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LAND USE/ LAND COVER ANALYSIS OF JAMMU CITY USING GEO-SPATIAL TECHNIQUE

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ABSTRACT: Jammu is one of the three administrative divisions within Jammu and Kashmir, the northernmost state in India. It consists of the districts of Jammu, Doda, Kathua, Ramban, Reasi, Kishtwar, Poonch, Rajouri, Udhampur and Samba. Most of the land is hilly or mountainous, including the Pir Panjal Range which separates it from the Kashmir Valley and part of the Great Himalayas in the eastern districts of Doda and Kishtwar. Its principal river is the Chenab. Jammu is located at 32.73°N 74.87°E. It has an average elevation of 327 m (1,073 ft). It covers an area of about 167 sq.km. Jammu city lies at uneven ridges of low heights at the Shivalik hills. It is surrounded by Shivalik range to the north, east and southeast while the Trikuta Range surrounds it in the north-west. It is approximately 600 kilometers (370 mi) from the national capital, New Delhi. The city spreads around the Tawi River with the old city overlooking it from the north (right bank) while the new neighborhoods spread around the southern side (left bank) of river. The present paper attempts to explain the landuse and landcover analysis of Jammu city using GEO-SPATIAL technique.

KEY WORDS: ERDAS (Earth Resources Data Analysis System), cropping pattern, Agricultural land, Waste land, Barren land, Built up land, Vegetation

INTRODUCTION

From the ashes of the big bang, a planet emerged as a mass of energy and elements, the blue planet**.** From that newly born mass of energy and elements evolved structural dynamic system of solids, liquids and gases. The evolution of this planet continued to unfold over billions of years in such a unique way that eventually condition arose with ability to foster life. Human evolution from the very beginning has changed the earth surface in one way or the other. In the past the scene was not too large, but the real picture has come forward with the continuous increase in population. Land is the most important natural resource which embodies soil, water and associated flora and fauna involving total ecosystem. The knowledge of land use and land cover is important for many planning and management activities as it is considered as an essential element for modelling and

understanding the earth feature system. The term land use relates to the human activity or economic function associated with a specific piece of land, while the term land cover relates to the type of feature present on the surface of the earth (Lillesand and Kiefer, 2000). Land use or land cover inventories are assessed in increasing importance in various sectors like agricultural planning, settlement and cadastral surveys, environmental studies and operational planning based on agro-climatic zones. Information on land use or land cover allows a better understanding of the land utilization aspects like cropping patterns, fallow lands, forests, pasture lands, wastelands and surface water-bodies which are vital for development planning. Land cover maps are presently being developed from local to national to global scales. If site is small and easily accessible a suitable land cover may be based on ground observations and surveys. However, such methods are quickly become less feasible, if the site is large or difficult to access. Toposheets may be used for references 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. Land cover is defined as the features that are present on the earth's surface. Land use refers to the human induced changes for agricultural, industrial, residential or recreational purposes. Land cover changes refer to conversion and modification of vegetation, changes in biodiversity, soil quality, runoff, erosion, sedimentation and land productivity. LULC change is a major issue of concern with regards to change in the global environment. The rapid growth and expansion of urban centers, rapid population growth, scarcity of land, the need for more production, changing technologies are among the many drivers of LULC in the world today. In an urban environment natural and human-induced environmental changes are of concern today because of deterioration of environment and human health. The study of land use/land cover (LU/LC) changes is very important to have proper planning and utilization of natural resources and their management. Traditional methods for gathering demographic data, censuses, and analysis of environmental samples are not adequate for multicomplex environmental studies, since many problems often presented in environmental issues and great complexity of handling the multidisciplinary data set; we require new technologies like satellite remote sensing and Geographical Information Systems (GISs). These technologies provide data to study and monitor the dynamics of natural resources for environmental management.

Information on land use or land cover allows a better understanding of the land utilization aspects like cropping patterns, fallow lands, forests, pasture lands, wastelands and surface water- bodies which are vital for development planning. Land cover maps are presently being developed from local to national to global scales. If site is small and easily accessible a suitable land cover may be based on ground observations and surveys. However such methods are quickly become less feasible, if the site is large or difficult to access. Toposheets may be used for references 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.

Many researchers argue that LULC emerged as a major aspect in the wider debate of global change; and that change originates from human-induced impacts on the environment and their implications for climate change. The indicators of these changes can be clearly seen in the current major global concerns such as increasing concentrations of carbon dioxide (CO_2) in the atmosphere, loss of biological diversity, conversion and fragmentation of natural vegetation areas and accelerated emission of greenhouses gases today. In an urban environment natural and human-induced environmental changes are of concern today because of deterioration of environment and human health. The study of land use/land cover (LU/LC) changes is very important to have proper planning and utilization of natural resources and their management. Traditional methods for gathering demographic data, censuses, and analysis of environmental samples are not adequate for multicomplex environmental studies, since many problems often presented in environmental issues and great complexity of handling the multidisciplinary data set; we require new technologies like satellite remote sensing and Geographical Information Systems (GISs). These technologies provide data to study and monitor the dynamics of natural resources for environmental management. Information on land use or land cover allows a better understanding of the land utilization aspects like cropping patterns, fallow lands, forests, pasture lands, wastelands and surface water- bodies which are vital for development planning. Land cover maps are presently being developed from local to national to global scales. If site is small and easily accessible a suitable land cover may be based on ground observations and surveys. However such methods are quickly become less feasible, if the site is large or difficult to access. Toposheets may be used for references 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. Many researchers argue that LULC emerged as a major aspect in the wider debate of global change; and that change originates from human-induced impacts on the environment and their implications for climate change. The indicators of these changes can be clearly seen in the current major global concerns such as increasing concentrations of carbon dioxide (CO2) in the atmosphere, loss of biological diversity, conversion and fragmentation of natural vegetation areas and accelerated emission of greenhouses gases.

