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Land Use Land Change Study of Hemavathi Watershed, Karnataka State, India

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Abstract: *The identification of Land use and Land cover (LULC) changes in Hemavathi watershed has been attempted in the present study. Satellite imagery for the years 1995, 2005 and 2017 are used in ArcGIS software to generate LULC maps. The result shows changes in land cover over the period. The changes have occurred in the Deciduous Forest, Crop land and Shrub land. The study reveals that there is an expansion in plantations area and built-up land, and there is no Barren land on the watershed.*
Key Word: *Land use, Land cover, Change detection, Remote sensing.*

I. INTRODUCTION

In the last few decade specially after an industrial revolution, land surface modification has significantly increased, which is driven by the need to acquire more land resources to satisfy the rising need. Land use pattern indicate the land was employed by individuals, whether or not for development, conservation or otherwise. Land cover refers to the insights that cowl the surface of the planet. Land cover study meant to know what proportion a study area is consists of forest land, crop land, built up land, water bodies, grass land etc..

LULC planning has an important role at macro-level planning which gives natural and socio-economic aspects and their use by human being with time. The modification of land to development activities such as agricultural farming, industrialization has become necessitated due to increase in demand. The change in environment is observed due to the greater change in LULC intern conditions of ecology, biodiversity, soils, air and water is felt. Deriving LULC data and LULC change identification for the period is useful for future prediction of land utilization and particularly helpful for urban and common assets administration. In recent past rapid changes in land use/cover is often a common feature. Remote detecting and Geographic Information System (GIS) application can be utilized for analyzing the LULC changes over the time to administer the various natural resources harnessing.

II.LITERATURE REVIEW

The following paragraph discusses the study done by various researchers on the change detection in land use and land cover of various parts of the world.

Om Prakesh Tripathi and Jyotishman Deka et al. (2015), have studied the land use and land cover dynamics in Kamrup district of Assam from 1991 to 2011 using Remote Sensing and Geographical Information System (GIS) using the an object-oriented classification approach for LULC mapping and a post-classification change-detection technique for quantifying the changes for twelve major land use and land cover types. They found the land cover changes in built-up at + 45.82%, wetlands at −39.45%, croplands at + 4.16% and forest cover at −3.09% areas. It is been reported that most of the areas have been compensated to expansion in areas under built-up and cultivated lands.

The land use land cover change detection for Rib watershed of Ethiopian highlands has been done by Tesfa Gebrie Andualem et.al. (2018) using the satellite images and by classifying land with ERDAS Imagine software. The results of the study indicated that there was a dramatic land use land cover change over 11 years, with an increase of agricultural land by 13.78%, and a decrease of grass land by 15.97% from 2007 to 2018. The grassland was basically changed to agricultural land due to an increased population growth and hence higher demand for cropland in the area.

The researcher Shereif H. Mahmoud, A. A. Alazba (2015) have carried out work on quantitative assessment in land cover changes in the AI-Baha region of Saudi Arabia between 1990 and 2000 by using ArGIS 10.1. The study reveals a 26 % decrease in forest and shrub land and at the same time decrease of 26 % area in irrigated land.

Tiwari, K. and Khanduri, K. (2011) have reported their study on Land Use / Land cover change detection for Doon valley between 2000 to 2009 with satellite images of Landsat (ETM + , TM, MSS), LISSIII, SRTM and digital SOI topographic maps. The study reveals a decrease of forest area by 3.75 % water by 9.5 % and it has also reported a remarkable growth of 112.4 % in built up area due to increasing demand for institutional and residential space for capital level establishments as the population growth over 3.4 folds.

The status of landuse-land cover in the districts of Panchkula, Ambala and Yamunanagar has been studied by Arvind.C.Pandey, M.S.Nathawat(2006) by digital analysis of satellite data which shows majority of areas in these districts (36% in Panchkula, 85% in Ambala 77.5% in Yamunanagar) are used for agricultural purpose. The hilly regions of the Panchkula and Yamunanagar districts exhibit fair development of reserve forests, 30% and 9% respectively. Wasteland occupies about 16%, 8.7% and 7.88% area in Panchkula, Ambala and Yamunanagar districts respectively.

