https://doi.org/10.33472/AFJBS.6.13.2024.1590-1597

AFJBS

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper

Open Access

SPATIOTEMPORAL ANALYSIS OF LAND USE/LAND COVER STUDY IN GUNTUR CITY USING REMOTE SENSING AND GIS

Chitimala Venkata Koteswara Rao[1], Ch. Manasa Reddy[2], Asadi. Sai Bhavya Reddy[3] Asadi. Sai Namratha Reddy[4], SS. Asadi[5]

[1,2]Scholars, Department of Civil Engineering, Vignan's Foundation for Science, Technology and Research, Vadlamudi, Guntur,Andhra Pradesh, India.

[3]Student, Department of Computer Science & Engineering, Koneru Lakshmaiah Education Foundation, (deemed to be University) Vaddeswaram, Guntur (D.t), A.P

[4]Student, Department of Civil Engineering, Koneru Lakshmaiah Education Foundation, (deemed to be University) Vaddeswaram, Guntur (D.t), A.P.

[5]Professor, Department of Civil engineering, Vignan's Foundation for Science, Technology and Research, Vadlamudi, Guntur,Andhra Pradesh, India.

Article Info

Volume 6, Issue 13, July 2024

Received: 02 June 2024

Accepted: 30 June 2024

Published: 24 July 2024

doi: 10.33472/AFJBS.6.13.2024.1590-1597

ABSTRACT:

Land constitutes a vital natural asset upon which all developmental endeavours hinge. With a burgeoning population, the dynamic of land utilization and land cover undergoes continual transformation. Over recent decades, the conception of "land use" has evolved, encompassing its socioeconomic functionality. However, accurately representing and assessing land use changes through remote sensing poses a formidable challenge for the scientific community. This study focuses primarily on the evolution of land utilization and land cover in Guntur town, Andhra Pradesh. A methodological framework, utilizing multi-temporal satellite imagery, has been devised to scrutinize these changes. Employing IRSP6 and R2-LISS III sensors, boasting a spatial resolution of 23.5 meters for the years 2012 and 2022 respectively, remote sensing techniques were applied to discern alterations in land utilization. Geospatial Information System (GIS) software, alongside the Earth Resource Data Analysis System (ERDAS), facilitated this analysis. Unsupervised classification was employed to delineate the shifts in land use and land cover within Guntur City, Andhra Pradesh, thereby furnishing comprehensive insights into these transformations.

Keywords: ERDAS, GIS, Land use/Land cover, Remote sensing

1. INTRODUCTION

1.1 Background

The terms "land use/land cover" are distinct, albeit frequently used synonymously. Land cover pertains the tangible attributes of Earth's surface, encompassing vegetation patterns, water distribution, soil composition, and human-made alterations such as urban developments. Conversely, land use denotes the manner in which humans have utilized land and its environment, typically highlighting its functional significance for economic endeavours. The composition of land utilization and land cover within a specific region is shaped by both natural conditions and socio-economic influences, along with their utilization by humans across various time frames and spatial scales. Information regarding land utilization and land cover and opportunities for their efficient utilization are essential for identifying, planning, and implementing land management strategies aimed at satisfying the escalating demands for fundamental human necessities and well-being. Furthermore, this knowledge aids in monitoring the dynamics of land utilization resulting from evolving requirements driven by population growth (Rawat and Kumar, 2015).

In emerging countries, the increasingly swift alterations in land use and cover are often marked by extensive urban sprawl, land deterioration, or the transformation of fertile land into shrimp aquaculture, resulting in substantial adverse ecological Impacts (Hegazy and Kaloop, 2015)Such changes have a significant impact on the local and/or regional environment, which in turn has an impact on the global environment. For example, changes in land cover brought about human activities influence the global carbon cycle and elevate atmospheric CO levels (Riebsame, Meyer and Turner, 1994).Therefore, assessing alterations in land cover and use is vital for comprehending their implications on terrestrial ecosystems and for crafting blueprints for sustainable land management practices (Turner and Ruscher, 1988; Ruiz-Luna and Berlanga-Robles, 2003).

