LAND USE/LAND COVER WITH SPECIAL REFERENCE TO AGRICULTURE / HORTICULTURE IN DISTRICT PULWAMA J&K USING REMOTE SENSING AND GIS TECHNIQUES

Mr. Javeed Ahmad Rather*, Department of Remote Sensing and GIS, North Orissa University, Baripada-757003, Orissa, india, e-mail: javeed.gis@gmail.com
Dr. Tasneem Keng**,Scientist Department of Environment and Remote Sensing, J&K Government Srinagar– 190018, J&K, India e-mail: tasneemkeng@gmail.com

ABSTRACT:

The mapping of land use land cover with special reference to Agriculture/Horticulture in district Pulwama using Remote Sensing and GIS was taken up for present study. The District Pulwama is reported to be one of the pretty spots on the earth, because of its congenial climate, innumerable springs, streams, waterfalls, fragrant flowers delicious fruits and other natural sceneries. Pulwama district is spread over an area of 1398 km². It is bounded by Srinagar district in the Northern side, Budgam and Poonch in the Western side and Anantnag in the Southern side.

The land use /Land cover map of Pulwama district on 1:50,000 scale was prepared using Resourcesat-1 LISS-III satellite images and secondary data from different Government departments like Agriculture, Horticulture, Census, Forest etc. The approach involved

- Geo rectification of satellite data.
- On screen preliminary interpretation of satellite images.
- Ground truth survey.
- Map finalization.
- Spatial Statistics generation.

The study presents the estimate of area under each land use category. The work addresses 8 classes at level 1 and 29 classes at level 2. The built up area is 48.84 Sq. km, Agricultural land 754.81 Sq. Km, Forests 336.16 Sq. km, Grass/Grazing land 10.97 Sq. km, Waste lands 154.4 Sq. km, Wetlands 3.18 Sq. km, Water bodies 30.14 Sq. km and Snow and Others 59.47 Sq. km.

Key words: *Land use/Land cover, Ground truth, congenial climate, Agriculture, Horticulture, Geo rectification, interpretation.*

INTRODUCTION

Although the terms land cover and land use are often used interchangeably, their actual meanings are quite distinct. Land cover refers to the surface cover on the ground, whether vegetation, urban infrastructure, water, bare soil or other. Identifying, delineating and mapping land cover is important for global monitoring studies, resource management, and planning activities. Identification of land cover establishes the baseline from which monitoring activities (change detection) can be performed, and provides the ground cover information for baseline thematic maps.

Land use refers to the purpose the land serves, for example, recreation, wildlife habitat, or agriculture. Land use applications involve both baseline mapping and subsequent monitoring, since timely information is required to know what current quantity of land is in what type of use and to identify the land use changes from year to year. This knowledge will help develop strategies to balance conservation, conflicting uses, and developmental pressures. Issues driving land use studies include the removal or disturbance of productive land, urban encroachment, and depletion of forests.

It is important to distinguish this difference between land cover and land use, and the information that can be ascertained from each. The properties measured with remote sensing techniques relate to land cover, from which land use can be inferred, particularly with ancillary data or a prior knowledge.

There are two primary methods for capturing information on land cover, field survey and analysis of remotely sensed imagery.

Agriculture is the science or practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool, and other products.

Agriculture has played a key role in the development of human civilization. Until the Industrial Revolution, the vast majority of the human population labored in agriculture. The type of agriculture they developed was typically subsistence agriculture in which farmers raised most of their crops for consumption on farm, and there was only a small portion left over for the payment of taxes, dues, or trade. In subsistence agriculture cropping decisions are made with an eye to what the family needs for food, and to make clothing, and not the world marketplace. Development of agricultural techniques has steadily increased agricultural productivity, and the widespread diffusion of these techniques during a time period

is often called an agricultural revolution. A remarkable shift in agricultural practices has occurred over the past century in response to new technologies, and the development of world markets. This also led to technological improvements in agricultural techniques, such as the Haber-Bosch method for synthesizing ammonium nitrate which made the traditional practice of recycling nutrients with crop rotation and animal manure less necessary.

Horticulture is the Branch of agriculture concerned with the cultivation of garden plants generally fruits, vegetables, flowers, and ornamentals such as plants used for landscaping (landscape gardening). Propagation, the controlled perpetuation of plants, is the most basic horticultural practice. Its objectives are to increase the numbers of a plant and to preserve its essential characteristics. Propagation may be achieved sexually by use of seeds or asexually by use of techniques such as cutting, grafting (graft), and tissue culture. Successful horticulture depends on extensive control of the environment, including light, water, temperature, soil structure and fertility, and pests. Two important horticultural techniques are training (changing a plant's orientation in space) and pruning (judicious removal of plant parts), used to improve the appearance or usefulness of plants.

In Pulwama district the estimate of area under each land use categoryis as: The work addresses 8 classes at level 1 and 29 classes at level 2. The built up area is 48.84 Sq. km, Agricultural land 754.81 Sq. Km, Forests 336.16 Sq. km, Grass/Grazing land 10.97 Sq. km, Waste lands 154.4 Sq. km, Wetlands 3.18 Sq. km, Water bodies 30.14 Sq. km and Snow and Others 59.47 Sq. km. The total Geographical Area of the district is about 1090 Km^2.

