



RAPID ASSESSMENT OF LAND-USE CONVERSION PATTERNS USING GEOSPATIAL TECHNOLOGY IN APPLE DOMINATED AREAS OF KULGAM AND SHOPAIN DISTRICTS, JAMMU AND KASHMIR, INDIA

Sanu Kumar[§], Shruti Kanga[§], Majid Farooq[#] and Suraj Kumar Singh^{*}

[§]Centre for Climate Change & Water Research, Suresh Gyan Vihar University, Jaipur, India

[#]Department of Ecology, Environment and Remote Sensing, Jammu and Kashmir, India

^{*}Centre for Sustainable Development, Suresh Gyan Vihar University, Jaipur, India

Corresponding author:shruti.kanga@mygyanvihar.com

Abstract

GIS is the systematic introduction of numerous different disciplinary spatial and statistical data that can be used in inventorying the environment, observation of change and constituent processes and prediction based on current practices and management plans. Remote Sensing helps in acquiring multi spectral spatial and temporal data through space borne remote sensors. Thus, spatial and temporal analysis technologies are very useful in generating scientifically based statistical spatial data for understanding the land ecosystem dynamics. In the present study multi-temporal satellite images of 1976 and 2011 were evaluated and mapping was performed using visual interpretation technique and extensive ground verification was carried out to monitor the land use/land cover change detection. The major classes of land use/land cover classes identified and demarcated on the satellite images are agriculture, horticulture, plantation, alpine pastures, alpine scrub, barren rocky, boulder beds, built-up and degraded forests. Major change has been seen from agriculture into agro-horticulture, due to high per capita income in agro- horticulture products.

Keywords : Rapid assessment, geospatial technology, Land-Use conversion.

Introduction

The earth's total land area is about 114.8 million square kilometers or about 29% of the surface of the globe. Land cover is the physical material at the surface of the earth. Land covers include grass, asphalt, trees, bare ground, water, etc. There are two primary methods for capturing information on land cover, field survey and analysis of remotely sensed imagery. Land-use refers to the way in which land has been used by humans and their habitat, usually with accent on the functional role of land for economic activities. Recent study says that there are only a few landscapes on the earth which has remained unchanged/unaltered. The earth surface is being altered rapidly and significantly due to many anthropogenic activities thus resulting in observable land use and land cover pattern. In general the problem concerns both detecting whether or not a change has occurred, or whether several changes might have occurred, and identifying the times of any such changes. Specific applications may be concerned with changes in the mean, variance, correlation, or spectral density of the process. More generally change detection also includes the detection of anomalous behavior: anomaly detection.

Change detection is the measure of the distinct data framework and thematic change information that can guide to more tangible insights into underlying process involving land cover and land use changes than the information obtained from continuous change. Change detection is useful in many applications such as land use changes, habitat fragmentation, rate of deforestation, coastal change, urban sprawl, and other cumulative changes through spatial and temporal analysis techniques such as GIS (Geographic Information System)

and Remote Sensing along with digital image processing techniques.

Land cover and land use change are increasingly recognized as major factors of global environmental change (Meyer and Turner 1994; Singh and Kanga 2017) and important for sustainable management of natural resources. In most parts of the world, land cover/land-use can be considered an interface between natural conditions and anthropogenic influences. Both human-induced and natural land covers conversion; land-use and habitat fragmentation). Both human-induced and natural land cover changes interact with the global carbon cycle, climate, and biodiversity and landscape ecology (De Fries *et al.*, 1997; Houghton 1994; Nathawat *et al.*, 2010). Detecting change in land cover/land-use is therefore important to informing management decisions on how particular interventions affect the sustainability of natural resources.