Remote sensing and GIS technologies play a critical role in the analysis and management of land use and land cover, serving as indispensable tools for understanding and overseeing spatial patterns and dynamics.(LU/LC). Here, Remote sensing acquires data through satellite or aerial imagery, providing insights into land cover types, vegetation, soil moisture, and environmental changes (Ch. Manasa Reddy and S.S. Asadi, 2019)GIS integrates diverse data layers like land cover classifications, elevation models, and socio-economic data, enabling planners to identify suitable land use locations, assess environmental impacts, and devise sustainable land management strategies. These technologies facilitate informed decision- making and effective land use planning (Suri Babu, Bhaskar and Neelakantan, 2012).A comparative analysis of various methods for detecting alterations in land utilization and land cover unveils the distinctive strengths inherent in each approach.while emphasizing that no single method is universally effective in addressing this challenge.Anunsupervised classification was used for land utilization and land cover classification.The variations are examined for time periods of 2012 and 2022, pre processing and analysis done in Arc GIS and ERDAS softwares.It is essential to have timely and accurate information concerning the current distribution and alterations in land use/land cover patterns to inform planning, resource utilization, and policy formulation at both local and global scales (SS. Asadi, 2013) Given the dynamic nature of urban development, there is an urgent need for proactive city and town planning, particularly in areas experiencing substantial changes in land use/landcover (SS Asadi and M.V.Raju, 2019).

1.2 Objective

To integrate remote sensing data and GIS technologies for the production of a comprehensive Land Use/Land Cover map of Guntur, Andhra Pradesh, facilitating detailed spatial analysis and informed decision-making.

2. Description of Study area

In the Indian state of Andhra Pradesh, Guntur serves as both the district's administrative centre and its city. The third-largest city in AP is Guntur City. The total area of Guntur city is
158.47 square kilometres. The city lies roughly 400 km to the southwest of Visakhapatnam, the capital of the state. Notable for its exports of tobacco, cotton, and chillies, Guntur boasts Asia's largest chilli market yard. This is the state's principal transportation, educational, and commercial centre. There are numerous historic temples and sites all around the city, such as Kondavidu, Amararama, Caves, and Pedakakani. The language most people speak is Telugu. In Figure 1, the study area's location map is depicted. As per the 2011 census data, the city stands as the third most populous in India.

3. METHODOLOGY

3.1 Satellite Data

Remote sensing captures data via satellite or aerial imagery, revealing details about land cover, vegetation, soil moisture, and environmental shifts.In this investigation, a series of two IRS satellite& LISS-III sensor images having 23.5m spatial resolution spanning the years 2012 and 2022 were acquired from the National Remote Sensing Centre (NRSC) located in Hyderabad, India, Satellite imaginary showed in Figure 2.The Topographic charts with a 1:50000 scale dating back to 1970 were also referenced. The principal goal of this study was to detect shifts in land use and cover attributed to urbanization over the specified time intervals.The selection of satellite imagery was predicated on notable shifts in land use occurring at triennial intervals, prioritizing dates characterized by extensive urban coverage and minimal cloud interference. Five principal land use and cover categories were delineated and scrutinized, comprising vegetation, Water bodies, Fallow land, Built up land and hilly area. Image processing tasks were undertaken leveraging ERDAS 2014 software suites, while ArcGIS 10.2 facilitated map layout.