The knowledge of land use and land cover is important for many planning and management activities and is considered an essential element for modeling and understanding the earth as a system. Land cover maps are presently being developed from local to national to global scales. The use of panchromatic, medium-scale aerial photographs to map land use has been an accepted practice since the 1940's.More recently, small-scale aerial photographs and satellite images have been utilized for land use/land cover mapping.

The main objectives of this work are:

1. To prepare a land use land cover map of the study area.
2. To generate a spatial database on land use land cover in Pulwama district.
3. To identify areas under Agriculture/Horticulture in Pulwama district.

THE STUDY AREA

A. General: The Study area is Pulwama district of Jammu and Kashmir State. The district is centrally located in the valley of Kashmir and is a resting place for Adventure Tourists since it is full of clean water Streams, Lakes, Magnificent Trees and Mighty Mountains where the air is cool and water sweet.

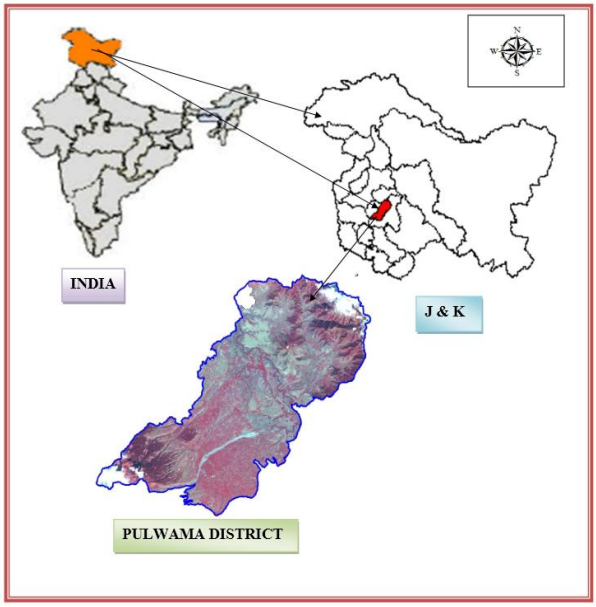

Figure 1: Study area map.

B. Geolocation: Pulwama district is located at Latitude of 33 degrees, 54.1 minutes North and Longitude of 74 degrees, 53.8 minutes east. It has an average elevation of 1630 meters (5347 feet) above sea level. It is bounded by Srinagar in the North side, Budgam and Poonch in the West side and Anantnag in the South side. The total geographical area of the district is 1090 km^2.

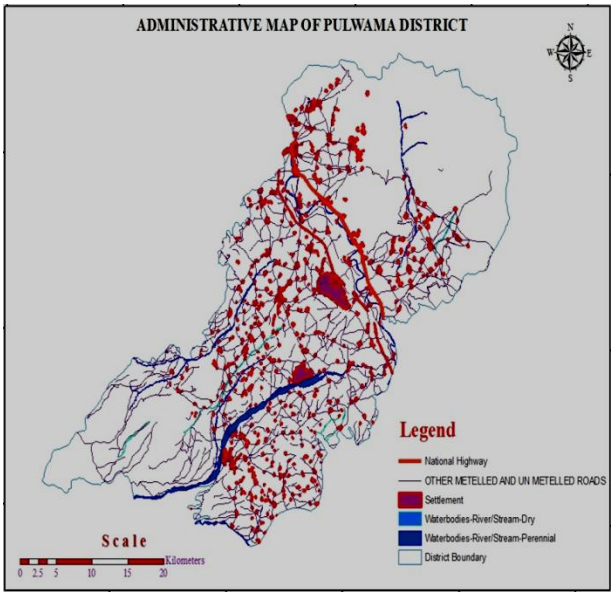

Figure 2: Administrative map of study area.

MATERIALS

Materials required for analysis of land use land cover are described below:

- Hardware
- Software
- Ancillary Data
- Satellite Data
- Topographic Maps
- Field work & Ground Truth Interpretation

Hardware:

- Processor : 30 GHz P-IV
- Disk space : 80 GB

Software: Software's used in this Project:

- ERDAS IMAGINE 8.6
- ARC GIS 9.3.1 (Arc Edit, Arc Map)
- MICROSOFT OFFICE

Ancillary Data

Toposheets: Survey of India (SOI) topographic maps on 1:250,000, 1:50,000 scales cover entire project area were procured. These maps have been used for preparing base map, drainage etc., for the study area and carrying out field work. Forest cover type map prepared by Forest Survey of India (FSI) was used for as ancillary information for forest mapping (Table 1).

Table 1: Details of SOI Maps:

SOI Map No.	Scale	Purpose
43J/16, 43N/04, 43K/09, 43K/10 43K/13, 43K/14, 43O/01, 43O/02	1:50,000	Geo-referencing of satellite data Ground truth
43N, 43O	1:250,000	Ancillary data

SRTM Data: SRTM Data from GLCF (Global Landcover Facility) was downloaded and rectified for use in terrain features.

Territorial Forest Boundary: Territorial forest boundary was obtained from SOI. *Forest Working Plan Maps:* Forest working plan maps were procured from the forest department and management boundaries were digitized from these maps.

