastructure facilities. This is particularly true for developing cities like Jammu. This also has posed serious implications on the resource base of the region. The urbanization takes place either in radial direction around a well-established city or linearly along the highways. This dispersed development along highways, or surrounding the city and in rural countryside is often referred as sprawl (Theobald, 2001). The direct implication of such urban sprawl is the change in land use and land cover of the region.

The land use/land cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. The terms "land use" and "land cover" are often used simultaneously to describe maps that provide information about the types of features found on the earth's surface is called as land cover and the human activity that is associated with them. Land cover is an important input parameter for a number of agricultural, hydrological and ecological models, which constitute necessary tools for development planning and management of natural resources in the territory. In order to use the land optimally and to provide as input data in modeling studies, it is not only necessary to have information on existing land use/ land cover but also the capability to monitor the dynamics of land use resulting out of changing demands. If the site is small and easily accessible a suitable land cover may be based on ground observation and surveys. However such methods are quickly become less feasible, if the site is large or difficult to access. Toposheets may be useful for reference but are generally outdated and too coarse for detailed analysis. With the improvement in software and hardware and decrease in the cost of imagery, satellite remote sensing is being used for more and more studies particularly at the landscape level. (Monalisha Mishra)

Therefore at attempt will be made in this study to map out the status of land use/ land cover of the Jammu between 1972 and 2011 with a view to detecting the land consumption rate/ urban expansion and the changes that has taken place in this status particularly in their built-up land. So as to predict possible changes that might take place in this status in the next 30 years using both Geographic information system and Remote Sensing data. In this study, we demonstrate how satellite imagery can be displayed and manipulated and analyzed using digital techniques in popular digital image processing software Erdas Imagine 9.1 and GIS software ArcGis10.

II. STUDY AREA

Jammu is the south western district of Jammu and Kashmir state (India), it lies between 32 º 27′ and 33º 50′ N latitude and to 75º19′ and 75º 20′ E longitude, with an approximate geographical area of 2,942 sq. km. The altitude varies from 320 m to 1,675 m above the sea level. It comprises of four tehsils: Jammu, Akhnoor, Ranbir Singh Pura and Bishna. Jammu district, situated in subtropical part, has markedly periodic climate, characterized by dry and increasingly hot season from March to June, a warm humid monsoon season from July to

September and dry and cold weather from October to December. Jammu, the city of temples and the winter capital of J&K state has a distinct image due to its heritage, location and linkages.