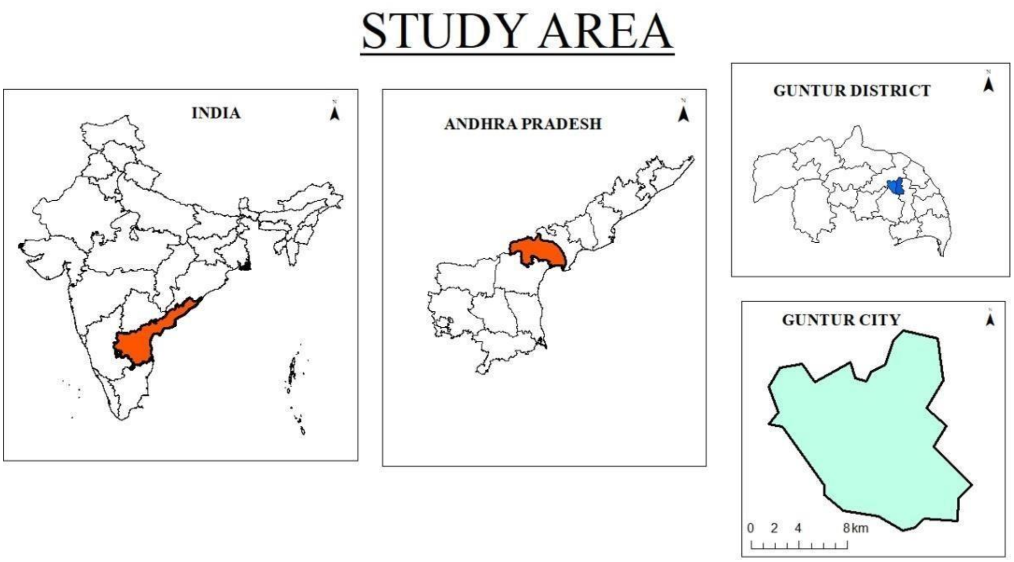


Figure1.Map Illustrating Study Area Location

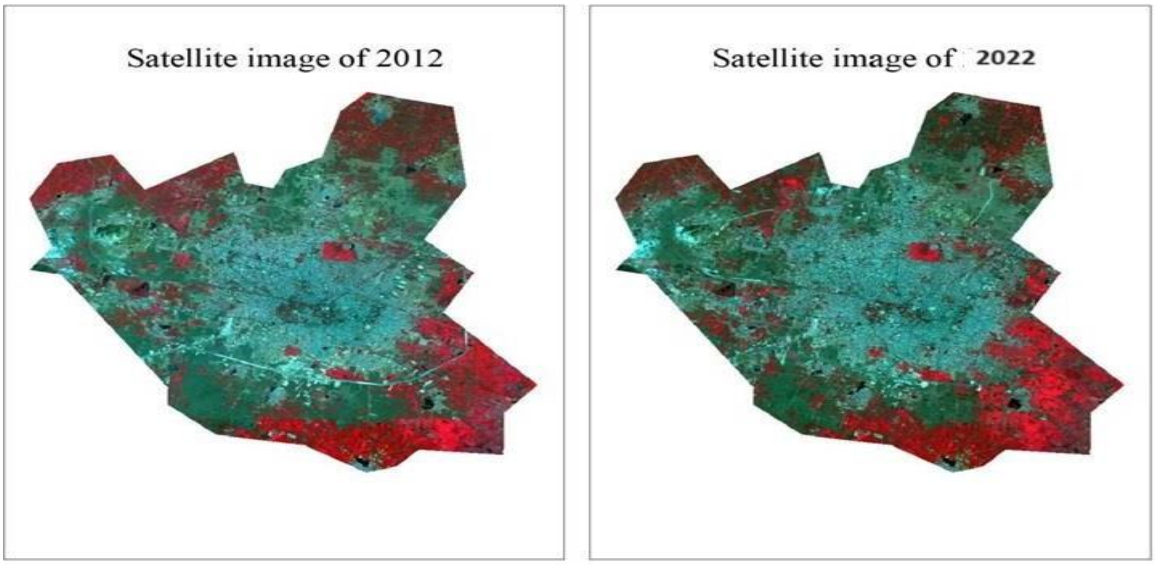


Figure 2. Satellite Views: Study Area Evolution Over 2012 and 2022

GIS integrates multiple data layers, including socioeconomic data, elevation models, and Classification of Land Cover Types.Arc GIS10.2 is used to generate different thematic maps.Arc map 10.2 is used in this investigation. ArcGIS is used for toposheet georeferencing, layout creation, and built-up land digitization. Software for processing images is called ERDAS. In the Earth Resource Data Analysis System, unsupervised classification was carried out for change detection analysis (ERDAS). The detailed methodology showed in Figure 3.

