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Identifying the changes of surface cover pattern using spatial technology of Padmanabham Mandal, Visakhapatnam District, Andhra Pradesh – India

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Abstract - Land use Land cover (LULC) classification is vital in identifying, assessing and analyzing the changes of surface cover pattern by using the Remote Sensing (RS) and Geographic Information System (GIS). Land cover especially implies the spatial distribution of the various classes of land cover that can be assessed both qualitatively as well as quantitatively through remote sensing techniques, while land use mainly focuses on human activities determined by the integration of natural and social scientific methods in various landscapes even having same land cover (Nilimesh Mridha et al., 2021). Modifications in LULC have a significant impact on both urban and environmental planning, especially in light of the fast urbanisation cycle (Anant Patel et al., 2024). This study analysed the status of LULC changes for the last 20 years. The results show that Agricultural Plantation decreased by 8.74%, Cropland decreased by 3.28%, Built up increased by 11.11%, water Bodies increased to 1.67%.

Index Terms- Arc GIS Pro, GIS, Land use Land cover classes, Remote Sensing.

I. INTRODUCTION

Agriculture is the backbone of the Indian economy which plays the most decisive role in the rural development. Agriculture is an important part of rural India's economy. A huge part of Indian population lives in villages. 83.3 crore (68.84%) Indian population lives in 6, 40,867 villages and its size is more than 833.33 million. Agriculture is the primary source of livelihood for about 58% of India's population. Agricultural sector provides 43.21 percent employs in India and contributes around 14% of India's gross domestic product (GDP) (Vishnu Kant Verma et al., 2020). But due to rapid urbanisation, agriculture activities are decreasing from decades even in the rural areas. So we need to find the area used for agriculture activities and for various purposes. In order to estimate the surface area covered by various features on the earth surface Land Use Land Cover (LULC) method can be utilised.

LULC spatial data is a fundamental requisite to determine the quantitive and qualitative changes in a region. To determine these changes, Remote sensing (RS) and Geographic Information System (GIS) techniques were considerably helped over the past few decades. With the progress of the development of these technologies in terms of improving the accuracy of Image's resolution, spatial accuracy and the availability of multiple image satellites, motivating innovations have been created, accompanied by high accuracy in changes over the earth's surface. LULC change describes all physical and man-made changes that occur on the earth's surface including vegetation, forests, topography, residential, agricultural, industrial and recreational uses (Hemin Nasraldin et al., 2023).

Earth natural resources mainly land surfaces has already degraded in a large portion (>80%) through human activities and the regions with high population density faces the intense degradations (Md Mahadi Hasan Seyam et al., 2023). Due to high urbanization rates, land use is changing from natural to man-made along with resource extractions that accelerate the land cover changes (Sami AI Jaber et al., 2014).

Change detection is a process of identifying and analyzing the differences of an object or a phenomenon through monitoring at different times. A wide range of applications can be benefited from the study of change process over a specified area at different times. Application of remotely sensed data made to study the changes in land cover in less time, at low cost and with better accuracy in association with GIS that provide suitable platform for data analysis. Change detection is either changes in the land itself or objects on the land, it provides

information that is important when making decisions that affect land use. The collaboration of remotely sensed data and field observations can accomplish land cover classification and change detection (Siva Prathap T et al., 2015). The main focuses of this study is to identify and analyse the changes of LULC in Padmanabham Mandal from 2003 to 2023 by using Landsat-4 and Sentinel-2B satellite images. The LULC changes are confirmed by using Remote sensing, GIS and limited field observations in the study area.

II. STUDY AREA

The area of study Padmanabham Mandal is located in Visakhapatnam District of Andhra Pradesh - India and bounded by $17^0 59' 40''$ North latitude and $83^0 33' 53''$ East longitude, covering an area of 137.12 km^2. (Fig-1). It is bounded by Bheemunipatnam towards the south, Jami Mandal towards the west, and Bhogapuram Mandal towards the east in Vizianagaram district. Gostani river flows through this area stretching nearly 120 km. As per 2011 census the total population of the Mandal was 52,079, and has a population density of 347.5 inhabitants per square kilometre. There are about 13,274 houses in the sub-district. When it comes to literacy, 45.15% population is literate, out of which 52.05% males and 38.30% females are literate. There are about 25 Revenue Villages and 22 Gram Panchayats in Padmanabham Mandal. The climate of this region is tropical wet and dry climate. The temperature varies from 24.47 °/C to 31.93 °/C. The soil of this area is mostly suitable for agriculture.