Satellite Data: RESOURCESAT-1 IRS-P6 launched by Polar Satellite Launch vehicle (PSLV- C5) on Oct 17 2003. It is polar satellite at an attitude of 821 km in a Polar Sun Synchronous Orbit (SSO). Details of the satellite data used in the present study are given in table 2.

Table 2: Detail of satellite data used in the study

Data Used	Path/Row	Date of Pass	Bands
IRS-P6 LISS-III	92/46	24, Oct 2007	4
IRS-P6 LISS-III	92/46	15, May 2007	4
IRS-P6 LISS-III	92/46	24, Oct 2007	4
IRS-P6 LISS-III	92/46	15, May 2007	4

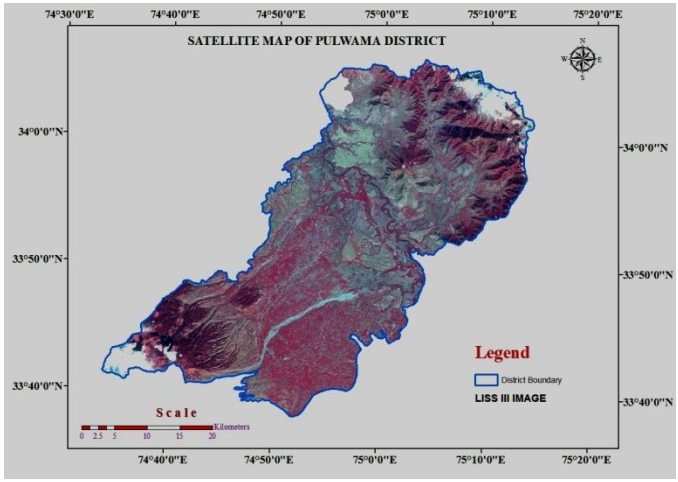

Figure 3: Satellite map of Study area

Field work and Ground Truth Interpretation: Field work and ground truth data have been collected for correcting the interpretation as derived from satellite image.

METHODOLOGY

The methodology adopted in the present study is on screen visual interpretation using Arc Software (both Arc Edit and Arc Map).The following procedure has been adopted as discussed below:

Registration: Image to image registration option has to be used for selection of ground control points (GCPs). Registration involves selection of GCPs input LISS-III image. The following are the steps involved during the process –
Transformation of the raster with a geometric result in warping the raster to map co-ordinates specified. The essentially involve use of a mathematical transformation to determine the correct map co-ordinates specified. The essentially involve use of a mathematical transformation to determine the correct map co-ordinate location for each cell in the raster.

Since the images of hilly terrain and also for the areas with large geometric distortions due to the relief and viewing angles, orthorectification method has been adopted.

AOI Image Preparation: Satellite image for the boundary of the study area as digitized and built earlier through Arc edit has been clipped from the original image. ARC Map 9.3 has been utilized for this purpose.

Base Layer Generation: Base layers like road, settlement have been digitized from toposheets and the layer wise coverage's have been integrated with the study area boundary.

Image Interpretation: The LISS III images were interpreted as per the classification dicussed above and a pre field map digitized.

Ground Verfication: Some sample areas have been verified on the ground to ensure the accuracy of the interpretation. The doubtful area encountered during pre field visual interpretation has been also surveyed.

Field Questionnaire: The Questionnaire play an important role to fulfill the objective especially of micro level vulnerability assessment and land use/land cover mapping and collection of data regarding agriculture and horticulture. The questionnaire used for investigation is described as under:

Post Field Modification: The post field interpretation has been modified as per the necessity on the basis of data collection during ground verification (field visit).

Final Cartographic Representation: Final land use/ land cover map has been prepared using cartographic symbolization techniques through are map software became the source data to be input in the second part of the present study.

Land Use Land Cover Interpretation System Generation: Finally land use/ land cover information system for the study area has been generated in ARC MAP including both spatial and attribute database.

Land use Land cover Classification Used: The USGS devised a land use and land cover classification system for use with Remote Sensor data in the mid-1970's (Anderson et al., 1976). The basic concepts and structure of this system are still valid today. A number of more recent land use land cover mapping efforts follow these basic concepts and, although their mapping units may be more detailed or more specialized, and they may use more recent remote sensing system as data sources, they still follow the basic structure originally set forth by the USGS. In Pulwama district the LULC classification is as there are 8 classes in level 1 and 29 classes at level 2.

Table 3: Land use and land cover classification system followed for present study.

