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Research Paper

Land Use and Land Cover Change Dynamics Analysis Using Remote Sensing and GIS Technologies-A Review

Chidananda AV

Abstract

Land Use and Land Cover (LULC) changes are among the most visible and impactful transformations in ourenvironment. However, the complexity, variety, and spatial variability of these changes make them challengingtoquantifyandassess. This review consolidates findings from global studies employing remote sensing and Geographic Information System (GIS) tools to analyze and monitor LULC changes. The studies highlight rapid urbanization, deforestation, agricultural expansion and other land transformations driven by population growth, economic development, and infrastructural demands.

Keywords: *LULC, Remotesensing, Land transformations, Geographic Information System.*

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I. INTRODUCTION

A country like India, with its diverse flora and fauna, requires comprehensive information across various interconnected areas of activity. One such area is Land Use and Land Cover (LULC), LULC classification is an important technique to assess the relationship between the environment and human activity (Abdulbasit A. Darem, 2023). Land cover pertains to the tangible characteristics of the Earth's surface, including features like forests, grasslands, and bodies of water. In contrast, land use defines the functions that the land fulfils, such as agricultural activities, urban development, or mining operations. India faces several challenges, including uncontrolled development, declining environmental quality, loss of agricultural land, and destruction of critical habitats. To address these, accurate and up-to-date land use data is essential. Reliable information on how land is being used is crucial for both government and private sectors to understand ongoing changes and to develop effective strategies for future planning.

The classification of land use and land cover, based on remote sensing data and GIS, is vital for managing and understanding environmental changes. Remote sensing provides significant advantages for this task by capturing data across various spectral bands, allowing the identification of different land cover types through their unique spectral signatures. This technology helps distinguish between various forms of land cover.

Accurate land cover maps are essential for urban planning, resource management, and environmental monitoring. With the ability to acquire data at regular intervals, remote sensing facilitates temporal analysis, enabling the detection of land cover changes over time, such as deforestation, urban growth, or shifts in agricultural land use. These datasets allow for the evaluation of land use dynamics and the effectiveness of land management policies.

II. RELATED WORK

2.1 Abdulbasit A. Darem et al., this paper focuses on LULC classification in the Northern Border Region (NBR) of Saudi Arabia using RS data from Landsat 5 and Landsat 8 between 1990 and 2022. The study classifies LULC bare land, built-up areas, rocks and vegetation (Abdulbasit A. Darem, 2023).

2.1.1Objective:

The objective was to analyse the patterns and factors influencing LULC changes over the past thirty years.

- To investigate LULC change patterns in the NBR of Saudi Arabia from 1990 to 2022.
- To classify various LULC types using RS data from Landsat imagery within this period.
- To perform a time-series analysis to detect LULC changes over time (Abdulbasit A. Darem, 2023).

- To support sustainable land management, urban planning, and natural resource conservation in the NBR (Abdulbasit A. Darem, 2023).

2.1.2 Methodology:
The research employed Landsat imagery spanning from 1990 to 2022 to categorize four primary land use and land cover (LULC) types: bare land, built-up areas, rocky terrain, and vegetation. A maximum likelihood classifier (MLC) was utilized for the classification of LULC, while geographic information systems (GIS) facilitated spatial analysis, concentrating on historical changes in LULC.

2.2 M.Gurbuz et al., this study focuses on urban land use changes in Ankara province between 2000 and 2020 using remote sensing and GIS techniques (M. Gurbuz, 2023). The study employs the Random Forest (RF) classifier and identifies six major land use/land cover (LULC) categories: urban areas, agricultural lands, forest, water surfaces, open areas, and roads.

2.2.1 Objective:
The focus is on mapping the urban expansion in Ankara and Assessing the characteristics, scale, and trajectory of urban development over the last two decades (M. Gurbuz, 2023).

- To map and assess the urban region of Ankara from 2000 to 2020 using remote sensing techniques.
- To classify land cover and assess the transformation of LULC classes, focusing on urban development over 20 years.

2.2.2 Methodology:
Satellite imagery from Landsat 7, Sentinel-2 satellite image and GEE platform (M. Gurbuz, 2023). It applies several indices like NDVI and NDWI and explores categorical, pixel-value, and time-series change detection techniques. This study primarily focuses on the comparison of land use patterns in between (2000 and 2020) and their environmental implications.