According to FAO (1998), "land use is characterized by the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it". Thus, this expression "establishes a direct link between land cover and the actions of people in their environment".

Similarly, Lambin et al. (2006, p. 4) defines land use as "the purpose for which humans exploit land cover". Land use includes "both the manner in which biophysical attributes of the land are manipulated and the intent underlying that manipulation, i.e., the purpose for which the land is used".

According to Ellis and Pontius, "Land cover refers to the physical and biological cover over the surface of the land, including water, vegetation, bare soil, and/or artificial structure."

According to Barley, "Land cover describes the vegetation and artificial construction covering the land surface." Thus land use is a description of how people utilize land and socioeconomic activity-urban and agricultural land uses are two of the most commonly known land use classes. At any one point or place, there may be multiple and alternate land uses, the specification of which may have a political dimension.

Proper planning, management and monitoring of the natural resources depend on the availability of accurate land use information. Land use analysis is an important aspect of geographic studies in geography. This aspect of geography is represented in the land use map prepared with help of land use surveys. It has become essential to prepare land use map because they are recognized as necessary tools for the preparation of land capabilities and land classification map which in term provide guidelines for regional planning, development and future orientation of agriculture. The

knowledge of land use and land cover is important for many planning and management activities and is considered as essential element for modeling and understanding the earth as a system.

LAND USE/ LAND COVER CLASSIFICATION

The most successful attempt in developing a general purpose classification scheme compatible with remote sensing data has been by Anderson et al. 1976, which is also referred to as USGS system of classification.

Classification scheme. Other classification schemes available for lu/lc with remotely sensed data are basically modification of the above classification scheme. So above classification scheme is used for the study of land use in study area. The USGS scheme of land use/land cover classification is being adopted for the detail study of study area and following classes fall under study area:

1. **Urban or built-up land:** Urban or built-up land composed of areas of intensive use with much of the land covered by structures included in this category are cities, towns, villages, strip developments along highways; transportation, power and communication facilities and areas such as those occupied by mills, shopping centers, industrial & commercial complexes, and institutions that may, in some instances, be isolated from urban areas.
2. **Agricultural land:** Agricultural land may be broadly defines as land used primarily for production of food and fiber. The category includes the following uses; cropland & pasture, orchards, groves and mine yards, nurseries and ornamental horticultural areas, and confined feeding operations.
3. **Forest land:** Forest land represents areas that have a tree-crown areal density of 10% or more, are stocked with trees capable producing timber or other wood products and exert an influence on the climate or water regime.
4. **Waste land:** Waste land is land of limited ability to support ability life and in which less than one-third of the area has vegetation or other cover. This category includes such as salt flats, bare exposed rocks, strip mines, quarries and open spaces.
5. **Water:** The water category includes streams, canals, lakes, reservoirs, bays and estuaries.
6. **Forest land:** Forest land represents areas that have a tree-crown areal density of 10% or more, are stocked with trees capable producing timber or other wood products and exert an influence on the climate or water regime.
7. **Waste land:** Waste land is land of limited ability to support ability life and in which less To study and classify the land use/ land cover of Jammu city.

OBJECTIVES:

1. To calculate the area covered under different land use.

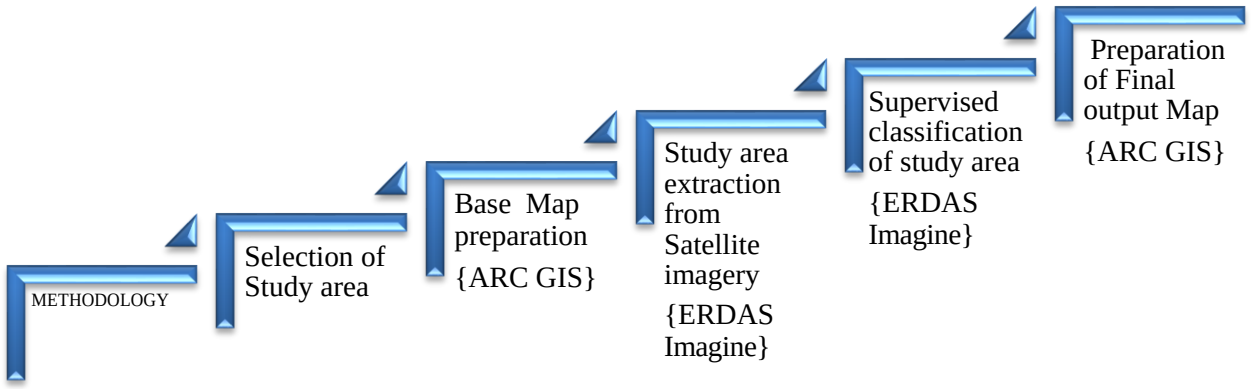
2. To study land use pattern and to prepare map using geo-spatial techniques.

DATABASE & METHODOLOGY

The study is based on secondary data.