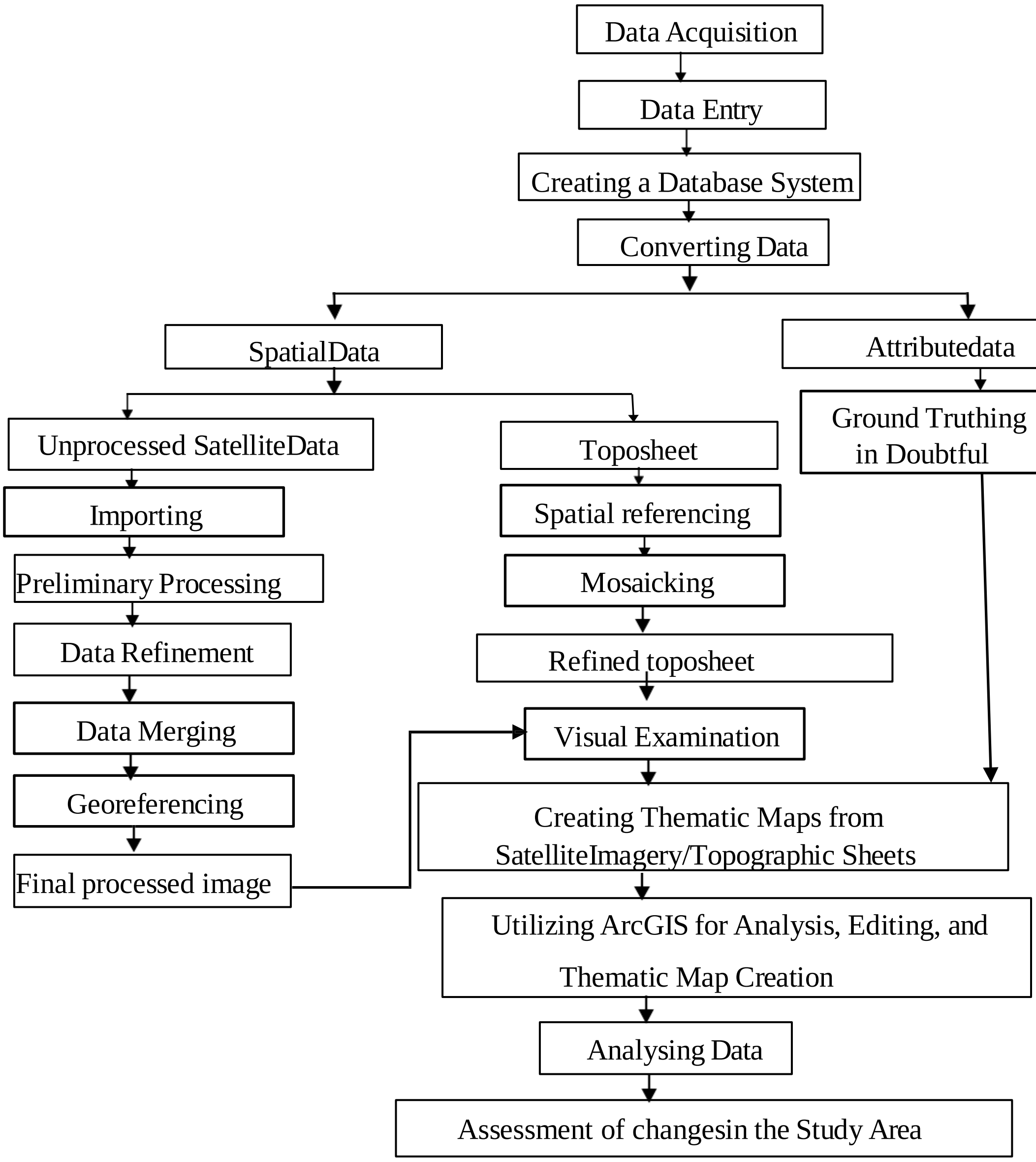


Figure 3.Step-by-Step processing of Methodology

3.2 Change detection analysis

Change detection between two images of the same resolution was conducted using the change detection tools available in ERDAS 2014. Subsequently, change detection statistics were generated comparing the processed images from 2012 and 2022. It was observed that land use changes between water bodies, vegetation, fallow land, built-up areas, and hilly terrain were quite common across the study area. However, the transformation of built-up regions into other land use categories was relatively rare in the current urbanization scenario. Encroachment in hilly areas was also noted. In urban contexts, classification confusion often arises due to the presence of various tones for impervious areas. While diverse features such as rooftops, paved areas within building premises, cement roads, bitumen roads, and walkways typically fall under the built-up category, significant variations in tonalities were observed in the images within the metropolitan region. Consequently, these pixels were reclassified in the model maker to ensure accurate representation and classification.

