

Landuse and Land cover change in doon valley (Uttarakhand)

Abstract

This article presents an overview of land use/ land cover changes in Doon valley of Uttarakhand. Basically land use is the human use of land. Land use involves the management and modification of natural environment or wildness into built of environment. Land cover is the physical material at the surface of the earth. Land use and land cover is an important component in understanding the interactions of the human activities with the environment and thus it is necessary to be able to simulate changes. The study has been done through remote sensing approach using SOI map of Doon Valley. The aim of this study is to detect land use changes between 1990 to 2011 using satellite images of Landsat, LISS-III, SRTM and digital SOI topographic maps have been used. The aim of this study is to produce a land use/ land cover map of Doon Valley with the help of EDRAS imagine 9.3, ArcGIS9.3 which helps to plan development activities such as major schemes and their land requirements. Land Use/Land cover map Landsat imagery data and LISS III composites of 1990, 1998, 2005 and 2011 were employed and discussed for the land use map of Doon valley . This study illustrated increasing trend urban areas with a decreasing trend of forest cover. Due to decrease in forest cover there is an increase landslide and erosion. The most remarkable change has taken place in the built up area, it is observe that the year 1990 indicate only 4.09% which increase to about 9.36% in the year.



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Introduction

The Doon valley, a unique micro- geomorphic unit, is a parallelogram shaped structural valley and is bounded in the North by lesser Himalaya and in the South by Siwalik, in the NW by river Yamuna and in the SE by the river Ganga. Geographically, it lies between latitudes 29°55' and 38°30' N longitudes 77°35' and 78°28' E covering an area of 2202.95 sq.km. Its elevation range from 315 m. to 2500 m while the gradient varies between 7 and 10 m/km. this synclinal trough receives 210 cm. rainfalls annually and the summer temperature ranges between 38°C and 41°C, while the winter temperature varies between 15° C and 50° C. (saxena *et.al.*,1974).

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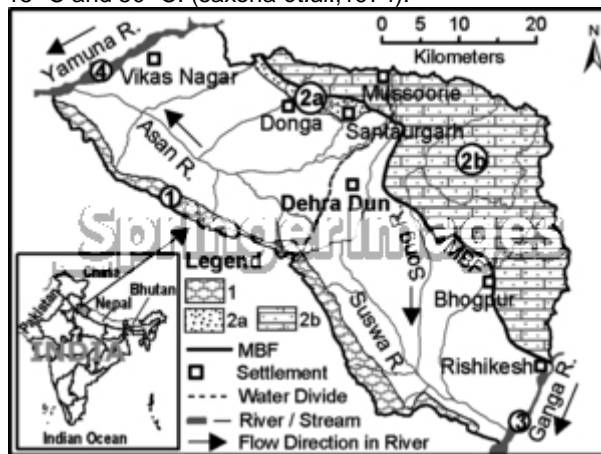


Fig. 1. Location map of Doon valley

People living in the Doon valley believe that environmental quality has deteriorated during living memory. One of the major a sons of this is over harvest of trees & other forest produce the forest department, cutting and collection of trees, branches and other forest products by the villagers and heavy a razing pressure. In order to obtain reliable and latest formation on the temporal, spatial and structural change in forest cover and to appreciate the relationship between the current development and its likely impact on land cover/landuse and total environment of the region. The variations in the attribution of total area into various specific land cover/ use classes have been studied.

Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental change. The rapid development of the concept of vegetation mapping has led to increased studies of land use and land cover change worldwide. Although the terms 'Land Use' and 'Land Cover' are often used interchangeably, their actual meanings are quite distinct. 'Land Use' refers to human activities that take place on the earth's surface. (How the land is being used; such as residential housing or agricultural cropping.) 'Land Cover' refers to the natural or man-made physical properties of the land surface (Tiwari *et al.* 2010).