- *Area selected:* The area selected for study is Jammu city.
- *Software used:* ERDAS Imagine & ARC GIS Software
- *Data used:* Ward map of Jammu city & LISS-4 Image (2015)

Steps



1. Jammu city was geo-referenced & used as base map using ARC GIS 10.5.
2. The study area is being subset from LISS-IV image for detail analysis using ERDAS Imagine 2016 Software.
3. The next step includes the supervised classification of subset layer of study area again using ERDAS Imagine 2016 Software.
4. Then different maps were prepared from classified image of study area using ARC GIS 10.5 Software.
5. The land use/ land cover classified image is being interpreted.

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Plate No. 2.1: Location map of Jammu city

Map No. 1.1 - Jammu City: Land use/ land cover map (2015)

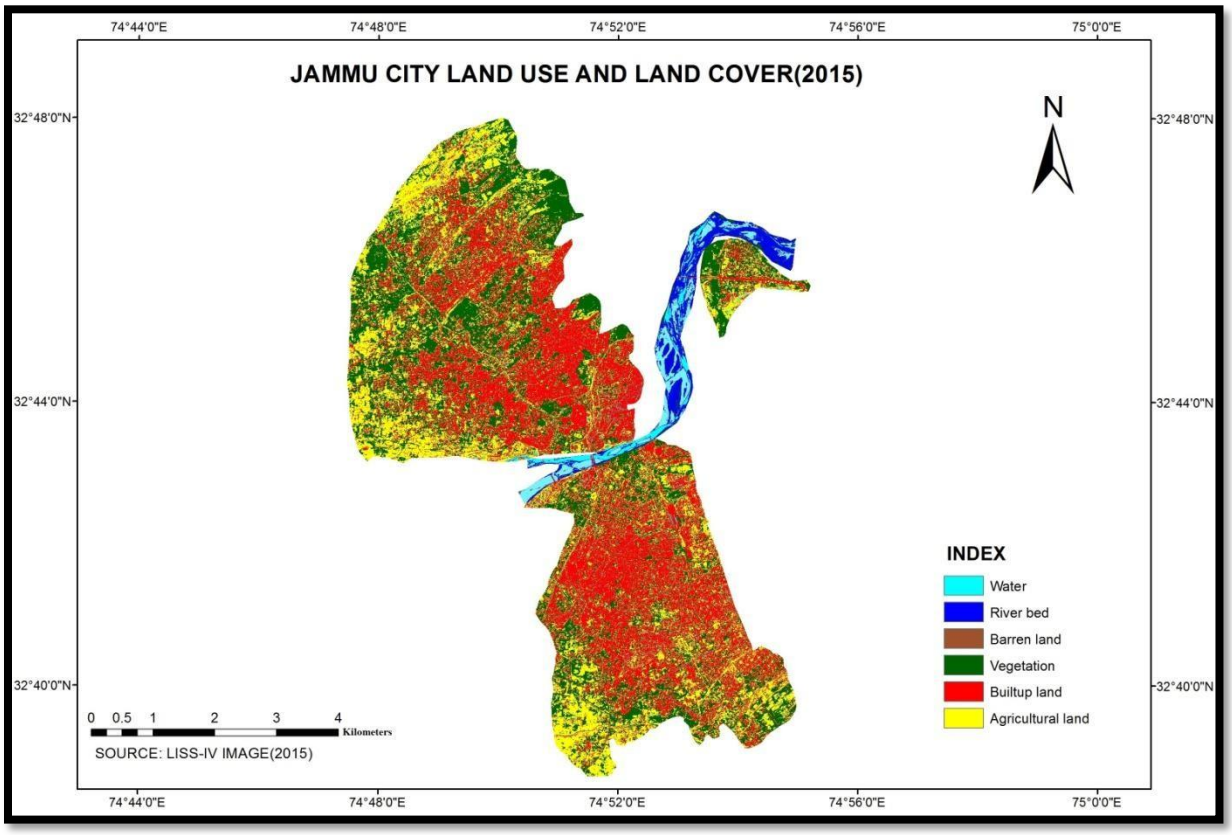

Table No. 1.1: Area (in Ha) under land use/ land cover

S. No.	Land use/land cover	Area (in Ha)	Area (in %)
1	Water	337.65	3.6
2	River bed	410.13	4.36
3	Barren land	37.88	0.39
4	Vegetation	2662.41	28.31
5	Built up land	3451.84	36.50
6	Agricultural land	2554.66	26.98
7	**Total Area**	**9457.57**	**100.00**