2.3 Mohammed Kareem Sameer et al., This study, set in Al-Kut City, Iraq, examines LULC changes between 2004 and 2014. The study uses high-resolution Quick Bird satellite images and categorizes various types of land use, including agricultural land, developed areas, barren land, bodies of water, and vegetation (Mohammed Kareem Sameer, 2023).

2.3.1 Objective:
This study aimed to monitor land use changes,the extent of deforestation, urban expansion, and other cumulative transformations by employing spatial and historical analysis methods in Al-Kut City, Iraq.

- To create a land use and land cover map for Al-Kut city in Iraq using high-resolution remote sensing data.
- To develop a spatial and geographic database for 2004 and 2014.
- To evaluate changes in specific LULC classes over time.

2.3.2 Methodology:
High-resolution Quick bird satellite images were used for 2004 and 2014.
The study used a supervised classification method with GIS tools to map and quantify changes in agricultural land, built-up areas, vegetation, wastelands, and water bodies.
Statistical analysis and change detection were performed using the ArcGIS platform.

2.4 Mitiku Badasa moisa et al.,this study focuses on evaluating the significant land use and land cover (LULC) changes in the Upper Anger watershed using GIS and remote sensing techniques (Mitiku Badasa Moisa, 2023). The authors used Landsat satellite images from 1990, 2003, and 2020 to identify patterns in land cover change.

2.4.1 Objective:
To explore the impacts of human-induced LULC changes, emphasizing the effects of agricultural expansion and deforestation in the Upper Anger watershed in Ethiopia.

- To investigate spatiotemporal land use and land cover (LULC) changes in the Upper Anger watershed, Western Ethiopia.
- To analyse LULC changes using satellite images from 1990, 2003, and 2020 with supervised classification techniques.
- To determine the main drivers behind LULC changes, including deforestation and agricultural expansion.

2.4.2 Methodology:
The paper employs supervised classification using the maximum likelihood algorithm, along with NDVI analysis, to study vegetation cover change in the Upper Anger watershed (Mitiku Badasa Moisa, 2023). The study highlights the high accuracy of its classification results through Kappa indicesGIS and remote sensing.

2.5 Ashangbam Inaoba singh et al., this study focuses on LULC changes in Chandel District, Manipur, India, covering a geographical area of 3313 km². This research was conducted using remote sensing and GIS techniques to understand the spatial and temporal trends between 2000 and 2021 (Ashangbam Inaoba Singh, 2021). The region, like many parts of north-eastern India, has experienced rapid changes due to urbanization, population growth, deforestation, and changes in land use patterns.

2.5.1 Objective:
The study focusing on deforestation and urbanization trends.
- To examine land use and land cover (LULC) changes over two decades (2000–2021).
- To Map the spatial and temporal LULC trends using remote sensing data from LANDSAT satellites.
- To identify deforestation and urban expansion patterns due to population growth.

2.5.2 Methodology:
Remote sensing using LANDSAT imagery and ArcGIS 10. Supervised classification was employed to generate LULC maps.
2.6 Caleb et al., the study addresses the growing challenges of urbanization and land use changes, emphasizing how unplanned urban expansion can harm environmental sustainability. The authors point out that sustainable urban development requires efficient land use planning to balance the needs of human populations with environmental preservation. In regions like Sub-Saharan Africa, where cities are growing rapidly, uncoordinated land use is becoming a critical issue. This is particularly true for Minna, where rapid urban expansion is causing shifts in land cover, necessitating better-informed urban planning strategies using GIS and RS technologies (CALEB & DURU, 2021).