Land use/land cover (LU/LC) changes was studied by Praveen Kumar Mallupattu and Jayarama Reddy Sreenivasula

Reddy (2013) for an urban area, Tirupati, India from 1976 to 2003 by using Geographical Information Systems (GISs) and Remote Sensing technology. The study reveals that there is a significant increase in built-up area, open forest, plantation, and other lands. It is also noted that substantial amount of agriculture land, water spread area, and dense forest area has decreased due to rapid urbanization.

Vijayashanthi et al (2018) have reported their study on the use of the land use and land changes during the period 2000 to 2017 for Malaprabha basin. The results shows an increase of built up area by 4.41%, while there is decreasing trends for other land cover classifications, for example, Agricultural Fallow land (0.15%), wetland/others (1.99%), Agricultural cropland (2.18%), and Agricultural plantation (0.71%) and also the forest area (0.05%) whereas water body is being consistent with negligible change. Further demonstrated the use of these data to predict future scenario corresponding to the year 2025 and 2035 using markov chain system.

B S Bisht and B.P. Kothyari (2001) have studied the LULC changes in Garur watershed of Bageshwar district of Uttranchal state for the period 1963 to 1996 and 1986 to 1996. The study revealed that the area under agriculture and settlement increased from 34.98 to 42.34%, whereas the forest and barren land shows a declining trend. The expansion of agriculture land and builtup area has been found to be maximum in the 1200–1600 m elevation zone with 7–14° slope class. The loss of vegetation cover has been estimated to be 5.07% between the year 1963 and 1996 and 0.81% between the year 1986 and 1996.

Land use Land cover change analysis on Kanchinegalur sub-watershed of Dharma Watershed, Hangal Taluk, Haveri District was studied by A. Reddy, et al (2017) using Remote Sensing and GIS Technologies. Land Use Land cover Classification is performed over the temporal resolution from 2003 to 2015 using Survey of India (SOI) toposheets, LANDSAT-7 (2003 & 2015) and IRS-P6-LISS-III (2012) dataset. Maximum Likelihood method is used in supervised classification algorithm of image classification technique. Thematic maps are prepared using GIS software. Ground truth observations are used to validate the result of classification. They have reported in their study revealing exploitation of natural resources with the urban sprawl and have modified the pattern of land use and land cover. Rapid urbanization has led to reduction of natural resources such as forest land, water bodies and arable land.

S. Astuti, K. Sahoo, A. Milewski, and D. R. Mishra, (2019) have studied rapid landscape change over a Upper-Brantas watershed in East Java, Indonesia. This study demonstrates the impact of Land Use Land Cover (LULC) changes on surface runoff in a tropical, urbanized, and data scarce watershed. The LULC changes were quantified between 1995 and 2015 and their impact on the hydrological processes was analyzed using the Soil and Water Assessment Tool (SWAT) model. During the study period, the watershed experienced an increase in settlement and dry land agriculture, and a decrease in the forest, rice field, and sugarcane plantation.

The present study deals with the identification of LULC in Hemavathi watershed using Satellite imagery for the years 1995, 2005 and 2017 in ArcGIS software.

III.STUDY AREA

One of the major tributaries to join the river Cauvery on its northern bank is the Hemavathi river. The river rises in the Ballalarayanadurga in Western Ghats of Mudigere taluk, Chikmagalur district. The watershed ranges between East longitudes 75° 310 30″ to 76°390 45″ and North latitudes 12°350 15″ to 13°220 30″. The Hemavathi river joins the Cauvery in the Krishnarajasagar reservoir (KRS) near Akkihebbal having 245 km in length. The river basin elevation lies between 748 m and 1,853 m above the mean sea level. The economy of the basin depends primarily upon planting and agriculture. The basin experience summer from March to May whereas rainy season from June to October. During the rainy season, very strong rainstorms it receives. The winter months are November to February. During these months, severe colds are felt. Hilly catchment with a steep to intermediate slope is observed in the study area.

