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Detection of Land Use & Land Covers Change With Ndvi in Anantapur Mandal, Anantapur District, Andhra Pradesh

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Abstract:
The management of natural resources and monitoring environmental changes now heavily relies on understanding land use and land cover alterations. In Anantapur mandal, a study was conducted to map and monitor land use and land cover changes to safeguard natural resources and investigate the impacts of soil and water resource exploitation. By analyzing satellite images from 2014 and 2024 through LULC Supervised classification and NDVI calculations, the study aims to assess the transformations in land use and land cover as well as Normalized Difference Vegetation Index (NDVI) is a simple graphical indicator that is often used to analyze Remote sensing & GIS measurements and assess whether the target being observed contains green health vegetation or not in the Anantapur mandal from 2014 to 2024 using Geoinformatics tools and applications.

Keywords: Landuse, Land cover, RS, GIS, Change Detection & NDVI

Introduction:

Land use and land cover changes are critical aspects of environmental monitoring and management. Anderson (1977) proposed a framework for monitoring these changes, emphasizing the importance of understanding how human activities impact the landscape. This framework serves as a foundation for studies like those conducted by Chen et al. (2012) and Im et al. (2007), who explored object-based change detection techniques using remote sensing technology. By analyzing correlation images and employing image segmentation, researchers can identify and quantify changes in land use and cover over time.

Furthermore, studies such as Rawart et al. (2013) and Sankhala et al. (2014) have applied geospatial techniques to assess changes in land use and cover in specific regions. For example, Rawart et al. (2013) conducted a case study in the Ramnagar town area of Uttarakhand, India, using remote sensing data to track changes in land use patterns. Similarly, Sankhala et al. (2014) evaluated urban sprawl and land use changes in Jaipur City, India, utilizing remote sensing and GIS techniques to analyze spatial trends.

Land use/land cover change is a critical aspect of urban development that requires continuous monitoring and assessment to understand the impact on the environment and society. In a study conducted by Roohifatma & Vandana Kumari Chouhan (2019) in Unnao Town, Uttar Pradesh, the authors assessed the land transformation due to urban sprawl using remote sensing and GIS techniques. The findings of the study revealed significant changes in land use patterns, with a noticeable increase in

built-up areas at the expense of agricultural land. This transformation has implications for food security, environmental sustainability, and overall urban planning in the region.

Similarly, Sadhana Jain & Swadesh Kumar (2010) conducted a study on settlements mapping using high-resolution imagery for disaster mitigation and rehabilitation. The research focused on identifying vulnerable areas and developing strategies to enhance disaster preparedness and response. The results of the study provided valuable insights into the spatial distribution of settlements and infrastructure, aiding in the formulation of effective disaster management plans.

Furthermore, Shoukat Ali Shah & Mdheeha Kiran (2021) employed GIS-based techniques to analyze land use and land cover change detection in taluka Mirpur Mathelo, district Ghotki, Pakistan. The study highlighted the dynamic nature of land use changes in the region, emphasizing the need for sustainable land management practices to mitigate environmental degradation and promote socio-economic development.

In a geographical analysis conducted by Vineet Kumar Rai & Gayatri Rai (2019) in Ghazipur district, Uttar Pradesh, the authors examined land use changes and their implications on local communities. The study underscored the importance of understanding the drivers of land use change, such as population growth, urbanization, and agricultural practices, to inform policy decisions and promote sustainable development in the region.Overall, these studies highlight the importance of monitoring land use and cover changes to inform sustainable land management practices. By utilizing remote sensing technology and geospatial analysis, researchers can gain valuable insights into the dynamics of land use changes and their implications for environmental conservation and urban development, these studies demonstrate the significance of utilizing remote sensing and GIS techniques to assess land use/land cover changes, providing valuable insights for informed decision-making and sustainable development planning (Rahman et al., 2011).

Study Area:

The study area of Anantapur mandal is located in the northern part of Anantapur district (Fig:1). It is positioned between 14˚40' 54"N latitude and 77˚36' 44" E longitude. Anantapur mandal is bordered by Garldine mandal to the north, Kudair mandal to the northeast, Atmakur mandal to the west, Raptadu mandal to the south, Dharmavaram and Bathalapalle mandals to the southeast, and Bukkarayasamudram and Narpala mandals to the east and northeast. The geographical area of the mandal covers 362 sq km, with a population of 388,023 as per the 2011 census. The population density is 1396 persons per sq km. Anantapur district faces challenges of inadequate monsoons and frequent droughts due to unfavorable weather conditions. The average rainfall in the district is 553.0 mm, making it one of the regions with the lowest rainfall in Rayalaseema and other parts of Andhra Pradesh.