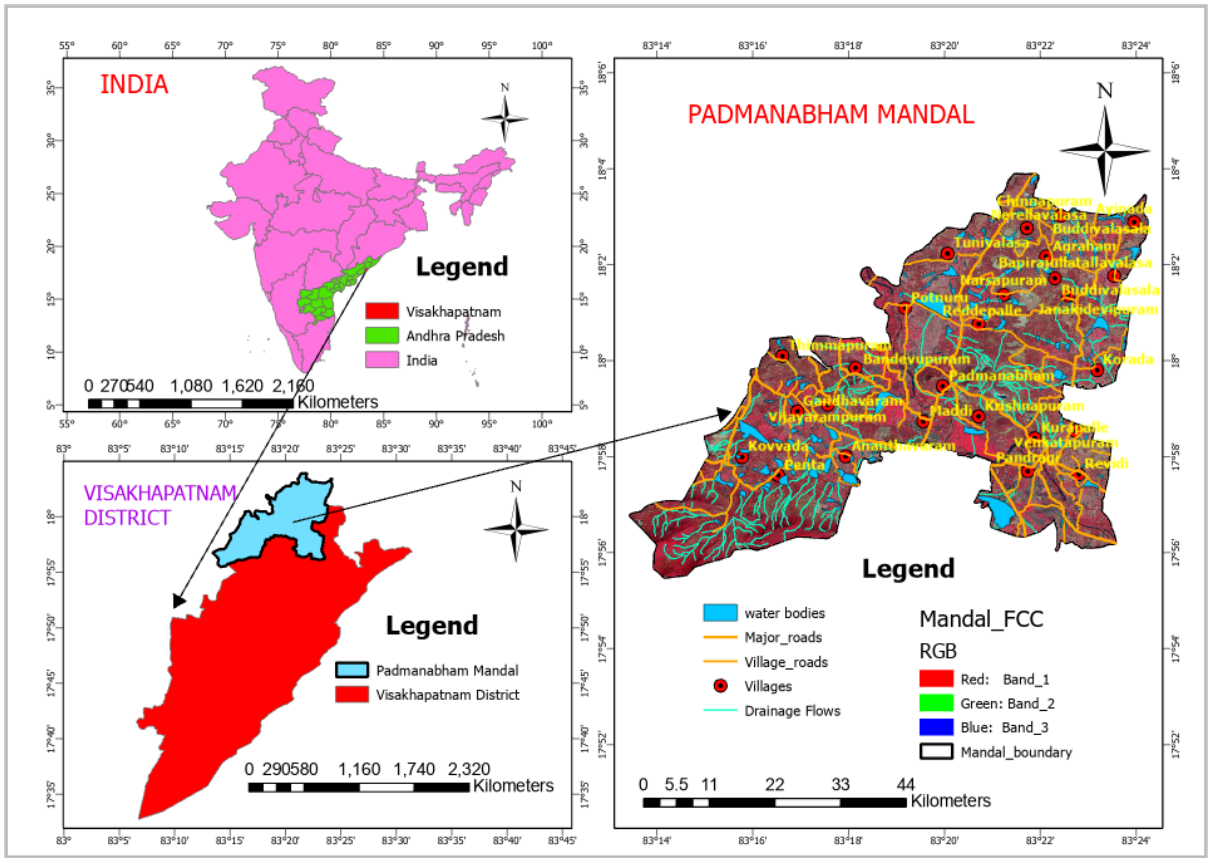

Fig-1: Location map of Padmanabham Mandal

III. DATA USED

For monitoring the changes in LULC, Landsat-4 data of 2003 and Sentinel-2B digital data of 2023 and also, Survey of India (SOI) topographical maps of the series 65 O/1, 65 O/5, 65 N/4, and 65 N/8 with a scale 1:50000 have been used (Table-1).

