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A COMPARATIVE STUDY OF THREE DECADAL LU/LC MAPS OF SABARMATI RIVER BASIN

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Abstract: India is a country of heterogeneous land uses/ land covers. And each LU/LC plays an essential part in maintaining and conserving our natural environment. Land use is created by human beings for the betterment of human beings which includes built-up areas, agricultural areas, industrial areas, recreational areas, etc whereas land cover is the natural environmental cover present on the earth surface such as vegetation cover, forests, water bodies, wetlands etc. The main objective of the paper is to compare the three LU/LC (1985-1995-2005) maps using remote sensing and ArcGIS software to detect change analysis. In order to achieve the objectives a case study of Sabarmati river basin was taken to identify key parameters that causes flood and to determine the maximum- minimum changes happening during 1985 to 2005. The results indicate that during the last two decades, crop land and built-up land have been increased by 1.59 % (60238 km²) and 0.46% (17508 km²), while there is a steep reduction in deciduous broadleaf forest, shrub land, fallow land and waste land by 0.47% (-17643 km²), 0.53% (-20049 km²), 1.11% (-41925 km²) and 0.79% (-30071 km²) respectively. Final result shows that the urbanization increases flood situations every time monsoon hits Gujarat.

Keywords: Land use/ land cover; vegetation cover; built-up land; urbanization.

I. INTRODUCTION

The land use/ land cover maps are that map which represents the physical features of land such as vegetation cover, built-up areas, forest areas, barren land areas, agricultural areas, site under construction areas etc. In India the LU/LC maps are heterogeneous in nature as compared to other countries of the world. The term Land use and land cover are two different terms where land use represents the uses of land by the people for the people. On the other hand the land cover represents the natural cover on the land such as vegetation cover, forests cover, barren land, wetland, other land, water bodies etc. These LU/LC map plays an essential part in maintaining and conserving our natural ecosystems. Hence the study of LULC is our utmost priority now days.

On comparison with the global LU/LC, our LULC show that our datasets represents maximum land diversity with 90% accuracy especially at the regional level[1]. Spatial correlation was found between agricultural land area and precipitation that describes the dependency of cropping patterns on the monsoon in the country [1].

In any watershed, the flood risk generally increases with the increase of the land use by humans on the other side it decreases the land cover. Hence the study of LU/LC is significant in determining the risk factors of the watershed as well as helps in reducing the high risk from floods or related problems [2]. Land use changes usually affects land cover changes due to changing demands by increasing populations [3].

The latest remote sensing and GIS techniques are now days in demand for acquiring various databases like LULC, DEM, SOIL, Terrain maps etc. For acquiring the LULC maps remote sensing and GIS plays an important role. The various satellites provide LULC with different levels of accuracy based on their pixel sizes. Getting the database is not enough, supervised classification methods are used in distinguishing between various LULC with the help of ARCGIS software. The supervised classification methodology can be used by ERDAS 9.3 software[3]. The supervised classification is the pixel classification processes where the pixels are grouped into their specific classes. The images were usually categorised into five major classes namely vegetation, agriculture, built-up, barren and water body[3].

Assessment of digital change detection of land use pattern is useful in planning and management of water resources and land resources of the basin[4]. The heavy changes can affect water quality and water supply in the watershed as demands of water supply will be continuously increasing due to over land uses which suggests proper management of the watershed otherwise our precious water resources will soon be lost[4]. For proper management of watershed, the assessment of past and present conditions of the land cover is required to understand the trend of fast changing environment[5].

There are many factors that contribute to the changes in LULC are urbanization, built up areas etc. The rapid urbanization is that factor that leads to dramatic changes in land use and also affects land cover. This gives us insight in decision making of environmental management and future planning for sustainability of the environment[6]. The change detection can be done by using various hydrological models such as EPA, SWMM (Storm water management model), SWAT (Soil and water assessment tool) model etc. The SWAT model is applied to examine the long term hydrological impacts of LULC changes in the watershed[7].

II. Objective of the Study

The main objective of the paper is to compare the three LU/LC maps by using remote sensing and ArcGIS software. For the study purpose LU/LC 1985, LU/LC 1995 and LU/LC 2005 maps were acquired and used to identify key parameters that causes flood and to identify maximum and minimum changes happening during 1985 to 2005 and detect change analysis. And also propose the critical strategies to be applied to the LU/LC map so as to manage and preserve our natural environment.

III. Study Area

The Sabarmati basin extends from Rajasthan and Gujarat having an area of 21,674 Sq.km with maximum length of 300 km and width of 150 km. It lies between 70°58' to 73°51' east longitudes and 22°15' to 24°47' north latitudes. The study basin is bounded by Aravalli hills on the north and north-east, by Rann of Kutch on the west and by Gulf of Khambhat on the south. The basin is having a main river namely the Sabarmati River which originates from Aravalli hills at an elevation of 762 m near village Tepur, in Udaipur district of Rajasthan. The total length of river from origin to outfall into the Arabian Sea is 371 km and its tributaries are the Wakal, the Hathmati, the Vatrak and the Sei. The major part of basin is covered under agricultural land and water bodies of the total area. The watershed has a major Dharoi dam project and many minor projects such as Guhai dam, Hathimati dam and Harnav dam.

