# Land use and Land Cover Change detection in the Catchment Boundary (CB) of Thadipudi Reservoir, Andhra Pradesh, India

Ummaneni Ajay Kumar[1], M Sarveswara Rao[2], Dr.T Byragi Reddy[3], K Punny[4], V Krishna Naik[5], Parvathi G[6], V Venugopala Rao[7], M Rajesh[8]

[1,2,8]*Research scholar (JRF), Department of Environmental sciences, Andhra University, Visakhapatnam 530003*

[3]*Professor, Department of Environmental sciences, Andhra University, Visakhapatnam 530003*

[4,7]*Research scholar, Department of Environmental sciences, Andhra University, Visakhapatnam 530003*

[5,6]*Research scholar, Department of Environmental sciences, Acharya Nagarjuna University, Guntur, 512612*

*Abstract* - **The land use/land cove (LULC) patterns of a region is an outcome of natural and socio – economic factors and their utilization by ma n in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on LULC and possibilities for their optimal use is crucial for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of adjusting demands of accelerating population.**

**Therefore, the present study is made to detect the land use/ land cover change between 2005-06 and 2015-16 for the Thadipudi Reservoir Catchment of Visakhapatnam and Vizianagaram districts, Andhra Pradesh, India using geo-spatial technologies. Landsat TM data for the year 2015 and IRS-1D-LISS-III data for the year 2015 have been used for extraction of thematic information on the analysis of land use/ land cover change detection. After drawing the maps and Graphs of Change detection, We concluded that the Varied Land use Land cover patterns like Agricultural Land-Cropped in two Seasons consists of 5.02% in 2005-06 and it had been changes to 4.17 % in 2015-16, Waterbodies-Reservoir/Tanks-Permanent consists of 2.69 % in 2005-06 and it absolutely was changes to 0.09% in 2015-16, Waterbodies-River/Stream-Non Perennial consists of 0.66% in 2005-06 and it had been changes to 0.02% in 2015-16 & Waterbodies-Reservoir/Tanks-Seasonal consists of 0.93% in 2005-06 and it had been changes to 3.54 % in 2015-16. During this study, we use the ARC GIS software version 10.2.2.1 for the Land use and Land cover change detection in Study area and find the varied changes in the patterns as explained above. The symptoms of LULC manifest because the current global environmental concerns like increasing concentrations of greenhouses gases within the atmosphere, loss of biodiversity and conversion and fragmentation of natural vegetation areas. Human activities like agriculture and mining strongly influence the hydrological cycle because of the alterations in infiltration, overland flow and or evapotranspiration as they cause changes in land-use.**

*Index Terms* - **Land use and Land Cover, Change detection, ARC GIS, Desktop, Catchment Boundary, Base Map & Drainage patterns etc.**

## 1.INTRODUCTION

Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes. The advancement within the concept of vegetation mapping has greatly increased research on land use land cover change thus providing an accurate evaluation of the spread and health of the world's forest, grassland, and agricultural resources has become a crucial priority. Urbanization, rapid population growth, land scarcity and expansion of agricultural land are among the various drivers of LULCC within the world. Global cities, which are the engines of economic development (Sherbinin, et al., 2007) with large populations, are most vulnerable to the impacts of land use and land cover (LULC) changes.

Rapid increase in human population and associated economic development further exacerbates the speed of these changes especially in fast growing urban areas (Liping, et al., 2018) threatening their sustainable growth. In keeping with the figures from the UN (2016), over 54.4% of the planet population in 2016 lived in cities and its projected to extend to 60% by 2030 exerting extra pressure on urban resources. This increase is progressing at a next rate within the developing countries where cities are growing thereby rapidly changing urban landscapes. Such zoom in the absence of adequate plan and infrastructure expedites LULC changes which are related to degrading ecosystem services and human well-being (Mallupattu and Sreennivasula, 2013; Kanal, et al., 2019; Mishra, et al., 2019. Generally, cities in developing nations are characterized by poor infrastructural plans, high immigration rates, growing squatter settlements, etc. This demand addressing unique challenges and opportunities for urban adaptation and mitigation responses and for mainstreaming them into urban development plans.