Table-1: List of Satellite Images used in the study

Image	Sensors	Spatial resolution	Wave length range	Selected bands	Path/Row	Date of acquisition	% of scene cloud coverage
Sentinal-2B	Multi Spectral Instrument (MSI)	10m	443-2190 nm	8,4,3	NO509/ RO76	28/9/2023	0.1%
Landsat-4	Thematic Mapper (TM)	30m	0.45-2.35um	4,3,2	141/48	5/10/2003	1.0 %

IV. METHODOLOGY

Present study is based on geo-referenced Survey of India topomaps with a scale of 1:50,000 and satellite images for the years 2003 and 2023. The goal of using these images is to identify the long term change in land use pattern.

Satellite images of Landsat 4 (2003) and Sentinel 2B (2023) were used for visual interpretation of features by the guideline NRSA (1989). Visual interpretation in remote sensing is a method used to analyze and interpret images captured by satellites or aerial sensors. This process involves examining these images to identify and classify features on the Earth's surface.

The major classes or features identified from Landsat - 4 (2003) image were Agriculture plantation, Cropland, Fallow land, Forest plantation, Built-up, Water bodies, River, Waste land, Abounded Quarry, Gullied and Grazing; from Sentinel – 2B image, major classes identified were Agriculture plantation, Cropland, Fallow land, Forest plantation, Built-up, Water bodies, River, Agri-Industries, Waste land, Abounded Quarry, Gullied and Grazing. Limited field survey was performed for Sentinel – 2B image of 2023 for each LULC class included in the classification scheme throughout the study area. Arc GIS Pro software was utilized for visual interpretation and map layout in the study area.

V. RESULTS AND DISCUSSIONS:

The general land use of an area depicts an idea of overall areal utilization of resources, natural or cultural. LULC occupied classes in Fig-2 and the graphical representation of the LULC classes in Fig-3. The LULC class areas are occupied as agriculture plantation 49.78 km^2, cropland 43.234 km^2, built up land1.332 km^2, forest plantation 13.245 km^2, fallow land 18.269 km^2, river area 2.25 km^2, water body 2.689 km^2, waste land 3.347 km^2, abounded quarry 0.663 km^2, gullied land 2.221 km^2 and grazing land 0.045 km^2 respectively.

