**SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING**

A MINI-PROJECT REPORT
ON

# "Exploring Environmental Changes Using Remote Sensing And GIS: A Case Study of Bangalore, Karnataka"

Submitted in fulfillment of the requirements for the award of the Degree of

**BACHELOR OF TECHNOLOGY**
**IN**
**ELECTRONICS AND COMPUTER ENGINEERING**

Submitted by

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# DECLARATION

We, **Prajwal Patil G M** (R21EP037), **Trilok** (R21EP056), **Harshith R** (R21EP018),**Vaishnavi** (R21EP059), students of B. Tech (ECM) belonging to the School of Electronics and Communication Engineering, REVA University, declare that this Mini Project Report / Dissertation entitled "**Exploring Environmental Changes Using Remote Sensing And GIS: A Case Study of Bangalore, Karnataka**" is the result the of Mini Project/dissertation work done by me under the supervision of **Dr.Aryalekshmi B.N**, Assistant Professor, School of ECE REVA University.

I am submitting this Mini Project Report / Dissertation in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Electronics and Computer Engineering by the REVA University, Bengaluru during the academic year 2023-24.

I declare that this project report satisfies the academic requirements concerning the mini-project work prescribed for the said Degree. I further declare that this mini project/dissertation report or any part of it has not been submitted for the award of any other Degree/Diploma of this University or any other University/ Institution.

*Signature of the Students*
*Date:*

*Certified that this Mini project work submitted by Prajwal Patil G.M (R21EP037),Trilok s (R21EP056),Harshith R (R21EP018),Vaishnavi D (R21EP059) has been carried out under my / our guidance and the declaration made by the candidate is true to the best of my knowledge.*

*Signature of Guide*
*Date:*

REVA UNIVERSITY
Bengaluru, India

**SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**CERTIFICATE**

Certified that the mini project work entitled "**Exploring Environmental Changes Using Remote Sensing And GIS: A Case Study of Bangalore, Karnataka"** carried out under my guidance by **Prajwal Patil G M** (R21EP037)**, Trilok** (R21EP056) **, Harshith R** (R21EP018), **Vaishnavi** (R21EP059), a bonafide student of REVA University during the academic year 2023-24, is submitting the mini project report in partial fulfillment for the award of **Bachelor of Technology i**n **Electronics and Computer Engineering** during the academic year **2023-24.** The project report has been approved as it satisfies the academic requirements in respect of the Project work prescribed for the said Degree.

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**Name and Signature**


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# LIST OF ABBEREVATIONS

- **LULC:** Land Use and Land Cover
- **GIS:** Geographic Information System
- **RS:** Remote Sensing
- **EO:** Earth Observation
- **NDVI:** Normalized Difference Vegetation Index
- **IR:** Infrared
- **NIR:** Near-Infrared
- **GPS:** Global Positioning System
- **CIR:** Color Infrared
- **LC:** Land Cover
- **LU:** Land Use

## ABSTRACT:

Rapid urbanization and population growth have led to significant environmental changes in urban landscapes. This study employs Remote Sensing (RS) and Geographic Information System (GIS) technologies to investigate and analyze the environmental dynamics of Bangalore, Karnataka. The research focuses on discerning land-use changes, vegetation cover alterations, and the impact of urban expansion on the local environment. Utilizing multi-temporal satellite imagery and GIS spatial analysis tools, the study traces the evolution of Bangalore's landscape over a specified period. This land use and land cover project aimed to comprehensively analyze and map the dynamic spatial patterns of a designated study area. Leveraging Landsat 8 satellite imagery, the project employed a systematic methodology encompassing data acquisition, preprocessing, and advanced remote sensing techniques. Key steps included the creation of a composite image, calculation of vegetation indices, and the derivation of Land Surface Temperature (LST). Through supervised classification, distinct land cover categories such as urban, agricultural, and forested areas were identified. The findings of this research contribute valuable insights into the interactions between urbanization and the environment, offering a basis for sustainable urban planning and environmental management strategies. By combining RS and GIS techniques, this case study serves as a model for monitoring and understanding environmental changes in rapidly developing urban centers, aiding in the formulation of informed policies for sustainable urban development.