Level I	Level II
1. Urban or Built-up Land	1.1 Built up Urban 1.2 Built up Public Semi Public 1.3 Built up Public Utility 1.4 Built up Transportation 1.5 Built up Rural 1.6 Built-up Industrial area Mining/Quarry
2. Agricultural Land	2.1 Agricultural Land Kharif 2.2 Agricultural Land Rabi 2.3 Agricultural Land Double 2.4 Fallow Land 2.5 Current Fallow 2.6 Agricultural Land Plantation 2.7 Agricultural Land Horticulture
3. Forest Land	3.1 Forest Evergreen Dense 3.2 Forest Evergreen Open 3.3 Forest Scrub 3.4 Forest Blank
4. Grass/Grazing Lands	
5. Waste Lands	5.1 Waste Land Gullied/Ravenous Land 5.2 Waste Land Shallow/Ravenous Land 5.3 Waste Land Deep Ravenous 5.4 Waste Land Dense Scrub 5.5 Waste Land Open Scrub 5.6 Waste Land Barren Rocky/Stony Waste
6. Wet Lands	6.1 Wet Lands Inland Natural
7. Water bodies	7.1 Water Body River /Stream-Dry 7.2 Water body lakes/Ponds 7.3 Water body lakes/Ponds-Perennial 7.4 Water body-Reservoir/Tanks 7.5 Water body-Reservoir/Tanks- Perennial
8. Snow and Others	

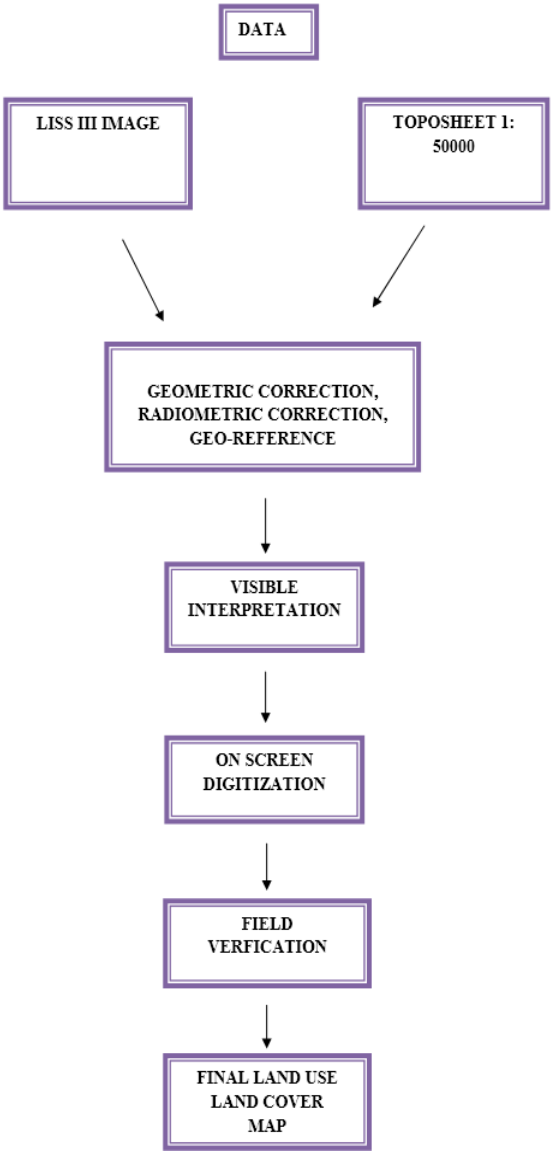

Figure 4: Methodology Flow Chart.

RESULT AND DISCUSSION

The study presents the estimate of area under each land use category. The work addresses 8 classes at level 1, 29 classes at level 2 such as Agriculture, Built up area, Forest, Grass/Grazing land, Waste land, Wet lands, Water bodies and Snow and Others. Major portion of the LULC is dominated by Agriculture, Forests and Waste lands. Agriculture practices included settled agriculture fields with Paddy, Maize, Mustard, Potato, vegetables and other crops are the major crops grown in the district. Horticulture is an indispensable part of agriculture which offers a wide range of choices to the farmers for crop diversification. There are some world famous varieties of fruits both fresh and dry, exotic flowers, honey saffron etc.

The natural vegetation of the area consists of the trees like *Salix alba* (Willow), *Populus alba* (Poplar), *Platanus orientalis* (Chinar) and *Roubinea pseuodacacia* (Kikar). The high hill ranges are covered with forests and the dominant species are *Pinus sylvestris, Pinus wallichiana, Cedrus deodara, Abies pindrow and Picea smitheana*. Several shrubs and herbs of medicinal value are also found in the forests

The land use land cover area statistics of Pulwama district is as under:

Table 4: Showing Land use/ Land cover Area Statistics of Pulwama District (In Sq.Kms.)

LU_CODE		DESCRIPTION	PULWAMA
010101	Built Up Area	Built Up Urban	2.773
010104		Built Up Public Semi-Public	3.0618863
010106		Built Up Public Utility	0.0134966
010110		Built Up Transportation	9.0594181
010200		Built Up Rural	32.643401
010302		Built Up Industrial Area Mining/Quarry	1.2892141
Total			**48.84042**
020101	Agricultural Land	Agricultural Land Kharif	92.955931
020102		Agricultural Land Rabi	35.923911
020104		Agricultural Land Double	372.57414
020200		Fallow Land	1.0107157
020201		Current Fallow	0.2023006
020301		Agricultural Land Plantation	129.55799
020302		Agricultural Land Horticulture	122.62284
Total			**754.8478**
030101	Forest	Forest Evergreen Dense	40.522937
030102		Forest Evergreen Open	159.53918
030400		Forest Scrub	125.50456
030500		Forest Blank	10.611059
Total			**336.1777**
040100	Grass land/ Grazing	Alpine Grasslands	10.971165
Total			**10.971165**
050201	Wasteland	Wasteland Gullied/Ravenous land	0.0220255
050202		Wasteland Shallow/Ravenous land	81.404211
050203		Wasteland Deep Ravenous	0.7947131
050301		Wasteland Dense Scrub	4.7634297
050302		Wasteland Open Scrub	7.3956853
050500		Wasteland Barren Rocky/Stony Waste	60.035804
Total			**154.4159**
060100	Wetlands	Wetlands Inland natural	3.1792571
Total			**3.1792571**
070102	Water body	Water body Dry	27.208495
070300		Water body Lakes/Ponds	2.8659288
070301		Water body Lakes/Ponds Perennial	0.017889
070400		Water body Reservoirs/Tanks	0.0392439
Total			**30.13156**
080000	Snow/ Glacier	Snow/Glacier	59.47511
Total			**59.47511**
Grand Total			**1398**

