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Assessment of Land Use and Land Cover Change in District Baramulla, Jammu and Kashmir

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Abstract
The present study aims to study the land use land cover change detection in district Baramulla from 1980 to 2014. The images of two different time periods 1980 (MSS) and 2014 (OLI) have been used to measure the change detection in the study area. Spatial and radiometric enhancement has been carried out to improve the image quality. The analysis revealed that the area under built-up, horticulture and pasture has shown a positive change and also represents higher conversion of other land uses into built-up. The area of remaining classes has decreased especially in forest with the decrease of 137.3 km^2, in which 87.33 km^2 was converted to pasture; such changes were mainly observed along the transportation networks and also along the banks of the River Jhelum. The error matrix has been conceded with 231 training sites which revealed an overall accuracy of 86.58% and the result of Kappa shows the accuracy with 83.8%.

Keywords: *LULC, change detection, GIS, population, remote sensing*

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INTRODUCTION
Land use/land cover (LULC) information is essential for the selection, planning and implementation of management strategies to meet the increasing demands for basic human needs and welfare of the ever growing population (Arveti *et al.* 2016 [1]). Historical land use and land cover and its changes that are being altered by human activities have a significant impact on the Earth's landscape, perturbing energy, moisture, and chemical fluxes which impact the Earth's climate. Earlier studies show the spatial land use/land cover changes and their implications on climatic variables (Bae *et al.* 2015) [2]. Monitoring the impact of current land use/land cover management practices on future ecosystem services provisioning has been emphasized because of the effect of such practices on ecological sustainability (Yirsaw *et al.* 2017) [3]. 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 and has become a central component in current strategies for managing natural resources and monitoring environmental changes (Tali *et al.* 2013) [4]. Land cover change is a major concern of global environment change and its modeling and projecting is essential to the assessment of consequent environmental impacts (Bhagawat, 2011) [5]. Remote sensing provides a viable source of data from which updated land cover information can be extracted efficiently and cheaply in order to inventory and monitor these changes effectively. Thus change detection has become a major application of remotely sensed data because of repetitive coverage at short intervals and consistent image quality (Mas, 1999). Remote sensing imagery of a large variety of space borne and airborne sensors provides a huge amount of data about our earth surface for global and detailed analysis, change detection and monitoring (Benz *et al.* 2004) [6].

Rawat JS, Kumar M. (2015) [7], studied the spatio-temporal dynamics of land use/cover of Hawalbagh block of district Almora, Uttarakhand, India highlights the importance of digital change detection techniques for nature and location of change of the Hawalbagh block. Landsat satellite imageries of two different time periods, i.e., Landsat Thematic Mapper (TM) of 1990 and 2010 were used to monitor the change detection. The results indicate that during the said period, vegetation and built-up land have been increased by 3.51% (9.39 km^2) and 3.55% (9.48 km^2) while agriculture, barren land and water body have decreased by 1.52% (4.06 km^2), 5.46% (14.59 km^2) and 0.08% (0.22 km^2), respectively. Adepoju *et al.* (2006) [8] examined the land use/land cover changes that have taken place in Lagos for the last two decades due to the rapid urbanization. A post-classification approach was adopted by Adepoju with a maximum likelihood classifier algorithm. El Gammal *et al.* (2010) [9] have used several Landsat images of different time periods (1972, 1982, 1987, 2000, 2003 and 2008) and processed these images in ERDAS and ARC-GIS softwares to analyze the changes in the shores of the lake and in its water volume. Bhagawat (2011) [5] presented the change analysis based on the statistics extracted from the four land use/land cover maps of the Kathmandu Metropolitan by using GIS. According to him, land use statistics and transition matrices are important information to analyze the changes of land use. El-Asmar *et al.* (2013) [10] have applied remote sensing indices, i.e., normalized difference water index (NDWI) and the modified normalized difference water index (MNDWI) in the Burullus Lagoon, North of the Nile Delta, Egypt for quantifying the change in the water body area of the lagoon during 1973 to 2011. Butt *et al.* (2015) [11] studied the land cover/land use change detection in Simly watershed, Pakistan using multispectral satellite data obtained from Landsat 5 and SPOT 5 for the years 1992 and 2012 respectively. The result indicated a significant shift from Vegetation and Water cover to Agriculture, Bare soil/rock and Settlements cover. These land cover/use transformations posed a serious threat to watershed resources. Hence, proper management of the watershed is required or else these resources will soon be lost and no longer be able to play their role in socioeconomic development of the area. Appiah *et al.* (2015) [12] analyzed the land use and land cover change dynamics in the Bosomtwe District of Ghana, for 1986, 2010 thematic mapper and enhanced thematic Mapper+ (TM/ETM+) images, and 2014 Landsat 8 Operational Land Imager and Thermal Infrared Sensor (OLI/TIS) image. The best Kappa hat statistic of classification accuracy was 83%. The results of the classification over the three periods showed that built up, bare land and concrete surfaces increased from 1201 in 1986 to 5454 ha in 2010. Dense forest decreased by 2253 ha over the same period and increased by 873 ha by the 2014. Low forest also decreased by 1043 ha in 2010; however, it increased by 13% in 2014. Malik and Bhat (2014) [13] analyzed the multi-temporal land use land cover (LULC) change detection of Lidder catchment in Kashmir valley The results have revealed that agriculture and forest area has been encroached by horticulture and built-up area. High growth rate of population and maximization of economic returns from cultivable land are identified as the two main drivers of LULC change in the watershed. The study proposes that a comprehensive land use policy must be implemented to avoid unsustainable expansion of various land uses at the cost of natural land cover.

