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Land Cover Change Quantification in a Watershed Using Geographical Information System & Remote Sensing Techniques A Case Study of Anand Region

Rajansinh L Zala[1], Saurabh J Mali[2], Bhavesh D Gohil[3]

[1] Partner and Valuer, Town Planner & Civil Engineer L.ZALA Associates, V.V.Nagar, India
[2]Associate Civil Engineer RAN-SOM Associates, Bakrol, Anand, India
[3] Assistant Professor, Faculty of Tech. and Engineering The MSU of Baroda Vadodara, India
[1] rajan_zala@yahoo.com

ABSTRACT

Water is one of the most important resources for sustaining human settlements. Hydrological cycle is one of the important cycles to balance and replenish the water resources in a area. Watershed is one of the basic units of this cycle. In present paper using Shuttle Radar Topographic Mission (SRTM) Digital Elevation Model (DEM) Watersheds are delineated and used for quantification of land cover changes in each watershed. For Land cover change analysis Landsat 5 TM for December 2008 Image and Landsat 8 for December 2018 multispectral images are used to quantify changes in land cover. Study reveals that there is increase in open land and decrease in vegetation of approximately 20%.

Keywords
Watershed; Land Cover Change; Hydrology;GIS, Remote Sensing

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Introduction

Water is one of the most important resources for sustaining human settlement. It is observed that all major civilization started and thrived near water source. Presently due to rapid population growth, urbanization and industrialization has resulted in high demand for the water. Also as we know the potable water resource available for the human consumption is very small. For Sustainable development watershed management is key tool. Geographical Information System (GIS) and Remote Sensing (RS) techniques can be used for analysis, planning and management of the watershed at regional level. Here the attempt is made towards quantifying land cover changes in last decade i.e. from 2008 to 2018. Which watershed seeks more attention owing to fast changes? The change in land use land cover characteristics of watershed creates problems like lowering of percolation, higher runoff etc which puts pressure on natural drainage system which can cause loss in agriculture area, flooding in urban areas etc. Here watershed delineation for Anand District was carried out and used for dividing area of Anand Taluka and land cover changes were quantified for Anand Taluka. In present study we have used open source GIS software QGIS 3.4 with Semi Automated Classification plug-in and Map Window GIS for Analysis. For Thematic Mapping, layout and exporting we have used ESRI ArcGIS Educational version.

Study Area Profile

Anand District, is situated between 22.07E to 22.57 E and 72.15N to 73.28N in Gujarat State. It has 8 Talukas and Anand Taluka is District Head Quarter. Figure 1 shows location map of the study area. Anand is famous for the Cooperative Movement, particularly AMUL DAIRY and National Dairy Development Board (NDDB) and Institute of Rural Management (IRMA) Campus. The District of Anand has experienced rapid stride in population growth in the last three decades. Density (Population per sq. km) of Anand district is 653. It also part of the Charotar and Bhal region which are the fertile lands and considered as food bowl of Gujarat. The Elevation varies from approximately 79m to 12m. The slope is from north-east to south west direction. The slope direction is in confirmation with the river and natural drainage system. The Mahi river is there on one boundary of the district.

Figure 1 Study Area Location

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Methodology

Using SRTM Global 1 arc second DEM data and boundary enclosing entire Anand District Grid was clipped and Watersheds are delineated using TauDEM processing in Map Window GIS. From this watersheds encompassing Anand Taluka were selected for further use. Landsat 5TM and Landsat 8 Images of December 2008 and 2018 were selected considering same spatial resolution of the imagery i.e. 30m, post monsoon season and availability of cloud free multispectral images for land cover change analysis. As the study area was covered by multiple tile, first mosaiking operation was done. Then using Red Band, Green Band and Near Infra Red (NIR) Band Images False color composite (FCC) is developed for both years and same was analyzed using supervised classification using QGIS-3.4 with Semi Automatic Classification Plug-in. The study methodology adopted is given in Figure 2.