Data Used:

The Digital Elevation Map of the study area, Hemavathi river basin is obtained from Bhuvan site having 30m resolution. Landsat satellite imageries for the Sakaleshpura watershed were downloaded from Earth Explorer (USGS site) having 30m resolution.

Change Detection Analysis:

Change detection analysis is the detection of change which has occurred in a place from one time period to another time period like agricultural expansion, urbanization, deforestation etc. RS and GIS images for two time series can be detected by using satellite images for different years. The technique of change detection helps the professionals to make better decisions, management and also help for better designing.

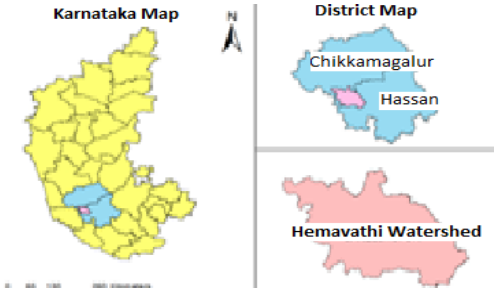

Figure No.1: Hemavathi Watershed

The methodology adopted for change detection analysis is as shown in the Figure 2 in the form of flow chart.

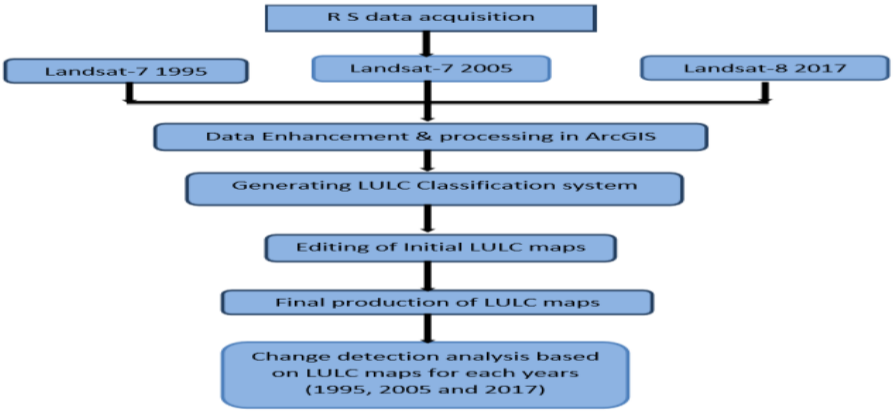

Figure No. 2: Flow chart for LULC detection

IV.RESULTS AND DISCUSSION

Corresponding to the year 1995, 2005 and 2017, Upper Hemavethi watershed imageries were downloaded from Bhuvan website. The LULC maps were prepared for the study area in Arc GIS10.4 using USGS classification. The Land use /Land cover maps were prepared by means of Landsat 7TM and Landsat 8 ETM+ imageries for the years 1995, 2005 and 2017 by Supervised Classification. The changes in LULC over the period were evaluated to identify the reasons for the changes that took place on the watershed. The Figure 3 to 5 shows the LULC map for the year 1995, 2005 and 2017 respectively with ten classes of landuse viz.: Deciduous Forest, Crop Land, Built-up Land, Mixed Forest, Shrub Land, Barren Land, Water Bodies, Plantations, Grassland, and Evergreen Forest.