The study of land use and land cover is not a new technique, it has been followed from the early times such as detailed information generated during ground surveys involving enumeration and observation by local planning agencies [14]. In 1971, like geological survey of the US Department of the Interior, the National Aeronautics and Space Administration (NASA), the soil conservation service of the US Department of Agriculture, the Association of American Geographers, and the International Geographical Union, have been supported by NASA and the Department of the Interior coordinated by the US Geological Survey (USGS); but the invention of artificial satellites and the images obtained using that, has triggered the researches in the field of land use and land cover analysis. The study of LULC does not end with the analysis of the existing land use and land cover changes and its extension; the studies done by Xiao *et al.* and El-Kawy proved that the LULC studies done by satellite data can be used to predict the changes in the future [15, 16].

The analysis of previous studies related to the LULC depicts that most of the researchers used satellite data for the change analysis [17–20]. It is because of multi-temporal availability of satellite imageries and rapid development of image processing software. Obtaining satellite based data for a research can be classified into two groups: one is collecting the imageries by paying money to the concerned organization and another one is freely available data which can be downloaded through the internet (USGS).

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 and has become a central component in current strategies for managing natural resources and monitoring environmental changes [4]. Modern technologies such as remote sensing and geographical information systems provide some of the most accurate means of measuring the extent and pattern of changes in landscape conditions, over time [21]. Land cover change is a major concern of global environment change and its modeling and projecting is essential to the assessment of consequent environmental impacts [5]. Changes in LULC are universal, increasingly rapid, and can have adverse impacts and implications at local, regional and global scales [22]. Urban growth and its associated population increase is a major factor which has altered natural vegetation cover. This has resulted in a significant effect on local weather and climate. The use of remote sensing data in recent times has been of immense help in monitoring the changing pattern of vegetation. Change detection, as defined by Hoffer is the temporal effects as variation in spectral response involves situations where the spectral characteristics of the vegetation or other cover type in a given location change over time [23]. Singh described change detection as a process that observes the differences of an object or phenomenon at different times [24].

Remote sensing provides a viable source of data from which updated land cover information can be extracted efficiently and cheaply in order to inventory and monitor these changes effectively. Thus change detection has become a major application of remotely sensed data because of repetitive coverage at short intervals and consistent image quality [25]. Remote sensing imagery of a large variety of space borne and airborne sensors provides a huge amount of data about our earth surface for global and detailed analysis, change detection and monitoring [6]. Advances in remote sensing science and in our ability to analyze temporal changes in our landscape hold great promise for putting to rest any questions of the relevancy of remote sensing to local land use decisions [26]. Satellite images can show larger areas and as a satellite regularly passes over the same plot of land, capturing new data every time, shows a change in the land use and conditions can be routinely monitored. In the land monitor programs, satellite images are being used to provide information on land conditions and the changes in that condition through time, specifically the status of remnant vegetation to help farmers, environmental managers and planners for better management of the land. The use of satellite images, as an effective technique to study changes in vegetation cover, is growing. Satellite data have become a major application in change detection because of the repetitive coverage of the satellites at short intervals [25].

The study of land use and land cover change is very important in the places like Jammu and Kashmir, because the place had witnessed rapid growth of population in recent decades and changing the existing recourses without proper planning. Several researchers have studied the land use and land cover of Jammu and Kashmir at macro level and have stated that the growing population has affected forest, agriculture built up and horticulture area in which first two have shown negative change, while a positive change was observed in built up and horticulture area [27–29].

METHODOLOGY

The images of two different time periods 1980 (MSS) and 2014 (OLI) have been used to show the change detection in the study area using unsupervised classification method. The obtained satellite images have been analyzed with Google map's topographical map prepared by the Survey of India Sheet number 43J/3, 43J/7, 43J/8, 43J/11, 43J/12, 43J/14 and 43K/5 for the improvement of accuracy. The collected satellite imageries have been verified to assess the quality of data for the study. After the determination of data quality, the atmospheric, radiometric and geometric correction of imagery has been carried out. The satellite imageries with 60 m spatial resolution (MSS satellite) were reclassified into 30 m to match its spatial resolution with the 2014 (OLI). The spatial resolution of selected satellite imageries of study is only suitable for level-I classification, as Anderson clearly indicates that, only level-I classification can be done using Landsat imageries [30]. Therefore the study has limited only eight major classes in level-I classification order, such as agriculture, barren, forest, horticulture, pasture, plantation, built up and water body. In unsupervised classification, the images have been classified into 75 classes and finally combine into eight major classes based on the standard producer given by NRSA classification scheme. The data has been tested for its accuracy using the methods called Error Matrix and Kappa Index.

ANALYSIS

Land Use and Land Cover in 1980

The Figure 1 shows the classified land use and land cover of Baramulla district for the year 1980.