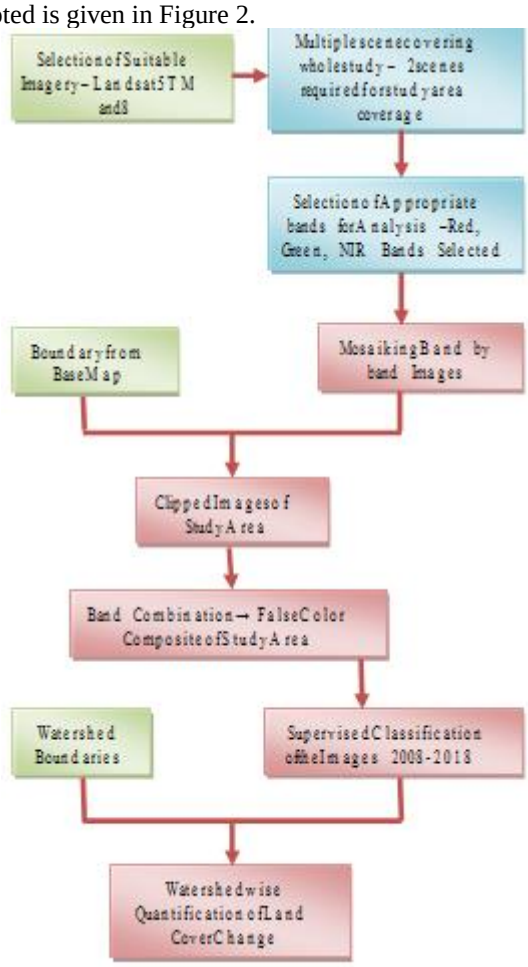

Figure 2 Study Methodology

Reults Findings And Discussion

Watershed delineated and overlaid on Anand District map for selecting the watershed covering Anand Taluka region is shown in figure 3 & 4. There are 9 watersheds that intersect with the boundary of the Anand Taluka.

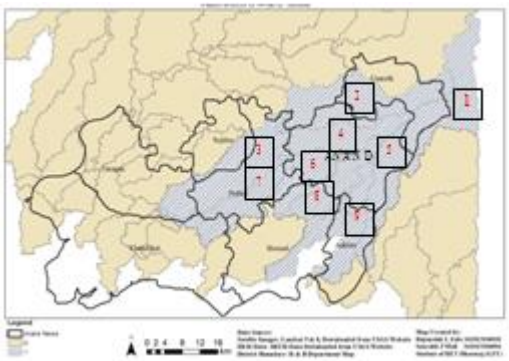

Figure 3 Watersheds Intersecting Study Area boundary

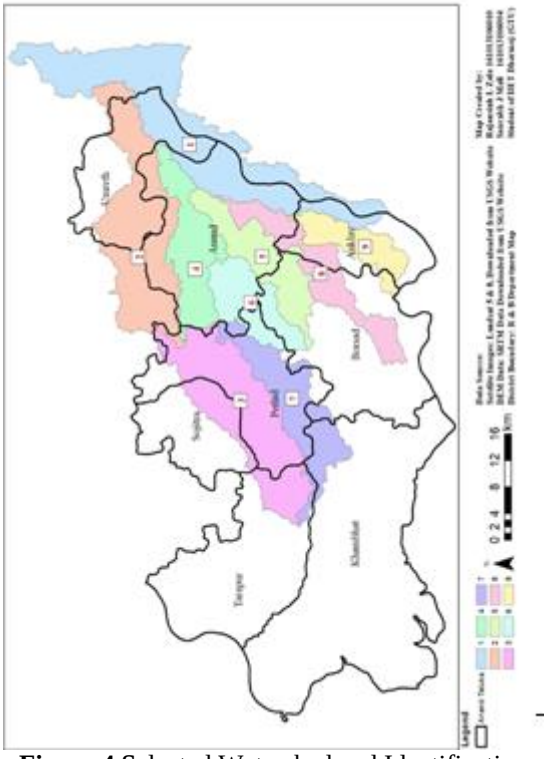

Figure 4 Selected Watershed and Identification

Landsat 5 and Landsat 8 Images of study area for December 2008 and December 2018 respectively were downloaded, mosaiked and band combination images for Red, Green and NIR band is created which resulted in FCC as shown in Figure 5.