Land use and land cover is an important component in understanding the interactions of the human activities with the environment and thus it is necessary to be able to stimulate changes. The study has been done through remote sensing approach using SOI map of Doon Valley. The aim of this study is to detect land use changes between 1990 to 2011 using satellite images of Landsat, LISS-III, SRTM and digital SOI topographic maps have been used. The aim of this study is to produce a land use/ land cover map of Doon Valley with the help of EDRAS imagine 9.3, ArcGIS9.3. Monitoring of Landuse/landcover changes which would help to plan development activities such as major schemes and their land requirements.

Information about changes is useful for updating land use/land cover maps for planning and management of Natural resources. Land Use/Land cover map Landsat imagery data and LISS III composites of 1990, 1998, 2005 and 2011 were employed and discussed for the land use map of Doon valley located in Uttarakhand state in India. This study illustrated increasing trend urban areas with a decreasing trend of forest cover. Due to decrease in forest cover there is an increase landslide and erosion.

Land use are generally develops over very long period of time under different socio-economic and environmental conditions. These conditions cause direct impact on land use and land cover. These socio-economic factors indicate how land is used regionally as well as locally. To better understand the impact of land use change on terrestrial ecosystems, the factors affecting land use change must be fully examined. Land use and land cover changes have become a central component in current strategies for managing natural resources and monitoring environmental changes. Satellite Remote Sensing data are a useful source of information and it gives timely and complete coverage report of any particular area. It is proved that remote sensing satellite data is useful in assessing and monitoring in natural resources and land use or land cover changes (Rantanasermpong *et al.* 1995, Satyanarayana *et al.* 2001).

Landuse refers to use of the land for the benefit of human kind (i.e. settlement, agricultural, transportation networks, canal, etc.) Land Cover is the natural or manmade physical properties of the earth surface. There is an urgent need to assess the land use and land cover dynamics and the role of the various anthropogenic, topographical as well as the

bioclimatic drivers in determining the land use and land cover in a region.

Remote Sensing and GIS in Landuse/Landcover Change

The process of acquiring information about the earth's surface without actually being in contact with it is known as remote sensing. This is done by remote sensing by recording the reflected energy, analyzing and extract the useful information. Remote Sensing and GIS technique for landuse/landcover change detection and monitoring has been used to assess the dissimilarities in forest cover over two or more time periods caused by environmental condition and human actions. Qualitative and quantitative knowledge about Land Use and Land Cover change enables the economic comparison of different ecosystem services within and across different countries (Kreuter *et al.*, 2001; Zhongmin *et al.* 2003).

Landuse/Land Cover Analysis of Doon Valley 1990-2011

The total geographic area of the study area is 2202.95 sq km. Sal forests had the highest land cover constituting 951.71 ha which is 43.2 % of total area. The next class with the higher area coverage was the agriculture which is in the middle part of study area is covering 638.91 ha about 32.12 % areas. The next highest class covers mixed deciduous was 258.99 which is 11.76 % of total area. The area of built up (construction) was 65.02 sq.km. which is about 2.95% is concentrated in the middle part of Doon valley. The LULC map of 1998 had land cover classes with the highest area covered is under the sal forest is 887.05 sq.km, which is about 40.27% areas. Next highest area is agriculture 658.55 sq.km is covering 29.89 % area. After the agriculture, mixed deciduous is highest area was covering in 1998 which is 255.88sq.km about 11.62 %. 44.4321ha area is for built up (construction) is about 4.29 % area.

The 2005, land use / land cover (LULC) map also showed Sal forest decline to 864.70 sq.km. which is 39.25 % of total area of Doon valley. Mixed deciduous 241.83 sq.km which is 10.98 of total area in 2005. And built up (construction) area is increasing very fast due to urbanization is 165.62 sq.km is 7.52 % of study area. Agriculture area was decreased 582.61 sq.km, which is 26.45 % of total area.