Aims & Objectives:

- To map the land use and land cover classes of Anantapur mandal in Anantapur District for 2014 and 2024.
- To determine the changes in land use and land cover for 2014 & 2024.
- To check the Normalized Difference Vegetation Index for 2014 & 2024.

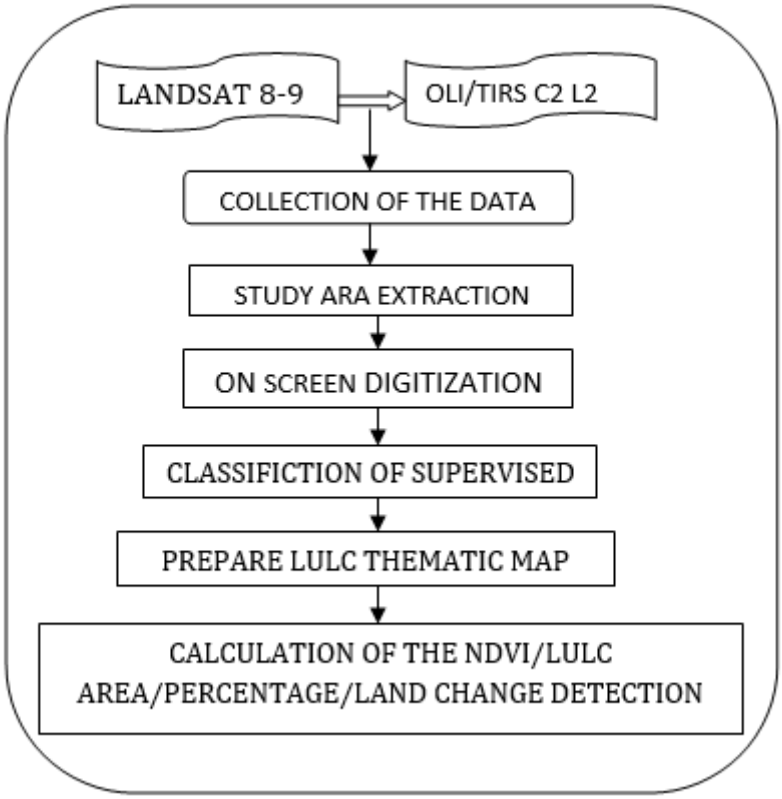
Data:

- Landsat images were utilized to identify changes during the study period from 2014 to 2024 Data on

land use, land cover, and change detection with NDVI were obtained from Landsat 8-9 OLI/TIRS C2 L2 for the years 2014 and 2024.

- The satellite images were downloaded freely from the USGS Earth Explorer Earth Resource Observation System data center.
- Software used: ArcGIS 10.3 & M.S. Office

Methodology:



Result and Discussion:

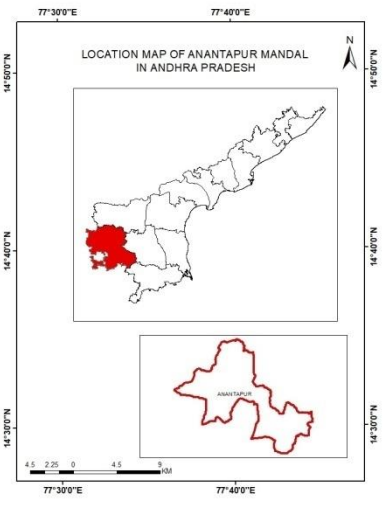


Fig:1

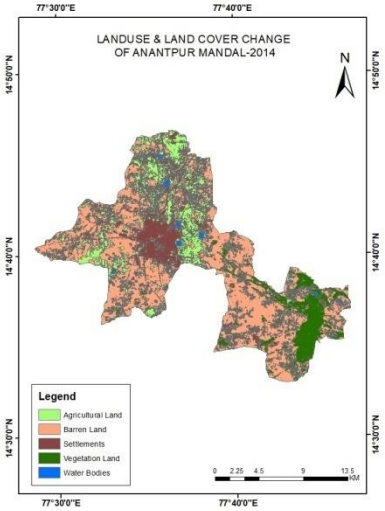


Fig:2

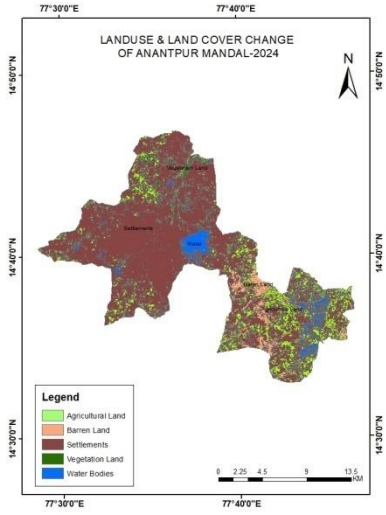


Fig:3

Table: 1 LANDUSE & LAND COVER CHANGE ANANTAPUR MANDAL-2014

s.no	Name of the Class	Areasqkm	Area percent
1	Water	2.747894	0.928498
2	Agriculture Land	55.327309	18.694783
3	Vegetation Land	44.570805	15.060221
4	Settlements	50.625517	17.106074
5	Barren Land	142.679007	48.210424

The table: 1 presents data on land use and land cover change in Anantapur mandal in 2014. The area in square kilometers and the corresponding percentage of each land class are provided. The classes include Water, Agriculture Land, Vegetation Land, Settlements, and Barren Land. Water covers the smallest area at 2.747894 sqkm, accounting for 0.928498% of the total area. Agriculture Land is the most extensive class, covering 55.327309 sqkm, which represents 18.694783% of the total area. Vegetation Land covers 44.570805 sqkm, accounting for 15.060221% of the area. Settlements cover 50.625517 sqkm, making up 17.106074% of the total area. Barren Land is the largest class, covering 142.679007 sqkm, which represents 48.210424% of the total area. This data provides valuable insights into the distribution of different land use and land cover types in Anantapur Mandal in 2014, which can be crucial for understanding the urban landscape and planning for sustainable development in the region.

Table:2 LANDUSE & LAND COVER CHANGE ANANTAPUR MANDAL-2024

s.no	Name of the Class	Areasqkm	Area percent
1	Water	12.608686	4.2604
2	Agriculture Land	58.177366	19.657787
3	Vegetation Land	4.626589	1.563297
4	Settlements	212.041888	71.647697
5	Baren Land	8.49621	2.870819

The table: 2 presents data on land use and land cover change in Anantapur Mandal area for the year 2024. The table consists of five classes: Water, Agriculture Land, Vegetation Land, Settlements, and Barren Land. The "Area sq km" column indicates the area covered by each land use class in square kilometers, while the "Area percent" column shows the percentage of the total area that each class covers.

Water covers an area of 12.608686 sq km, accounting for 4.2604% of the total area. Agriculture Land occupies the largest area, with 58.177366 sq km, representing 19.657787% of the total area. Vegetation Land covers 4.626589 sq km, making up 1.563297% of the total area. Settlements have the highest coverage, with an area of 212.041888 sq km, accounting for 71.647697% of the total area. Barren Land covers 8.49621 sq km, representing 2.870819% of the total area.

This data provides valuable insights into the distribution of different land use and land cover types in Anantapur mandal area in 2024. The high percentage of Settlements indicates significant urbanization in the area, while the presence of Agriculture Land and Vegetation Land highlights the importance of these areas for agricultural and ecological purposes. Understanding these land use patterns is crucial for effective urban planning and environmental management in the region.