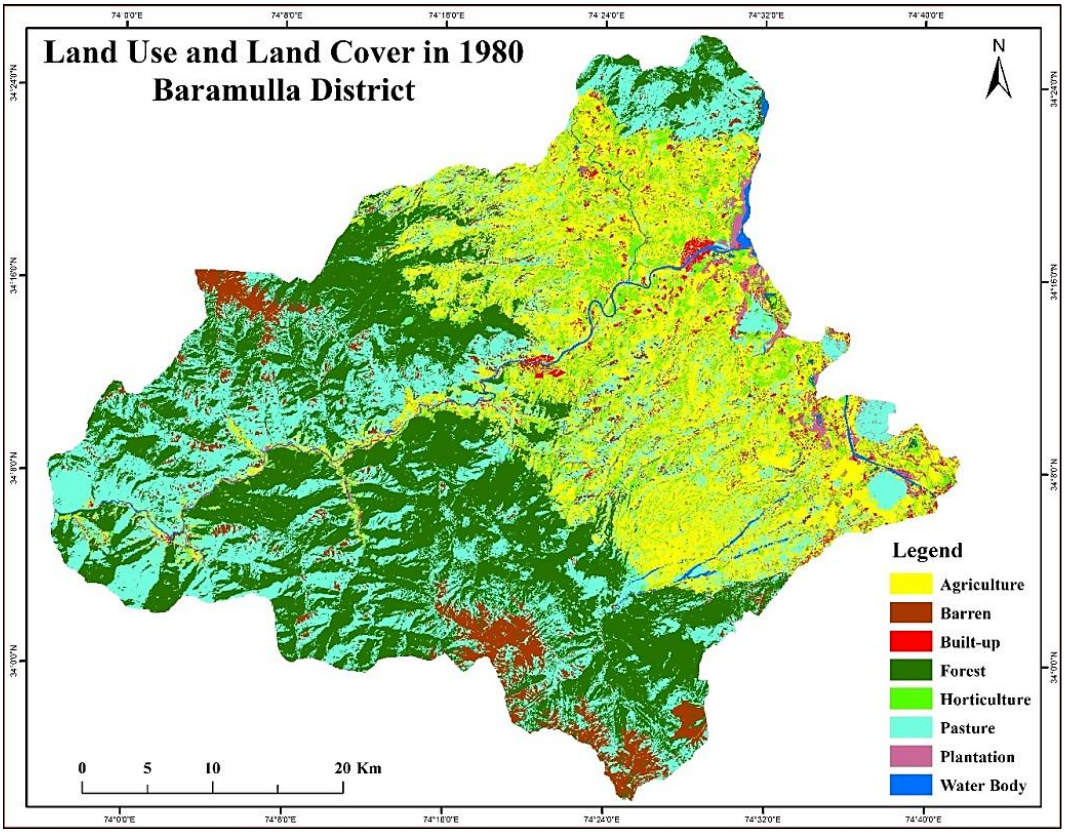

Fig. 1: *Land Use and Land Cover of Baramulla District for the Year 1980.*

Table 1: *Classified Land Use and Land Cover, 1980.*

Classes	Area (km^2)	Percentage
Agriculture	369.65	17.83
Barren	99.83	4.82
Built-up	61.66	2.97
Forest	897.41	43.30
Horticulture	156.66	7.56
Pasture	396.44	19.13
Plantation	73.4	3.54
Water Body	17.69	0.85

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The study area has been classified into eight major classes such as agriculture, barren, built-up, forest, horticulture, pasture, plantation and water body (Figure 1 and Table 1). Once the spatial classification is done, the areal coverage of each class and its percentage has been calculated. The results reveal that the agricultural land use was covered by 369.65 km^2, with a percentage of 17.83, barren land cover was 99.83 km^2 with a percentage of 4.82, built-up land use was 61.66 km^2 with a percentage of 2.97, forest land cover was 897.41 km^2 with a percentage of 43.30, horticulture land use was 156.66 km^2 with a percentage of 7.56, pasture land cover was 396.44 km^2 with a percentage of 19.13, plantation land use was 73.4 km^2 with a percentage of 3.54 and water body land cover was 17.69 km^2 with a percentage of 0.85.

From the result it is clear that, vast area is covered by forest followed by pasture and agriculture while horticulture covered only moderately. The other classes such as barren, plantation, built-up and water body were covered with least area compared with others.

Land Use and Land Cover in 2014

The Figure 2 shows the classified land use and land cover of Baramulla district for the year 2014. The detailed areal extent of each class is discussed below.