Fig. No. 1.1: Percentage of area under land use/land cover

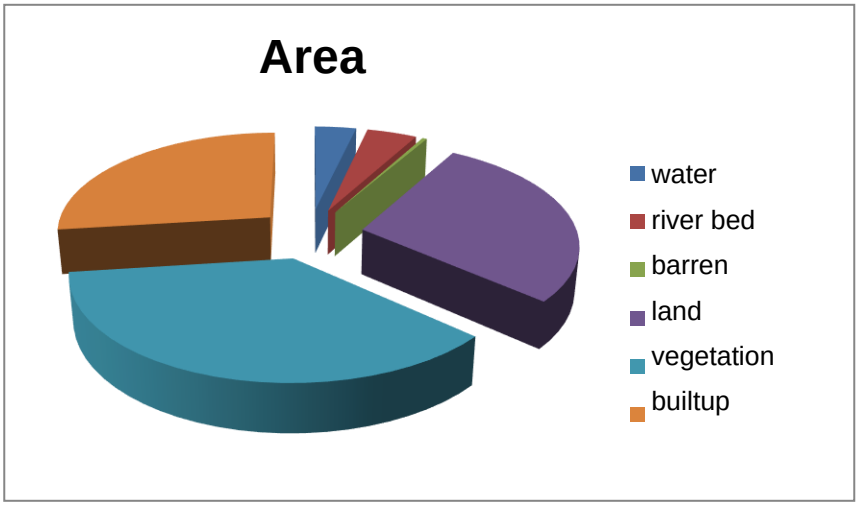

Figure 1.1 shows the percentage of different land use/ land cover area under Jammu city. From figure it is clear that built up land cover the largest area i.e. 36.50% while vegetation cover the second largest area i.e. 28.39%. Maximum vegetation area is found in north and north eastern part of the study area. Agricultural land covers the third largest area i.e. 26.95% which is mainly concentrated in the outer fringe area of the city due to flat and fertile land. Water bodies of Jammu city cover 7.9% which also include Tawi river. Barren land covers the lowest area i.e. 0.39% which is unevenly scattered in the study area.

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LAND USE

Map No. 1.2- Jammu City: Land Use (2015)

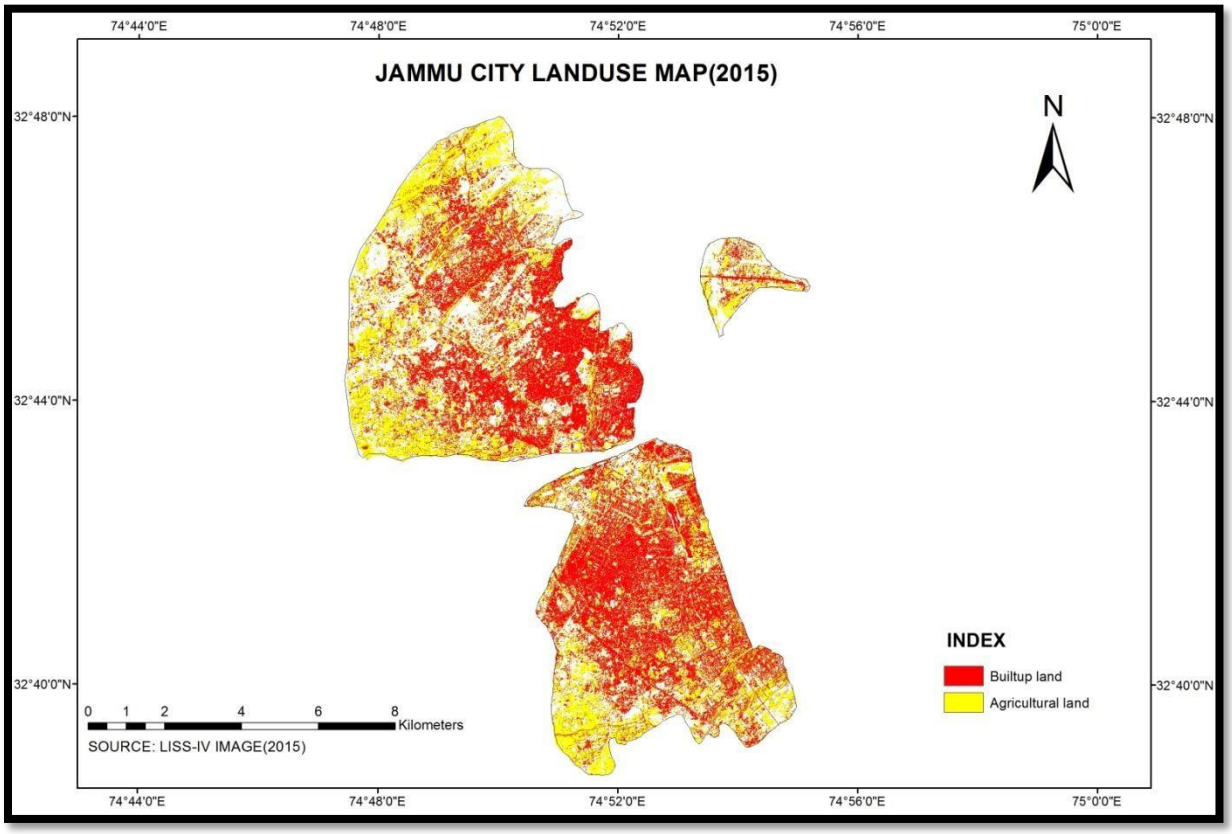

Table No. 1.2: Area (in Ha) under Land use

Land use	Area (in Ha)	Area in %
Built-up land	3451.84	36.50
Agricultural land	2554.66	26.98
Total area	6006.50	63.48

Map 1.2 shows the land use in Jammu city. Agricultural and built-up area together constitutes 6004.89 Ha (63.48%) of the total area. Majority of land use is concentrated in whole city in which built-up land is concentrated in central part of city along Tawi river where as agricultural land is concentrated in outer fringe of city. Dispersed settlement is found in outer area of city.