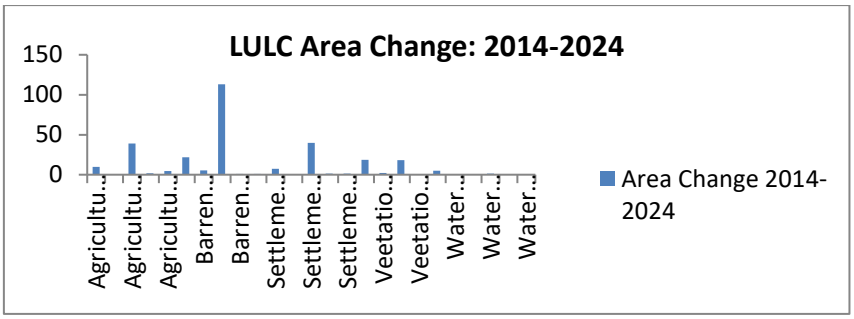


Fig:4

Table: 3 LAND USE & LAND COVER CHANGE DETECTION OF ANATAPUR MANDAL: 2014-2024

LULC change Detection 2014-2024	Area change(sq)
Agricultural Land – Agricultural Land*	9.968653
Agricultural Land - Barren Land	0.080984
Agricultural Land - Settlements*	38.851809
Agricultural Land - Vegetation*	1.73575
Agricultural Land - Water	4.641724
Barren Land - Agriculture Land	21.886104
Barren Land - Barren Land	5.431338
Barren Land - Settlements	113.175853
Barren Land - Vegetation Land	1.050591
Barren Land - Water	0.987589
Settlements - Agriculture Land	7.329062
Settlements - Barren Land	0.625835
Settlements - Settlements	40.002911
Settlements - Vegetation Land	1.403229
Settlements - Water	1.23314
Vegetation Land - Agriculture *	18.522665
Vegetation Land - Barren Land	2.325301
Vegetation Land - Settlements	18.259746
Vegetation Land - Vegetation Land*	0.257622
Vegetation Land - Water	5.15228
Water Bodies - Agriculture Land*	0.39246
Water Bodies - Barren Land	0.02459
Water Bodies - Settlements	1.563022
Water Bodies - Vegetation Land	0.176448
Water Bodies - Water	0.590928

Table: 3 presents the results of a land use and land cover change detection study conducted over the period of 2014-2024. The table specifically focuses on the changes in land use and land cover categories between 2017 and 2023, with the corresponding area changes in square units. The categories analyzed include Agricultural Land transitioning to various land cover types. The results indicate that a significant

portion of Agricultural Land has undergone changes during the study period. For instance, Agricultural Land transitioning to Agricultural Land experienced an area change of 9.968653 square units. Additionally, transitions to Barren Land, Settlements, Vegetation, and Water were also observed, with area changes of 0.080984, 38.851809, 1.73575, and 4.641724 square units, respectively. These findings suggest dynamic land use patterns and highlight the importance of monitoring and understanding land use changes for sustainable land management and environmental conservation efforts. The data presented in Table 3 provides valuable insights for policymakers, researchers, and land managers to make informed decisions regarding land use planning and resource allocation.

The data provided displays the transition probabilities between different land cover types in a specific area, with the values representing the likelihood of a transition occurring from one land cover type to another. In this context, the transition probabilities are expressed as percentages. For instance, the transition probability from Barren Land to Agriculture Land is 21.89%, indicating that there is a relatively high likelihood of barren land being converted into agricultural land. Conversely, the transition probability from Barren Land to Barren Land is much lower at 5.43%, suggesting that barren land is less likely to remain unchanged. The transition probability from Barren Land to Settlements is the highest at 113.18%, which may indicate a significant trend of barren land being converted into urban or residential areas. The transition probabilities to Vegetation Land and Water are relatively low at 1.05% and 0.99%, respectively, indicating limited likelihood of barren land transitioning into these land cover types. Overall, the table provides valuable insights into the dynamics of land cover changes in the study area, highlighting the potential shifts in land use patterns over time.

The distribution of land use within settlements is presented. The data shows that the majority of the land within settlements is categorized as "Settlements" with a value of 40.002911. This indicates that a significant portion of the area within settlements is occupied by buildings, infrastructure, and other urban developments. Agriculture land accounts for 7.329062, suggesting that some land within settlements is utilized for farming or agricultural purposes. Vegetation land and water make up smaller proportions of the land within settlements, with values of 1.403229 and 1.23314, respectively. This implies that there are green spaces and water bodies present within settlements, contributing to the overall landscape and environmental quality. Barren land has the lowest value of 0.625835, indicating that there is a minimal amount of unproductive or unused land within settlements. Overall, the data provides insights into the land use patterns within settlements, highlighting the diverse range of activities and features present in urban areas.

The data on the distribution of vegetation land cover in various categories within a specific geographic area. The values represent the percentage of land covered by vegetation in different land use types. Agriculture accounts for the highest proportion of vegetation land cover at 18.52%, indicating a significant portion of the area is utilized for agricultural purposes. Barren land, on the other hand, has a much lower vegetation cover of 2.33%, suggesting limited plant growth in these areas. Settlements have a substantial vegetation cover of 18.26%, indicating the presence of green spaces within urban or residential areas. Vegetation land itself has a relatively low percentage of vegetation cover at 0.26%, possibly due to the exclusion of other land use types. Water bodies exhibit a moderate vegetation cover of 5.15%, indicating the presence of aquatic plants or vegetation along water sources. Overall, the data provides insights into the distribution of vegetation land cover across different land use categories within the studied area, highlighting the varying degrees of vegetation presence in each land use type.