2.6.1 Objective:
This study investigates the LULC dynamics in Minna Metropolis, Nigeria. It focuses on how urbanization affects land cover, and it provides a detailed analysis using Landsat data to track urban expansion and its implications.
- To Track and quantify LULC dynamics from 1986 to 2016 using GIS and remote sensing data.
- To compute the LULC types that changed the most over the studied period.
- To provide baseline data to support informed land use planning in the Minna Metropolis

2.6.2 Methodology:
This study uses supervised and unsupervised classification techniques to analyse LULC changes. It applies Maximum Likelihood Classification (MLC) to assess urban expansion. Accuracy assessments are done using confusion matrices and kappa coefficients.
2.7 P Arulbalaji. This study emphasizes that urbanization, especially in developing countries like India, leads to the loss of fertile or agricultural land and water bodies. It underscores the need to monitor and quantify these changes for better land management and planning. The authors highlight that human activities, such as deforestation, land degradation, and urban sprawl, drive significant LULC changes, affecting both ecosystems and socio-economic conditions. Remote sensing and GIS technologies provide efficient tools to monitor these changes.

2.7.1 Objective:
The goal was to track LULC changes from 1992 to 2015.
- Analyse land use and land cover (LULC) changes in Salem district.
- Assess the impact of rapid urbanization on agricultural land, water bodies, and forests from 1992 to 2015.
- Utilize Landsat data from 1992, 2001, 2010, and 2015 to track changes in LULC.
- Apply supervised classification techniques for accurate LULC classification.
- Provide decision-makers with valuable data for sustainable land use planning and management.
- Address the need for quantifying urban growth and its effects on natural resources

2.7.2 Methodology:
The study used Landsat thematic mapper and OLI data for four time periods (1992, 2001, 2010, and 2015). The supervised classification technique was applied for image processing.

2.8 R.K Jain et al., the authors highlight the significance of LULC analysis in understanding environmental changes, especially in rapidly urbanizing regions like Gurgaon. As population and economic activities expand, land use changes become critical in understanding urban growth and planning for the future. The study aims to predict the future urban landscape of Gurgaon using satellite imagery and modelling tools, which will help decision-makers plan for sustainable development.

2.8.1 Objective:

The study was on urban growth in Gurgaon, India, from different years (1995, 2009, and 2016) and forecasting for 2020 and 2025.

- To Analyse past and predict future urban growth in Gurgaon using Landsat satellite images from 1995, 2009, and 2016.
- To utilize the Land Change Modeler (LCM) and Markov chain analysis to model and predict land use changes up to 2025.
- To Support urban planning by identifying the dynamics of land conversion, particularly the loss of vegetation and forest.

2.8.2 Methodology:

The study used the Land Change Modeler (LCM)

Temporal analysis was performed using Landsat satellite images from 1995, 2009, and 2016.

The Markov Chain method was used to predict the land-use scenario for 2020 and 2025.

III. COMPARISON OVERVIEW

Author	Region and time frame	Study on	Technique/Method	Result
Abdulbasit A Daremetal. [1]	Saudi Arabia's NorthernBorderRegion,alongthebord ers. 1990-2022	Vegetation, Rocks,Bare land, Built-uparea.	NBRMAP, Landsat,Landsat8, Google EarthPro,USGS	There is an increased Bare land area 0.92%, andDecreasedBuilt-uparea,Rocks,Vegetationofabout0 .10%, 0.80%, 0.02%respectively.
M gurbuzet al. [2]	AnkaraProvince,Turkey.2000-2020	Tree covered,Grassland, Cropland,wetland,Bare landandwaterbody.	Land sat 7 ETM+and Sentinel 2satelliteimageandGE Eplatform	ThereisanincreasedTreecoverland, Artificialland,waterbody about 4%,68% and 6% respectively anddecreasedGrassland,cropland, wetland,Barelandofabout2%,2%, 2%and7%respectively.
MoahmmedKareemsameeretal. [3]	Al-KutCity,Iraq.2004 -2014	Agriculture land, Built-up, Vegetation,Wasteland, WaterBodies	USGS,ArcMap	Agriculturelandincreased1.54%,Built-upareaincreasedto 2.47%, Vegetation increased to 0.58%, Wastelanddecreased to 4.34% and Water bodies decreased to0.24%.
MitikuBadasaMoisaetal. [4]	UpperAngerWatershed,WesternEthiopia.1990-2020	Settlement, Agriculture land ,forestland,grassland,a nd bareland	USGS, Landsat 5, Landsat 7, Landsat 8,Earth resourcesdata analysissystem (ERDAS),8ArcGIS 10.3 andArcSWAT.	Increased agriculture land from 45.3% to 83.2%,increased in bare land area from 0.2% to 1%, decreasedforest area from 20.3 %to 10.7%, Decreased grasslandarea from 34.1% to 4.8%, and Settlement increased from01%to 0.3%.
Ashangbam Inaoba singh et al. [5]	Chandel District, Manipur 2000-2021	Thickly vegetated area(TVA), Sparsely vegetated area (SVA), Populated area(PA), Agriculture area(AA), Barren area(BA) and Water bodies(WA)	collected data from USGS, Landsat4-5, Landsat 7ETM+, Landsat 8OLI.	Decrease in TVA from 65% to 52%, increase in SVA from 15% to 18%,increase in PA from 8% to 11%, Decrease in AA from 2% to 4, No traceable changes in WB, and increase in BA from 8% to 12%.
Caleb et al.[6]	Minna Metropolis Nigeria. 1986-2016	Water body, Built-up, Bare land, Arableland	Landsat TM,ETM+, OLI, USGS earth explorer and Arc GIS.	Increase in Urban built upland from 4.98% to 46.86%, Decreased in Arableland 70.94% to 27.08%, increased in water bodies 7.49% in 1986 to 27.08% 2016 and further Decrees in water bodies 11% in 2016. The bare land increased from 16.59% in 1986 to 43.46% in 1999 but Drastically decreased to 15.06% in 2016.
		Deciduous forest, ,	USGS, Landsat-	Between 1992 and 2015, LULC