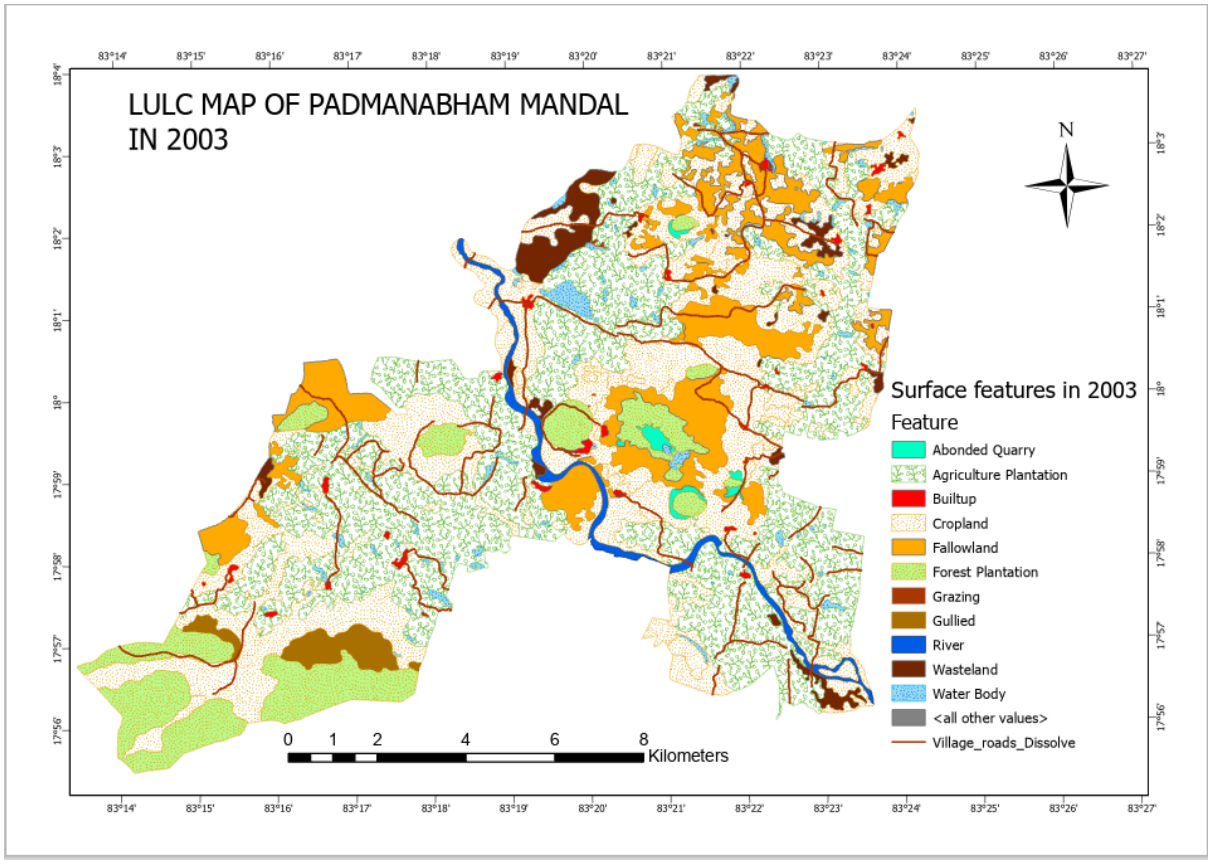

Fig-2: LULC map of Padmanabham Mandal of Landsat – 4 in 2003

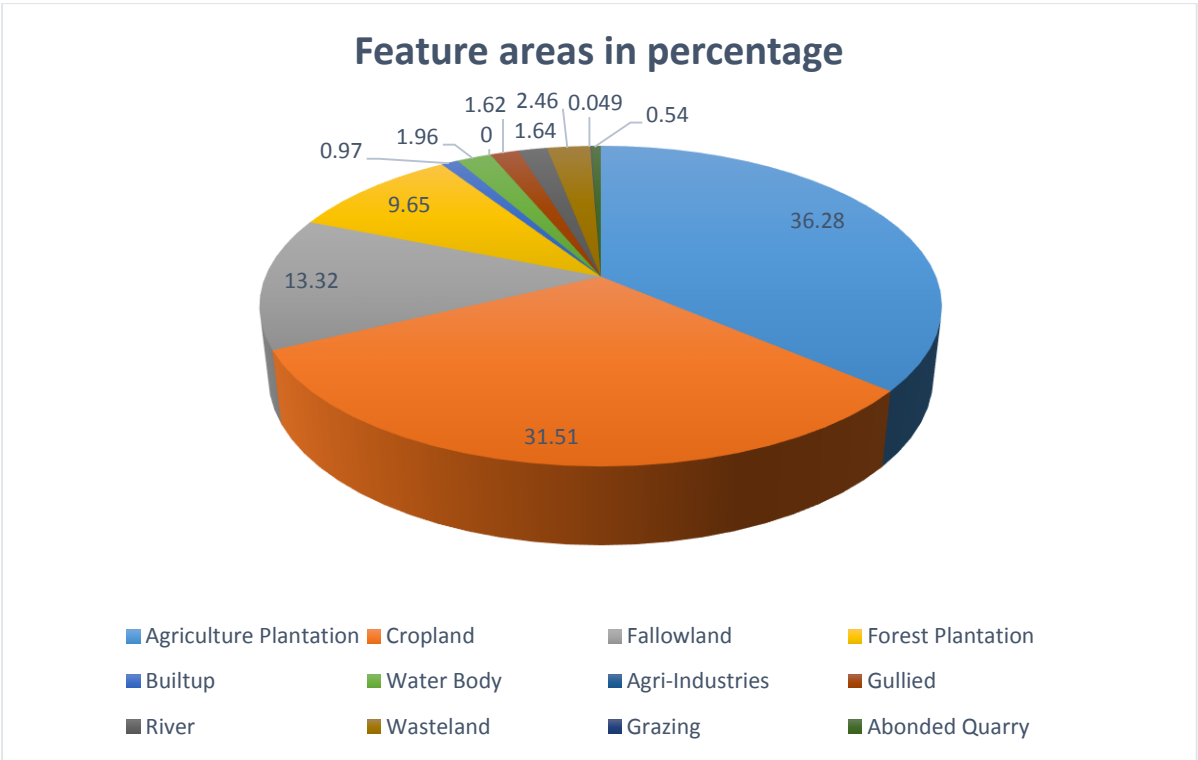

Fig-3: represents the percentages of areas of features in the year 2003

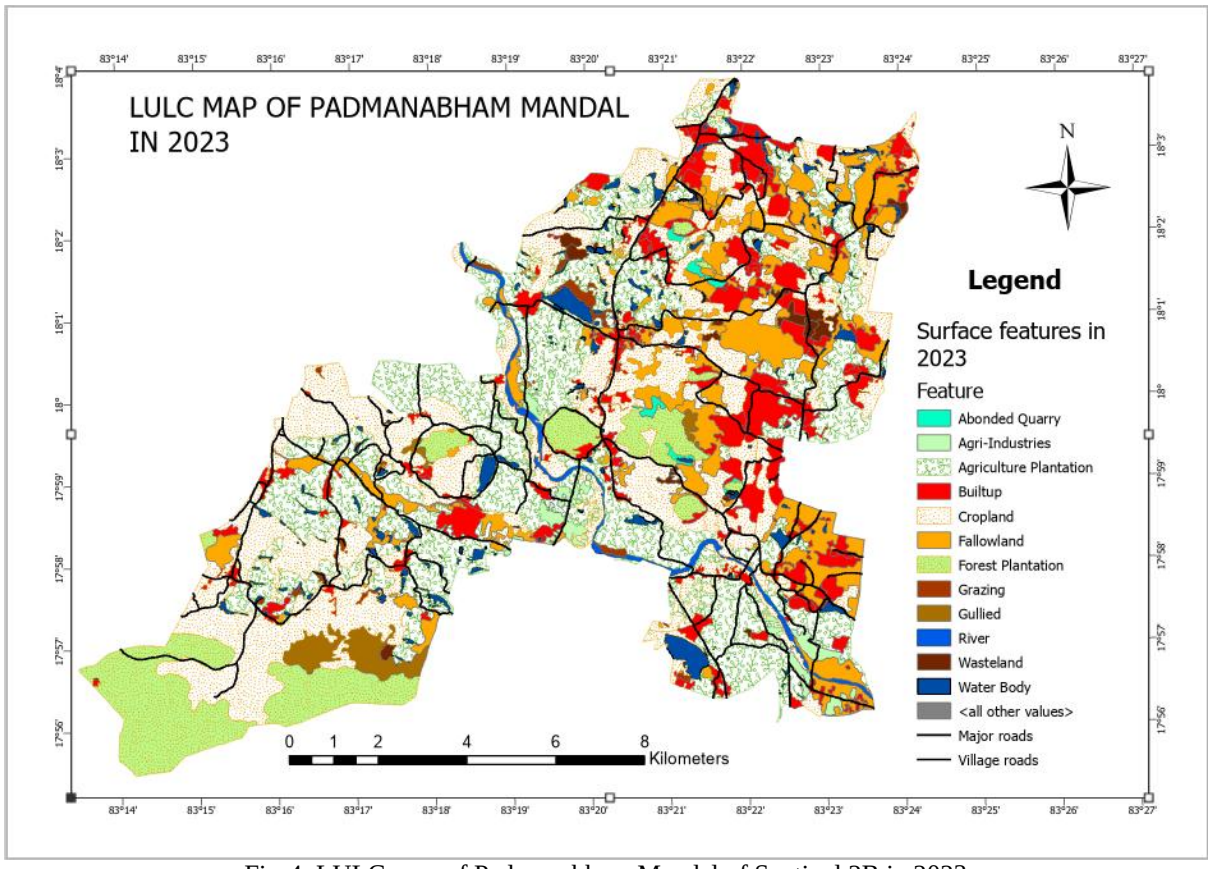

Fig-4: LULC map of Padmanabham Mandal of Sentinel 2B in 2023

