



Change Detection of Land-use and Land-cover of Shirpur Tehsil: A Spatio-Temporal Analysis

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Abstract: The general land use of region is control by various factors i.e. physical, cultural, social, environmental etc. economic activities, agricultural practices and their development depend on land use and intensity of land use. The temporal changes in land use pattern of Shirpur tehsil have studied for the period of 1991 to 2011 to find out the trends of variation in general land use and to identify the reasons for the changes. Spatial variation in land use changes studied on circle level. Last three decades land satellite images have been used. These satellite images further processed and analyzed by GIS software. Total population density of Shirpur Tehsil was 405 in 1991 that increase up to 507 in 2011. The total area of Shirpur tehsil is 83307.61 hectares out of that 1000.72 hectares area under built up in 1991 that increases by 1152.22 hectares in 2011. The agricultural land was 540.33 hectares in 1991 that has been decline 298.72 hectares in 2011. Forest area also decline by 3196.27 hectares in last three decades. It is concluded that in Shirpur tehsil Barren land and forest area decline and built up area, agricultural land, area under water bodies has increasing because of increasing population demands.

Keywords: Land use, density, forest area, barren, population demands etc.

I. Introduction

The general land use of region is control by various factors i.e. physical, cultural, social, environmental etc. economic activities, agricultural practices and their development depend on land use and intensity of land use. The general land use of any region experiences the changes in given period of time according to changing population number and its demands is called as temporal variation. The temporal changes in land use pattern of Shirpur tehsil have studied for the period of 1991 to 2011 to find out the trends of variation in general land use and to identify the reasons of the changes. Remote Sensing (RS) has been used to classify and map land cover and land use changes with different techniques and data sets. Landsat images in particular have served a great deal in the classification of different landscape components at a larger scale (Ozesmi and Bauer, 2002). Last three decades land satellite images have been used for this study. These satellite images further processed and analyzed by GIS softwares.

Change analysis of features of Earth's surface is essential for better understanding of interactions and relationships between human activities and natural phenomena. This understanding is necessary for improved resource management and improved decision making (Lu et al., 2004; Seif and Mokarram, 2012). Changes in land use can be categorized by the complex interaction of structural and behavioral factors associated with technological capacity, demand, and social relations that affect both environmental capacity and the demand, along with the nature of the environment of interest (Verburg et al., 2004). Change detection involves applying multi-temporal Remote Sensing information to analyze the historical effects of an occurrence quantitatively and thus helps in determining the changes associated with land cover and land use properties with reference to the multi-temporal datasets (Ahmad, 2012; Seif and Mokarram, 2012; Zoran, 2006).

The land use or land cover pattern of a region is an outcome of natural and socio – economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on land use / land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare (G. Sreenivasulu et al. 2013). Accurate LULC maps can be effective tools in aiding soil erosion control efforts. Such maps can play an important role in watershed management as a whole and help in deciding what sort of lands are capable of sustaining agriculture and which are not (Cihlar, 2000; Renschler and Harbor, 2002).

II. Study Area

Shirpur tehsil is located in Dhule district of Maharashtra. The study region is located in the northern part of Maharashtra. There are in all four tehsils in Dhule district. The tehsil has covered an area of 804.02 sq. km. Shirpur tehsil is lying between 21°11' north and 21°38' north latitudes and 74°41' east and 75°11' east longitudes. The study region is characterized by distinctive physical setting and socioeconomic conditions. It is delimited by Satpuda ranges in the north and Tapi river in the south. The region is drained by the Arunavati river a northern tributary of Tapi, flowing towards the south. River Aner in the east marked an eastern boundary, which flows towards south while in the west Nandurbar district and in the east Jalgaon district. The Northern boundary is marked by Madhya Pradesh. It comprises 147 villages.

Figure 1 Location Map of the Study Area



III. Methodology

The present study is based on secondary source of data. Shirpur tehsil studied with help of decadal land sat images. These land sat images of 1991, 2001 and 2011 processed with the help of ERDAS Imagine software and GIS software.