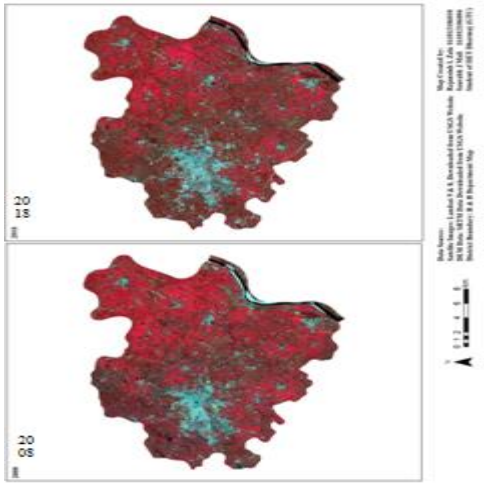

Figure 5 Map-FCC 2008 and 2018

Land cover changes can be seen visually from FCC itself. For the purpose of Quantification of changes it is necessary to classify the image. In present study it is classified in 4 Major basic land cover types i.e. Built up, Open Land, Vegetation and Water Body. Using resolution of image and number of pixels area for each land cover was calculated and then comparing those changes are quantified. Figure 6 Shows pie chart showing change in land cover from 2008 to 2018 and Figure 7 Shows the classified images of the study area. The total Area of Anand Taluka as per Georeferenced map created from Image provided by Road and Building Department is 473.159 km^2, It is divide in nine parts by watershed boundaries. Table I shows the Area of Taluka under each
Watershed

TABLE I. AREA UNDER EACH WATERSHED (KM^2)

Watershed	WS1	WS2	WS3	WS4	WS5
Area in km^2	88.285	69.784	2.077	139.844	71.132
Watershed	WS6	WS7	WS8	WS9	Total
Area in km^2	59.537	5.735	36.190	0.575	473.159

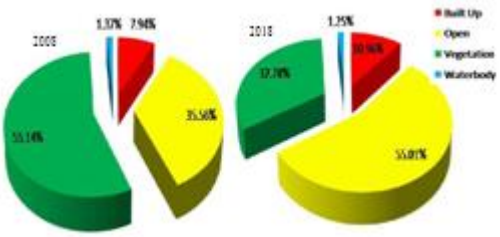

Figure 6 Chart-Land Cover change in Study Area:2008 to 2018

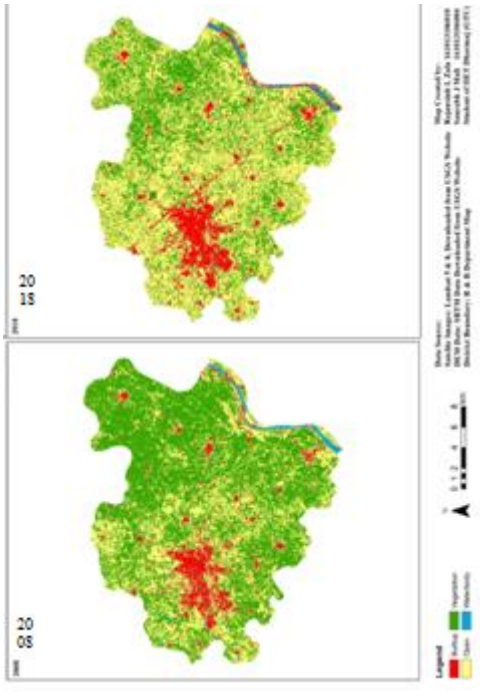

Figure 7 Map-Land Cover Change 2008 to 2018 in Study Area

Figure 8 Shows pie chart showing change in land cover from 2008 to 2018 and Figure 9 Shows the classified images of the study area.