Remote sensing is generally recognized as a major source of data for environmental monitoring however, because of its relatively short history, satellite remote sensing only allows the detection of changes in land cover over the past 30 years at most. Before 1970s, most land cover mapping activities at local level depended on field surveys and remote sensing through interpretation of aerial photographs. Field-based studies allow the observation and description of processes of land-cover then, the dynamics of change process have been investigated through temporal series of remote sensing data (Kwarteng and Small 2010; Roy *et al.*, 2017; Tripathi *et al.*, 2017) in a detailed and spatially disaggregated way. Thus they are generally not sufficient to qualify and analysis spatial-temporal patterns of

land cover/land-use changes at an aggregated level (Liverman *et al.*, 1998; Raman *et al.*, 2018). Since the 1970s, numerous satellite systems have been launched to obtain information on Earth's resources, and thus remote sensing has emerged as the most useful data source for quantitatively measuring land cover changes at the landscape scale (Rogan and Chen 2004, Since Jr 1998; Mas 1999; Munyati 2000; Petit and Lambin 2001; Apan *et al.*, 2002; Yang and Lo 2002; Tomar *et al.*, 2017).

It is well known that because of the economic development and the vulnerable ecology and Environment, Kashmir's environment is under increasing pressure. In South Kashmir (Kulgam) 'rice bowl of Kashmir' the rapid conversion of paddy land into horticulture from past two decades has taken place. The area was self-sufficient in the production of rice, but once can clearly mark the transformation to horticultural produce now-a-days. The two probable causes are decreasing discharge of water various rivers throughout the districts affecting irrigation system and high market value of horticultural produce. The major objectives of the study were to develop data integration strategy for a time series of land cover maps derived from multi-temporal and multi spectral data. Thereafter preparation of land cover/land use map of 1976 and 2011 of south Kashmir was performed and assessment of the change in Landuse/ landcover during 1976-2011 was analyzed.

Study area

Kulgam and Shopian stretches between 33° 39' N 75° 01' E and 33° 43' 75' 50 E. An average altitudes of 3500 mts. above mean sea level. The state of Jammu and Kashmir carries one of the finest developed sequences of rocks right from archaen Era to recent age. The Karewa situated in Qazigund, kulgam and river terraces of Jhelum (Figure 1). The state of Jammu and Kashmir a symbol of national integration and unity has a unique geographical personality. It is well endowed in renewable natural resources. Its mighty rivers, evergreen forests, snow covered peaks, invigorating climate and human population are unparalleled in world. Majestic mountainous range of Pir Panjal, acting as a massive topographical barrier but rich in vegetation and forests with extensive pastures on its lower slopes. Agriculture occupies an important place in the economy of the state. The share of agriculture and allied sectors in the gross state domestic product (at 1999-2000) for the year 2006-07 (preliminary) stands at 28.61% .on the other hand nearly 70% of the population in the state derives its livelihood directly or indirectly from the agriculture sector. Jammu and Kashmir is basically an agrarian economy. The favorable agro climatic conditions, fertile soils, sub-tropical climate are ideally suited for cultivation of fruits and vegetables in the state and offer immense scope for development of horticulture. In view of the potential available, fruit growing has become a major industry and contributes largely to the export trade of the state.

Data Used

Different type of data viz. spatial and non-spatial was used in the study. The description of data used is given below (Table 1).

Remote Sensing Data

The study is based on following data sources.

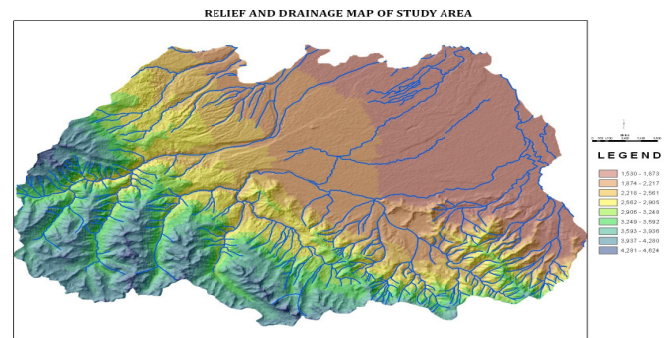


Fig. 1 : Relief map of the study area

S. No.	Satellite	Path/Row	Resolution	Date of pass
1.	LANDSAT MSS	146/37	70 m	15 Oct 1976
2.	IRS-P6 LISS III	92/46, 92/47	23 m	28 Oct 2011