A. Data Collection

For this study gets landsat images of three dates of August month from USGS Earth Explorer website. Here is a used landsat image of August month because in August landuse and land cover is nearly everyone clear and proper. Landsat images of the past three decades have been considered for temporal changes of LULC. Recently several change detection techniques have been developed that make use of remotely sensed images. A variety of change detection techniques and algorithms have been developed and reviewed for their advantages and disadvantages. Among these unsupervised classification or clustering, Supervised classification, PCA, Hybrid classification and Fuzzy classification are the most commonly applied techniques used in classification (Lu *et al.*, 2004; Rundquist *et al.*, 2001; Zhang *et al.*, 2000).

All the data are preprocessed and projected to the Universal Transverse Mercator (UTM) projection system. The details of collected landsat images are shown in the Table.1

Table 1- Details of Landsat Data Collected from USGS

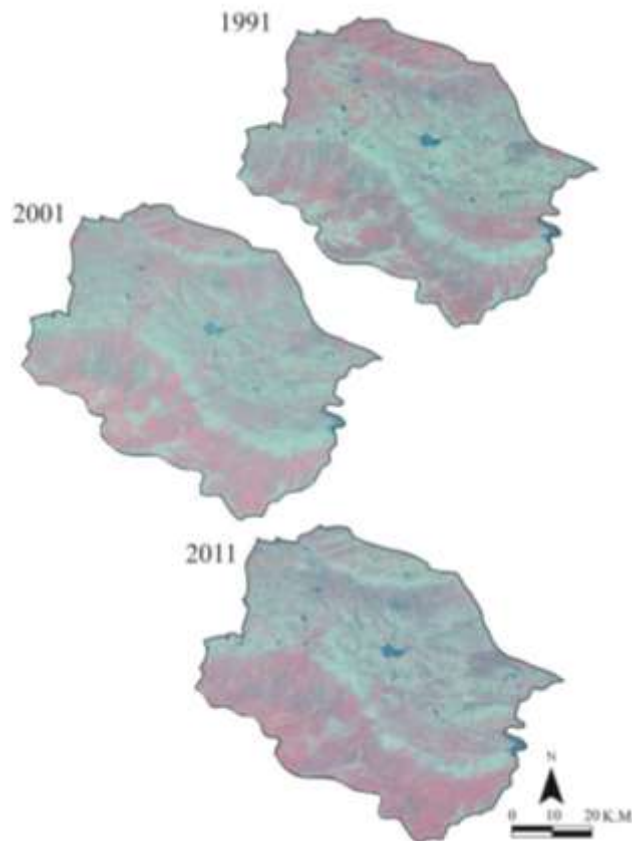
Sr. No	Landsat Image		Landsat Band			Date of Image
	Path	Row				
1	147	45	4	3	2	August 1991
2	147	46	4	3	2	August 1991
3	147	45	4	3	2	August 2001
4	147	46	4	3	2	August 2001
5	147	45	4	3	2	August 2011
6	147	46	4	3	2	August 2011

Source: USGS Earth Explorer website

B. Data Processing and Classification

All the downloaded images contain different types of bands and stacking get the composite image create mosaic of landsat images using ERDAS image software. Selects Mosaic Landsat digital image data for classify each land cover class in the digital image. The classification of land cover is based on the spectral signature defined in the training set. The ERDAS digital image classification software determines each class on what it resembles most in the training set. In this study use supervised classification algorithms are maximum likelihood and minimum-distance classification. The landsat images are classified by supervised classification through the steps select training areas generate signature file and classify. The classification finally gives the land use image of the area on which analysis five land cover classes namely cultivable area, forest area, water bodies, built up area and barren land. Satellite image re-processing prior to the detection of change is immensely needed and has a primary unique objective of establishing a more direct affiliation between the acquired data and biophysical phenomena (Coppin *et al.*, 2004).