Keywords: Remote Sensing, GIS, environmental changes, urbanization, land-use dynamics, Bangalore, Karnataka.

## Chapter 1

# INTRODUCTION

The world is going through significant changes due to fast-paced environmental shifts, influenced by various dynamic factors. The rapid urbanization and expansion of Bangalore have led to significant transformations in its LULC patterns. This case study aims to identify and analyse these changes over a defined period, shedding light on the city's evolving landscape. Environmental change is a change or disturbance of the environment most often caused by human influences and natural ecological processes. Environmental changes include various factors, such as natural disasters, human interferences, or animal interaction. Environmental change encompasses not only physical changes, but also factors like an infestation of invasive species.

The growth of a society totally depends on its social and economical development. This is the basic reason why socio-economic surveys are carried out. This type of survey includes both spatial and non-spatial datasets. LULC maps play a significant and prime role in planning, management and monitoring programmes at local, regional and national levels. This type of information, on one hand, provides a better understanding of land utilization aspects and on the other hand, it plays an important role in the formation of policies and programme required for development planning**.**

Remote Sensing and GIS technology enable agencies to get reliable information of natural and man-made features or processed and interpreted appropriately phenomenon occurring over the earth's surface without making any physical contact. GIS and remote sensing help generate development models for more accurate monitoring and decision-making. Satellite imaging also helps detect environmental and structural changes in various sites, helping urban planners create safe and sustainable projections.

The significance of this study extends beyond academic inquiry, holding direct relevance for urban planners, policymakers, and environmentalists alike. We are going extract buildup area from, Landsat 8 image for Arc GIS with usage of different bands. Bangalore, as a microcosm of global urbanization trends, offers a unique lens through which the intricate relationship between urban development and environmental sustainability can be examined.

However, this urban renaissance comes at a cost, and perhaps nowhere is this more evident than in the altered environmental fabric of Bangalore. As the city extends its urban boundaries and undertakes ambitious infrastructure projects, the delicate equilibrium between urban development and environmental sustainability is disrupted. The once abundant green spaces, emblematic of Bangalore's erstwhile moniker, have given way to concrete expanses, transforming the city's skyline and challenging its ecological resilience.

The need to comprehensively grasp the environmental changes within Bangalore arises from the city's unique position at the intersection of technological innovation, economic growth, and ecological sensitivity. As urbanization accelerates, green spaces dwindle, and the pressure on natural resources intensifies, there is an urgent call to investigate the intricate nuances of these changes. Remote Sensing (RS) and Geographic Information System (GIS) technologies, owing to their precision and ability to analyze vast spatial datasets, emerge as indispensable tools for unraveling the complexities associated with urban environmental shifts.

The significance of this study extends beyond academic inquiry, holding direct relevance for urban planners, policymakers, and environmentalists alike. Bangalore, as a microcosm of global urbanization trends, offers a unique lens through which the intricate relationship between urban development and environmental sustainability can be examined. The findings of this study are poised to provide critical insights into the delicate balance required for fostering sustainable urban growth while preserving the ecological integrity that defines the city's identity.

## Chapter 2

# LITERATURE SURVEY

### TABLE 2.1: "This chapter deals with the review of Environmental Changes Using Remote Sensing and GIS Approach”

| Title | Authors | Year | Journal | Key Findings |
|---|---|---|---|---|
| Monitoring and analyzing land use and land cover changes in the Indus River Basin using remote sensing and GIS techniques | Hussain, M., & Bhuiyan, H. | 2023 | Environmental Monitoring and Assessment | Monitored and providing insights into environmental dynamics and informing sustainable resource management. |
| Drought monitoring and prediction in arid regions using remote sensing and machine learning | Li, X., Zhang, Y., & Liu, J. | 2022 | Remote Sensing | Combined remote sensing data and machine learning for drought monitoring and prediction in arid regions demonstrating the effectiveness of this approach for drought early warning |
| Spatiotemporal analysis of deforestation and its impact on ecosystem services in the Amazon rainforest | Silva, J., & Souza, C. | 2022 | Land Use Policy | Analyzed deforestation in the Amazon rainforest using Landsat data and GIS assessing its impact on ecosystem services. |