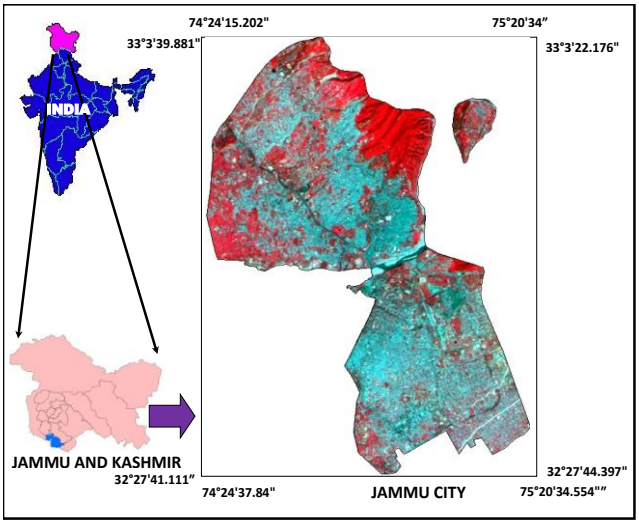

Figure 1: Location of Study Area

III. DATA SETS AND METHODOLOGY

In this study spatial data regarding the chronological nature were used to study the spatial and time-based patterns of urbanization. To accomplish the desired objective of the study, images datasets of LANDSAT MSS of 1972, LANDSAT MSS of 1982, LANDSAT TM of 1992, LANDSAT ETM+ of 2001 and IRS LISS III Image of 2011were used correspondingly, including the Survey of India Toposheets (1972). The area of interest (Municipal limits of Jammu city) was extracted by sub-setting of the town planning map. All the images were first geo-corrected and geo-referenced in Earth Re-source Data Analysis System (ERDAS) Imagine 9.0 software, assigning Universal Transverse Mercator with World Geocoded system (UTM WGS 84) projection parameters. Further for assistance in the process of interpretation SOI toposheet was also geo-referenced and was given similar projection and datum. Satellite imagery was stacked into different bands to produce a false color composite (FCC), the area of interest was extracted by sub-setting of the image. These images were digitized in GIS environment using ArcMap 10 software in the form of polygons representing different land use land cover categories. The data was classified into 6 land use land cover classes spread over a total area of 86.60sq.kms of the Jammu city (which incidentally is also the Municipal limits). The trend and pattern of urban expansion was calculated and every polygon representing the particular class was quantified and displayed in respective maps.
The aims of the this study is to produce a land use/ land cover map of Jammu at different year in order to detect changes that have taken place particularly in the built-up land and subsequently in the built-up land and subsequently to analyze the urban sprawl of the different time period and to predict the urban area growth in the same over a given period (1930-2031).

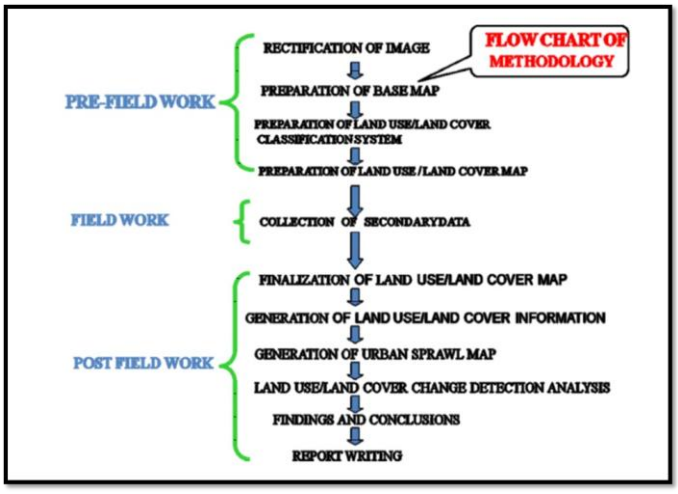

Figure 2: Methodology Flowchart

IV. RESULTS AND DISCUSSION

LAND USE/ LAND COVER Dynamics:

The present study for Jammu city is focused to analyze spatial and temporal information of land cover and land use patterns as well as the conversions therein. A detailed classification systems is being developed for mapping Jammu city using high resolution satellite data. The following classes are being adopted. i.e.1. Built up 2.Agriculture Land 3.Forest 4. Plantations 5.Wastelands 6.Waterbody.The present study is spread over 86.60 Sq. Km of land, which is also the municipal limit of the Jammu city. It is one of the fast developing cities in North India.The land use of the city over a period from 1972-2011 showed tremendous rises in the built-up-from agricultural area, vegetation and vacant land. There were ample agriculture and vegetation land in and outside the urban area. In this period of time industrial and residential areas were dominantly expanded. From 1972 to 2011, settlements increased to 50.59sq.km (59%), respectively. On the other hand agriculture land, forests, plantations, wastelands, and water bodies reduced to 7.92sq.km (9%), 7.86 sq.km (9%) and 0.77 sq.km (1%),2.44 sq.km (3%) and 2.14 sq.km (2%) respectively.