Figure 2- Shirpur Tehsil- Land use



IV. Results and discussion

A. General Landuse Pattern

In Shirpur tehsil 62626.61 ha area was cultivable that 75.18% out of the total geographical area in 1991. Highest cultivable area observed in Holnanthe and Thalner Circles because area of these tehsils relatively plain than Boradi and Sangavi Circles because being there Satpura mountain ranges. Out of geographical total area of Shirpur tehsil 15.86% (13217.09 ha) area was under forest in 1991.

Table 2- Shirpur Tehsil: Decadal General Landuse Pattern

Sr. No.	Landuse Category	Year		
		1991	2001	2011
1	Cultivable Area	62626.51	65893.94	65752.31
2	Forest	13217.09	10041.96	10020.82
3	Water Bodies	1232.81	1506.22	1527.35
4	Barren land	5230.49	4812.28	4854.91
5	Built up Area	1000.72	1053.21	1152.22
6	Total Geographical Area	83307.61	83307.61	83307.61

Source: Landsat Image, 1991, 2001 and 2011

In tehsil 13270.09 ha area under forest, out of that 86.95% (8713.67 ha) area belongs to Sangavi, Boradi and Holnanthe circles. In these three circles area under forest was higher because being there Satpuda mountain ranges. Forest area has been gradually decreased in last three decades (1991-2011) by 3196 ha, from 132017.09 ha in 1991 to 10020.82 ha in 2011. Most of forest is area observed in North and Northern part of Shirpur tehsil. (Figure 2 and 3).

Area under water bodies consist area of lakes, dams, ponds, rivers, streams etc. In 1991 there was 1232.81 ha area under water bodies which is 1.48% out of total geographical area of Shirpur tehsil. Maximum area under water bodies was observed in Shirpur, Sangavi and Holnanthe circles because Arunavati, Aner and Tapi rivers flowing through these Circles.

