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Land use and Land Cover change Detection using Remote sensing and Geographical information system in Tungabhadra River Basin of Kurnool District, Andhra Pradesh

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Abstract: *Land is becoming scarce resource due to population growth and rapid urbanisation.in many areas the land is put to misuse, under and over use. Further, the needs of growing population made man to convert the natural land cover to land use areas. with the result, most of the land surface has been affected or changed by man. Change detection studies are very important to have proper planning, monitoring, utilisation of natural resources and their management. In general, rural land use is dominated by cultivation, livestock, aquaculture and forestry and urban land use characterised by settlements, Recreation and industrial uses. This study applied supervised classification-Maximum likelihood algorithm in Arc GIS 10.3 to detect land use and land cover changes observed in Tungabhadra River basin of Kurnool district, using survey of India topographic maps 57E/1 to 57E/16 and 57 I/1 to 57 I/5 and the Remote sensing data of Landsat 5 thematic mapper (TM) and Landsat 8 Operational land imager (OLI)for the years 1990 and 2020 respectively. The Tungabhadra River basin was classified in 5 major land use and land cover classes viz. Agricultural land, forest, barren land, built-up area and water bodies. Resultant land use /land cover indicated a significant negative shift in Agricultural area and positive shift built-up area, water bodies and forest as -2.24%, 1.23%, 1%, 0.85 % respectively.*

Key words*: Land use /land cover, Remote sensing, Geographical information system (GIS), Land sat TM, land sat 8, supervised image classification, Tungabhadra River basin*

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I. Introduction:

Land use and land cover is an important component in understanding interactions of the human activities with the environment and thus it is necessary to monitor and detect the changes to maintain a sustainable Environment, identifying, delineating and mapping land cover is an important for Global monitoring studies, Resource management, planning Activities. Accurate and up-to -date land cover change information is necessary to understanding and assessing the environmental consequences of such changes.

Land use and Land cover pattern of a region is an outcome of the natural and socio-economic factors and their utilisation by man in time and space. Land is becoming scarce resource due to immense agricultural and demographic pressure. Hence information on land use and land cover possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demand for basic human needs and welfare. **(Zubair,Ayodeji opeyemi,2006, Praveen kumar mallupattu et,al 2013,Dires Tewabe et., al 2020).**Land use land cover change analysis assist decision makers to understand the dynamic of changing environment and can ensure sustainable development(**Xiulian Bai et,al,2017,)** and it plays an important role in the study and analysis of global changed scenario today as the data available on such changes is essential for providing critical input to decision – making of ecological management and environmental planning for feature (**Zahra Hassan et,al 2016).** Land use changes not only affects the soil environment, atmospheric environment and water environment but also has an impact on the balance of various systems on the earth's surface. These changes not only have increased have increased the frequency and intensity of natural disasters (such as flood) but also have improved soil salinity and land erosion (Qingmu et al

2021)). Change detection is useful many applications related to land use and land cover changes, such as land scape changes, land degradation and desertification, urban land scape pattern change, afforestation, deforestation, water spared area, mining activities, industrial expansion.

Rubia Khan et al (2016) analysed the land use and cover changes in the Raipur Municipal corporation, Raipur, and Chhattisgarh, India using multitemporal remote sensing data (LAND SAT of year 1999 and 2016) and land use and land cover has been performed. Eight LULC classes were established as settlements, road, cultivation, Industry, Drainage, Lake, Open land, Vegetation. The LULC changes were of Highest amount in settlement and cultivation from 1999 to 2016. Comparison of LULC 1999 to 2016 indicates that the anthropogenic activity like settlement, road and industrial area is largely broadened. **Praveen kumar et al (2013**), have analysed land use and land cover changes using Remote sensing data and GIS of an area of Tirupati, India .Land use and land cover changes were determined from 1976 to 2003 by using Remote sensing and Geographical information system .these studies were employed by using the survey of Indian Topographic map 57 o/6 and the remote sensing data of LISS III and PAN of IRS ID OF 2003.The study area was classified into eight categories on the basis of field survey , and remote sensing data. The comparison of land use and land cover in 1976 and 2003 Derived from toposheet and satellite imagery interpretation indicates 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 vanished during the period of study which may be rapid urbanisation of the study area. **Zahra Hassan (2016),** have studied, changes in Islamabad and its surroundings from 1992 to 2012. Quantification of spatial and temporal dynamics of land use /land cover changes was accomplished by using two satellite images, and classifying them via supervised classification algorithm and finally applying post-classification change detection technique in GIS. The increase was observed in agriculture area, built-up area and water body from 1992 to 2012. On the other hand, forest and barren area followed a declining trend. The Driving force behind this change was economic development, climate change and population Growth. Rapid urbanisation and deforestation resulted in a wide range of environmental impacts, including degraded habit quality.