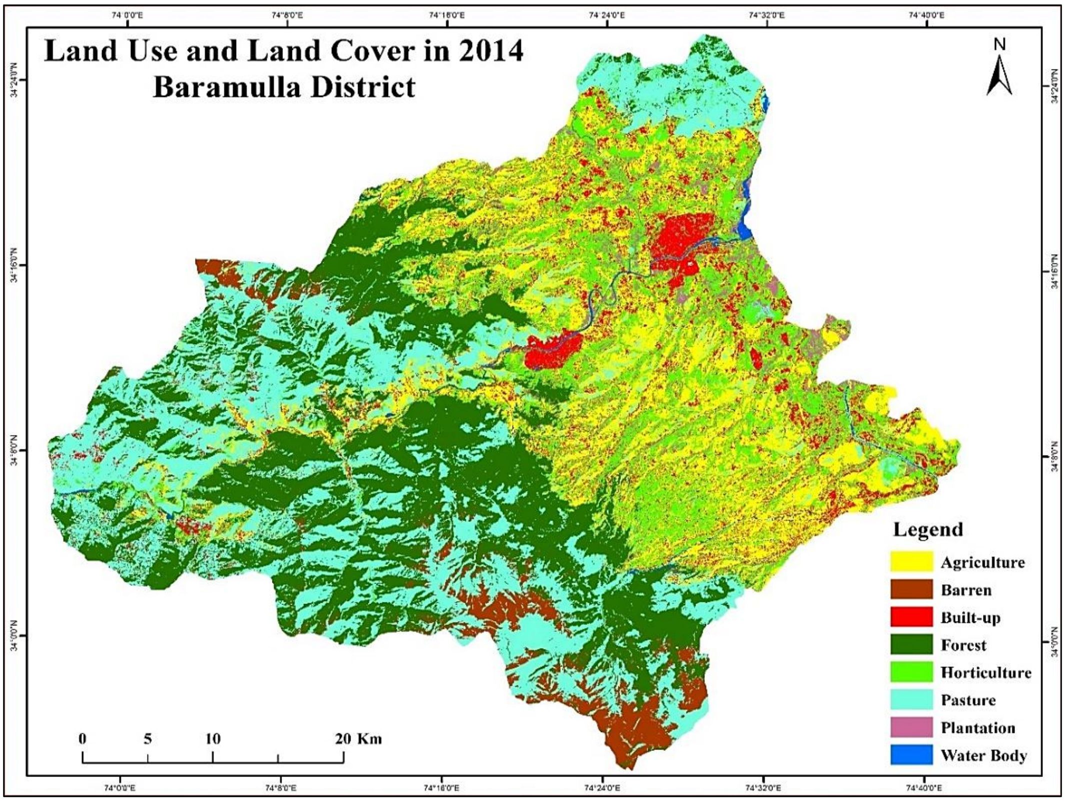

***Fig. 2:** Land Use and Land Cover of Baramulla District for the Year 2014.*

***Table 2:** Classified Land Use and Land Cover, 2014.*

Classes	Area (km^2)	Percentage
Agriculture	327.81	15.82
Barren	56.23	2.71
Built-up	149.85	7.23
Forest	760.11	36.67
Horticulture	312.54	15.08
Pasture	420.54	20.29
Plantation	35.4	1.71
Water Body	10.26	0.49

The analysis reveals that, the agricultural land use was covered by 327.81 km^2, with 15.82 percentage; barren land cover was 56.23 km^2 with 2.71 percentage; built-up land use was 149.85 km^2 with 7.23 percentage; forest land cover was 760.11 km^2 with 36.67 percentage; horticulture land use was 312.54 km^2 with 15.08 percentage; pasture land cover was 420.54 km^2 with 20.29 percentage; plantation land use was 35.4 km^2 with 1.71 percentage and water body land cover was 10.26 km^2 with a percentage of 0.49 as shown in Table 2 and Figure 2.

RESULTS

Land Use and Land Cover Change Detection between 1980 and 2014

Table 3: *Temporal Changes of LU/LC between 1980 and 2014.*

Classes	**Years (Area in km^2)**		**Changes (km^2)**	**Changes (%)**
	1980	**2014**	**1980–2014**	**1980–2014**
Agriculture	369.65	327.81	–41.84	–11.32
Barren	99.83	56.23	–43.6	–43.67
Built-up	61.66	149.85	88.19	143.03
Forest	897.41	760.11	–137.3	–15.30
Horticulture	156.66	312.54	155.88	99.50
Pasture	396.44	420.54	24.1	6.08
Plantation	73.4	35.4	–38	–51.77
Water Body	17.69	10.26	–7.43	–42.00

The forest land during the year of 1980 was 897.41 km^2 and it had been decreased to 760.11 km^2 in the year of 2014. It clearly depicts that, 137.3 km^2 of area decreased which is equal to –15.30% of land. Followed by the forest land, agriculture land had been changed; during the year of 1980, the area of agriculture was 369.65 km^2 and it had been reduced to 327.81 km^2 in the year of 2014. This shows that the area of 41.84 km^2 agriculture land had been decreased which is equal to –11.32%.

The spatial extent of plantation was 73.4 km^2 during the year of 1980 and it had been reduced to 35.4 km^2, in the year 2014, it confirms 38 km^2 of plantation had been changed, which is equal to –51.77% of land. The change of barren land also shows the decreased value from 99.83 km^2 during the year of 1980 to 56.23 km^2 in the year of 2014, which is equal to –43.6 km^2 (–43.67)%. The areal extent of water bodies has been changed from 17.69 km^2 during the year 1980 to 10.26 km^2 in the year 2014, the result shows that, 7.43 km^2 had been changed, which is equal to –42.00%.

The result of built-up land shows the areal extent of built-up land from 61.66 km^2 from 1980 to 149.85 km^2 in 2014. This says 88.19 km^2 of land had been increased which is equal to 143.03%. The changes of pasture show increased area between the selected years, such as it was 396.44 km^2 during the year of 1980 and it had been increased to 420.54 km^2 in the year of 2014, which represents the 24.1 km^2 of pasture area had been increased, which is equal to 6.08%. Finally, the changes of horticulture show higher than any other classes in the study; the areal extent of horticulture was 156.66 km^2 in the year of 1980 and it had been increased to 312.54 km^2 in the year of 2014, which represents the increased area of 155.88 km^2, which is equal to 99.50%, as shown in Table 3 and Figure 3.

Accuracy Assessment

After each class assessment was carried out, the overall accuracy assessment of the classification was done. The result of overall accuracy is 86.58%, which is acceptable accuracy or strong agreement of land use and land cover classification analysis [31]. Then the result of classification has been used to find out the Kappa index, the result of Kappa shows the accuracy with 83.8%. Here is an equation of Kappa technique, which has been used in accuracy assessment. This technique is computed as:

$$\acute{K} = \frac{N\sum_{i=1}^{r} x_{ii} - \sum_{i=1}^{r}(x_{i+} * x_{+i})}{N^2 - \sum_{i=1}^{r}(x_{i+} * x_{i+})}$$

Where, r is the number of rows in the matrix, x_{ii} is the number of observations in row i and column i, x_{i+} and x_{+I} are the marginal totals of row i and column i, respectively, and N is the total number of observations [32, 33].