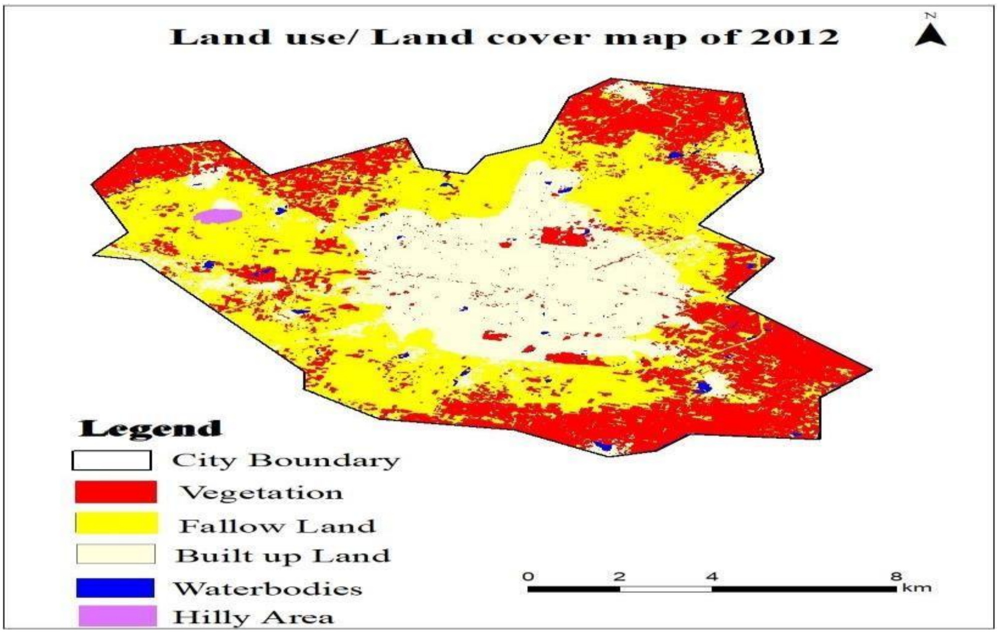
4. Findings and Analysis

The Land Use/Land Cover (LULC) project provides important insights into the dynamics and implications of land cover change in our study region. We classified numerous land use and land cover categories using satellite imagery and GIS analysis, including vegetation, waterbodies, fallow land, built-up areas, and hilly terrain. Our analysis revealed observable spatial patterns, particularly urban expansion at the expense of natural landscapes such as mountainous regions. The table that follows provides further information. Through temporal analysis, we identified key causes of land cover modification, particularly growing urbanization. Despite the robustness of our technique, we acknowledge constraints related to data resolution and classification accuracy. Looking ahead, our findings highlight the importance of establishing sustainable land management techniques and regulations to prevent the negative effects of land cover changes and bolster ecosystem resilience.

S.No.	**LULCCategories**	**2012Area(Hectors)**	**2022Area(Hectors)**
1	Vegetation	4658.1842	4557.2425
2	Waterbodies	153.69	174.311
3	Fallowland	6428.24	5989.8178
4	Builtup lands	4554.9047	5074.1197
5	Hillyarea	51.281	50.800

Table 1. Dynamics of Land Use/Land Cover Changes in Guntur City (2012-2022)