P Arulbalaji [7]	Salem District Tamilnadu, South India. 1992-2015	crop land, built-up land, water bodies, mines and barren land	5TM,ERDAS imagine 9.2, ArcGIS 10.2, landsat-7TM and Landsat-8 OLI	changes in deciduous forest by 398 sqkm (-8%), agricultural lands deceased by 250sqkm (-5%), water bodies decreased by 16sqkm (- 0%), evergreen and semi evergreen forests increased by 288sqkm (+6%) and mines and barren lands increased by 128 sqkm (+2%).
R K Jain et al.[8]	Gurgaon, India. 1995-2016	Settlement, Vegetation, Scrubland and water body	Land change Modeler(LCM) and Markov chain method	Increase in settlement (+8.49%), increase in vegetation of about (+4.9%), decrease in scrub land of about (-12.2%) and decrease in water body of about (-1.2%)

IV. CONCLUSION

All the studies use remote sensing and GIS tools for LULC analysis, monitoring land use changes. While the specific objectives and regions differ, their findings underscore the common theme of rapid urbanization leading to significant land cover transformations, necessitating careful planning for sustainable urban growth. Each study provides valuable insights relevant to specific regional challenges, but the methodologies could be applied universally with some adaptation.

The conclusions can be summarized as follows:

- **Significant Urban Expansion**: Urban areas have expanded rapidly due to population growth, infrastructure development, and economic activities. This expansion often leads to the conversion of agricultural and natural lands into built-up areas.
- **Decrease in Agricultural Land**: There has been a consistent decline in agricultural areas, especially around expanding city centres, as these lands are converted into residential, commercial, or industrial zones.
- **Loss of Vegetation and Green Spaces**: Urban sprawl has resulted in the reduction of vegetation and green spaces, contributing to environmental challenges like reduced biodiversity and increased urban heat island effects.
- **Variability in Urban Growth Patterns**: Different regions show varied growth patterns based on geographical, economic, and infrastructural factors, demonstrating the complexity and regional specificity of urbanization.
- **Future Urbanization Trends**: If current trends continue, further reduction in agricultural and natural lands is expected, necessitating immediate interventions to protect remaining green and agricultural spaces.
- **Call for Sustainable Urban Development**: The analysis emphasizes the importance of integrating sustainable land use practices and smart city planning to minimize negative environmental impacts and enhance the quality of urban life.

REFERENCE:

[1]. Abdulbasit A. Darem , Asma A. Alhashmi, Aloyoun M. Almadani, Ali K. Alanazi, Geraldine A. Sutantra(2023)" Development of a map for land use and land cover classification of the Northern Border Region using remote sensing and GIS" https://doi.org/10.1016/j.ejrs.2023.04.005.