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BUILT-UP AREA

Map No. 1.3- Jammu City: Built-up Area (2015)

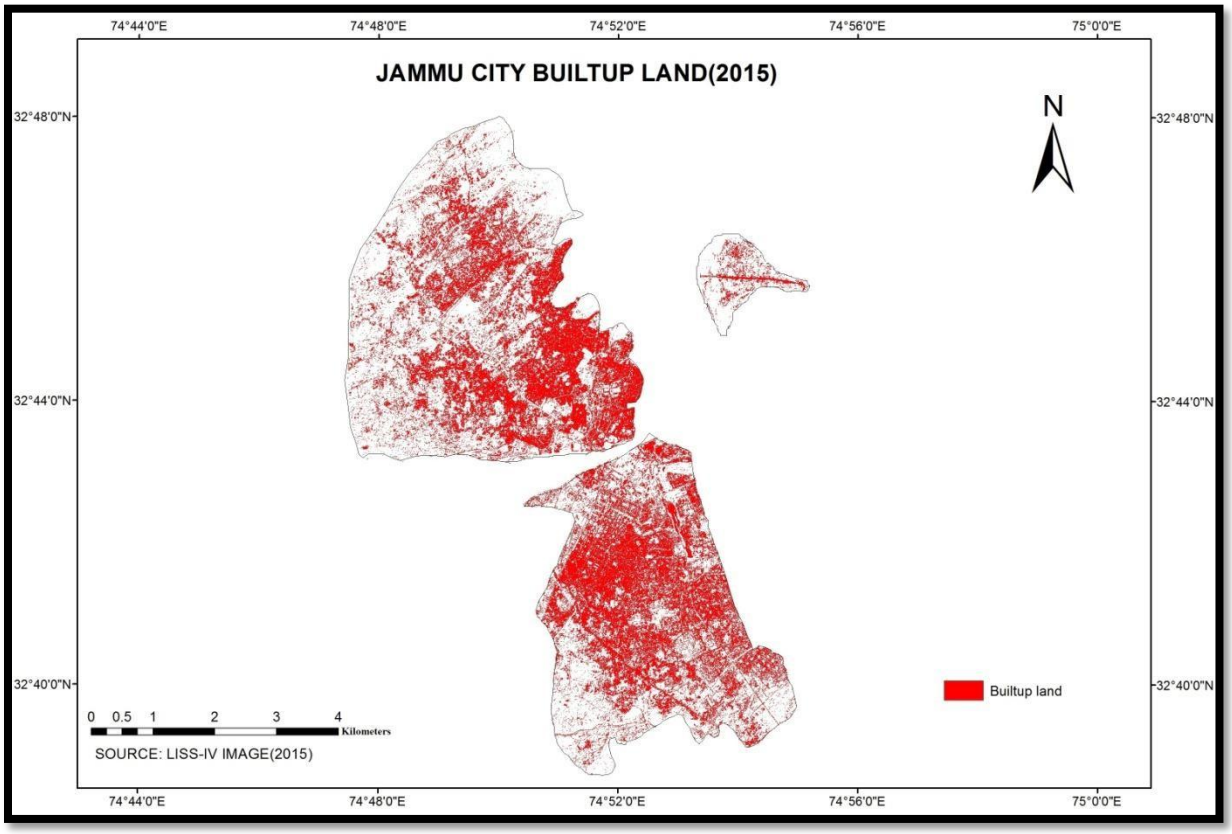

Table No. 1.3: Area (in Ha) under Built-up Area

Land use	Area (in Ha)	Area in%
Built-up land	3451.84	36.50

Map 1.3 shows the built-up Area of Jammu city. Built-up land covers the largest area i.e. 36.50%. Maximum built-up land is concentrated in the central part of the city and along the Tawi river.

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AGRICULTURAL LAND

Map No. 1.4- Jammu City: Agricultural Land (2015)