Viewing the Earth planet from space is now crucial to the understanding of the influence of man's activities on his resource base over time. In situations of rapid and infrequently unrecorded land use change, observations of the world from space provide objective information of human utilization of the landscape. Over the past years, data from Earth sensing satellites has become vital in mapping the Earth's features and infrastructures, managing natural resources and studying environmental change. Under such scenarios, studies using high resolution images and GIS can provide scientifically reliable information for planning environmental and economic development programs that are sensitive to achieving social and environmental goals (Weng, 2001; Rogan and Chen, 2004; Suresh, et al.,2011; Dutta, 2012; Rimal, et al. 2018). Remote Sensing (RS) and Geographic System (GIS) are now providing new tools for advanced ecosystem management. The gatherings of remotely sensed data facilitates the synoptic analyses of Earth - system function, patterning, and alter at local, regional and global scales over time; such data also provide an important link between intensive, localized ecological research and regional, national and international conservation and management of biological diversity (Wilkie and Finn, 1996). GIS is application oriented and also the digitized GIS an even be revised and also the databases is edited frequently as changes are often monitored. Remote sensing data is helpful to several disciplines because it can be utilized in geology, land-use/land cover, hydrology, forestry and or fisheries and plenty of others.

## 2. REVIEW OF LITERATURE

Land Use Land Cover (LULC) in urbanized areas is often a mosaic of human induced land uses; infrastructure (roads, bridges, and railways), built-up area, agricultural land, drainage/ water-bodies, waste land, etc. Therefore, conventional ground methods of land use mapping become labor intensive and time consuming. These maps soon become outdated with the passage of time, particularly in a rapidly changing environment. In fact, according to Olorunfemi (1983), monitoring changes and time series analysis is quite difficult with traditional method of surveying. In the last three decades there are large numbers of studies carried out on LULC change. Many authors have convincingly argued that LULC change in urbanized area is different from that of non-urbanized area (Cohen, 2006). Urbanized areas are predominantly covered with impervious area or built-up area with scattered & fragmented natural area.

Remote sensing and GIS are prominent tools which can be used to create accurate and timeous data pertaining to large scale LULC changes (Rogan and Chen, 2003). GIS provides a flexible and automated environment for collecting, storing, displaying and analyzing digital data which is necessary for change detection. Satellite imagery is used for recognition of synoptic data of earth's surface thus remote sensing provides pivotal data for GIS. Satellite data has high spectral resolution and rich archives of information and this makes them important for change detection (Reis, 2008).

In a study to analyze LULC changes in the Rize (North East of Turkey), Reis (2008), realized severe land cover changes in agriculture, pasture, urban and forestry areas between 1976 and 2000. Urbanization was identified as the main driver of land cover change in the Mula and Matha river catchment in India by Wagner et al., (2013).

Land-use changes are known to have an impact on the hydrology of any catchment area (Fohrer et al., 2001; Bronstert et al., 2002; Ott and Uhlenbrook, 2004; Tang et al., 2005). Research on the impact of land-use changes on surface hydrology has received considerable attention from both field observations and model simulations. Deforestation and forest degradation are the most important land-use change processes in Pangani River Basin, Tanzania (IUCN, 2003).

Madhuri Mulpuru et.al, (2019) has carried out Land Use/Cover change detection analysis for Thandava Reservoir Catchment of Visakhapatnam using Geo-Spatial technologies. In the analysis, both digital and visual interpretations of land use/land cover have carried out. The land use/land cover categories delineated from the study area categorized as Built-up land, Deciduous Forest, Degraded forest, Water body, Reservoir, Agriculture land, Dry land and other, Plantations, Barren rocky land. Land use/cover change detection for the years 2000 and 2011 were studied to project the extent and severity of deforestation in the reservoir catchment.