Figure 4.Land Use/Land Cover Map of 2012



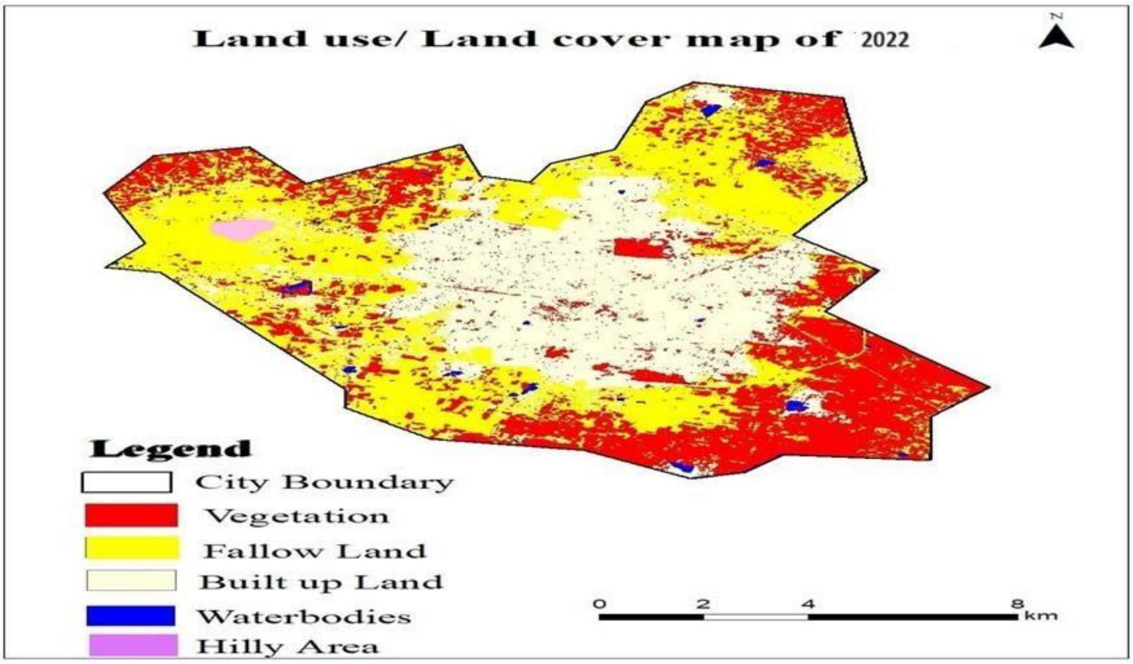


Figure 5. Land Use/Land Cover Map of 2022

5. CONCLUSION

This study focuses on the transformations observed in Guntur city, Andhra Pradesh, owing to the escalating population growth, resulting in heightened demands. To ensure the sustenance of future generations, it becomes imperative to curb illicit activities contributing to alterations in land utilization and land cover. The imagery utilized in present study were categorized into five distinct classes: water bodies, fallow land, vegetation, hilly terrain, and built-up areas. Following image classification, change mapping was conducted for 2012 and 2022 images, with fallow land and crop classes being interchanged. Subsequently, statistical analyses were performed to delineate class-to-class alterations within the images. The detection of such changes holds paramount importance for effective management and monitoring of terrestrial activities. The statistical analyses revealed notable shifts, particularly witnessing significant increments in built-up areas by 2012, attributed to the reduction in fallow lands compared to 2022. Moreover, there was a decline in vegetation cover, with a concomitant rise in built-up areas. In light of these findings, the study advocates for the implementation of geo-tagging to track land encroachments, holding government land assignees directly accountable. Additionally, maintaining comprehensive records of land parcels and ownership details emerges as a crucial recommendation.

6. REFERENCES

1. Ch. Manasa Reddy and SS. Asadi (2019) “Land Use Changes in Government Lands and it’s Monitoring using Multi Temporal Satellite Data: A Case Study on Amadalavalasa Mandal, Srikakulam District ,” International Journal of Recent Technology and Engineering (IJRTE) , 7(6C2).
2. Hegazy, I.R. and Kaloop, M.R. (2015) “Monitoring urban growth and land use change detection with GIS and remote sensing techniques in Daqahlia governorate Egypt,” International Journal of Sustainable Built Environment, 4(1), pp. 117–124.
3. Rawat, J.S. and Kumar, M. (2015) “Monitoring land use/cover change using remote sensing and GIS techniques: A case study of Hawalbagh block, district Almora,

Uttarakhand, India," The Egyptian Journal of Remote Sensing and Space Science, 18(1), pp. 77–84.

4. Riebsame, W.E., Meyer, W.B. and Turner, B.L. (1994) "Modeling land use and cover as part of global environmental change," Climatic Change, 28(1–2), pp. 45–64.
5. Ruiz-Luna, A. and Berlanga-Robles, C.A. (2003) "Land use, land cover changes and coastal lagoon surface reduction associated with urban growth in northwest Mexico," Landscape Ecology, 18(2), pp. 159–171.
6. SS. Asadi (2013) "Evaluation of Land Use/Land Cover Changed Detection Using RS & GIS A Model Study From Vijayawada, AP ," International Journal of Engineering and Innovative Technology (IJEIT), 3(4).
7. SS Asadi and M.V.Raju (2019) "Land Use/Land Cover Mapping Using Geospatial Technology for Environmental Management ," International Journal of Innovative Technology and Exploring Engineering (IJITEE) , 8(9), pp. 168–172.
8. SS.Asadi (2016) "Evaluation of Land use Land Cover Impacts on Environmental Parameters in municipal corporation of Vijayawada, A.P," International Journal of Advanced Scientific and Technical Research, 3(6), pp. 82–100.
9. Suribabu, C.R., Bhaskar, J. and Neelakantan, T.R. (2012) "Land Use/Cover Change Detection of Tiruchirapalli City, India, Using Integrated Remote Sensing and GIS Tools," Journal of the Indian Society of Remote Sensing, 40(4), pp. 699–708.
10. Turner, M.G. and Ruscher, C.L. (1988) "Changes in landscape patterns in Georgia, USA,"
11. Landscape Ecology, 1(4), pp. 241–251..
12. V.Subhash,S.V.S.B.Mahidar ,K.Praveen, Asadi. Sai Namratha Reddy, Asadi. Sai Bhavya Reddy,SS. Asadi, "Evaluation of Environmental Impact on Ground water quality : A Model study",Journal For Basic Sciences, Volume 23, Issue 12, 2023, PP: 104-117.