[2]. M. Gurbuz , A. Cilek(2023)" Analysis Of Urban Land Use Change Using Remote Sensing And Different Change Detection Techniques: The Case Of Ankara Province" https://doi.org/10.5194/isprs-archives-XLVIII-M-1-2023-515-2023.

[3]. Mohammed Kareem Sameer, Adnan Muttashar Hamid (2023)" Remote Sensing and GIS Techniques in Monitoring Land Use Land Cover Change"https://doi.org/10.30880/ijscet.2023.14.01.002.

[4]. Mitiku Badasa Moisa, LachisaBushaHinkosa, GedaFeyeraNegasa, GamtesaOlika, TekalignEmiruIjigu, Yonas Name Wedajo, MengistuMuletaGurmessa, KirosTsegayDeribew&DessalegnObsi Gemeda (2023)" GIS and remote sensing Based Analysis of Land use and Land cover Change in the Upper Anger watershed, Western Ethiopia" https://doi.org/10.1080/24749508.2023.2237323.

[5]. Ashangbam Inaoba Singh, Kanwarpreet Singh (2021)" Remote Sensing and GIS based Land Use Land Cover Analysis in Chandel District, Manipur, India"https://doi.org/10.1088/1755-1315/889/1/012046

[6]. CALEB, Andrew Bissala,OWOICHO, Christopher,ANWANA, Samuel Bassey, ABDUSALAM, Biliaminu; DURU, Tochukwu Collins (2021)" Land Use Land Cover Dynamics: Integrating GIS and Remotely Sensed Data to Support Land Use Planning In Minna Metropolis Nigeria" Journal of Research in Environmental and Earth Sciences Volume 7 Issue 12 (2021) pp: 53-59 ISSN(Online) :2348-2532.

[7]. P. Arulbalaji(2019)" Analysis of land use/land cover changes using geospatial techniques in Salem district, Tamil Nadu, South India" https://doi.org/10.1007/s42452-019-0485-5.

[8]. R. K. Jain, Dr. Kamal Jain, Dr. S. Rehan Ali (2017) "Modeling Urban Land Cover Growth Dynamics Based on Land Change Modeler (LCM) Using Remote Sensing: A Case Study of Gurgaon, India" Advances in Computational Sciences and Technology ISSN 0973-6107 Volume 10, Number 10 (2017) pp. 2947-2961.

[9]. SanchayeetaAdhikari, Timothy Fik and PuneetDwivedi (2017) "Proximate Causes of Land-Use and Land-Cover Change in Bannerghatta National Park: A Spatial Statistical Model" https://doi.org/10.3390/f8090342.

[10]. Nayana S. Ratnaparkhi, Ajay D. Nagne and Bharti Gawali (2016) "Analysis of Land Use/Land Cover Changes Using Remote Sensing and GIS Techniques in Parbhani City, Maharashtra,India" http://technical.cloudjournals.com/index.php/IJARSG/article/view/Tech-573.

[11]. Ibrahim RizkHegazy a, MosbehRashedKaloop(2015) "Monitoring urban growth and land use change detection with GIS and remote sensing techniques in Daqahlia governorate Egypt" http://dx.doi.org/10.1016/j.ijsbe.2015.02.005.

[12]. Kim, I.; Le, Q.B.; Park, S.J.; Tenhunen, J.; Koellner, T. (2014) "Driving Forces in Archetypical Land-Use Changes in a Mountainous Watershed in East Asia" https://doi.org/10.3390/land3030957.

[13]. K. Sundarakumar, M. Harika, SK. AspiyaBegum , S. Yamini , K. Balakrishna. (2012) "Land Use and Land Cover Change Detection and Urban Sprawl Analysis of Vijayawada City Using Multitemporal Landsat Data" https://www.researchgate.net/publication/293821516.

[14]. Praveen Kumar Mallupattu and Jayarama Reddy Sreenivasula Reddy.(2013) "Analysis of Land Use/Land Cover Changes Using Remote Sensing Data and GIS at an Urban Area, Tirupati, India" http://dx.doi.org/10.1155/2013/268623.

[15]. M. S. Aduah, P. E. Baffoe (2013) "Remote Sensing for Mapping Land-Use/Cover Changes and Urban Sprawl in Sekondi-Takoradi, Western Region of Ghana" The International Journal Of Engineering And Science (IJES) ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805.