## 3. METHODOLOGY

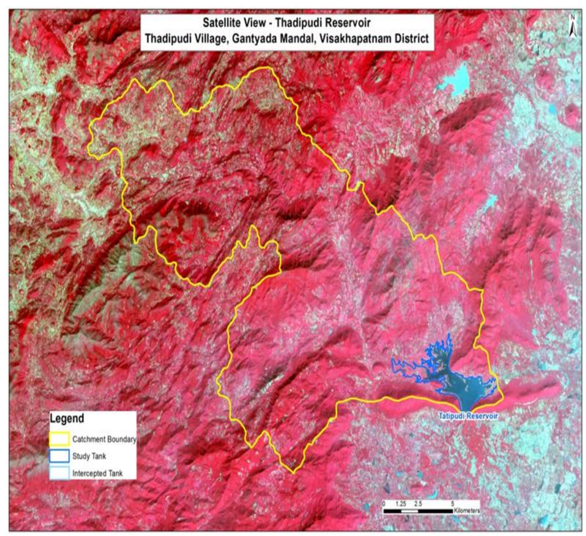
### 3.1. Study Area:-

The Thatipudi dam was built in the year 1963-68. The Thatipudi dam is in the Gantyada mandal of Vijayanagaram District, Andhra Pradesh, India. The Thatipudi reservoir is built across the Gosthani rever, with a capacity of 3.175 TMC water. At a distance of 8 KM from Vizag Araku road this reservoir is supplying water to Vizag city. The barrage is constructed over river Gosthani in Vizianagaram District. While travelling to Araku from Vizag this junction is at 50 KM distance from Kotha road Junction (Visakhapatnam) and this will come before the hilly area.

At a distance of 65 Kms from Vizag, 55 Kms from Araku & 632 Kms from Hyderabad, the Tatipudi Reservoir is located near Srungavarapukoda (also called S Kota) town situated between Vizag and Araku Valley in Vizianagaram district. The Cost of the project is Rs. 1,820 crores. T

he Ayacut of 15,378 acres (62 km2) has been stabilized in Gantyada, S.Kota and Jami Mandals of Vizianagaram District. The Reservoir is about 10 Kms from S Kota and can be reached via Kothavooru and Krishnapuram (while coming from Vizag), or via Tennuboddavara and Tadupudi village (while coming from Araku). Private vehicles can be hired by S Kota town to reach this place.

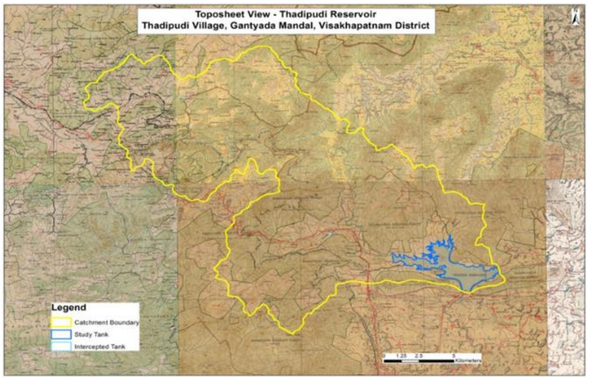
Below Map 1 shows the satellite view Thadipudi reservoir CB




### 3.2. Base Map Preparation –

Base map of the study area was prepared from the Survey of India Toposheet on 1:50,000 scale. The preparation of base map of the study area is the first step in the analysis of land use and land cover. Various permanent features like roads, rivers or any other land based features were transferred to the base map. Thereafter preliminary interpretation of satellite data was carried out and a preliminary interpretation key was prepared. The preliminary interpreted maps thus prepared were taken to field for ground checking.

Below Map 2 shows the Toposheet Map (Base map) Thadipudi reservoir



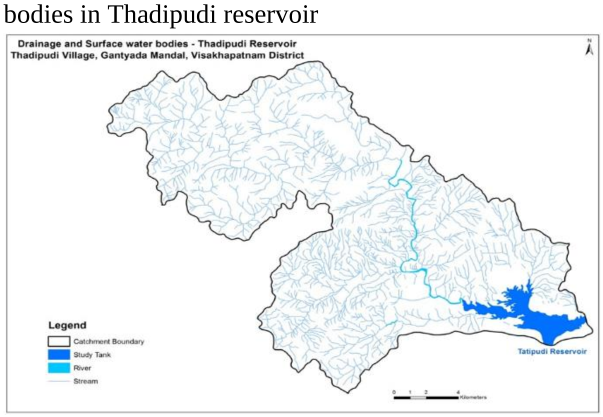

3.3. Software and Platforms:

Image processing was carried out by standard method followed by ground truth collection. Preparation of thematic maps from the digital satellite data was carried out by using ERDAS Imagine ver. 2015 and ArcGIS ver. 10.2.1.1. Standard methods, which included use of image elements like tone, texture, shape, location, association, pattern, etc., of digital image processing were adopted for vegetation mapping and ancillary information like elevation and landforms. These interpretation elements were followed by the preparation of interpretation key.