Ancillary Data

Ancillary/collateral data constitute an important part of data base in remote sensing. They provide the overall idea about the study area and also increase the interpretation accuracy and reliability of remote sensed satellite data. It also enables verification of the interpreted details by supplementing it with the information, which cannot be obtained directly from satellite imagery. The important collateral data includes administrative boundary of the state, district and blocks, location of settlements, drainage/rivers and horticulture crop area and other important crops of the area.

Ground Truth Data

Ground truth data of field investigation forms an important and integral part of the interpretation methodology of remote sensing data. Ground truth data is attributed to collection, verification and measurement of information about the different features on the earth surface contributing to spectral reflectance pattern during the desired period. The information and location were noted with the help of maps, image prints outs and global positioning system.

Materials and Methods

Data integration is a set of data possessing strategies in a GIS environment that can bring together spatial data from historical maps and different satellite images and bring them to a consistent thematic and spatial detail level for the purpose of further landscape change analysis. The study is based on remotely sensed data (satellite images) combined with the extensive field checks and surveys. The advantage of remote sensed data are many because region land cover are dynamic and complex in nature, conventional methods are unable to cope with many changes that take place over a short period of time. Satellite imagery are appropriate for the evaluation of rapid change in land cover. The study is spread over 35 years' time span (1976-2011). For

the georeferencing survey of India (SOI) toposheet was referenced. The map to image georeferencing was carried out in ERDAS Imagine software. Satellite imageries were stacked in different bands to produce false colour composite, further mosaicking and subsetting of the image yielded the image for study area (figure 2).

The image were digitized in GIS environment using Arc Map software in the form of polygon and line features representing different land use/land cover spread over a total of 1728.40 sq km area of twin districts. Satellite images were 1st visually interpreted with the help of separate interpretation keys to identify various land use classes. Details of the final map were then transferred into a base map, bringing all the maps to scale and these were digitized for analysis. Techniques coupled with satellite imagery are essential elements for the preparation of integrated development plan. Together they provide the means for rapid production of accurate and up to date data bases for planners at all levels. After digitization of both land cover/ land use (1976-2011), Arc tool box was used for analysis processes. Analysis tool was open for overlay process. Both Land use/ land cover of 1976 and 2011 were intersected as a new shape file formed.