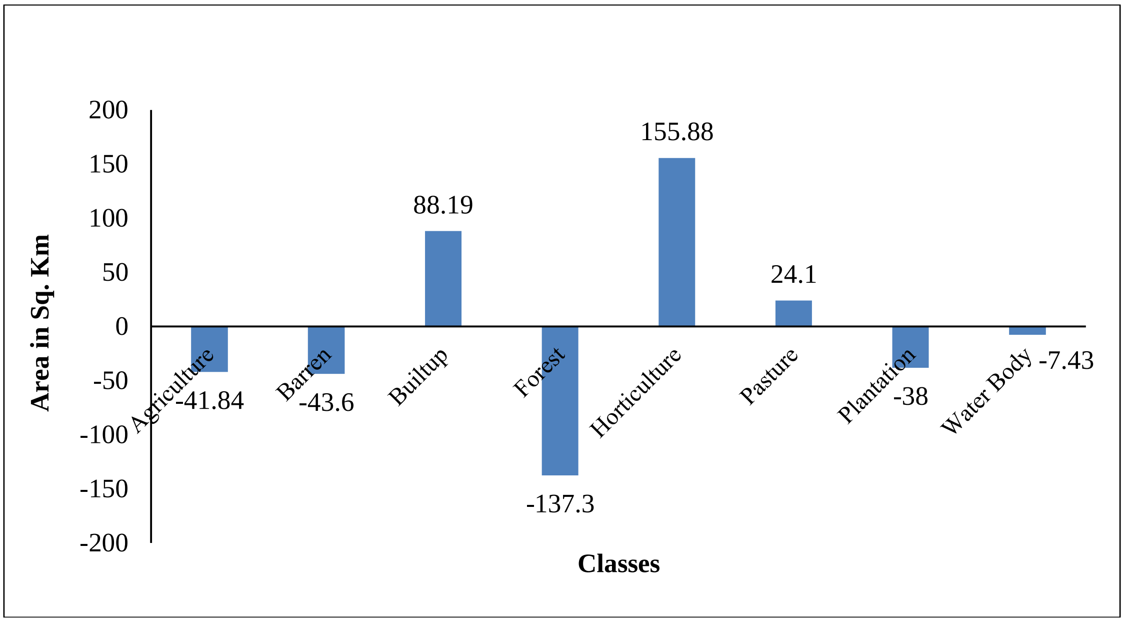

Fig. 3: *Land Use and Land Cover Change between 1980 and 2014.*

The data has been tested for its accuracy using the methods called Error Matrix and Kappa Index. The error matrix has been conceded with 231 training sites, such as for agriculture 47, horticulture 40, forest 42, barren 21, pasture 44, plantation 16, built-up 11 and water bodies 3. The selected training sites' location from the classified imagery has been transferred into Garmin handheld GPS and the respective ground locations on study area have been visited. The field verification and comparison of selected and ground truth values on image resulted that, water bodies have higher accuracy in user and producer with 100%, and built-up shows 100% in accuracy in user and 78.5% in producer. The accuracy of agriculture and plantation shows 100% in producer and user is 87.0 and 75% respectively. The forest has 95.2% in user and 72.7% in producer, and the accuracy of horticulture shows 75.0% in user and 83.3% in producer. The pasture user accuracy shows with 88.6% and producer is 92.8%, while barren has 85.7% user and 81.8% producer accuracy. The detailed report of accuracy assessment has been given in Table 4.

Land Use and Land Cover Conversion of Baramulla District

Once individual selected years' land use and land cover have been detected, the overlay analysis has been performed in ArcGIS to find out the changes between the selected years. The analysis has been performed to find out the changes between 1980 and 2014. The detailed discussion of changes between the mentioned time periods is following below.

Table 4: *Error Matrix and Accuracy Indices for Land Use Land Cover Map (2014).*

Class Name	A	H	F	B	PA	PL	R	W	Row Total	User Accuracy
Agriculture (A)	47	3	1	2	0	0	1	0	54	87.0
Horticulture (H)	0	30	8	0	2	0	0	0	40	75.0
Forest (F)	0	0	40	0	1	0	1	0	42	95.2
Barren (B)	0	0	3	18	0	0	0	0	21	85.7
Pasture (PA)	0	3	0	1	39	0	1	0	44	88.6
Plantation (PL)	0	0	3	1	0	12	0	0	16	75.0
Built-up (R)	0	0	0	0	0	0	11	0	11	100.0
Water Body (W)	0	0	0	0	0	0	0	03	03	100.0
Column Total	47	36	55	22	42	12	14	03	231	
Producer Accuracy	100.0	83.3	72.7	81.8	92.8	100.0	78.5	100.0	*Overall*	*=86.58%*