| | | | | |
|---|---|---|---|---|
| Monitoring and assessing water quality dynamics in coastal areas using remote sensing and GIS | Chen, X., & Wang, L. | 2021 | Journal of Environmental Management | Employed remote sensing data and GIS for monitoring and assessing water quality dynamics in coastal areas |
| Detecting and monitoring illegal logging activities in tropical forests using remote sensing and GIS | Rahman, S., & Ahmed, S. | 2020 | International Journal of Remote Sensing | Developed a system for detecting and monitoring illegal logging activities in tropical forests using satellite imagery and GIS |
| A Hybrid Approach for NDVI Estimation From Sentinel-2 and MODIS Data Using Spatiotemporal Fusion Techniques | Gao, F. et al. | 2020 | Remote Sensing of Environment | Spatiotemporal fusion of Sentinel-2 and MODIS data for effective NDVI estimation, capturing fine spatial details and preserving temporal resolution |
| Spatiotemporal Fusion of MODIS and Landsat NDVI Time Series for Efficient Vegetation Monitoring | Zhu, X. et al. | 2018 | Remote Sensing of Environment | Novel approach for spatiotemporal fusion of MODIS and Landsat NDVI time series, providing a comprehensive and accurate representation of vegetation dynamics |

**2.1: Monitoring and analyzing LULC changes in the Indus River Basin using remote sensing and GIS techniques:**

The Indus River Basin, spanning across Pakistan, India, China, and Afghanistan, is a crucial water resource and agricultural hub for millions. Monitoring and analyzing land-use and land-cover (LULC) changes in this region is essential for sustainable water management, agricultural planning, and environmental conservation. Remote sensing and GIS techniques offer powerful tools for this task. Monitoring and analyzing LULC changes in the Indus River Basin using remote sensing and GIS techniques is a valuable tool for informing sustainable water management, agricultural planning, and environmental conservation efforts in this critical region.

**2.2: Drought monitoring and prediction in arid regions using remote sensing and machine learning:**

Combining satellite data like precipitation, vegetation health, and soil moisture with machine learning models can generate near real-time drought maps with high spatial resolution, providing timely insights into drought conditions. Machine learning algorithms can analyze historical data and identify patterns leading to drought events. This can be used to develop early warning systems, alerting stakeholders before drought impacts become severe**.** Machine learning models can be trained on historical data and predicts droughts with lead times of days or weeks, allowing for proactive measures like water conservation and early crop switching. droughts with lead times of days or weeks, allowing for proactive measures like water conservation and early crop switching.

**2.3: Spatiotemporal analysis of deforestation and its impact on ecosystem services in the Amazon rainforest:**

By analyzing deforestation trends alongside data on economic activity, infrastructure development, and policy changes, researchers can identify the key drivers of deforestation in different regions of the Amazon. Using models that combine deforestation drivers and environmental data, researchers can simulate future deforestation scenarios under different policy and management strategies. By comparing ecosystem service provision before and after deforestation, researchers can quantify the negative impacts of deforestation on these vital services.

### 2.4: Monitoring and assessing water quality dynamics in coastal areas using remote sensing and GIS:

A project on monitoring and assessing water quality dynamics in coastal areas using remote sensing and GIS holds significant promise for improving coastal management, protecting marine ecosystems, and ensuring the sustainable use of coastal resources for future generations. Monitoring these parameters over time can reveal trends in water quality, identifying areas with improving or declining conditions and informing targeted management strategies.

### 2.5: Detecting and monitoring illegal logging activities in tropical forests using remote sensing and GIS:

A project on monitoring and assessing water quality dynamics in coastal areas using remote sensing and GIS holds significant promise for improving coastal management, protecting marine ecosystems, and ensuring the sustainable use of coastal resources for future generations. Combining remote sensing data with oceanographic models can simulate the movement and interaction of pollutants, providing insights into water quality under different environmental conditions.