Data Integration For Land Cover Change Detection

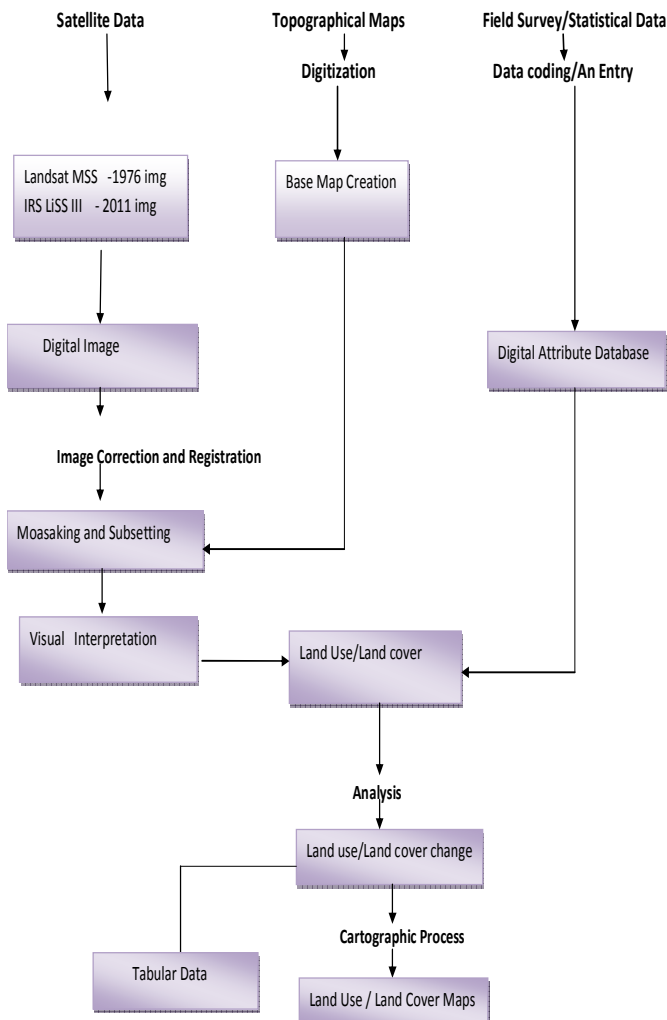


Fig. 2 : Flowchart for the methodology involved in the study.

Results and Discussions

Eight major classes of land use/land cover classes were identified for 1976 image. They are: Agriculture, Agriculture/Horticulture, agriculture/Willow Plantation, Alpine pastures, Alpine scrub, Barren rocky, Boulder beds, Built-up, Degraded Forests, Forest Cover, Horticulture, and Plantation. Statistical analysis of multi temporal land cover/land use of south Kashmir reveals that significant change taken place from 1976-2011 (figure 2a & b).