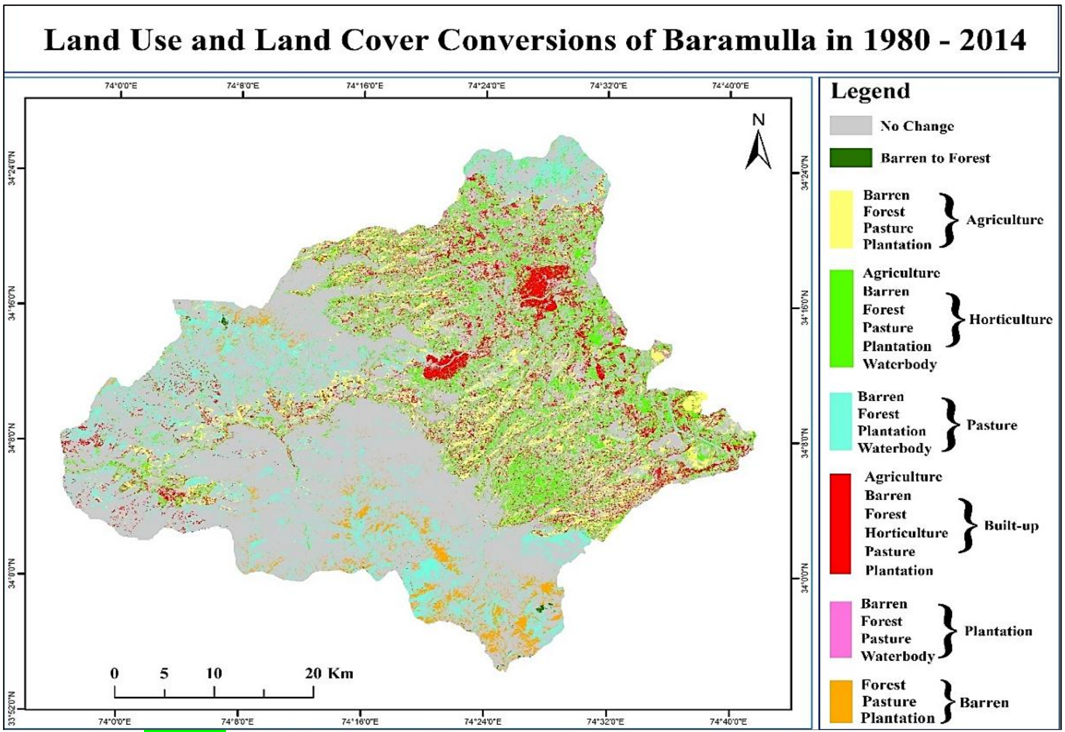

Fig. 4: *Spatial Distribution of LU/LC Conversions in 1980–2014.*

Table 5: *Land Use and Land Cover Conversion Matrix (1980 and 2014).*

Class	A	B	B-up	F	H	Pa	Pl	W	2014
Agriculture (A)	**369.7**		14.74		27.73				327.18
Barren (B)	10.8	**99.8**	0.64	1.88	0.58	29.68	0.02		56.23
Built-Up (B-Up)			**61.66**						149.85
Forest (F)	9.28	4.66	11.52	**897.41**	24.5	87.33	0.01		760.11
Horticulture (H)			37.09		**156.66**				312.54
Pasture (Pa)	12.01	10.14	17.4		81.38	**396.44**	37.9		421.79
Plantation (Pl)	4.09	2.01	6.8		18.23	6.87	**73.4**		35.4
Water Body (W)					3.46	1.47	2.5	**17.69**	10.26

Agriculture

It is a land used to produce the food for human and livestock, the major cultivating crops in the Baramulla are paddy, wheat, maize and mustard. The classification of land use and land cover depicts that agriculture land in the district were decreased from the year 1980 to 2014.

During the year 1980, 369.7 km^2 (17.84%) of area was used for agricultural purpose but this area came down to 327.18 km^2 (15.79%) in the year 2014. The decreased agriculture area of 27.73 and 14.74 km^2 (2.04%) was converted into horticulture and built-up land (Table 5). The reason behind the conversion of agriculture land into horticulture is higher profit from horticulture crops and the reason behind the conversion of agriculture into built-up is increasing population in the district.

The conversion of agriculture land into other land uses is not only witnessed in Baramulla, there are few studies conducted in Kashmir Valley which state that the same scenario of Baramulla is countersigning in entire state. Mirani states that, the total area under cultivation has been decreased between 1981 and 2012, especially the major decrease had happened between 2009 and 2012. Per day on an average, the valley is losing 228 *Kanals* (Local Unit) of cultivation land into other uses.

An article published in Kashmir Observer on 18th-Feb-2016 states that, if the conversion rate of agriculture land continues as same, there will not be any land for cultivation in the year 2040. The major reasons for the conversion of land into other uses are: (a) unplanned development in the state, and (b) rapid urbanization that have converted agriculture land into residential colonies across the valley. The decrease of agriculture land also reduced the production of state gross domestic products over the last two decades.

According to Romshoo, the increasing trend of horticulture on agricultural land is due to horticulture sector can provide six times more revenue than agricultural sector [34]. He also states that, currently the state has 60% of food deficient; if the situation continues same, the state will face 100% of food deficiency in near future.

As the result of Baramulla represents the same as the condition of entire Kashmir Valley; the major driving forces are increasing population pressure and the conversion of agriculture land into horticulture land for higher profit.

Barren

The classification result depicts that almost 50% of barren land was converted into other uses between the years 1980 and 2014. The higher rate of barren land was converted into pasture that holds the area of 29.68 km^2 followed by agricultural land which holds the area of 10.8 km^2 (Table 5). Further, barren land has also converted into built-up, forest, horticulture and plantation significantly. The increasing area of pasture on barren land was caused due to the lesser effect of snow on barren land, which indorsed grasses and tiny plants on the area which was covered by snow earlier. The reason behind increasing of agriculture land on the barren was caused due to the adaptation of new farming techniques that can rejuvenate barren land for being suitable for agriculture by proving high fertilizer to improve soil fertility. The conversion of barren into agriculture land was witnessed in southern part of the valley.