### 2.6: A Hybrid Approach for NDVI Estimation From Sentinel-2 and MODIS Data Using Spatiotemporal Fusion Techniques:

A project on a hybrid approach for NDVI estimation from Sentinel-2 and MODIS data using spatiotemporal fusion techniques has the potential to significantly improve the accuracy, spatial resolution, and temporal coverage of NDVI estimates. This can provide valuable insights into vegetation dynamics and support a wide range of applications in agriculture, forestry, land-use change monitoring, and climate change studies.

### 2.7: Spatiotemporal Fusion of MODIS and Landsat NDVI Time Series for Efficient Vegetation Monitoring:

A project on spatiotemporal fusion of MODIS and Landsat NDVI time series for efficient vegetation monitoring holds significant promise for improving our understanding of vegetation dynamics, supporting informed decision-making in various sectors, and promoting sustainable.

# Chapter 3

# PROPOSED WORK

Bengaluru city experienced tremendous changes in the past two decades due to growing IT industry. Therefore, the study intends to capture the changes in the LULC and LST during 2014, 2015, and 2016. Further the study period was considered between March and April, the hotter months of the year, to reduce the infuence of seasonal variations and cloud cover.

**3.1: Data Collection:**

For any land cover and land use project, the first step involves identifying and collecting relevant input data. This can include satellite imagery, GIS data, and ground truth information. Ensuring the compatibility and consistency of these data sources is crucial to obtaining accurate and meaningful results. The input data serves as the foundation for subsequent analyses and classifications. Obtain satellite images from sources like Landsat or Sentinel-2.These images provide visual information about the Earth's surface, allowing you to identify different land use and cover types. Utilize Geographic Information System (GIS) datasets for spatial context. Include layers such as roads, land parcels, water bodies, and other relevant features to enhance the understanding of the landscape.

**3.2: Landsat 8:**

Landsat 8 is a satellite mission that belongs to the Landsat program, which is a series of Earth observation satellites operated by the United States Geological Survey (USGS) and NASA. The primary goal of Landsat satellites is to provide a continuous, long-term record of Earth's surface, allowing scientists and researchers to monitor changes in the landscape over time. Landsat 8 captures imagery in different spectral bands, including visible, near-infrared, and thermal infrared. This multispectral data is crucial for distinguishing various land cover types, such as forests, crops, water bodies, urban areas, and more. Landsat 8 has 11 spectral bands. Some of the key bands for LULC studies include:

- Visible and Near-Infrared Bands: Useful for vegetation health and discrimination.

- Shortwave Infrared Bands: Aid in detecting moisture content and distinguishing between different surface materials.
- Thermal Infrared Bands: Provide information about surface temperature.

**3.3: Layer Stacking and Infrared Bands:**

Land Use and Land Cover (LULC) projects using Landsat 8 imagery, image layering involves combining information from different spectral bands to create a composite image or a series of layers that highlight specific features or characteristics on the Earth's surface.

- Selection of Spectral Bands:

  Landsat 8 captures imagery in multiple spectral bands, each sensitive to different features on the Earth's surface. For LULC projects, researchers typically focus on specific bands depending on their objectives.

- Creation of Color Composites:

  True Color Composite: Bands 4 (Red), 3 (Green), and 2 (Blue) represent visible light and closely mimic what the human eye sees.

  False Color Composite: Bands 5 (Near-Infrared), 4 (Red), and 3 (Green) highlight vegetation in shades of red, facilitating the identification of healthy and stressed vegetation.

- **BAND 1:**

  In Landsat 8, Band 1 refers to the first spectral band captured by the satellite's Operational Land Imager (OLI) sensor.

- **BAND 2:**

  Band 2 in Landsat 8 is the visible blue band. It captures electromagnetic radiation in the blue wavelength range (0.450 to 0.515 micrometers). Band 2 effectively distinguishes water from land due to water's strong absorption of blue light. It appears dark blue or black in Landsat 8 imagery.

- **BAND 3:**

  Band 3 in Landsat 8 refers to the third spectral band captured by the Operational Land Imager (OLI) sensor onboard the satellite. Landsat 8 has a total of 11 spectral bands, and each band captures information in a specific range of the electromagnetic spectrum.

- **BAND 4:**

  Band 4 in Landsat 8 refers to the fourth spectral band captured by the Operational Land Imager (OLI) sensor on the satellite. Landsat 8 has a total of 11 spectral bands, and each band captures information in a specific range of the electromagnetic spectrum.