"Land use" is the term to describe the human use of land. It represents the economic and cultural activities (Ex, Agriculture, residential, industrial, Mining and recreational uses) that are practiced at a given place. Land use applications involve both baseline mapping and subsequent monitoring, since timely information is required to know what current quantity of land is in what type of use and to identify the land use changes from year to year. This knowledge will help develop strategies to balance conservation, conflicting uses, and developmental pressures. Land cover refers to the surface cover on the ground, whether Vegetation, water, rock/ Bare soil or other. Identifying, Delineating and mapping of land cover is important for global monitoring studies, Resource management and planning activities. Identification of land cover establishes the base line from which monitoring activities (change Detection) can be performed, and provides the ground cover information for base line thematic maps.

The satellite Remote sensing data with their respective nature have proved to be quite useful in mapping land use and land cover patterns and changes with time. Quantification of such changes is possible through GIS Techniques even if the resultant data sets are of different scales resolutions (**sarma et al.2001, Tesfa Gebrie Andulem,2018**). Remote sensing and GIS are providing new tools for advanced ecosystem management. The collection of remotely sensed data facilitates the synoptic analysis of earth system functions pattern and change at local, Regional, and Global scales over time. Such data also provides vital link between intense localized ecological researchers and the regional, national and international conservation and management of biological diversity (**Vishwanath B.C,2014**). Remote sensing and GIS based technologies may be applied to an area in order to generate a sustainable development plans and modelling. (**Singh 2012**).

Study area: The study area is located northern part of the Kurnool District, the area covered in this investigation is about 6933.946 Sq.km lying in between 77^{0}0'00" E to 78^{0}15'00" E Longitude and 15^{0}15'0" N to 16^{0}0'0" N Latitudes.it is covered by the survey of India toposheet 57E/1 to 57E/16 and 57 I/1 to 57 I/5.

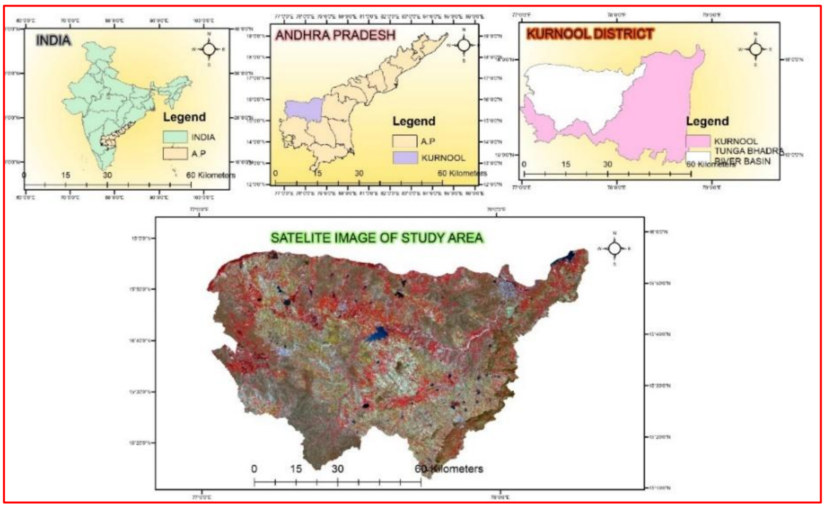


Fig: 1 Location map of the study area

II. Data and Methodology

In the present study have used mainly two types of data. These are Topographic maps and RS Data. The remote sensing data of georeferenced and land sat Thematic mapper at a resolution of 30 m of 1990 and land sat 8 at resolution of 30 M of 2020 were used for land use and land cover the digital mode are obtained from the USGS earth Explorer. The topographic map 57E/1 TO 57 E/16 and 57I/1 TO 57I/5(1:50,000 scale) is obtained from the survey of India, Hyderabad, which was surveyed and prepared in 1976; it is converted to digital mode using scanning. The topographic map is georeferenced with longitude and latitudes using the ArcGIS 10.3 Software and Using spatial analyst tools to demarcated the drainage basin. A supervised signature extraction with the maximum likelihood algorithm was employed to classify the digital data of Land sat 5 TM and Land sat 8 OLI for land use/land cover mapping for the years 1990 and 2020. Before the pre-processing and classification of satellite imagery began, an extensive field survey was performed throughout the study area using global positioning system and cross check using google earth and toposheet. This survey was performed in order to obtain accurate locational point data for each land use and land cover class included in the classification scheme as well as creation of training samples and for signature generation. In supervised classification-Maximum likelihood algorithm, spectral signatures are developed from specified locations in image. These specified locations are given the name “Training samples”. These training samples are in raster format so transform raster to vector layer using arc tool box. These vector layers consist of various polygons overlying different land use types. This classification is the most commonly used quantitative method of change detection with fairly good results.