3.4. Drainage and Surface Water Bodies:-

Thadipudi Reservoir is constructed among the Gosthani River and Catchment area of Thadipudi reservoir is 79125.46 Sq.Kms and consists of 25 intercepted tanks which we called as Kuntas and having ayacut more than 15,000 acres. It is the one of the major reservoir that supplies drinking water for Visakhapatnam city and benefits more than 140 villages that covered in 5 mandals. The river stream consists of dendritic pattern, Centrifugal pattern and Rectangular patterns from main river stream.

Below Map 3 shows the Drainage patterns & water bodies in Thadipudi reservoir




3.5. Land use and Land cover classes Change detection:-

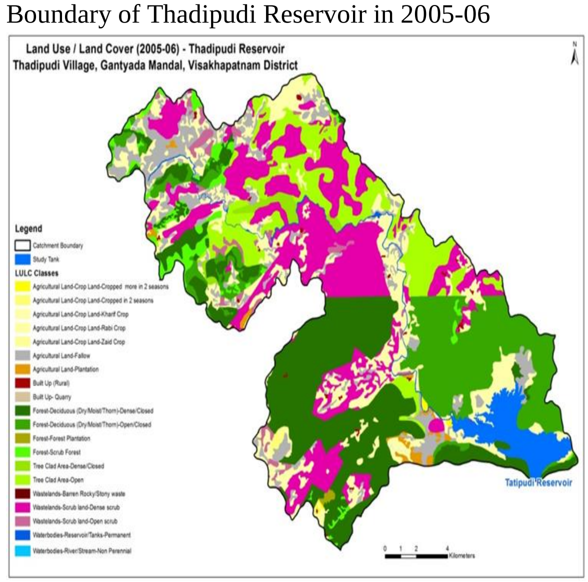
To prepare the LULC map from satellite imageries, a classification scheme which defines the LULC classes was considered. The numbers of LULC classes are preferred based on the requirement of a specific project for a particular application (Arora and Mathur, 2001; Saha et al., 2005). Level-1, level-2 and level-3 categories were identified following the NRSC (1990) guidelines. Six major LULC classes were chosen for mapping the entire watershed area viz; agricultural land; barren land; built-up land; dense forest; open forest and water-bodies. Area under irrigated agricultural land was included as agricultural land while area under agroforestry was included under open forest due to the similar spectral response of tree covers in agroforestry systems to open forests.

## 4. RESULTS AND DISCUSSION

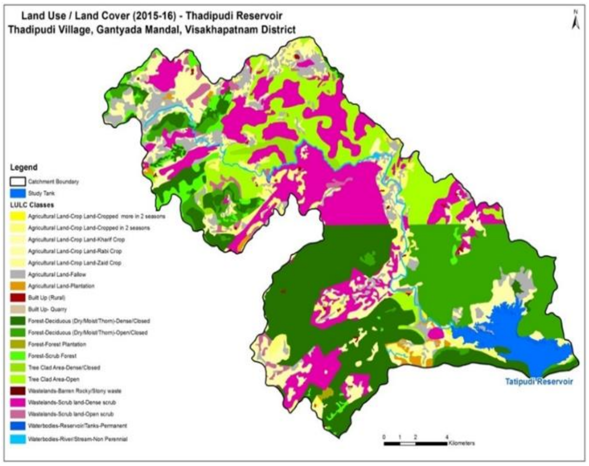
4.1. Encroachments in Land Use & Land Cover (LULC):-

After studying the Land use and Land cover patterns in the catchment boundary of Thadipudi reservoir, from 2005-05 to 2015-16 there are so many Land use land cover patterns will be changes takes place during the period.