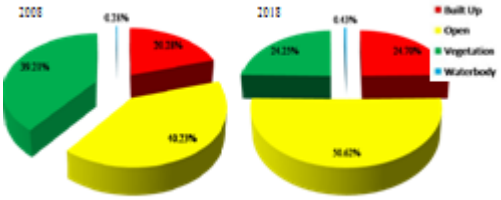

Figure 8 Chart-Land Cover Change in Watershed 6:2008 to 2018

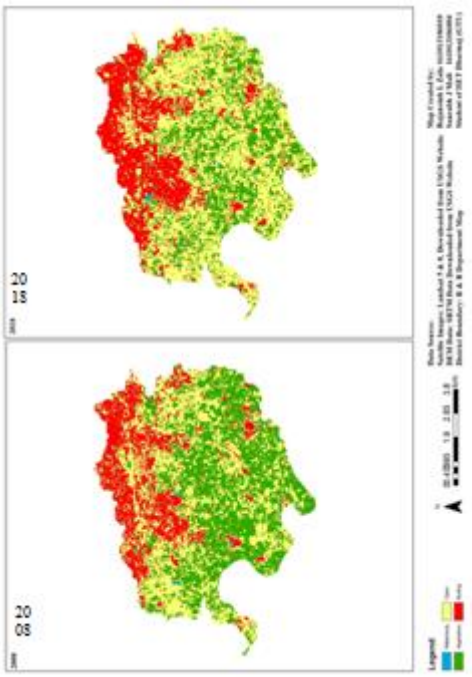

Figure 9 Map-Watershed 6 Land Cover Change 2008 to 2018

Figure 10 shows the changes in area for each land cover type in each watershed from 2008 to 2018

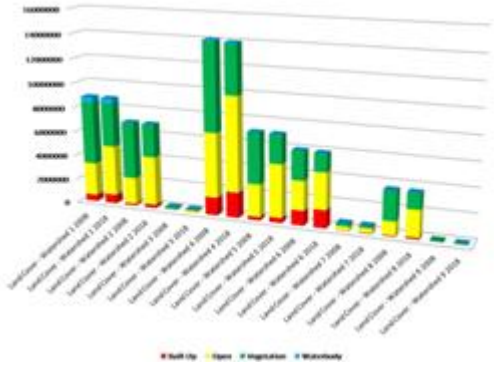

Figure 10 Graph-Watershed wise Land Cover Change 2008 to 2018

Table II shows the percentage change in land cover in each watershed. The Negative sign shows reduction in particular land cover from 2008 to 2018. Watershed 4, 6 and 7 being watershed encompassing Anand Urban Complex, there is major increase in Built Up areas followed by increase in Open Area.

TABLE II. WATERSHED WISE %LANDCOVER CHANGE

Land use	WS1	WS2	WS3	WS4	WS5
Built Up	2.170	1.753	2.04	4.49	1.86
Open	15.850	25.843	32.12	17.95	23.70
Vegetation	-17.660	-27.110	-34.33	-22.25	-25.85
Water body	-0.360	-0.486	0.17	-0.19	0.29

Land use	WS6	WS7	WS8	WS9
Built Up	4.42	4.474	1.897	2.656
Open	10.39	9.973	28.976	30.048
Vegetation	-14.96	-13.837	-31.173	-32.860
Water body	0.15	-0.610	0.300	0.156

For overall Taluka, Increase in Open Land from 35.56% to 55.01% i.e. increase of 19.45% of open land that can be due to reduction in net sown area in particular year, land conversion from agriculture to non agriculture and increase in development. Increase in Built up from 7.94% to 10.96 % i.e. increase of 3.02%. This can be attributed to increase in built up due to urbanization and growth of villages. Decrease in Vegetation from 55.14% to 32.78%. This can be due to reduction in agriculture and increase in built up. Decrease in Water body is from 1.37% to 1.25%. This may be due to pond deepening and development activities, which resulted in drying of water bodies. The decrease in vegetation cover and increase in built up and open land may result in increase of runoff, and inadequacy of existing natural drainage system in turn which may cause flooding in low lying and developed areas.

Acknowledgment

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References

[1] NarayanPanigrahi, "Geographical Information Science," University Press

[2] David L Verbyla, Practical GIS Analysis, Taylor &Fransis, London and Newyork.

[3] David G Tarboton, Ibrahim N Mohammed, "TauDEM 5.0 QUICK START GUIDE TO USING THE TAUDEM ARCGIS TOOLBOX," May 2010.

[4] A Canada Centre for Remote Sensing Remote Sensing Tutorial, "Fundamentals of Remote Sensing".

[5] Rajansinh L Zala, Saurabh J Mali, and Bhavesh D Gohil, "Watershed Delineation Using Open Source GIS Software – A Case Study of Anand District," . (2019). Issue 4 www.jetir.org(ISSN-2349-5162