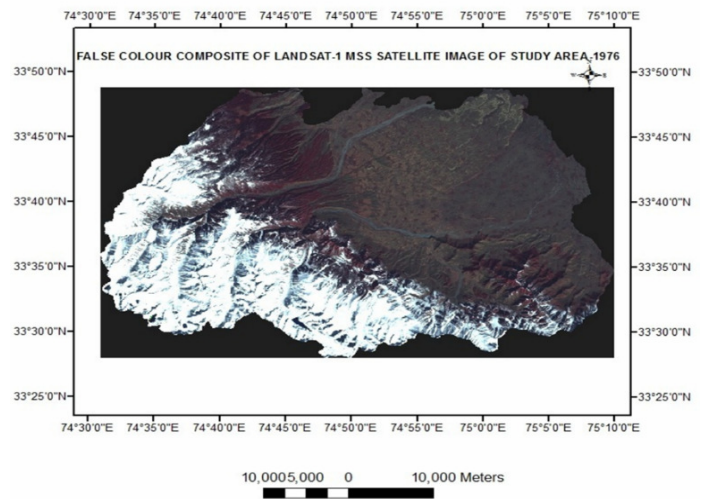


Fig. 2a : False colour composite (FCC) of 1976

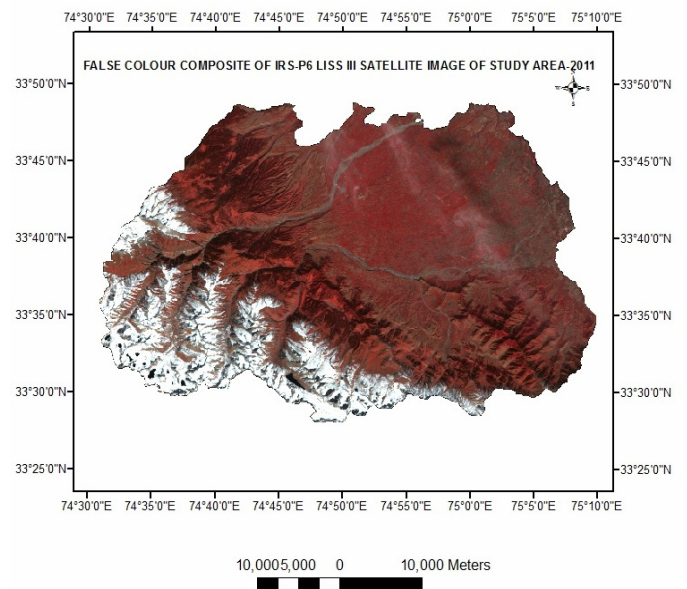


Fig. 2b : False colour composite (FCC) of 2011

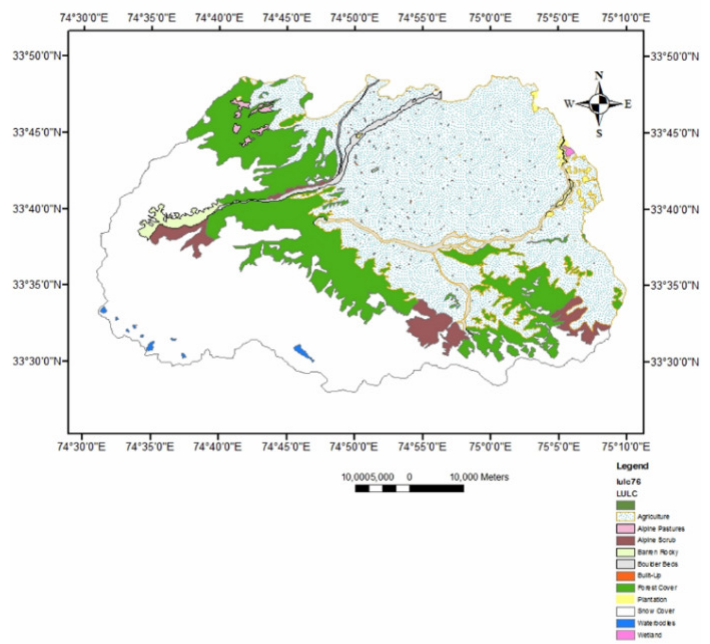


Fig. 3a: Land use land cover mapped in 1976

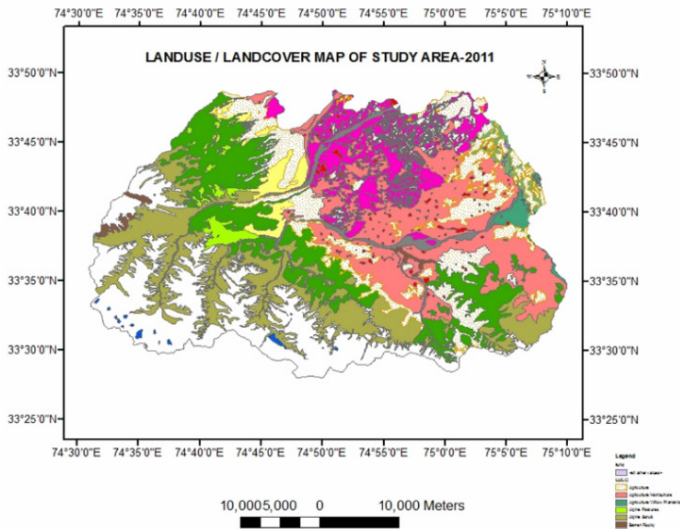


Fig. 3b: Land use land cover mapped in 2011

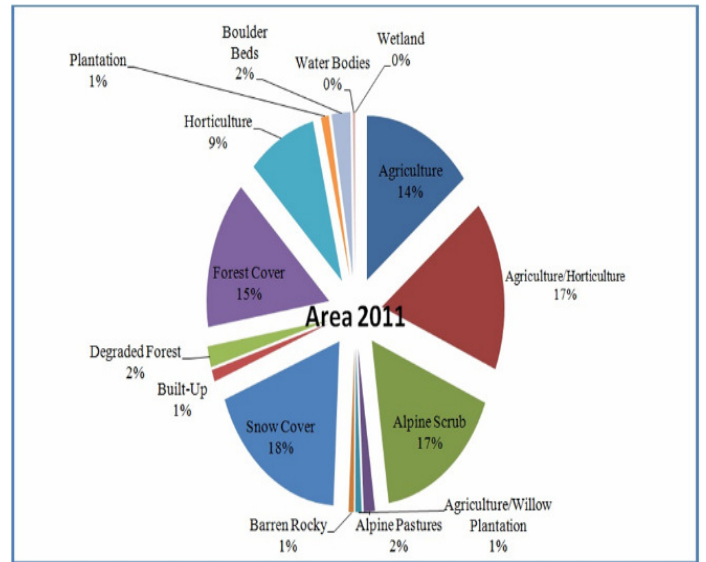


Fig. 4b : Percentage of land use/ land cover area in 2011.