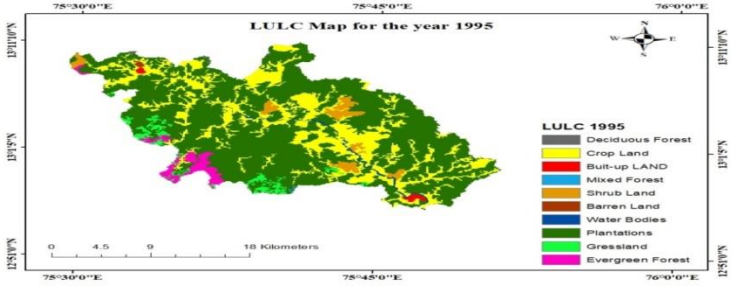

Figure No. 3: LULC map for the year 1995

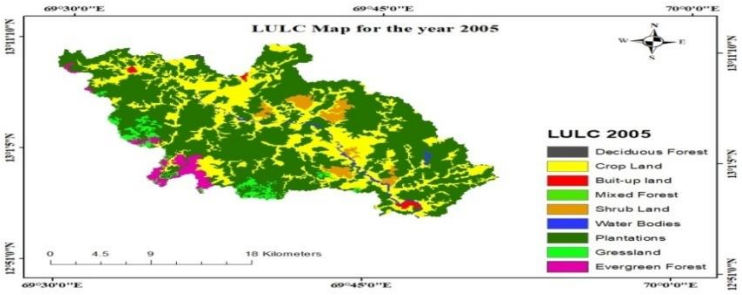

Figure No. 4: LULC map for the year 2005

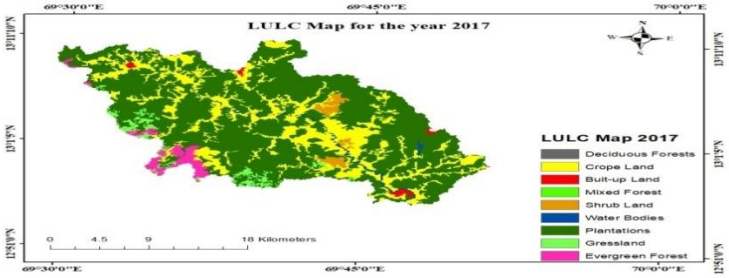

Figure No. 5: LULC map for the year 2017

Land Use Land Cover Change Detection Analysis:

Table 1 shows percentage change in different land use types from the year 1995 to 2017. Positive values indicate percentage increase in LULC area and whereas negative values indicate percentage decrease in LULC area.

The study reveals that there is a decrease in percentage area of land with reference to Deciduous Forest, Cropland, Mixed Forest and Shrub land, whereas there is an increase in percentage area of land with respect to Built-up Land, Water

Bodies, Plantations, Grassland and Evergreen Forest between the year 1995 and 2017. It is found that the deciduous Forest has decreased from 0.66 sq.km to 0.34 sq.km, Cropland has been decreased from 128.14 sq.km to 127.35 sq.km, Built-up Land is increased from 2.14 sq.km to 3.21 sq.km, Mixed Forest is decreased from 0.23 sq.km to 0.18 sq.km, Shrub land area is decreased significantly from 15.33 sq.km to 9.09 sq.km, the extent of area of water bodies has increased from 4.8 sq.km to 5.62 sq.km, Plantations area is increased marginally at 4.94 % from 361.38 sq.km to 379.23, Grassland has increased from 13.06 sq.km to 13.55 sq.km area, Evergreen Forest area has increased by 7.76 percent between 1995 and 2017 (13.79 to 14.86 sq.km) and interestingly the barren land has been reduced to zero between 1995 and 2017.

The shrub land has been decreased from the 15.33 Sq. Km in 1995 to 9.09 Sq.Km. in 2017, whereas deciduous forest has decreased from 0.66 Sq. Km in 1995 to 0.34 Sq.Km. in 2017. At the same time the built up land has increased from 0.4 percent of the watershed area (2.14 Sq. Km.) to 0.58 (3.21 Sq.Km.) from 1995 to 2017 respectively.

Table No. 1: Land use/cover change analysis between 1995 and 2017

SL. No.	Land use type	Year 1995		Year 2017		Percentage change in land use from 1995 to 2017
		Area in sq.km	Area in %	Area in sq.km	Area in %	
1	Deciduous Forest	0.66	0.12	0.34	0.06	-48.48
2	Cropland	128.14	23.72	127.35	23.01	-0.62
3	Built-up Land	2.14	0.4	3.21	0.58	50.00
4	Mixed Forest	0.23	0.04	0.18	0.03	-21.74
5	Shrub land	15.33	2.84	9.09	1.64	-40.70
6	Barren Land	0.658	0.12	-	-	-100.00
7	Water Bodies	4.8	0.89	5.62	1.01	17.08
8	Plantations	361.38	66.90	379.23	68.53	4.94
9	Grassland	13.06	2.42	13.55	2.45	3.75
10	Evergreen Forest	13.79	2.55	14.86	2.69	7.76