Figure 3: Shirpur Tehsil: Landuse Change

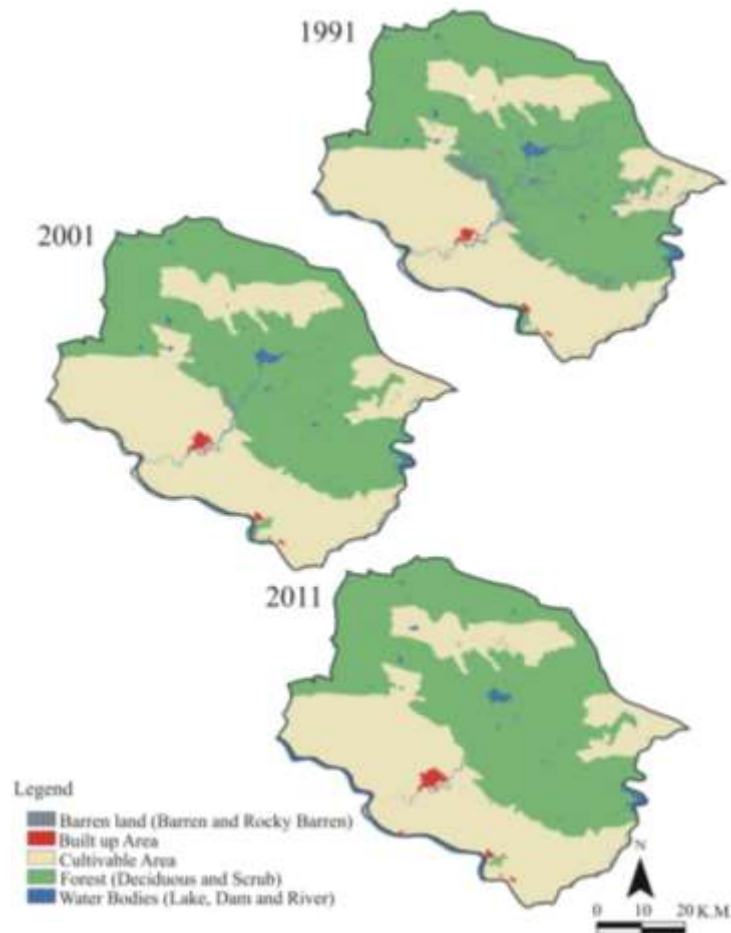


Table 3- Shirpur Tehsil: Spatial Landuse Pattern in 2011

Sr. No.	Landuse Category	Boradi	Sangavi	Arthe	Shirpur	Thalner	Holnanthe	Tehsil
1	Cultivable Area	10406.64	13047.30	13036.53	7130.55	9570.91	12560.38	65752.31
2	Forest	878.06	7001.03	603.89	6.54	696.72	834.58	10020.82
3	Water Bodies	275.43	367.78	253.54	193.17	140.38	297.04	1527.35
4	Barren land	295.64	781.91	814.97	797.35	985.08	1179.96	4854.91
5	Built up Area	207.78	277.45	191.27	145.73	105.90	224.09	1152.22
6	Total Geographical Area	12063.55	21475.47	14900.20	8273.34	11499.00	15096.05	83307.61

Source: Landsat Images 2011

Area under water bodies continuously increase because of increasing number of small and medium irrigation projects which are constructed over Aner, Arunavati and Tapi River. Area under water bodies increases from 1332.81 hectares in 1991 to 1527.32 hectares in 2011. The Work of Mr. Suresh Khanapurkar (retired Geologist) in field of underground water enriches in Shirpur tehsil also helps to increase area under water bodies in last decade. Now his work is popular in over all India as Shirpur Pattern.

Table 2 shows 5230.49 ha area was barren which is 6.27% out of total geographical area of Shirpur tehsil in 1991. Highest barren area was observed in Shirpur and Holnanthe circles because of plotting surround to Shirpur

city and Holnanthe Village. 1000.72 ha (1.29%) area was built up area in 1991. Barren land has decreased in Shirpur tehsil from 5230.49 ha in 1991 to 4812.28 in 2001 (Table 2) but in last decade (2001-2011) barren land quit increase because of transmission of agricultural land in to plotting and industrial plants. Highest built up area observed in Sangavi and Holnanthe circles in 1991. Arthe, Thalner and Holnanthe circles are relatively plain so many large settlements are there. Other hand the maximum part of Sangavi and Boradi covered by hilly and mountain ranges hence settlements are small and sparse.

Table 3 reported spatial land use pattern in Shirpur tehsil. Total cultivable area of Shirpur tehsil is 65752.31 ha in 2011. The highest cultivable area observed in Sangavi circle because it is largest circle of Shirpur tehsil and its southern part relatively flat. Lowest cultivable area notes in Shirpur circle because it has initially small size and most of area under non-agricultural activities. In Shirpur tehsil has 12.02 percent area (10020.82 ha) under forest in 2011. Highest forest area observed in Sangavi Circle (specially northern part of circle) by 7001.03 ha that is 69.86 out of total forest area of tehsil because of being there Satpura maintain ranges. Lowest forest area observed in Shirpur circle because of flat surface and urban area.

Area under water bodies is 1527.35 ha which 1.83 percent out of total geographical area is in 2011. Highest area under this category observed in Sangavi circle by 367.78 which 24.07 percent out of total area under water bodies in tehsil. Lowest area under water bodies observed in Thalner by 140.38 ha (9.19%). In 2011, 4854.91 ha (5.80%) area is barren land. Highest barren land observed in Holnanthe circle by 1179.96 ha that is 24.30 percent of total barren land in tehsil. 1152.22 ha area under built up in 2011 that is 1.38 percent to total geographical area. Highest built up area observed in Sangavi circle by 277.45 ha (24.07%). Built up area of Shirpur tehsil increased because of expansion of Shirpur city and increasing population (Mahajan Y.J., *et. al.* 2017).

V. Conclusion

It is concluded that in Shirpur tehsil Barren land and forest area decline and built up area, agricultural land, area under water bodies has been increase because of increasing population demands in last three decades.

VI. References

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