Below map 5 shows the LULC patterns in catchment Boundary of Thadipudi Reservoir in 2005-06



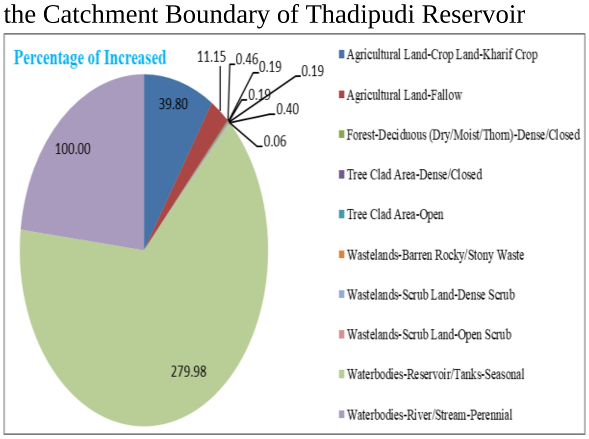

Below map 5 shows the LULC patterns in catchment Boundary of Thadipudi Reservoir in 2015-16




4.2. Increased LULC patterns in the Catchment Boundary:

Increasing area of LULC classes (percentage) in the catchment boundary are following: Agricultural Land-Crop Land-Kharif Crop (39.80%), Agricultural Land-Fallow (11.15%), Waterbodies-Reservoir/Tanks-Seasonal (279.98 %) & Waterbodies-River/Stream-Perennial (100.00%).

Below Graph 1 shows the Increased LULC patterns in the Catchment Boundary of Thadipudi Reservoir

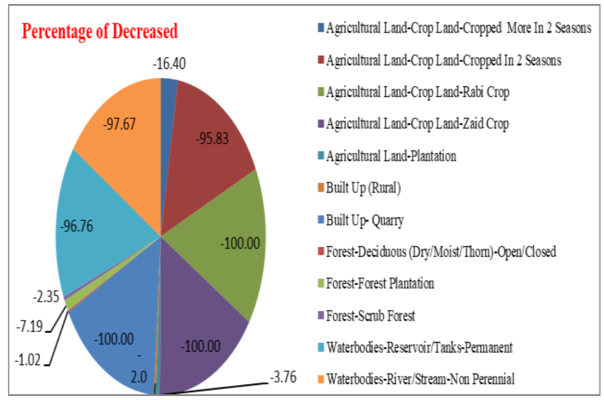



Decreased LULC patterns in the Catchment Boundary:

B Decreasing area of LULC classes (percentage) in the catchment boundary are following:

Agricultural Land-Crop Land-Cropped More In 2 Seasons -16.40, Agricultural Land-Crop Land-Cropped In 2 Seasons (-95.83%), Agricultural Land-Plantation (-3.76 %), Built Up (Rural) (-2.09 %), Forest-Deciduous (Dry/Moist/Thorn)-Open/Closed ( -1.0%), 2 Forest-Forest Plantation (-7.19%), Waterbodies-Reservoir/Tanks-Permanent (-96.76 %) &Waterbodies-River/Stream-NonPerennial(-97.67% )

Below graph shows the Increased LULC patterns in the Catchment Boundary of Thadipudi Reservoir




## 5. CONCLUSIONS

Remote Sensing and Geographical Information System (GIS) are well accepted and more dependable advance techniques to detect change in land use and land cover pattern by providing more reliable direct quantitative information. Land use/cover change detection for the years 2005-06 and 2015-16 were studied to project the extent and severity of deforestation in the Thadipudi reservoir catchment. From the study of Land use & Land cover changes in the catchment boundary of Thadipudi reservoir, the feeder channels of the Thadipudi reservoir are either choke with vegetation or disruptive with local constructions through illegal operations which results in low inflow into existing reservoir. The changes in the catchment area observed as the existing farm lands are diverted either into real estate business or industrial purpose. From the satellite images, it is also observed the discharges from the residential areas are causing change in catchment boundary of reservoir which in turn alters in the biodiversity in the area. At present the responsibility for the protection of boundaries of water bodies lies with the State Governments, as they are the absolute owners of water bodies located in their State. ‘Water’ being a State subject, several steps for augmentation, conservation and efficient management to ensure sustainability of water resources are undertaken by the respective State Governments

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