Table: 1 Interpretation Key for Satellite Imagery Elements

Elements	Interpretation technique	Description
Water bodies	Water bodies include that pixel reflecting dark blue to light blue in standard FCC and linear and irregular shape	This category comprises areas with surface water in the form of ponds, lakes, canals, etc.
Agricultural land	pixel reflection varies from light red to bright red and irregular to linear in shape	This category involves land under, crops, fallows, plantations.
Barren land	It appears in greenish blue and brown in colour with varying size and irregular to discontinuous shape	It is a bare exposed land devoid of vegetation.
Built-up land	It is having irregular to semi-circular shape and appears in cyan colour.	This category includes Residential, commercial, industrial, transportation, roads, mixed urban communication and recreational utilities.
Forest land	It exhibits bright red to dark red colour, smooth to medium texture and contiguous to non-contiguous pattern.	This is categorized as Mixed Forest lands, reserve forest scattered plants

Characteristics of colour reflection of pixels are with reference to standard False Colour Composition (FCC)

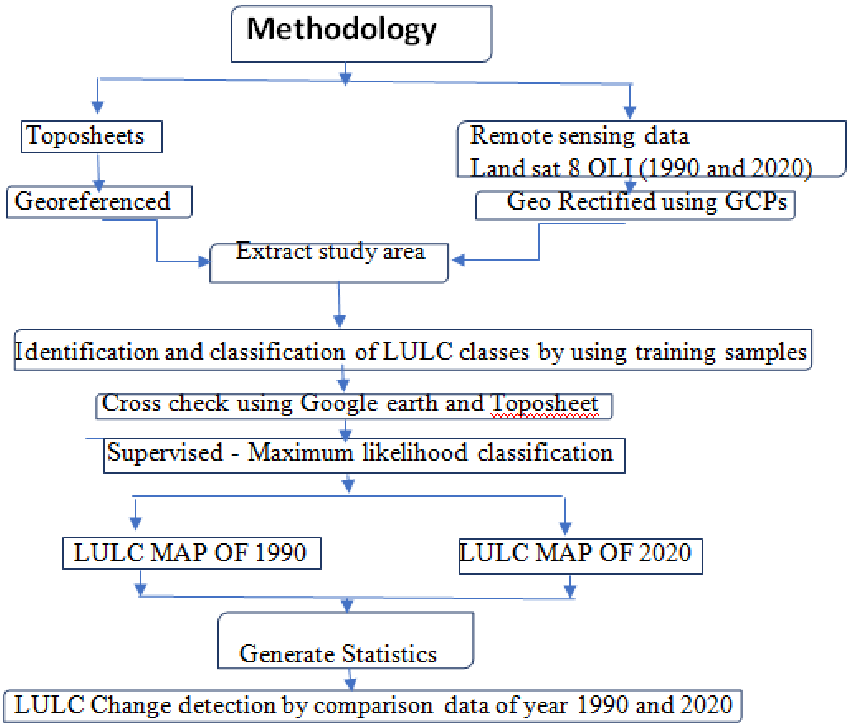


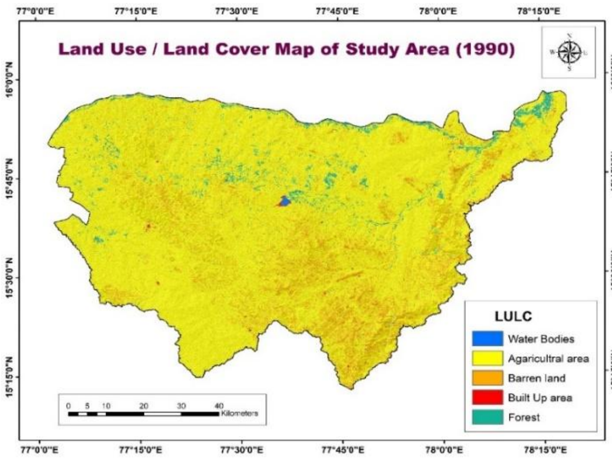
Figure 2: flow chat of methodology for LULC change detection

III. Result And Discussion:

The classified LULC Map of Tungabhadra River Basin of years 1990 and 2020 is given in (Fig 3, Fig4). The classification results summarised in (Table-2). percentage of classes based on these results shows the Land use and Land cover practices observed in basin area during 1990 and 2020, resultant Land use and land cover indicated a significant negative shift in agricultural land /crop land -2.24% and positive shift built- up area, waterbodies and forest 1.23%, 1%, 0.85% respectively. The comparison of each class 1990 to 2020 showed that there has been marked land use and land cover change during the study period 30 years.