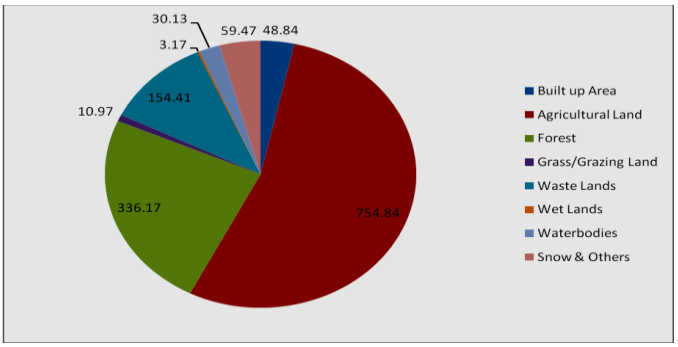

Figure 5: Land use status chart in PulwamaDistrict.

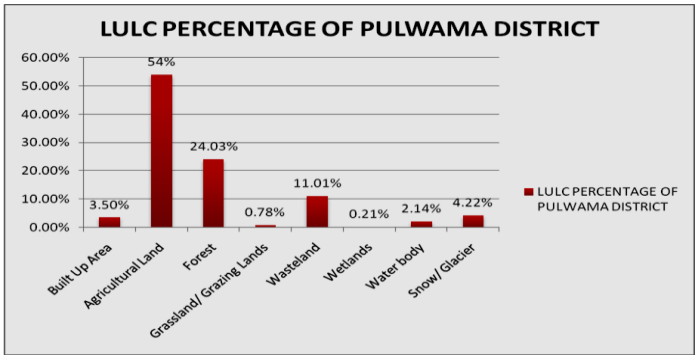

Figure 6: LULC Percentage of Pulwama District.