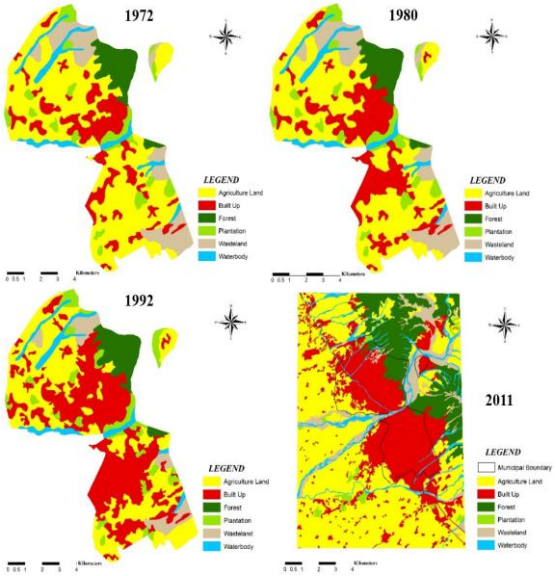

Figure 3: Land use Maps of Jammu from 1972 to 2011

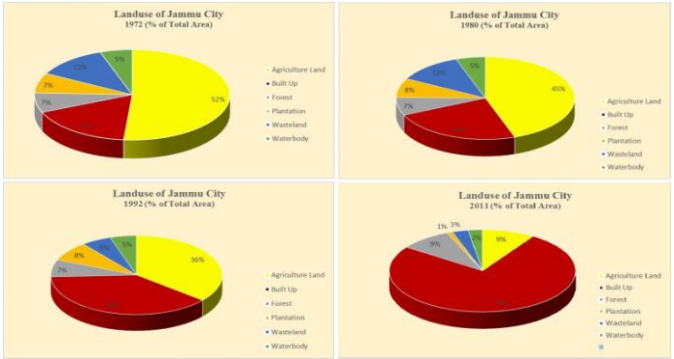

Figure 4: Pie chart of above land use maps:

Row Labels	Area (Sq. Km) 1972	Area (Sq. Km) 2011	Area in % (1972)	Area in % (2011)	% change
Agriculture Land	44.51	7.92	51.40%	9.14%	-42.26%
Built Up	14.90	65.49	17.20%	75.63%	58.42%
Forest	6.11	7.86	7.05%	9.07%	2.02%
Plantation	6.20	0.77	7.16%	0.88%	-6.28%
Wasteland	10.26	2.44	11.85%	2.81%	-9.03%
Waterbody	4.62	2.14	5.34%	2.47%	-2.87%
Grand Total	86.60	86.60			

Table 1. DIFFERENCE LAND USE BETWEEN YEAR 1972 AND 2011

Table 2. %age change in land use different decades

Row Labels	Area (Sq. Km) 1980	Area (Sq. Km) 1992	Area in % (1980)	Area in % (1992)	% change
Agriculture Land	38.69	31.23	44.67	36.06	-8.62
Built Up	20.38	33.08	23.53	38.20	14.67
Forest	6.11	6.11	7.05	7.06	0.01
Plantation	6.55	6.95	7.56	8.03	0.47
Wasteland	10.26	4.93	11.85	5.69	-6.16
Water body	4.62	4.31	5.34	4.97	-0.37
Grand Total	**86.60**	**86.60**			

Urban sprawl and population trends in the city Urban sprawl refers to the area expansion of urban concentration beyond what they have been. Urban sprawl can be continuous, ribbons or check broad type. The increase population and rapid urbanization causes great change in the center of the city and the problem of the expansion of the city center is complicated by the fact that, it must take place within the built-up area which is not possible. Thus the pressures of the continuous growing city center gradually change the surrounding environment and neighborhoods. Sprawl generally refers to some type of development with impacts such as loss of agricultural land, open space, and ecologically sensitive habitats. In simpler words, as population increases in an area or a city expands to accommodate the growth; this expansion is considered as sprawl. Usually sprawls take place on the urban fringe, at the edge of an urban area or along the highways. The total built up area inside the municipal boundary of jammu city in 1972 was 14.90 sq.km with a decadal increase of 20.38 sq.km in 1980, 33.08 sq.km in 1992 and 65.49 sq.km in 2011. The city today has its centre at the core areas. Now it is growing largely towards all directions along the main transport routes. The road structure of the city has not involved to cater the changing pattern in the city and to cater its functions. Fig 5 shows the urban sprawl from 1972-2011.