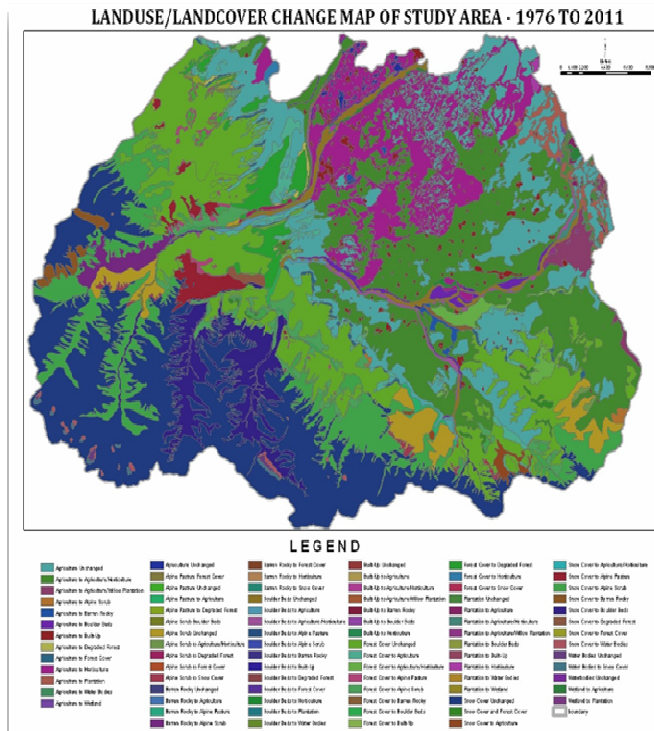


Fig. 3c: Change detection map of the study area

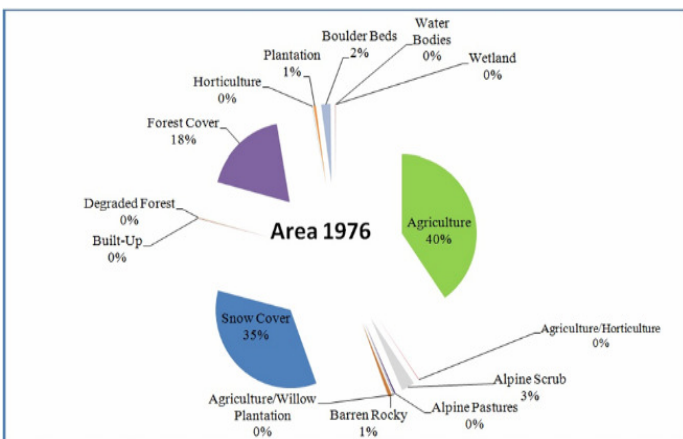


Fig. 4a: Percentage of land use/ land cover area in 1976.