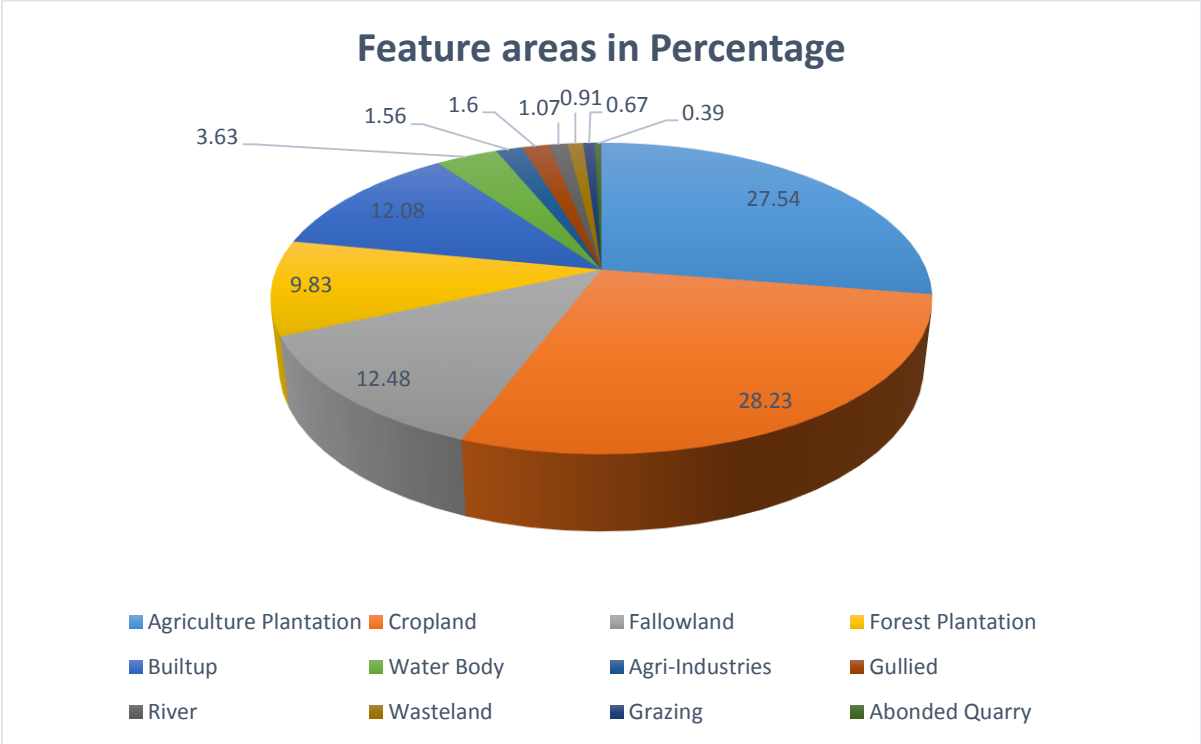

Fig-5: represents the percentages of areas of features in the year 2023

The LULC classes of 2023 are in Fig-4 and the graphical representation of the occupied LULC classes are in Fig-5. The areas of LULC classes are cropland 38.736 km^2, agriculture plantation 37.784 km^2, built up area 16.577 km^2, forest plantation 13.491 km^2, fallow land 17.124 km^2, river area 1.473 km^2, water bodies 4.984 km^2, waste land 1.245 km^2, abounded quarry 0.496 km^2, gullied land 2.202 km^2, grazing land 0.923 km^2. And the variation of the LULC classes from 2003 to 2023 is in Fig-6