LULC map of 2011 showed that the Sal forest has decreased to 864.60 sq.km which is about 39.25% area. Next highest area is agriculture 557.57 sq.km is covering 25.31% area. Mixed deciduous 238.77 sq.km this is 10.84 of total area in 2011. The area 206.17 sq.km is for built up (construction) about 9.36 % is increasing.

From the statistics we can observe that the agriculture area has decreased over the period while there has been a tremendous increase in the built up in the area. This is due to the influx of the population from the different parts of the state after the formation of Dehradun as a capital of new state. Increase in the built up area by around 6.87 % of the total geographic area is at the expense of the other land use and land cover classes. The most encroached upon class by the built up is the agriculture followed by forests both Sal and mixed deciduous.

Table 1: Area Statistics of Landuse and Landcover during 1990-2011

Landuse Class	1990		1998		2005		2011	
	AREA (sq km)	%	AREA (sq km)	%	AREA (sq km)	%	AREA (sq km)	%
Agriculture	650.58	29.53	658.55	29.89	582.61	26.45	557.57	25.31
Built up	90.18	4.09	94.59	4.29	165.62	7.52	206.17	9.36
Sal forest	895.37	40.64	887.05	40.27	864.70	39.25	864.60	39.25
Forest plantation	53.81	2.44	53.85	2.44	50.77	2.30	50.13	2.28
Scrub	72.26	3.28	71.90	3.26	82.75	3.76	74.01	3.36
Mixed deciduous	263.98	11.98	255.88	11.62	241.83	10.98	238.77	10.84
Grass land	3.2	0.15	3.20	0.15	3.20	0.15	3.20	0.15
Tree clad area (tree outside forest)	6.51	0.30	7.47	0.34	7.40	0.34	6.52	0.30
River bed dry	146.82	6.66	150.66	6.84	185.78	8.43	177.24	8.05
Water body	20.24	0.92	19.80	0.90	18.30	0.83	24.73	1.12
Total	2202.95	100.00	2202.95	100.00	2202.95	100.00	2202.95	100.00

Table 2: Change Matrix of 1990 to 2011 (area sq.km.)

Class	Agriculture	Built-up	Sal forest	Forest plantation	Scrub	Mixed deciduous	Grassland	Tree-clad area (tree outside forest)	Dry-river bed	Water-body	Total	% age
Agriculture	548.10	90.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	638.91	29.00
Built-up	0.00	65.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	65.02	2.95
Sal forest	41.18	20.66	870.61	3.66	15.59	0.00	0.00	0.00	0.00	0.00	951.71	43.20
Forest plantation	5.80	9.90	0.00	38.10	0.00	0.00	0.00	0.00	0.00	0.00	53.81	2.44
Scrub	3.04	4.80	0.00	0.00	45.43	0.00	0.00	0.00	0.00	0.00	53.27	2.42
Mixed deciduous	18.67	5.18	0.00	0.00	4.60	230.54	0.00	0.00	0.00	0.00	258.99	11.76
Grassland	0.00	0.00	0.00	0.00	0.00	0.00	4.19	0.00	0.00	0.00	4.19	0.19
Tree-clad area (tree outside forest)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.52	0.00	0.00	8.52	0.39
Dry-river bed	3.48	3.40	0.00	0.00	0.00	0.00	0.00	0.00	116.38	15.04	138.30	6.28
Water-body	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.24	30.24	1.37
Total	620.28	199.77	870.61	41.77	65.62	230.54	4.19	8.52	116.38	45.28	2202.95	100.00