Out of the total land use/land cover agriculture was the major category, in land use land/cover 1976 agriculture was 695.16 square km, which drastically reduces to 249.62 square km in 2011 and percentage of change (1977-2011) is -64.09 percent. Cultivation of crops is the dominant occupation in Jammu and Kashmir, farming directly or indirectly supports about 81 per cent of the state (figure 3a). The main reason for drastic decrease was Horticulture emerging as a new category; more people converting their agriculture land in horticulture from past two decades. There are many factors like social, economic and political for conversion of agricultural land. As “Kulgam” was called rice bowl of Kashmir. Kulgam is the leading producer of rice in valley. The average yield of rice in Kashmir division is about 15 quintals per hectare. As the farmers in south Kashmir are marginal farmers holding a small piece of land, which do not yield enough income to purchase of pesticides, fertilizers and new technology. In kandi areas and parts of Kerawas irrigation is not possible owing to undulating terrain and non-availability of underground water table and unscientific practices, per capita yield is low. This brings more thrust on agro-horticulture products. Shifting to horticulture has also to do with lack of proper irrigation facilities for water intensive agri-crop like paddy. Rapid conversion of paddy land into horticultural use and the mushrooming of commercial establishments and residential colonies in the areas which were once flourishing farm lands all these increases were at the cost of agricultural land. Institutional gaps are evident is that of credit and marketing of agricultural products. Poor connectivity to market in India particularly as National highway leading out of valley is extremely vulnerable to rains/Snow fall. Agriculture/willow plantation has also recorded increase in 1976 it was near about 1.00 square km which increase to 14.00 square km in 2011 and percentage of change is 1300.24 percent (figure 3b).

Table 2: Change detection of various land use/ land cover categories.

LU Land use/ land cover	Area 1976	Percent of total area	Area 2011	Percent of total area	Percentage of change	Folds of Change in % 1976-2011
Agriculture	695.16	40.22	249.62	14.44	-25.78	-64.09
Agriculture/Horticulture	1.00	0.06	289.70	16.76	16.70	28870.16
Agriculture/Willow Plantation	1.00	0.06	14.00	0.81	0.75	1300.24
Alpine Pastures	5.66	0.33	25.55	1.48	1.15	351.14
Alpine Scrub	49.49	2.86	286.75	16.59	13.73	479.43
Barren Rocky	13.51	0.78	12.00	0.69	-0.09	-11.16
Boulder Beds	34.35	1.99	42.59	2.46	0.48	23.99
Built-Up	1.98	0.11	19.87	1.15	1.04	903.91
Degraded Forest	1.00	0.06	35.73	2.07	2.01	3472.84
Forest Cover	313.32	18.13	254.89	14.75	-3.38	-18.65
Horticulture	1.00	0.06	155.56	9.00	8.94	15456.09
Plantation	8.76	0.51	17.81	1.03	0.52	103.46
Snow Cover	598.41	34.62	319.17	18.47	-16.16	-46.66
Water Bodies	2.83	0.16	4.53	0.26	0.10	60.08
Wetland	0.95	0.06	0.64	0.04	-0.02	-33.07
Total	1728.43	100.00	1728.43	100.00	0.00	

Followed by Degraded Forests in 1976, it was near about 1.00 sq km, which increases

Built-up has also increased 1.98 square km in 1976 and 19.87 square km in 2011, percentage of change is 903.91 percent (figure 3c). Built up has increased from last decade, due to the shortage of residential land for construction. There was increase in land values and land owners who previously use their land for agriculture now offer it for construction. Built up had in south Kashmir both in towns and villages. Due to formation of new district headquarters kulgam and shopian had got new built up for administration, residential and business purpose were built from last 8 years. Road network is also being developed .New road links are being connected through (PMGSY) scheme in remote area of kulgam and shopian. Inter district roads and main roads have metalled and widened e.g., wanpoh-aharbal via kulgam, kulgam-shoipan, kulgam-wanpoh via khudwani/ Qiamohetc All this causing a large conversion of agriculture land, followed by Alpine pastures it was 5.66 in 1976 and 25.55 in 2011, percentage of change is 351.14 percent. Alpine Scrub was 49.49 square km in 1976 and it has increased to 286.75 square km, percentage of change is 479.43 percent. Horticulture has also increased from 1.00 square km to 155.56 square km in 2011 (figure 4a). Percentage of change is 15456.09 square km. The area under plantation was 8.76 square km 1976 and 17.81 square km in 2011 during the period percent of change is 103.46 percent. One reason for this is people protecting their agriculture land from encroachment. By planting trees they wait for increase in land values. Another reason is that plantation crops need less care and protection. Like popular, willow etc. Average popular/ willow costs near about Rs 190 / feet. The growing market for horticulture and small bat making units provides an assured market. Water bodies also show increase from 2.83-4.53 square km in 2011, percentage of change in land use/land cover is 60.08 percent. Table 3 also shows increase in boulder beds from 34.35 in 1976 to 42.59 in 2011, percentage of change is 23.99 percent. Kashmir faced floods in 1995. Which widens the course of rivers like Rambiar and vishe; it also increases the boulder bed area of the region. The snow cover has recorded decrease during study