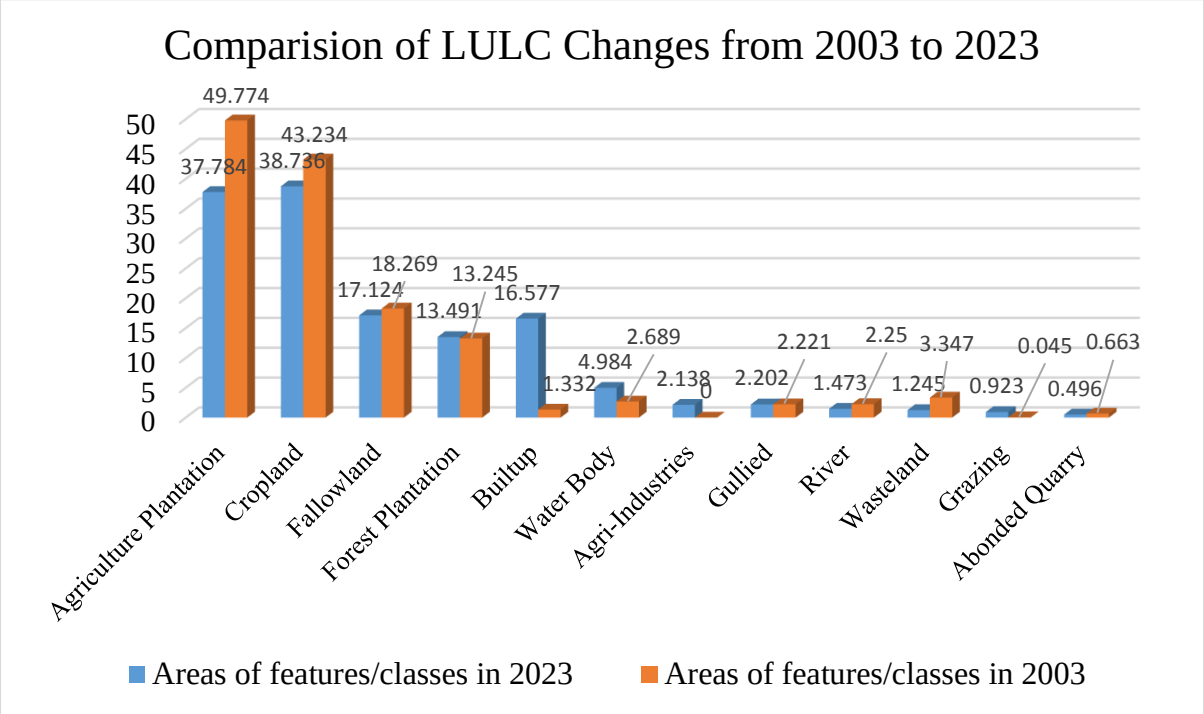

Fig-6: Graphical representation of LULC changes from 2003 to 2023 in the study area.

VI. CONCLUSIONS

Landsat imagery, Sentinel 2B and GIS-based remote sensing techniques have been used to evaluate LULC changes in the study area. These techniques greatly facilitated the method that calculates LULC changes between 2003-2023 in the study area. The study concluded that considerable changes occurred in LULC in the study area due to human activities. The research demonstrates from the Fig-6 is, the change in agriculture plantation is decreased by 8.74% from 2003 to 2023 due to scarcity of water, quarrying of hills and increased in built up near the foot hills, as mostly these can be observed at the foot hills and near the water bodies. Even though the land and soil present in this area is very fertile but due to scarcity of water as mostly, these people depend on the seasonal flow of river Gostani and rainfall and in increased built up i.e., urbanisation, so the area of cropland is decreased by 3.28%. We observed that there is tremendous increase in the built up i.e.,11.11% of the study area over the last two decades due to urbanisation, as this place is nearer to the Visakhapatnam city and Vizianagaram district. Besides this, we can also observe the development of agri-industries in this area i.e.,1.56% as this land is mostly suitable due to the flow of river. Area of the water bodies is increased to 1.67%, in order to provide storage for surface runoff and to prevent the area from flooding. Thus, it concludes that major LULC change is identified in agriculture plantation and built up due to rapid urbanisation as the study area is nearer to the cities of Visakhapatnam and Vizianagaram.