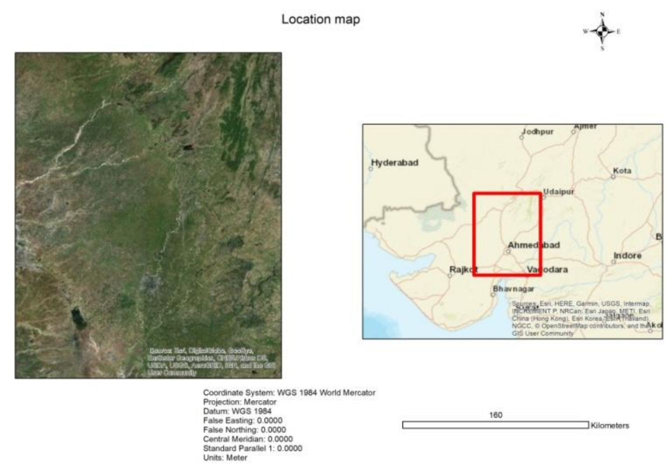


Figure 1: Location map of Sabarmati river basin

IV. Data Acquisition

For the study purpose the three decadal maps were acquired from the decadal maps of India website in the raster format. These maps were then first extracted to the new folder file and then pre-processed in ARCGIS software. In pre-processing, the pixel processing is done by supervised classification by identifying 11 classes in LU/LC maps using ARCMAP software.

Table 1. Characteristics of the three LU/LC maps

Data period	Satellite type	Sensor used	Data type	Resolution of data
1984-1985	Landsat 4	MSS	Vector	56 m
1994-1995	Landsat 5 & IRS 1B	TM & LISS-I	Vector	30 m & 72 m
2004-2005	Landsat 5 & Resourcesat	ETM+ & LISS-III	Vector	30 m

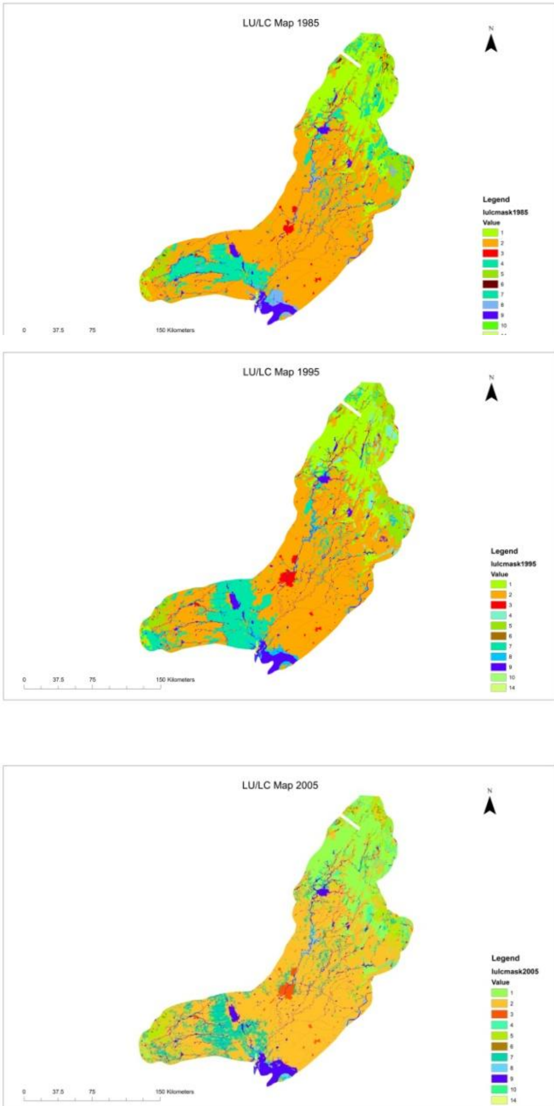


Figure 2: LULC 1985, LULC 1995 and LULC 2005 maps processed in ARCGIS software

V. Methodology

The methodology consists of the following steps: 1) First of all the three decadal maps (1985-1995-2005) were downloaded from the decadal maps of India website and then extracted to a new folder on the desktop. 2) Then the three LULC maps were pre-processed using ARCGIS software. 3) Then comparative analyses were performed based on the supervised classifications of the maps. 4) Identify the maximum and minimum change land areas and relating them with the key parameters that causes floods. 5) Finally to manage and conserve our natural environment some solutions were recommended.