period it was 598.41 square km in 1976 and 319.17 in 2011, percentage of change is -46.66 percent. Wetlands also show decline it was 0.95 square km in 1976 and 0.64 square km in 2011, percentage of change is -33.07 percent (figure 4b).

Table 2 clearly shows forest cover drastically reduces it was 313.32 square km in 1976 and 254.89 square km in 2011, percentage of change is -46.66 percent has accelerated as a result of poor government control (and in some cases corruption), lack of local awareness, unemployment. The valley forests include a wide variety of species evergreens, rose chestnut, alder, pine, laurel, sal, oak, magnolia, cedar, birch, hazel, spruce, juniper, and rhododendron. These forests provide a balanced habitat for the wildlife of Kashmir. Followed by barren rocky it was 31.51 square km in 1976 and 12.00 square km in 2011, percentage of change is -11.16 percent.

The classification accuracy assessment forms one of the most important activities in any project employing remote sensing technique. Therefore, the remote sensing specialists do not consider any classification as complete unless its accuracy is assessed (Lille sand and Kiefer, 2002).One of the most common methods of assessing classification accuracy is obtained through preparation of a contingency table also called as confusion matrix or error matrix. In this method, category-by-category comparison is sought between known reference data (mostly obtained through ground truth verification) and the corresponding results of obtained by computer. Kappa analysis is a discrete multivariate technique of using accuracy assessment. The "K" value of 0.8823 can be thought of as an indication that an observed classification is 88% better than one resulting from chance. To get impression and satisfaction, the accuracy assessment was carried using sample reference points. The overall accuracy resulted 89.25% and kappa statistic value of 0.8823 (88.23%).

Conclusion

Remote se-nused data such as imagery IRS LISS III and LANDSAT MSS give over all view which is very useful in change studies. The agriculture land which was 695.16

square km in 1976 got decreased to 249.62 in 2011. From past two decades consuming thousands of hectares of agricultural land. The forest area has recorded decrease. Due to reckless cutting of trees for different uses.

Agriculture/Horticulture has also increased, this increase has mainly effected on the agriculture land. If same trend will go on 70% Population dependent on agriculture will suffer. There has been increase in the area under plantation (tree crops). The built up has also increased in all area. Destroyed fertile agricultural lands which cannot be recovered and study are is losing its agrarian characteristics. Rivers and small streams which used to flow through agricultural fields are now encroached upon and used for disposal of garbage and wastes. Degraded forest cover has also increased in the area. Last 50 years deforestation has accelerated as a result of lack of local awareness, unemployment. The Boulder area increases from 34.35 square km to 42.59 square km gaining land from different classes and Built- up has increased from 1.98 square km to 19.87 square km. The Alpine pastures area increased from 5.66 square km to 25.55 square km. gaining land. Barren Rocky decreased area from 13.51 square km to 12.00 square km losing land. The Degraded forest has increased from 1.00 square km to 35.75 square km. The Forest cover has reduced from 313.32 square km to 254.89 square km losing its land. Drastic change has been seen in the horticulture as it has increased from 1.00 square km to 155.56 square km. gaining land. Plantation has also increased from 8.76 square km to 17.81 square km. Snow covers decrease from 598.41 square km to 319.17 square km. The water bodies has increased from 2.83 square km to 4.53square km. gaining area and Wet land cover has also decreased from 0.95-0.64 square km 2011, losing its land to different classes.

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