Table :2 Classification results for 1990 to 2020

Class Name	1990		2020		change 1990- 2020	
	Area (Km^2)	%	Area (Km^2)	%	Area (Km^2)	%
Water bodies	5.93	0.09	68.76	0.99	62.83	0.91
Agriculture land	6015.93	86.76	5860.34	84.52	-155.59	-2.24
Barren land	655.93	9.46	604.66	8.72	-51.27	-0.74
Built up area	35.05	0.51	120.19	1.73	85.14	1.23
Forest	221.30	3.19	280	4.04	58.70	0.85
total	6933.95	100.00	6933.95	100.00	0.00	0.00



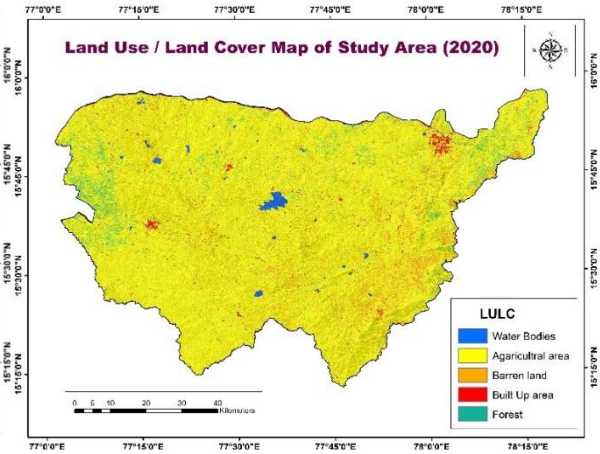


Figure 3: Land use and land cover map 1990   Figure: 4 Land use land cover map 2020

In the year 1990 agricultural /crop land was the single most important type of land use in the study area.it accounts a share of about (6015.93 sq.km)86.76% of the total area. In 2020, there has been decline in agricultural land. 5860.34 sq.km (84.52%) area was under this land use indicating 2.24% change. It has been observed in the basin that the settlement/built-up areas are mostly surrounded by agriculture area, especially in the catchment area and by the main streams. In 1990 the built-up area occupied an area about 35.56 sq.km accounting for 0.51% share of the total area. Most of the settlements are dispersed in form and pattern they are distributed throughout the study area. In 2020 this land use occupied 120.19sq.km area which accounts to about 1.73% of the total area. This land use thus, has shown a nearly three-fold increase between the time points taken for analysis. Due to Increased population and spread of urban related activities and other developmental activities. water bodies/water spread area both man-made and natural features such as Rivers, streams, wells, tanks reservoirs and canals are increased from 5.93sq.km in 1990 to 68.76sq.km in 2020.with net addition 62.83 sq.km due to implementation of watershed development projects like the Drought prone area programme (DDAP), Desert development programme (DDP), Integrated watershed development projects (IDWP) and Employment assurance scheme (EAS). The forest cover has incresased by 0.85% due to implementation of integrated forest protection schemes,intesification of forest management schemes,fodder feed development schemes. On other hand Barren land had been decreased by 0.74% which is transformed to settlements , shurbs and other develomental activities.

IV. Conclusion :

Remote sensing is an important technique to study both spatial and temporal phenomena.Through the analysis of remotely sensed data ,one can derive different types of information that can be combined with other spatial data with in a GIS .The integration of the two technologies create a synergy in which the GIS improves the ability to extract information from Remotely sensed data ,and remote sensing in turn keep the GIS up- to-date with actual environmental information .The Remote sensing and GIS can thus help people arrive at informed decisions about their environment.In this study Land use and land cover change detection of Tungabadra river basin over last three decades has analysed . The result of the study showed that significant change detection had obsered during the study period . Built -up area ,water bodies and forest area showed an increasing trend of 1.23%,1%,0.85% respectively.while agricultural and barren lands showed decreaseing trend 2.24% and 0.74% respectively.our results shows that there is a change in very small percentage incresed in water bodies (1%) and forest (0.85%) from 1990 to 2020. These changes have not fullfil the farming, live stock production, demostic needs and ecological balance and management in the basin.There fore improve the land management practies (soil and water conservation)integrated watershed management,with the help of GIS technique , areas may be identified for micro irrigation facilities implementation, constuction of check dams and moderanization of canals , improve plantation through social forestry and active participation of local communinity.

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