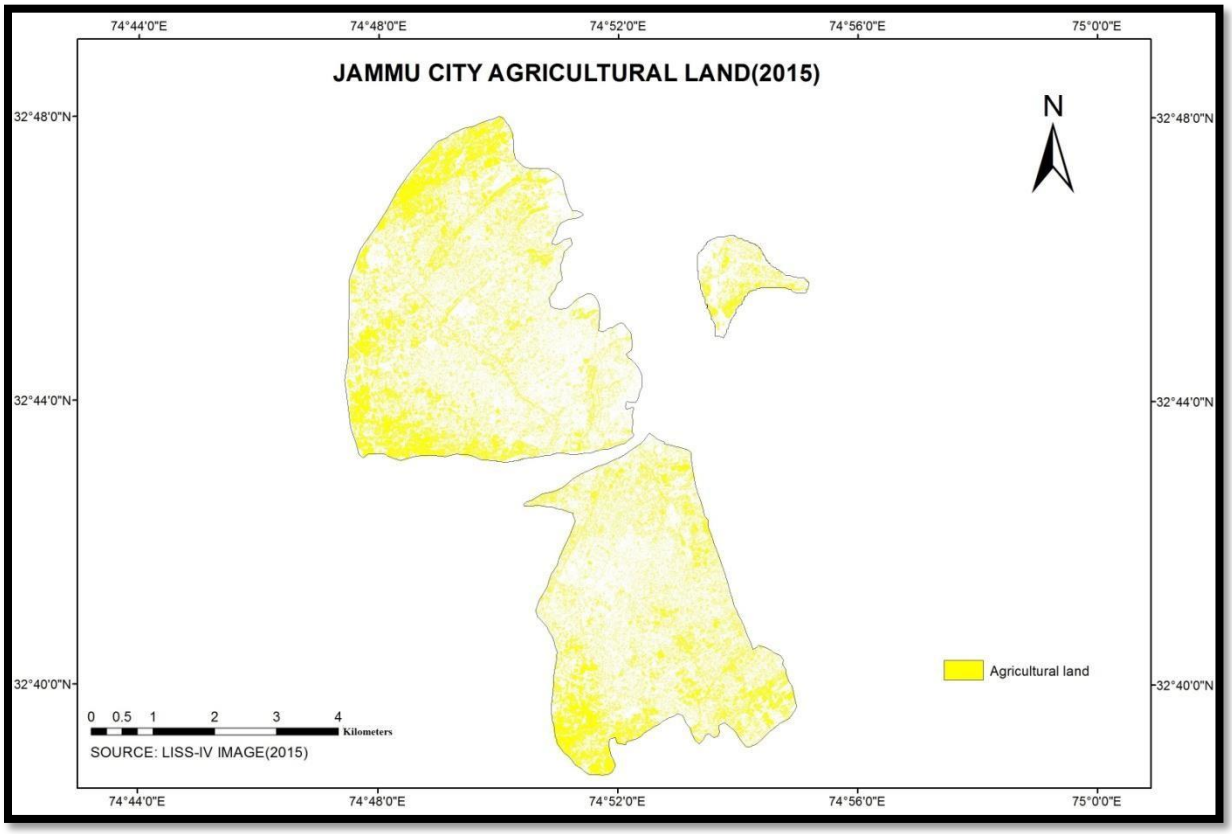

Table No. 1.4: Area (in Ha) under Agricultural land

Land use	Area (in Ha)	Area in %
Agricultural land	2554.66	26.98

Map 1.4 shows the agricultural land use of Jammu city. Agricultural land covers the third largest area i.e. 26.98% which is mainly concentrated in outer boundary of city. Some patches of sparse agricultural land use are also found in central part of city.

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LAND COVER

Map No. 1.5- Jammu city: Land Cover (2015)

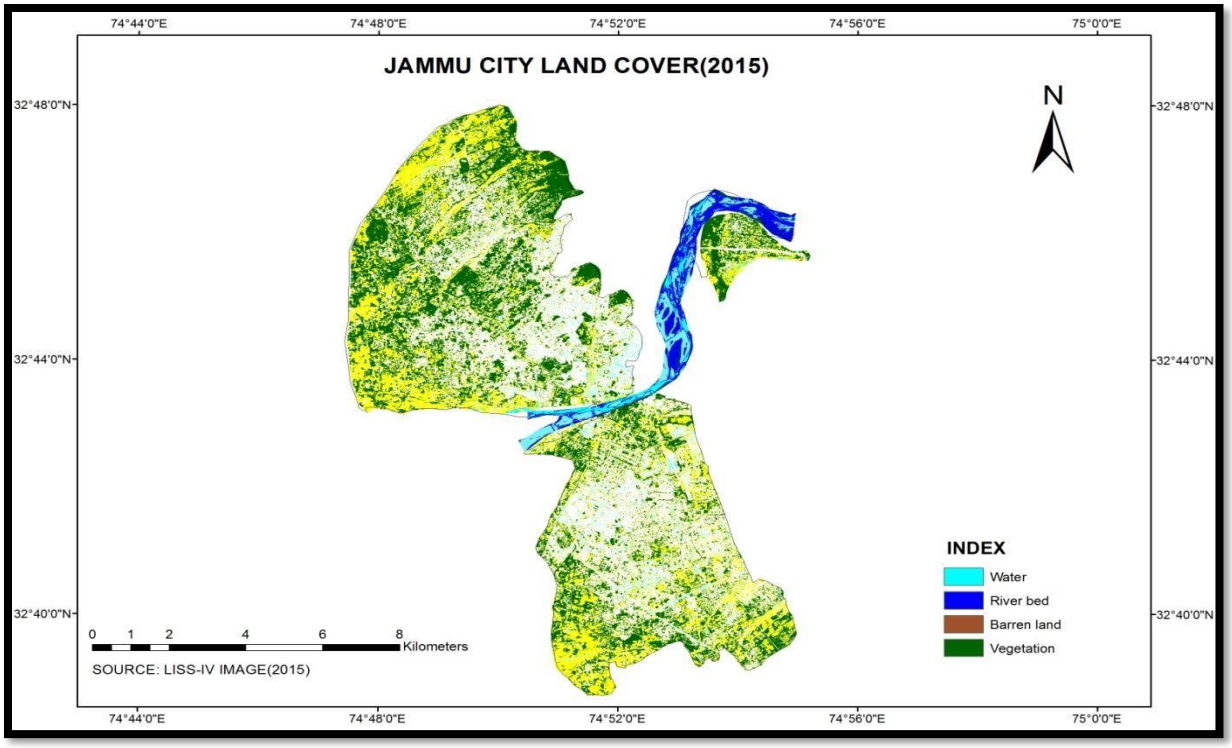

Table No. 1.5: Area (in Ha) under Land cover

Land cover	Area (in Ha)	Area in %
Water	337.65	3.6
River bed	410.13	4.36
Barren land	37.88	0.39
Vegetation	2662.41	28.31
Total area	3448.07	36.52

Map 1.5 shows the land cover of Jammu city. Total area covered by land cover is 36.52% which include vegetation, water, river bed, barren land. Vegetation covers the largest area i.e. 28.31% which include dense and open forest. Dense forest is found in north and north eastern part of the study area. Water bodies of Jammu city cover 7.96% area which include Tawi river. Barren land covers the lowest area i.e. 0.39% which is sparsely distributed in study area.