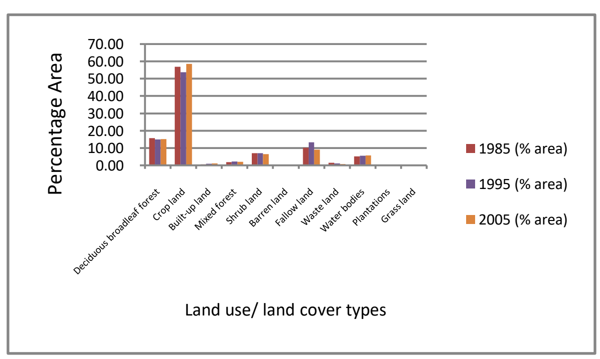
VI. Results and Discussions

The comparative study of the three decadal LULC maps represents the percentage transition of land use/ land cover during 1985 to 2005. The LU/LC classes were supervised classified into eleven classes: deciduous broadleaf forest, crop land, built-up land, mixed forest, shrub land, barren land, fallow land, wasteland, water bodies, plantations and grass land. These eleven classes were compared with each other from the three decadal maps. The total area of Sabarmati river basin is 3787137 km² which is further divided into these eleven classes.

Table 2. Change detection analysis of three LU/LC maps

Sr. no.	LU/LC types	1985 (km²)	Area1985 area)	(%1995 (km²)	Area1995 area)	(%2005 (km²)	Area2005(% area)
1	Deciduous broadleaf forest	594318	15.69	566069	14.95	576675	15.23
2	Crop land	2154180	56.88	2032897	53.68	2214418	58.47
3	Built-up land	26144	0.69	41462	1.09	43652	1.15
4	Mixed forest	72876	1.92	88343	2.33	79931	2.11
5	Shrub land	268705	7.10	271819	7.18	248656	6.57
6	Barren land	10411	0.27	8658	0.23	13088	0.35
7	Fallow land	390682	10.32	506091	13.36	348768	9.21
8	Waste land	61655	1.63	46935	1.24	31584	0.83
9	Water bodies	198602	5.24	215299	5.69	220322	5.82
10	Plantations	6201	0.16	6201	0.16	6657	0.18
11	Grass land	3363	0.09	3363	0.09	3386	0.09

Graph-1: Total area in percentage covered by different types of LU/LC classes



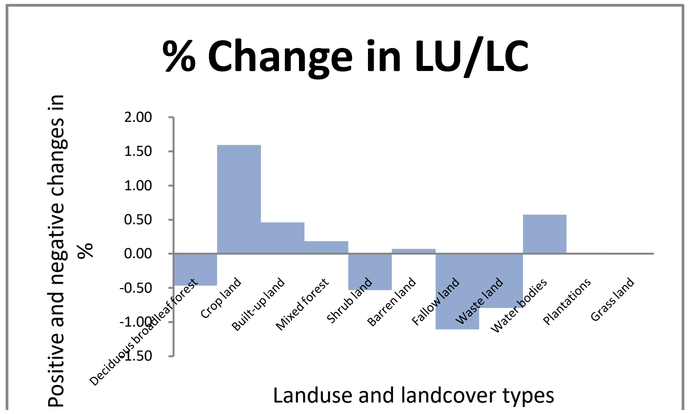
This graph represents the total percentage area covered under various land use/ land cover classes. As per the above graph the maximum land use is crop land which is more than 50% in all the three years. The deciduous broadleaf forest is at second maximum LULC type covering more than 15 % area; fallow land is third LU/LC type covering 10% to 14% area out of whole watershed area. The three minimum land use/ land cover changes are grass land with 0.09% area, plantations with 0.16 to 0.18 % areas and barren land with 0.27 to 0.35% areas.

Table-3: LU/LC change detection in Area and percentage

Sr. no.	LU/LC types	1985 Area (km²)	2005 Area (km²)	2005-1985 Area (km²)	2005-1985 (% area)
1	Deciduous broadleaf forest	594318	576675	-17643	-0.47
2	Crop land	2154180	2214418	60238	1.59
3	Built-up land	26144	43652	17508	0.46
4	Mixed forest	72876	79931	7055	0.19
5	Shrub land	268705	248656	-20049	-0.53
6	Barren land	10411	13088	2677	0.07
7	Fallow land	390682	348768	-41914	-1.11
8	Waste land	61655	31584	-30071	-0.79
9	Water bodies	198602	220322	21720	0.57
10	Plantations	6201	6657	456	0.01
11	Grass land	3363	3386	23	0.00

The table represents the LU/LC changes that take place in two decades during 1985 to 2005. The results indicate major changes such as increase of crop land by 1.59 % (60238 km²), built-up land by 0.46% (17508 km²) and water bodies by 0.57% (21720 km²) while reduction in deciduous broadleaf forest by 0.47% (-17643 km²), shrub land by 0.53% (-20049 km²), fallow land by 1.11% (-41925 km²) and waste land by 0.79% (-30071 km²). This table clearly shows that some part of land cover has been converted into land use part.