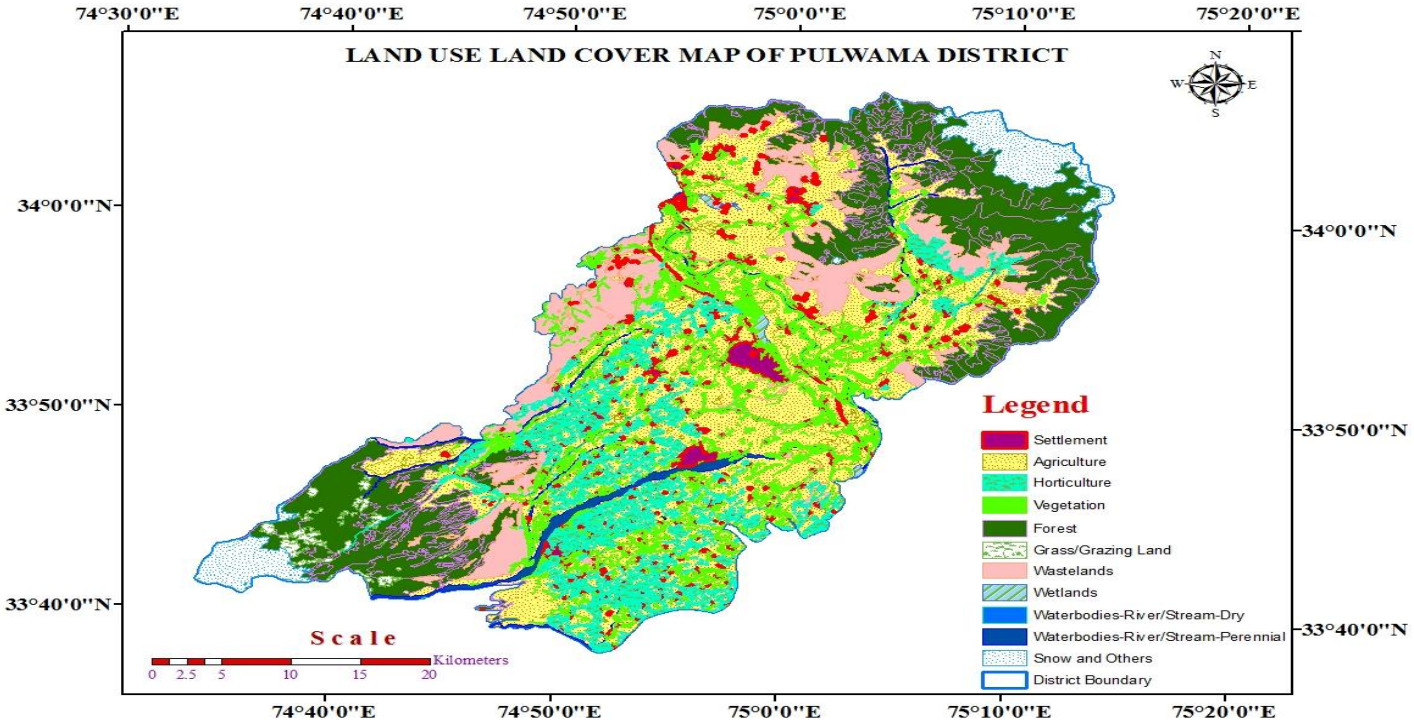

Figure 7: Land use Land cover map of Study area

The Pulwama district is rich in Horticulture and Agriculture. As such Agriculture is the main occupation of people in the district. About 70% people are engaged with this activity and the remaining 30% are engaged with other occupations. The district is also famous in Fruit Cultivation. The Population of the upper belt of the district i.e. Tehsil Shopian is mainly engaged with this Industry. Tehsils Pampore and Tral have acquired in the district a distinction for cultivation of SAFFRAN. The Saffron "Crocus-Sativus" of Kashmir is famous for its bouquet and is in great demand as condiment and as a pigment for forehead marks of the Hindus. Agriculture contributes a major portion of the income of the people residing in the district followed by Fruit Cultivation. However, Industrial Sector is also developing. Till date 1268 SSI units have come up in the district and registered with the district Industries Centre, Pulwama (excluding 748 non-SIDO) providing employment to 5711 persons (position ending 31.03.2001).

The agriculture products like paddy, oil seeds, fodder, saffron & milk are the main contributors to the Gross Domestic Product (GDP) of the District. Area sown more than once is about 0.26 lac hectares & the productivity of the land in the district is higher than in any other District in the State. District Pulwama is famous for saffron cultivation which is mainly grown in Karewa lands of Pampore, Kakapora and Pulwama blocks. The area under saffron cultivation during 2006-07 was 2600 hectares. Among the fruits, apple, almonds, walnut & cherry are the important one produced in this District.

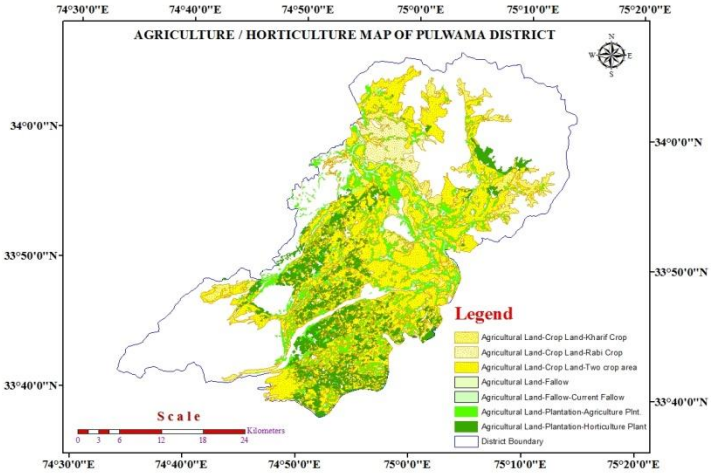

Figure 8: Agriculture / Horticulture map of Pulwama District

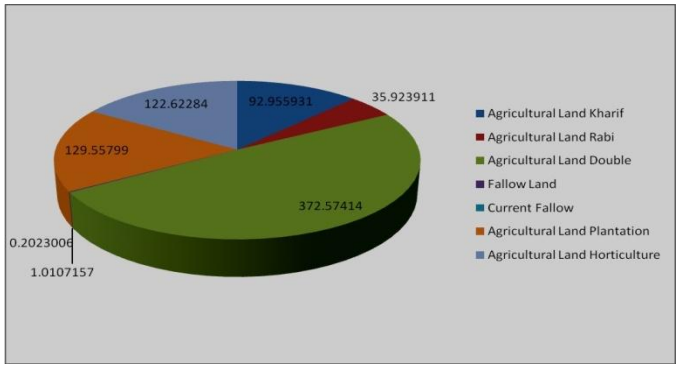

Figure 9: Agriculture / Horticulture status chart in Pulwama District.

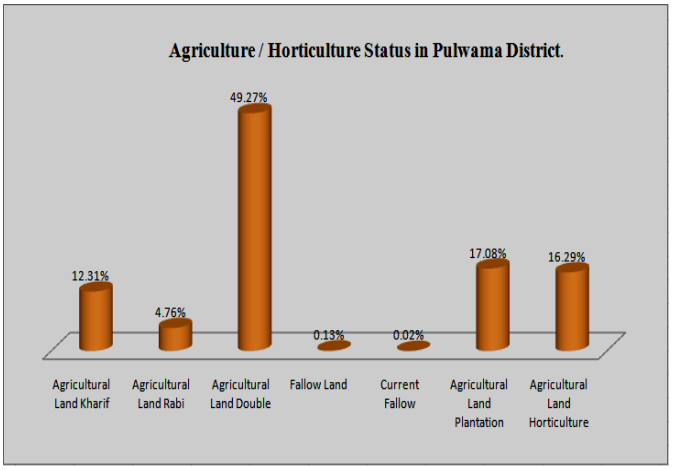

Figure 10: Agriculture / Horticulture status in Pulwama District.