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VEGETATION

Map No. 1.6-Jammu City: Vegetation (2015)

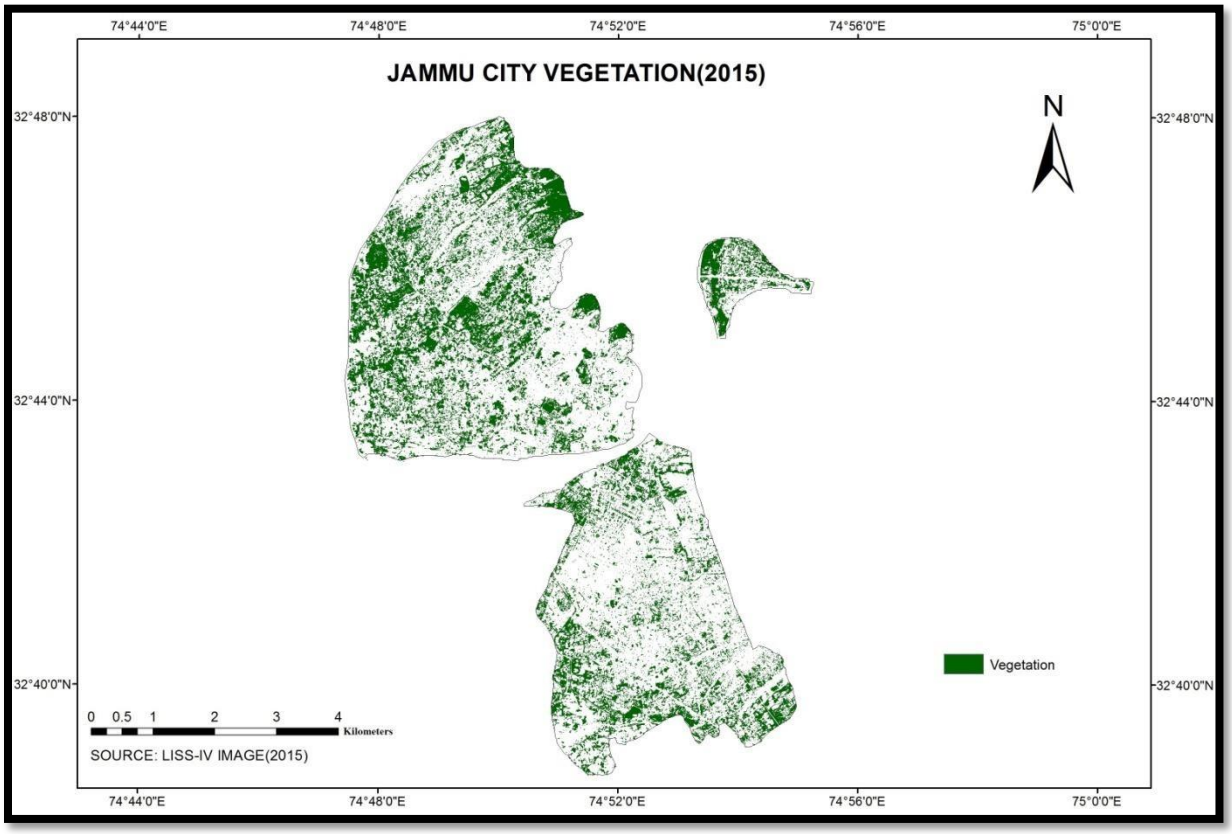

Table No. 1.6: Area (in Ha) under Vegetation

Land cover	Area (in Ha)	Area in %
Vegetation	2662.41	28.31

Map 1.6 shows the vegetation of Jammu city. Total area covered by vegetation is 28.31%. Vegetation of Jammu city falls under second largest category after built-up land. It includes open forest and dense forest. Maximum vegetation area is found in north and north eastern part of the study area.

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WATER BODIES

Map No. 1.7- Jammu City: Water Bodies (2015)