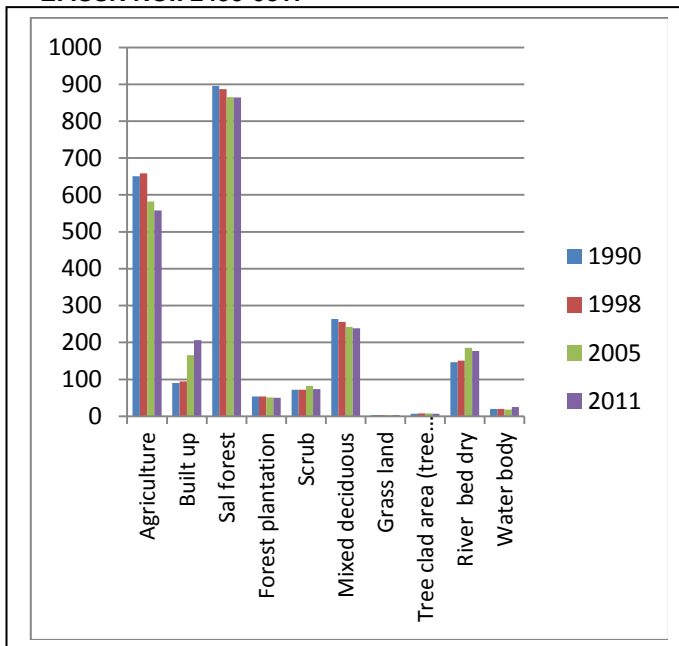


Fig. 2: Graphical representation of LULC proportion during 1990-2011

The Doon valley has a very good forest and there are extensive network of National Parks and other protected forest regions with good number of wildlife. It is observed that in the year 1990 about 52.12% area was covered by forest (Sal and deciduous) while in the year 2011 it reduced to about 50.09%. In 1998 agriculture area increase from 29.89 % to 29.53 % and it remain 25.31% in 2011. However in the built up area it is observed that the year 1990 shows only 4.09 % which increased to about 9.36% in the year 2011.

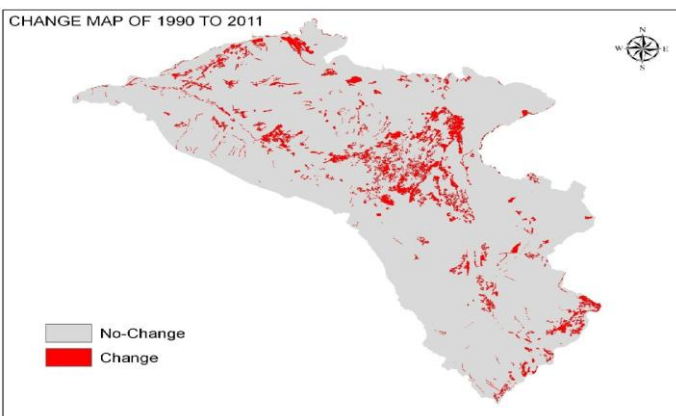


Fig.3. Change map of 1990 to 2011

Conclusion

Understanding the spatial dynamics of land use and land cover change has been a challenge for the geospatial scientists and till date there is not a single robust model which can capture the land use and land cover dynamics of a region.

The temporal LULC maps from 1990-2011 has shown a clear trend of the built up increasing at a tremendous pace. The increase in the built up will be mostly at the cost of the agricultural lands as the

forested areas are more or less protected by the various legislations and laws. Due to increase in the human population in the hilly regions of the Doon Valley covered mostly by Sal and Mixed Deciduous forests, there will be increase in the fire occurrences. The limitation in this study has been the use of limited number of driver variables. With increase in the driver variables the prediction accuracy will increase and the accuracy of prediction of some of the classes will increase which is very less at present.

Land is main natural resource for life support system. The land and land cover changes are equally important elements of the larger problem of global and regional environmental changes. Remote sensing technology and satellite data are very helpful for the detection of changes in landuse/landcover between 1991 to 2011. The increasing urban Population pressures is putting tremendous pressure on the land use & landcover of Doon valley. The expansion of agriculture land can also be attributed to increasing demand to feed the growing population. The decline in the area of the scrub land is due its Conversion to arable land. The increase in the built up area is because of increasing demand for institutional and residential space for capital level establishments. Beside urban population of the valley has grown 3.4 fold during four decades (1961-2001) and is causing immense pressure for Built up area. The water body (seasonal streams) has shown little change area due to encroachment slum dwellers and land developers.

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