The percentage of different land cover types adjacent to water bodies in a specific geographic area. The data shows that the highest proportion of land cover adjacent to water bodies is settlements, accounting for 1.563022. This indicates that a significant portion of the area surrounding water bodies is occupied by human settlements. Following settlements, water bodies themselves cover 0.590928 of the area, suggesting the presence of substantial water resources in the region. Agriculture land covers 0.39246 of the area, indicating the utilization of land for farming practices near water bodies. Vegetation land accounts for 0.176448, suggesting the presence of natural vegetation in proximity to water bodies. Lastly, barren land covers the smallest proportion at 0.02459, indicating limited barren areas near water bodies. Overall, the data provides insights into the distribution of different land cover types surrounding water bodies in the study area, highlighting the dominance of settlements and the importance of water resources in the region.

NDVI of Anantapur mandal for 2014 & 2024:

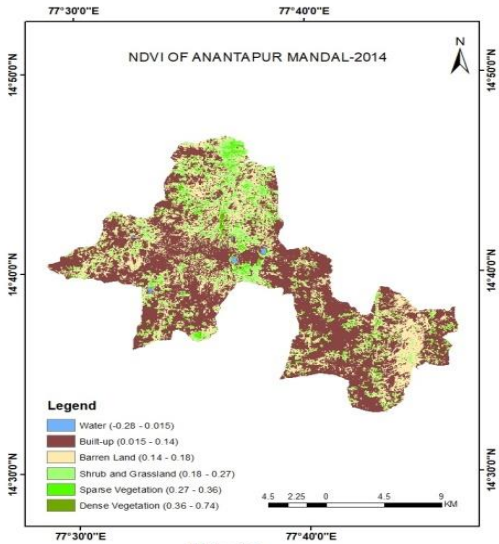


Fig:5

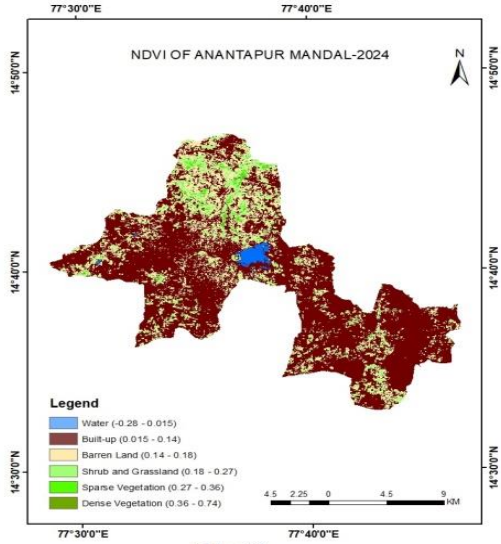


Fig:6

The Normalized Difference Vegetation Index (NDVI) ranges for different land cover classes in Anantapur Mandal from 2014 (Fig:5) to 2024(Fig:6). NDVI is a widely used index to assess vegetation health and density based on satellite imagery. In this study, six land cover classes were identified: Water, Built-up, Barren Land, Shrub and Grassland, Sparse Vegetation, and Dense Vegetation. The NDVI ranges associated with each class are as follows: Water (-0.28 – 0.015), Built-up (0.015 – 0.14), Barren Land (0.14 – 0.18), Shrub and Grassland (0.18 – 0.27), Sparse Vegetation (0.27 – 0.36), and Dense Vegetation (0.36 – 0.74). These ranges indicate the level of vegetation cover and health within each land cover class over the specified time period. The data presented in the table can be used to monitor changes in vegetation dynamics, land use patterns, and environmental conditions in Anantapur Mandal, providing valuable insights for land management and conservation efforts.

Conclusion:

The results of a land use and land cover change detection study conducted between 2014-2024 show significant changes in various land cover categories, with transitions observed in Agricultural Land to different types such as Agricultural Land, Barren Land, Settlements, Vegetation, and Water. These findings emphasize the dynamic nature of land use patterns and the importance of monitoring changes

for sustainable land management. Transition probabilities between land cover types indicate the likelihood of transitions occurring, with insights into potential shifts in land use patterns over time. The distribution of land use within settlements reveals the predominance of urban developments, while the distribution of vegetation cover across different land use types highlights varying degrees of vegetation presence. The data also shows the distribution of different land cover types adjacent to water bodies, emphasizing the significance of settlements and water resources in the studied area.

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