The below Table 2 shows the results of LULC change between the period 1995 to 2005 and 2005 to 2017. It shows that there is an increase in cropland, Built-up land, shrub land, Water bodies, Grassland and Evergreen forest and on the contrary there is a decrease in deciduous forest and Plantations from the year 1995 to 2005. However it is noticed that there is no change in the mixed forest during the period from 1995 to 2005. Whereas, from the year 2005 to 2017, there is an increase in Built-up land, Water bodies, Plantations and Evergreen forest and decrease in deciduous forest, cropland, shrub land and Grassland. However the area of Mixed Forest has decreased to 21.74 percent from 1995 to 2017. The barren land of 0.65 Sq. Km. which was existing in the year 1995 has been converted into other land use type by 2005 and hence the watershed do not have any kind of barren land in its catchment.

Though a large portion of deciduous forest has been decreased (45.45) between 1995 and 2005, the same percent magnitude is not seen (5.56) during 2005 and 2017. The crop land, shrub area and grass land area has increased during 1995 and 2005. The same trend is not observed between 2005 and 2017 in these classes of land. At the same time, the plantation which has a negative trend in the period 1995 to 2005, has gained a positive trend between 2005 and 2017.

Table 2: Percentage change in land use pattern betweenthe period 1995 to 2005, and 2005 to 2017

Land use Class	1995-2005 (%)	2005-2017 (%)
Deciduous Forest	-45.45	-5.56
Cropland	13.77	-12.64
Built-up Land	23.83	21.13
Mixed Forest	0.00	-21.74
Shrub land	8.22	-45.21
Barren Land	-100.00	0
Water Bodies	14.58	2.18
Plantations	-2.08	7.17
Grassland	5.21	-1.38
Evergreen Forest	6.67	1.02

V. CONCLUSION

The Hemavathi watershed has been studied for a change in LULC from the year of 1995 to 2017. In this study, satellite data is used on ArcGIS to create various Landuse /Cover maps of the years 1995, 2005 and 2017. Land use /cover map which has been prepared for change detection analysis with use of ArcGIS. There is a considerable change in Deciduous Forest, Built-up Land, Mixed Forest, Shrub land, Barren land, Water Bodies from 1995 to 2017. The change detection analysis reveals that there is a significant change in Deciduous Forest from 0.66 sq.km to 0.34 sq.km (i.e. 48.48% decrease), Built-up Land from 2.142 sq.km to 3.213 sq.km (50 % increase), Mixed Forest 0.23 sq.km to 0.18 sq.km (21.74 % decrease), Shrub land from 15.33 sq.km to 9.09 sq.km (40.70 % decrease), Water Bodies 4.8 sq.km to 5.62 sq.km (17.08 increase), Plantations 361.38 sq.km to 379.23 (4.94 % increase), Grassland 13.06 sq.km to 13.55 sq.km (3.75 increase), Evergreen Forest 13.79 to 14.86 sq.km (7.76 % increase) and there is no Barren Land existing on the watershed. Barren land and Mixed Forest has decreased with increase of Plantations. The study reveals there is an increase in area of Built-up land, Water bodies, Plantations and Evergreen Forest since 1995.

The study help the administrators of various organization such as forest, agriculture, irrigation personnel to take appropriate decision on the optimal use of natural resources for the development of the region.

References

[1]. *Praveen, K. M. and Jayarama, R. S. R (2013),"Analysis of Land Use/Land Cover Changes Using Remote Sensing Data and GIS at an Urban Area, Tirupati, India", The scientific world journal, Volume 2013 |Article ID 268623 | https://doi.org/10.1155/2013/268623.*

[2]. *H. Sahour, A. Mokhtari, and E. N. Tehrani, (2014)," Effects of Land Use/Land Cover changes on surface runoff (A case study in Siahroud Watershed, Iran)",Elixir International Journal, Remote Sensing 74, pp:26867-26870.*

[3]. *M. L Sundar, C. A. Prasath, H. E. Rosario, K. Tamilselvan,(2019),"Urban Sprawl Mapping and Land Use Change Detection Analysis, International Journal on Advanced Science, Engineering and Information Technology, Vol. 9,No. 1,pp:281-286, DOI:10.18517/ijaseit.9.1.8080.*