Built-up

The built-up land refers the land that has been covered by artificial materials such as buildings and roads. The notable point is that, once the land has been converted as built-up then it cannot be renewed for any other use. In recent decades, the conversion of other land use and land cover into built-up has been witnessed rapidly due to population growth which was also observed in Baramulla. The land use and land cover changes of Baramulla district represent higher conversion of other land uses into built-up. Generally, the major changes on land are caused by human activities by altering earth surface for their convenience.

The assessment of population between 1981 and 2011 of Baramulla represents positive growth of population and household. Further, correlating the increase in population and the rate of land use and land cover change depicts the rapid increase of population in Baramulla is one of the main reasons that caused the changes. The classification of land use and land cover represents that, 14.74 km^2 which was in agriculture land use during 1980 has converted into built up in 2014. Like this, 0.64 km^2 barren land, 11.52 km^2 forest, 37.09 km^2 horticulture, 17.4 km^2 pasture and 6.8 km^2 plantation also have converted into built up between these selected years, while 61.66 km^2 of existing built up during the 1980 was not changed and used as same in 2014 (Table 5).

The result of land use and land cover clearly states that, the existing built-up land cannot be converted in to any other uses as it has lost all it potential qualities in soil, where as other existing land use and land cover features have converted into built up. Notably, the high amount of horticulture land use has converted into built-up while lesser amount of barren land has converted. Using the obtained numerical values, the changes between two selected years have been calculated statistically, further to identify the spatial changes over the study area, the maps have been prepared in GIS.

The land use and land cover change maps prepared in ArcGIS software using overlay analysis technique represents that, higher changes have occurred along the transportation networks and the River Jhelum. During the field visit in the study area it has been found that, the horizontal growth of settlement in the region were higher than vertical growth because of the natural barriers in the districts, such as rough terrain and major volcanic active zone.

Forest
The result of land use and land cover depicts that the forest area was 897.41 km^2 during the year 1980, but this decreased to 760.11 km^2 in the year 2014. The changes between other land use represents that, only 1.88 km^2 of barren land was converted to forest land while major area of forest land was converted into other uses, such as 9.28 km^2 was converted to agriculture, 4.66 km^2 was converted to barren, 11.52 km^2 was converted to built-up, 24.5 km^2 was converted to horticulture and 87.33 km^2 was converted to pasture (Table 5).

The state policy report 2010 also represents that the forest area in the Kashmir Valley has been decreasing due to increasing human and livestock population, rapid industrialization and improper development activities. The continuous overgrazing of forest land and cutting of trees for timber have resulted in the degradation of forest land to pasture land, which is of the major changes in Baramulla. The forests are illegally converted to horticulture by residents in the forested area, as conversion of forest into horticulture provides economic benefits. The increasing population pressure also converted forest into built-up land, which is the third major conversion in the study area.

Horticulture
The result of land use and land cover represents that, 37.09 km^2 of horticulture land was converted into built-up land between the years 1980 and 2014. The other land uses were converted into horticulture over the years significantly, such as 27.73 km^2 of agriculture land, 0.58 km^2 of barren land, 24.5 km^2 of forest land, 81.38 km^2 of pasture land, 18.23 km^2 of plantation land and 3.46 km^2 of water bodies were converted into horticulture between 1980 and 2014 (Table 5). As mentioned earlier, the major reason behind the conversion of other land uses to horticulture is due to higher profit from horticulture.

The increasing trend in horticultural activities is not only seen in Baramulla alone, but it is a general trend all over Kashmir Valley. According to Agriculture Production Department of Jammu and Kashmir, the area under horticultural crops and production has been increasing continuously in the state, notably during the cropping year 2001–02, the area covered by horticulture was 2,21,512 ha and increased to 3,42,795 ha in 2011–2012. In the case of horticultural production during the year 2001–02, total production was 10, 97,208 Mt and increased to 21, 61,034 Mt in 2011–12. The reason behind the increasing trend of horticulture in the state was due to higher profitability and various initiatives taken by the Government of India and State Government towards market interventions, such as establishment of fruit *mandies*, provision for support price, technological support, awareness options, publicity inputs and research extension.

Pasture
The result represents that, pasture land was converted into other land uses as well as other land uses also were converted as pasture between 1980 and 2014. The conversion of pasture to other land uses are, agriculture, barren, built-up, horticulture and plantation which hold the conversion area of 12.01, 10.14, 17.4, 81.38 and 37.9 km^2 respectively. The conversion of other land uses to pasture are, barren, forest, plantation and water bodies that hold the area of 29.68, 87.33, 6.87 and 1.47 km^2 respectively (Table 5).

The total area of pasture in the year 1980 was 296.44 km^2 and increased to 421.79 km^2 in the year 2014. The area under pasture land was largely converted into horticulture, plantation, built-up and agriculture, whereas the conversion of forest to pasture is the highest in forest followed by barren, plantation and water bodies. The higher profit of horticultural crops is the main reason for a greater fascination for the conversion of pasture into horticulture and plantation.

The conversion of forest into pasture was caused by illegal timbering and overgrazing in the district which has disturbed the forest environment and caused degradation of forest. The melting of snow on the barren land was endorsed grasses and other plants to grow on it, hence significant amount of land which was noted as barren in 1980 has changed to pasture in 2014.