Graph-2: Percentage change analysis showing maximum and minimum changes from 1985 to 2005.



The graph-2 represents the maximum and minimum percentage changes occurring from year 1985 to 2005. From the graph, the maximum positive changes occurs in crop land (1.59%), built-up land (0.46%), mixed forest land (0.19%), barren land (0.07%), water bodies (0.57%) and plantations (0.01%). And the minimum negative changes occur in deciduous broadleaf forest (0.47%), shrub land (0.53%), fallow land (1.11%) and waste land (0.79%). The grass land remains unchanged with (0.00%).

Key parameters that leads to floods are the over use of land uses like built-up land, crop land and barren land etc which are increasing at a high rate as per the graph within two decades (1985 to 2005) because of rapid urbanization. As the population is increasing continuously in this watershed due to which deciduous broadleaf forest are decreasing because of deforestation, built-up land increases and crop land increases at a very high rate due to maximum demands for food and shelter is required. In other words rapid urbanization is taking place which leads to dramatic changes in the watershed which converts fertile lands into impervious land, thereby increasing the flood risk situations [6].

For sustainable development of our natural environment, urbanization can be controlled by providing vertical displacements to people. And the fallow land may be used as a crop land thereby increasing crop land for the people. The excessive use of land use like built-up land and agricultural land should be reduced to preserve our environment.

VII. CONCLUSIONS

Sabarmati river basin is a large basin which extends from a part of Rajasthan to Gujarat region. In this watershed rapid urbanization has taken place during 1985 to 2005 which in turn has decreased forest land, fallow land, shrub lands and managed to increase crop land, built –up land etc. The results indicate that during the last two decades, crop land, built-up land and water bodies have been increased by 1.59 % (60238 km²), 0.46% (17508 km²) and 0.57% (21720 km²) respectively, while there is a reduction in deciduous broadleaf forest, shrub land, fallow land and waste land by

0.47% (-17643 km²), 0.53% (-20049 km²), 1.11% (-41925 km²) and 0.79% (-30071 km²) respectively. The land cover has been converted into land uses during 1985 to 2005 because of rapid urbanization and if this will continue than our natural vegetation cover of forest will reduce which leads to degradation of our environment. Hence in order to sustain and preserve our environment, the forest cover should have to be increased which in long term will maintain ecological balance in natural environment.

VIII. References

[1] P. S. Roy, A. Roy, P. K. Joshi, M. P. Kale, V. K. Srivastava, S. K. Srivastava, R. S. Dwevidi, C. Joshi, M. D. Behera, P. Meiyappan, Y. Sharma, A. K. Jain and J. S., "Development of decadal (1985-1995-2005) land use and land cover database for India," *Remote sensing, MDPI journal,* pp. 2401-2430, 2015.

[2] M. Safaripour, M. Monavari, M. Zare, Z. Abedi and A. Gharagozlou, "Flood risk assessment using GIS (Case study: Golestan Provice, Iran)," *Journal of Environmental studies,* pp. 1817-1824, 2012.

[3] J. S. Rawat and M. Kumar, "Monitoring land use/ cover change using remote sensing and GIS technologies: A case study of Hawalbagh block, district Almora, Uttarakhand, India," *The Egptian journal of remote sensing and space sciences, Elsevier Journal,* pp. 77-84, 2015.

[4] A. Butt, R. Shabbur, S. S. Ahmad and N. Aziz, "Land use change mapping and analysis using remote sensing and GIS: A case study of Simly watershed, Islamabad, Pakistan," *The Egptian journal of remote sensing and space sciences, Elsevier journal,* pp. 251-259, 2015.

[5] M. I. Haque and R. Basak, "Land cover change detection using GIS and remote sensing techniques: A spatio-temporal study on Tanguar Haor, Sunamganj, Bangladesh," *The Egptian journal of remote sensing and space sciences, Elsevier journal,* pp. 251-263, 2017.

[6] L. Gadrani, G. Lominadze and M. Tsitsagi, "F assessment of landuse/ landcover (LULC) change of Tbilisi and surrounding area using remote sensing (RS) and GIS.," *Annals of Agrarian Science, Elsevier journal,* pp. 163-169, 2018.

[7] C. Zhu and Y. Li, "Long term hydrological impacts of landuse/ land cover change from 1984 to 2010 in the Little River watershed, Tennessee," *International Soil and Water Conservation Research,* pp. 11-22, 2014.

[8] J. Yadav, D. Yadav, R. Vashistha , D.P Goyal and D. Chhabra ," Green energy generation through PEHF–a blueprint of alternate energy harvesting," *International Journal of Green Energy*, 16(3), pp.242-255, 2019.