Demographic pressure is the main cause of expansion, the sprawl of Jammu has promoted an urge to correlate the population with the spatial expansion. The city has in recent years, faced unprecedented growth of population due to influx of migration from the valley and rapid growth of commercial and industrial activities. The demand for serviced land increased tremendously to accommodate the increasing population and diversified economic activities in and around the city. The increased demand of serviced land could not match with supply. As a result, the city experienced large scale development on private land without any planning norms which are now causing severe environmental problems. The old city has been further densified along with commercial activities thereby increasing the problems of traffic congestion, water and power shortage and environmental degradation This scenario has led to a severe urban sprawl.

With rapid industrialization, urbanization and mass migration from Valley, (between 1989 to 1994), the population of Jammu grew to 7,27,940 representing 225.90% increase over 1981 population. Now Jammu is one of the fastest growing cities in India in terms of population and area. Besides this increase in residential population, the floating population of pilgrims to Mata Vaishno Devi, military and para military forces and their families stationed at Jammu also add to the population of Jammu.

Population characteristics are one of the vital components for planning a city. Since census operations in Jammu & Kashmir were not conducted in 1991 and population scenario of Jammu drastically changed due to large migration of people from the Valley during 1989-94, data collected for Household Survey in Jammu during 1994 by JDA is the only base to assess the existing characteristics of population for the purpose of planning.