Plantation

As like pasture, plantation also represents the changes from other land uses to plantation as well as plantation to other land uses. The total area covered by plantation in the year 1980 was 73.4 km^2 and was decreased to 35.4 km^2 in the year 2014. By looking at the changes of other land uses to plantation it is clear that, higher amount of pasture land was converted into plantation followed by water body, barren and forest as 37.9, 2.5, 0.02 and 0.01 km^2 respectively (Table 5). From the changes from plantation to other land uses, it is clear that higher amount of plantation land was converted into horticulture followed by pasture, built-up, agriculture and barren as 18.23, 6.87, 6.8, 4.09 and 2.01 km^2 respectively.

The major changes of land use from plantation to horticulture, built-up and agriculture was caused by anthropogenic activity in the district for higher profit as well as to fulfill their basic demand for food from agriculture and construction of residential units. The changes of plantation into other land uses were caused due to improper maintenance of land while changed to pasture.

Water Body

The result of land use and land cover represents that area of water bodies in Baramulla had decreased, during the year 1980, total area covered by water bodies was 17.69 km^2 and it was reduced to 10.26 km^2 in the year 2014. The decreased area of 7.43 km^2 was converted into horticulture; plantation and pasture as 3.46, 2.5 and 1.47 km^2 respectively (Table 5). The reason behind the conversion of water bodies into horticulture and planation was caused because of human encroachment of water bodies while the reason behind the conversion of pasture was due to drying of water bodies.

The decreasing of water bodies is not only observed in Baramulla; it is a general trend all over Kashmir Valley. Water bodies are worst victims of anthropogenic disturbance on nature. The rapid increase in population and urbanization is resulting in the siltation of lakes and water bodies. The water bodies are also decreasing because of natural processes such as, glacial action and low precipitation [35].

DISCUSSION

As a highly interdisciplinary field in systems science, landscape ecology integrates biophysical and analytical approaches with humanistic and holistic perspectives across the natural sciences and social sciences. Landscapes are spatially heterogeneous geographic areas characterized by diverse interacting patches or ecosystems, ranging from relatively natural terrestrial and aquatic systems such as forests, pastures, water bodies and plant community to human-dominated environments and agricultural settings [36, 37]. The most salient characteristics of landscape ecology are its emphasis on the relationship among pattern, process and scale, and its focus on broad-scale ecological and environmental issues. Main thrust in the landscape ecology include, land use and land cover change, scaling, relating landscape pattern analysis with ecological processes, and landscape conservation and sustainability.

The land use conversion in the form of decrease in forests, water bodies and plantation influence climate through physical, chemical, and biological processes that affect planetary energetics, the hydrologic cycle, and atmospheric composition. The complex and nonlinear interactions of these elements with atmosphere can amplify anthropogenic climate change. The prime contribution of forests is towards maintenance of ecological balance, conservation of biodiversity, regulation of hydrological regime, promotion of soil and water conservation, climate regulation, carbon sequestration and nutrient recycling. These also contribute directly or indirectly for sustaining agriculture, horticulture, animal husbandry, water supply, power generation, industry, herbal medicines and tourism [38].

Ecological structure of the district Baramulla has however, undergone extreme change. The changes were observed in the land use structure which has shown the drastic change since last three decades. Although the land use conversion is a continuous process and will continue in the future; however, the changes observed in forest cover, water bodies and plantation which have shown the decreasing trend and have changed the ecological structure of the district to a great extent [39]. The consequences of such land use conversion have been observed in the form of climatic change, sinking the water table, decrease in precipitation and increase in temperature. The influence of climatic change has been mainly observed from last two decades in the form of late winter precipitation (snowfall) which influences the agriculture and horticulture to a great extent. Low precipitation has also been observed from past 34 years which has not only shrunk the water table but also reduced the surface water. The system of farming-out timber to contractors has been observed in the district and has mainly resulted in the destruction of many fine forests in the vicinity of rivers, and the tract which the contractors have spared at the hands of *Gujjars* and *Bakarwals*, who with their small axes cut down trees partly for the sake of fodder and partly from a kind of natural instinct which impels them to make forest clearings for the sake of grass.

CONCLUSION

Land use change is a common phenomenon occurring in all places around the world. However in the context of land use change in Baramulla district, any land use change happens to be very critical in many perspectives, the ecological beauty is a strategic resource of the state of Kashmir in general and Baramulla in particular. Therefore sustaining the ecological balance is the prerequisite of planning and management. The essence of the various changes observed in land use over a period of 34 years indicates that there are in fact intend to the ecology of the region. Shifting or increases and decreases in the land uses such as agriculture, plantation, horticulture etc. which do not really make any difference in the ecological setting as long as they are shifting in the nature of plant species. The reduction of land uses in forest and water bodies and increase in the built-up land makes the difference a lot.

In our study, it was revealed that study area has experienced various LULC changes during past 34 years. There has been significant reduction in forests, plantation, water body and agriculture; however an increase in built up (143.03%), horticulture (99.50%) and pastures (6.08%) has been observed. There has been a decrease of 51.77, 42, 15.30 and 11.32% in water body, plantation, forest and agriculture respectively. The decrease in these land use and land cover classes are attributed to growing world population, conversion of farm lands to built-up, road extensions, continuation of uncontrolled grazing activities and other allied reasons. Apart from anthropogenic activities, natural disasters like earth quake also play a key role in decrease of natural vegetation. Despite the efforts of forest departments, there is still a large gap to be bridged between the rate of deforestation and afforestation.

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