Farming is the main stay of the people engaging more than 80% of the working population. About 62% of area is under cultivation and about 15% is under cultivation and about 15% is under forest and fruit trees. The remaining area is either left barren or un-cultivable/cultivable waste.

Table 5: The Detailed Land use Statistics of The District is shown as under:-

1.	Geographical Area.	1090 Km²
2.	Area as per village papers.	60772 ha
3.	Area under forests.	412 ha
4.	Land put on non Agriculture use.	70494 ha
5.	Barren and uncultivable land.	2592 ha
6.	Pastures and other grazing land.	6447 ha
7.	Land under miscellaneous crops (Not included in area sown).	1065 ha
8.	Cultivable waste land.	3758 ha (0.05%)
9.	Currents land other than (CF).	5947 ha
10.	Fallow land other than (CF).	812 ha
11.	Land under fruit crops.	8420 ha
12.	Net cultivated area.	32245 ha
13.	Grass cultivated Area.	56984 ha
14.	Area sown more than once.	24739 ha (76.72%)
15.	Cultivable Area.	70.37%
16.	Mono cropped Area.	7506 ha
17.	Area irrigated.	22000 ha (68.31%)
18.	Water Logged Area	2000 ha
19.	Flood prone Area.	3000ha

Forests also cover large area in the district, consists of the trees like *Salix alba* (Willow), *Populus alba* (Poplar), *Platanus orientalis* (Chinar) and *Roubinea pseudacacia* (Kikar). The high hill ranges are covered with forests and the dominant species are *Pinus sylvestris, Pinus wallichiana, Cedrus deodara, Abies pindrow and Picea smitheana.* Several shrubs and herbs of medicinal value are also found in the forests.

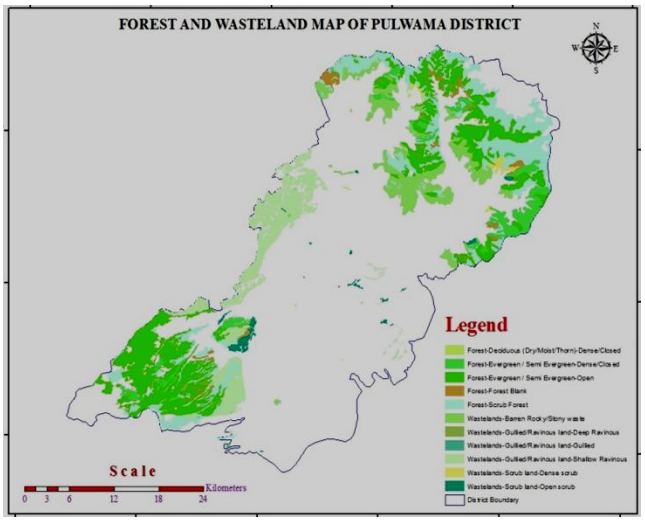

Figure 11: Forest and wasteland map of study area.

In Pulwama district the Population is mostly rural & 12.70% of it resides in towns. The biggest ethnic group is Muslim accounting for 95.88 % of population followed by Hindus 2.50 % & others 1.62 %. As per 2001 census working force accounts for 23.77 % of population. The main occupation engaging in the work force is cultivators, Manufacturing & processing & other than household sectors & Agriculture labour engaging 79.84 % of the working force.

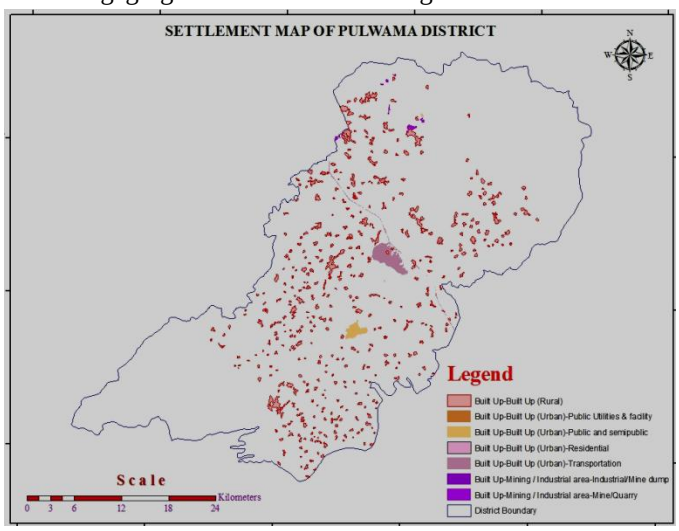

Figure 12: Settlement map of Study area.

Most of the population of the district is concentrated in valley portion drained by major rivers Jhelum, and its tributaries like Rembiara, Vishaw, Romshu and Sasara. In the past, development of ground water was mainly through dug wells and percolation wells along the riverbeds, Nallhas and also some springs has played a major role for sustainable domestic and irrigational purposes. In some of the areas, at present too these are the only sources of water.