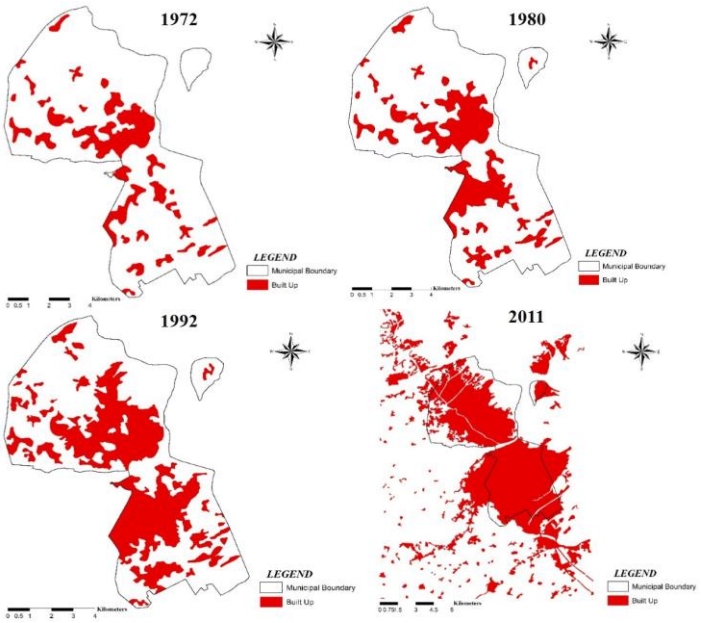

Figure 4: Urban sprawl from 1972 to 2011

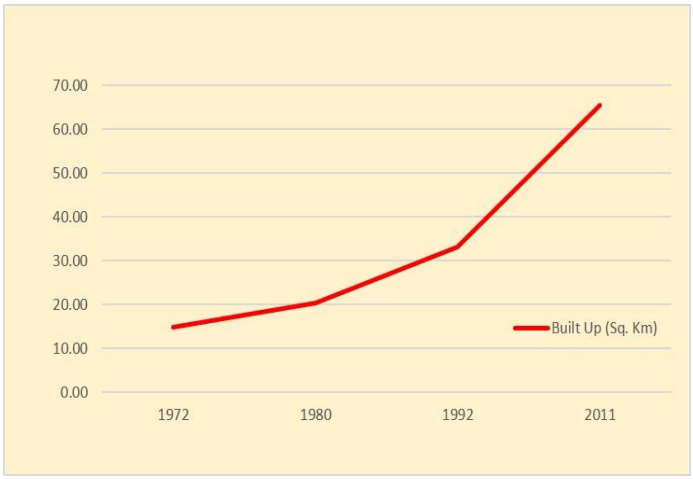

Figure 5 : Urban Sprawl Trend Graph

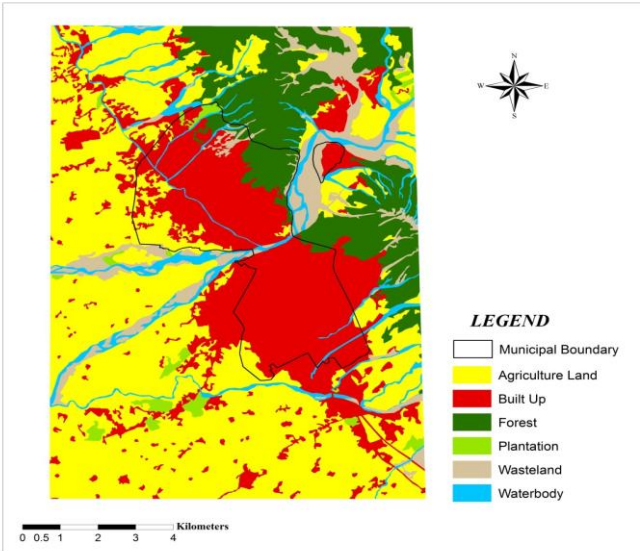

Figure 6. Urban Sprawl map 2011

V. FUTURE PROSPECTS

Urban Area Growth Forecasts

A methodology has been adopted for predicting future built up area growth. The methodology was applied for predicting the built up area for the year 2022, 2032, 2042.The trend analysis was carried using Minitab. It was found that the fitting trend line was a polynomial third trend line curve with Yt = -4.02 + 14.6*t. Thus the built up area for year 2011-2042, it is estimated to be 83.755 in2022, 98.384in 2032, 113.013 in 2042.

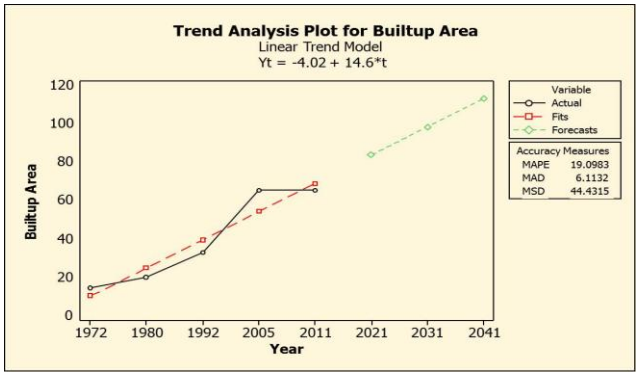

Figure 7. BUILT UP GROWTH (1972-2041)

VI. CONCLUSION

The present research focused on using geospatial techniques for combining geospatial themes to analyze the urban sprawl mapping and detect changes of urban land use/ land cover through different years in the environs of Jammu city. Satellite data are found to be useful in mapping and quantifying the extent of urban area in different time periods. The above study provides a methodology for better estimation of urban growth and population using various land uses with time. Geographical information system (GIS) and satellite images have been used in this study to provide spatial inputs and test the statistical model describing growth. The model developed in this study can be used for predicting the future land uses even when not much of old land use data is available. The main change observed for the time period of 1972-2011 was that the built-up area inside the municipal boundary of Jammu city in 1972 was 14.90 sq.km with a decadal increase of 20.38 sq.km in 1980, 33.08 sq.km in 1992 and 65.49 sq.km in 2011.Thus from 1972 to 2011, settlements increased to 50.59sq.km (59%), respectively. New urban region developments are growing largely all directions of city. While in the Lu/Lc mapping agriculture land has been witnessed as the prime victim of this land transformation during the study period. Agriculture land reduced to 7.92sq.km (9%) in 2011 from 44.51sq.km in 1972.

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