VII. REFERENCES

[1]. Akhtar Alam, M. Sultan Bhat, M. Maheen, Using Landsat satellite data for assessing the land use and land cover change in Kashmir valley, GeoJournal (2020) 85:1529–1543.

[2]. Anant Patel, Daivee Vyas, Nirali Chaudhari, Rinali Patel, Krisee Patel, Darshan Mehta, Novel approach for the LULC change detection using GIS & Google Earth Engine through spatiotemporal analysis to evaluate the urbanization growth of Ahmedabad city, Results in Engineering, 2024.

[3]. Anil Yedage, Sagar Mali, Application of Geo-Spatial Technology for land use land

cover change detection of Dharbandora Taluka of Goa-India, International Journal of Food and Nutritional Sciences, 2024, 554-560.

[4]. Ch. Vasudeva Rao, K. Hari Krishna, B. Rajya Lakshmi, E. Amminedu, G. Jai Sankar and V. Venkateswara Rao, studies on land use/land cover and change detection of G. Madugula tribal Mandal of Visakhapatnam district, Andhra Pradesh, India – using Remote Sensing and GIS techniques, International Journal of Advance Research in Science and Engineering, Vol. No.3, Issue No.9, 2014, 245-253.

[5]. Eric F. Lambin, Helmut J. Geist, and Erika Lepers, Dynamics of land-use and land-cover change in tropical regions, 2003, 205-241.

[6]. Gebeyehu Abebe1, Dodge Getachew, Alelgn Ewunetu, Analysing land use/land cover changes and its dynamics using remote sensing and GIS in Gubalafito district, North-eastern Ethiopia, SN Applied Sciences, 2022.

[7]. Harshika A Kaul and Ingle Sopan, Land Use Land Cover Classification and Change Detection Using High Resolution Temporal Satellite Data, Journal of Environment 2012, Vol. 01, Issue 04, 146-152.

[8]. Hemin Nasraldin, Sabah Majeed, Land Use and Land Cover Assessment of Kalar Area, Kurdistan using RS and GIS, 2023.

[9]. Jagdish Chand, Change Detection in Land Use and Land Cover Using Remote Sensing Data and GIS in Renuka Forest Division, European Academic Research, Impact Factor: 3.1, 2014, 432-447.

[10]. Land use Land cover guidelines of NRSA 1989.

[11]. Md Mahadi Hasan Seyam, Md Rashedul Haque, Md Mostafizur Rahman, Identifying the land use land cover (LULC) changes using remote sensing and GIS approach: A case study at Bhaluka in Mymensingh, Bangladesh, 2023.

[12]. Nilimesh Mridha, Debasish Chakraborty, Aniruddha Roy and Sushil Kumar Kharia, Role of Remote Sensing in Land Use and Land Cover Modelling, 2021.

[13]. P.S. Roy and Arijit Roy, Land use and land cover change in India: A Remote sensing & GIS prespective, Journal of the Indian Institute of Science, 2014, 489-502.

[14]. Sami Al Jaber, Amit Kumar Ghosh, Mallik Sezan Mahmud, Using Time Series of Satellite Images to Detect Vegetation Cover Change in Dhaka City, Journal of Geographic Information System, 2014, 6, 653-663.

[15]. Siva Prathap T, Srikanth Reddy D, Spatio-Temporal Analysis of Pulivendula Mandal, Andhra Pradesh, India using Remote Sensing and GIS, International Journal of Research in Engineering and Applied Sciences, Volume 5, Impact factor – 5.981, Issue 11-November, 2015, 133-143.