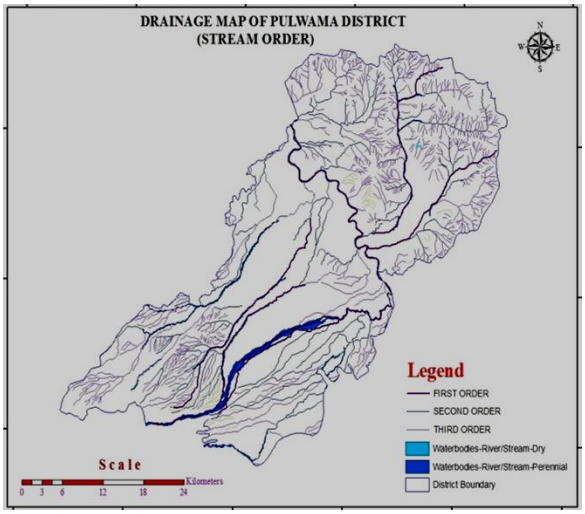

Figure 13: Drainage map of Study area.

CONCLUSION

The analysis of the Resourcesat-1 LISS-III satellite image of 23metre spatial resolution provide better opportunity for delineating different classes of land use /Land cover in any region.

The use of Geographic Information System for integrating land use /Land cover administrative layer help to identify the exact land use /Land cover status of the study area. The present study of the land use land cover mapping of the study area will also help in management of the land use and land cover categories.

Satellite based remote sensing techniques have proved successful in providing a comprehensive, reliable and up-to date information on land use/land cover in the most cost effective manner. Knowledge of the agro-climate and agro-ecological conditions of the area will helped to identify ecologically sensitive locations with special reference to Environmental Sensitivity Index

The spatial database of LULC classes presented in this project would be useful for the following.

- Formulation of development programmers in the Departments like Agriculture, Rural Development, Environment and Forest, Water Resources and others.
- Monitoring of dynamic land covers like surface water, forest, waste lands etc.
- Primary database for regional Environmental Impact Assessment (EIA) studies and for addressing global environmental issues like biodiversity, climate change, land cover-atmosphere interactions, carbon sinks etc.

Above all the development in Agriculture/Horticulture will help in socio economic upliftment of the district with increase in revenue and employment generation.

REFERENCES

1. Anderson, James R., 1971, Land use classification schemes used in selected recent geographic applications of remote sensing: Photogramm.Eng, v. 37, no. 4, p. 379-387.
2. Anderson, James R., Hardy, Ernest E., and Roach, John T., 1972, A land-use classification system for use with remote-sensor data: U.S. Geol. Survey Cire. 671, 16 p., refs.
3. Bhat M .M and Shah A R. 2011; Agricultural Land Use and Cropping Pattern in Jammu and Kashmir, Research Journal of Agricultural Sciences, 2(3): 710-712.
4. Chakraborty K, Joshi P.K,. Sharma K.K M 2009; Land use / Land cover Dynamics in Umngot Watershed of Meghalaya using Geospatial tools; .Journal of Indian Science of Remote Sensing. 37:99-106.
5. Daniel Ayalew Mengistu and Ayobami T. Salami 2007; Application of remote sensing and GIS inland use/land cover mapping and change detection in a part of south western Nigeria; African Journal of Environmental Science and Technology Vol. 1 (5), pp. 099-109, December,
6. Gautam N.C. and Raghavswamy V 2004; Land Use/Land Cover and Management Practices in India; BSP, viii, 310 p, maps, tables, figs, ISBN: 8178000520.
7. Golam Rasul2009; Ecosystem services and agricultural land-use practices: a case study of the Chittagong Hill Tracts of Bangladesh, Sustainability: Science, Practice, & Policy, Fall | Volume 5 | Issue 2.
8. Kaul M, Dadhwal V.K , Mohren G.M.J2009; Land use change and net C flux in Indian forests; Forest Ecology and Management 258 100–108, Indian Institute of Remote Sensing (IIRS), 4 Kalidas Road, Dehradun, UA 248001, India.
9. Krishnamurthy Y.V.N., Dy. Head, RRSSC, Nagpur and Shri S.Adiga, Director, NNRMS-RRSSC, ISRO Hqs, Bangalore Nationwide Land Use/Land Cover Mapping Using Indian Remote Sensing Satellite Data-a Digital Mapping Approach.
10. Wani M.H, Baba S.H and Shahid Yousuf 2009; Land-use Dynamics in Jammu and Kashmir. Agricultural Economics Research Review Vol. 22, pp 145-154.
11. National Wetland Atlas Jammu and Kashmir, Sponsored by Ministry of Environment and Forests, Government of India. SAC/RESA/AFEG/NWIA/ATLAS/16/2010.
12. Prakasam.C; Land use and land cover change detection through remote sensing approach: A case study of Kodaikanal taluk, Tamil nadu, International Journal of Geomatics and Geosciences Volume 1, No 2, 2010, ISSN 0976 – 4380.
13. Rounsevell M.D.A, Reay D.S Land use and climate change in the UK Land Use Policy 26S (2009) S160–S169