[4]. *A. C. Pandey and M. S. Nathawat, (2009)," Landuse-Land cover mapping through digital image processing of satellite data- A case study from Panchkula, Ambala and Yamunanagar districts, Haryana state, India",Geospatial world, http://geospatialmedia.net/09/01/2009.*

[5]. *Tesfa, G. A., Gizew, B. and Adebabay, G.,92018), " Land Use Change Detection Using Remote Sensing Technology, International Jl. of Earth Science Climate Change, an open access journal, ISSN: 2157-7617, Vol 9(10): 496, DOI: 10.4172/2157-7617.1000496.*

[6]. *Pandian. M, Rajagopal.N, Sakthivel. G and Amrutha. D.E (2014), "Land use and land cover change detection using remote sensing and GIS in parts of Coimbatore and Tiruppur districts, Tamil Nadu, India". International Journal of Remote Sensing & Geoscience (IJRSG). ISSN No: 2319-3484 Volume 3, Issue 1, Jan. 2014, pp:16-20, https://www.researchgate.net/publication/266210112.*

[7]. *M. Dimyati, K. Mizuno, S. Kobayashi, T. Kitamura (1996)," An Analysis of Land use/Land cover change using the combination of MSS Landsat and Land use map-A case study of yogyaketa, Indonesia". International Journal of Remote Sensing,Volume 17, Issue 5,pp:931-944.*

[8]. *J. Deka1, O. P. Tripathi, M. L. Khan (2014)," Study on Land Use/Land Cover Change Dynamics through Remote Sensing and GIS – A Case Study of Kamrup District, North East India", Journal of Remote Sensing & GIS, ISSN: 2230-7990, Volume 5, Issue 1, pp:55-62.*

[9]. *Vijayshanti, A. V. Shivapur, and N.S.Patil (2018), ""Land use land cover change simulation for future scenario for Malaprabha sub-basin", International Journal of Research in Advent Technology, E-ISSN: 2321-9637, Vol.6, No.6, June 2018, pp 1271-127.*

[10]. *B. S. Bisht, and B. P. Kothyari, (2001), " Land-Cover change analysis of Garur Ganga watershed using GIS/Remote Sensing technique", Journal of the Indian Society of Remote Sensing, volume 29, pages137–141.*

[11]. *A. Reddy, M. Kumar , H. H. Kumar , A. V. Shivapur, (2017), "Land Use Land Cover Change Detection on Kanchinegalur sub watershed using GIS and Remote Sensing Technique", International Journal for Research in Applied Science and Engineering Technology, Vol. 5, Issue XI, November 2017, pp:2128-2136.*

[12]. *S. Astuti, K. Sahoo, A. Milewski, and D. R. Mishra, (2019)." Impact of Land Use Land Cover (LULC) Change on Surface Runoff in an Increasingly Urbanized Tropical Watershed", Water Resources Management, Springer Nature Journal, Volume 33, pp:4087–4103.*

[13]. *Z. Hassan, R. Shabbir, S. S. Ahmad, A. H. Malik, N. Aziz, A. Butt and S. Erum, (2016), "Dynamics of land use and land cover change (LULCC) using geospatial techniques: a case study of Islamabad Pakistan", Springer Plus Open Access, Volume 5, Article number: 812 (2016).*

[14]. *K. Venkatesh1, H. Ramesh, (2018), "Impact of Land Use Land Cover Change on Run Off Generation in Tungabhadra River Basin", SPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume IV-5, 2018 ISPRS TC V Mid-term Symposium "Geospatial Technology – Pixel to People", 20–23 November 2018, Dehradun, India,pp:367-374.*

[15]. *T. Kuldeep, K. Kamlesh, (2011)," Land Use / Land cover change detection in Doon valley (Dehradun Tehsil), Uttarakhand: using GIS& Remote Sensing Technique", International Journal of Geomatics and Geosciences, ISSN 0976 – 4380, Volume 2, No 1,pp:34-41.*