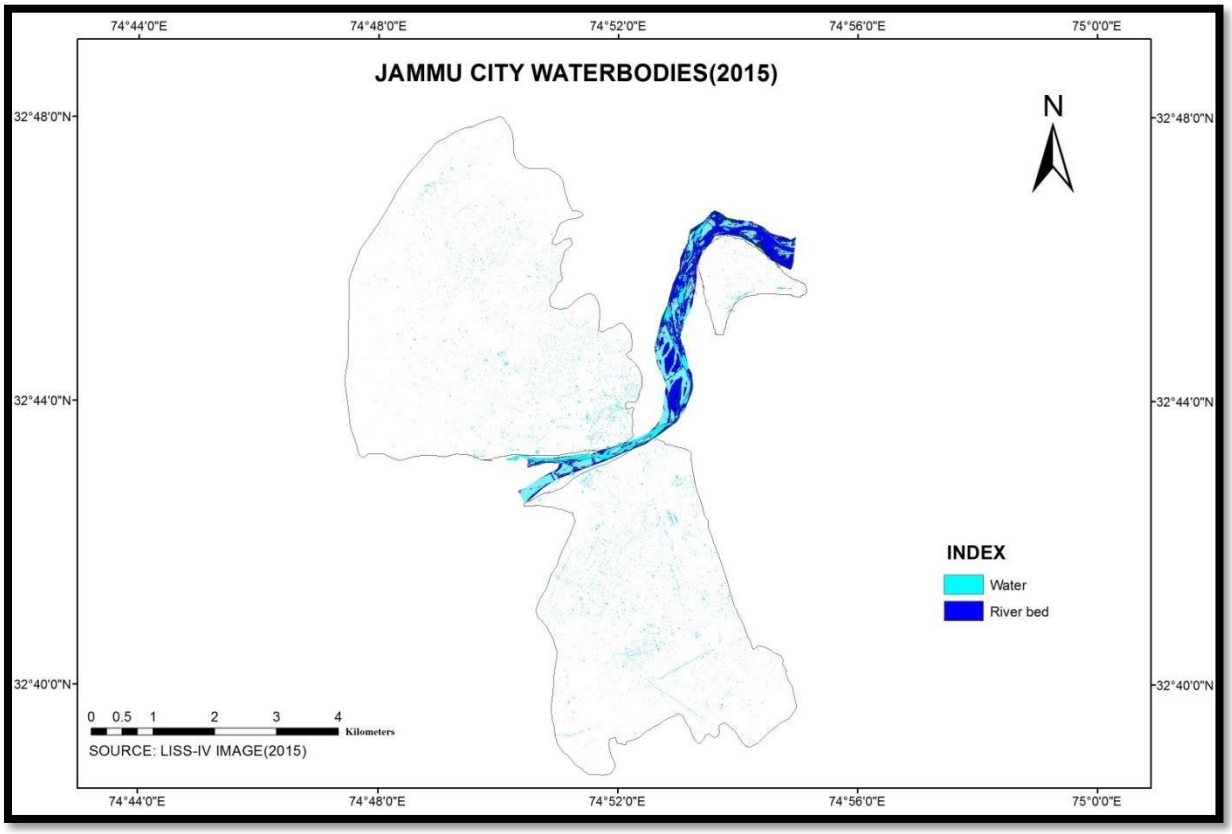

Table No. 1.7: Area (in Ha) under Water bodies

Land cover	Area (in Ha)	Area in %
Water	337.65	3.6
River bed	410.13	4.36

Map 1.7 shows the water bodies of Jammu city which include water of Tawi river and ponds and river bed of Tawi river. Tawi river passes through the center of city and divide city into two parts old city on right bank and old city on left bank. Jammu city is also known as city of bridge as it is connected by five bridges.

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BARREN LAND

Map No. 1.8- Jammu City: Barren Land (2016)

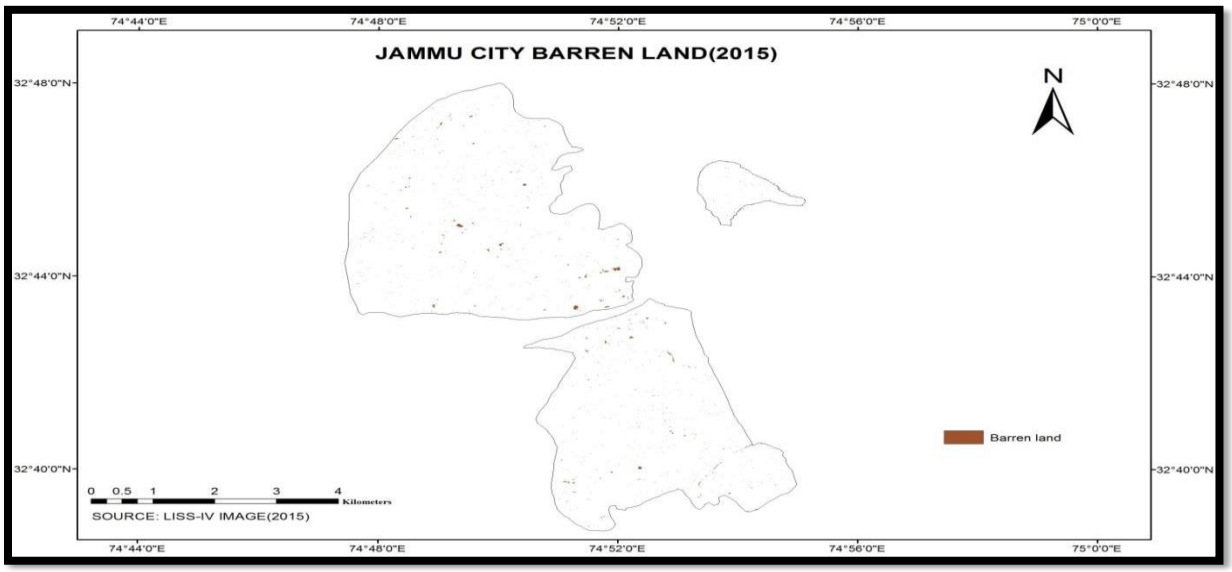

Table No. 1.8 Area (in Ha) under barren land

Land cover	Area (in Ha)	Area (in %)
Barren land	37.88	0.39

Map 1.8 shows barren land of Jammu city. Barren land covers the lowest area i.e. 0.39% which is sparsely distributed in study area.

RESULTS & CONCLUSION

- A detailed classification system is being developed for mapping Jammu city using LISS-IV data. The following classes are being adopted i.e.

1. Built-up land
2. Agricultural land
3. Vegetation
4. Water
5. River bed
6. Barren land

The present study is spread over 9457.57 Ha area of Jammu city.

- Results have shown that out of total area of 9457.57 Ha, largest area i.e. 36.5% covers under built-up land followed by 28.31% area under vegetation followed by 26.98% area under agricultural land and 7.9% under water bodies which include Tawi river while barren land constitute the lowest area i.e. 0.39%.

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