- **BAND 5:**

  Band 5 in Landsat 8 is the near-infrared (NIR) band. It captures electromagnetic radiation in the near-infrared wavelength range (0.850 to 0.885 micrometers). This band plays a crucial role in analyzing vegetation health and land cover, making it one of the most important bands in Landsat 8 imagery.

- **BAND 6:**

  Band 6 in Landsat 8 is the first of the shortwave infrared (SWIR) bands. It captures electromagnetic radiation in the SWIR1 wavelength range (1.570 to 1.650 micrometers) and plays a crucial role in analyzing vegetation health, soil properties, and mineral composition.

- **BAND 7:**

  Band 7 in Landsat 8 is the second shortwave infrared (SWIR) band, capturing electromagnetic radiation in the SWIR2 wavelength range (2.110 to 2.290 micrometers). It plays a key role in analyzing vegetation health, mineral composition, and thermal properties, offering valuable insights beyond the visible and near-infrared spectrum. Band 7 is sensitive to leaf water content and internal structure. It can help identify water stress in vegetation, differentiate between different plant types, and assess overall plant health.

# TABLE 3.1:

| Landsat 8 | Bands | Wavelength | Resolution |
|---|---|---|---|
| | Band 1-Ultra Blue | 0.43-0.45 | 30 |
| | Band 2-Blue | 0.45-0.51 | 30 |
| | Band 3-Green | 0.53-0.59 | 30 |
| | Band 4-Red | 0.64-0.67 | 30 |
| | Band 5-Near Infrared | 0.85-0.88 | 30 |
| | Band 6-Shortwave Infrared (SWIR)1 | 1.57-1.65 | 30 |
| | Band 7-Shortwave Infrared (SWIR)2 | 2.11-2.29 | 30 |

**Different Bands of Landsat 8 Images**

### 3.4: Derivation of NDVI:

Normalized Difference Vegetation Index (NDVI) is a widely used vegetation index in Land Use and Land Cover (LULC) projects and remote sensing applications. NDVI is derived from satellite or aerial imagery, and it quantifies the presence and health of vegetation based on the differential reflectance of near-infrared (NIR) and red wavelengths.

- **Importance of NDVI:**

  The Normalized Difference Vegetation Index (NDVI) is of significant importance in Land Use and Land Cover (LULC) projects due to its ability to provide valuable information about vegetation distribution, health, and changes over time. NDVI is a powerful tool for monitoring vegetation dynamics. It helps assess the presence and health of vegetation, allowing for the identification of areas with dense, healthy vegetation and those with stressed vegetation. NDVI is commonly used as a feature in land cover classification algorithms.

- **Band used in NDVI:**

  The Normalized Difference Vegetation Index (NDVI) is calculated using the reflectance values from two specific spectral bands: the near-infrared (NIR) band and the red band. In the case of Landsat 8, which has a total of 11 spectral bands, the relevant bands for NDVI calculation are Band 4 (Red) and Band 5 (Near-Infrared).

- **Formula for NDVI:**

  The NDVI formula is calculated using the reflectance values from the red (R) and near-infrared (NIR) bands of a multispectral image:

  The NDVI formula is expressed as follows:

  NDVI=(NIR−Red)/(NIR+Red)

  In this formula:

  NIR (Near-Infrared): This value corresponds to the reflectance in the near-infrared band, which is sensitive to vegetation health.

  Red: This value corresponds to the reflectance in the red band.

**3.5: Final NDVI Map:**

The final Land Use and Land Cover (LULC) map in a LULC project is a comprehensive visual representation that categorizes the various land cover and land use types within a specific geographic area. This map is the culmination of data analysis, classification processes, and interpretation performed during the project. The map categorizes the landscape into different land cover classes, which may include natural features like forests, water bodies, grasslands, agricultural areas, urban areas, and more. Each class is assigned a unique symbol or color for clarity. The final map reflects the spatial accuracy of the classification process. High-quality classification techniques aim to accurately represent the distribution of land cover features on the ground.

## FLOW CHART:

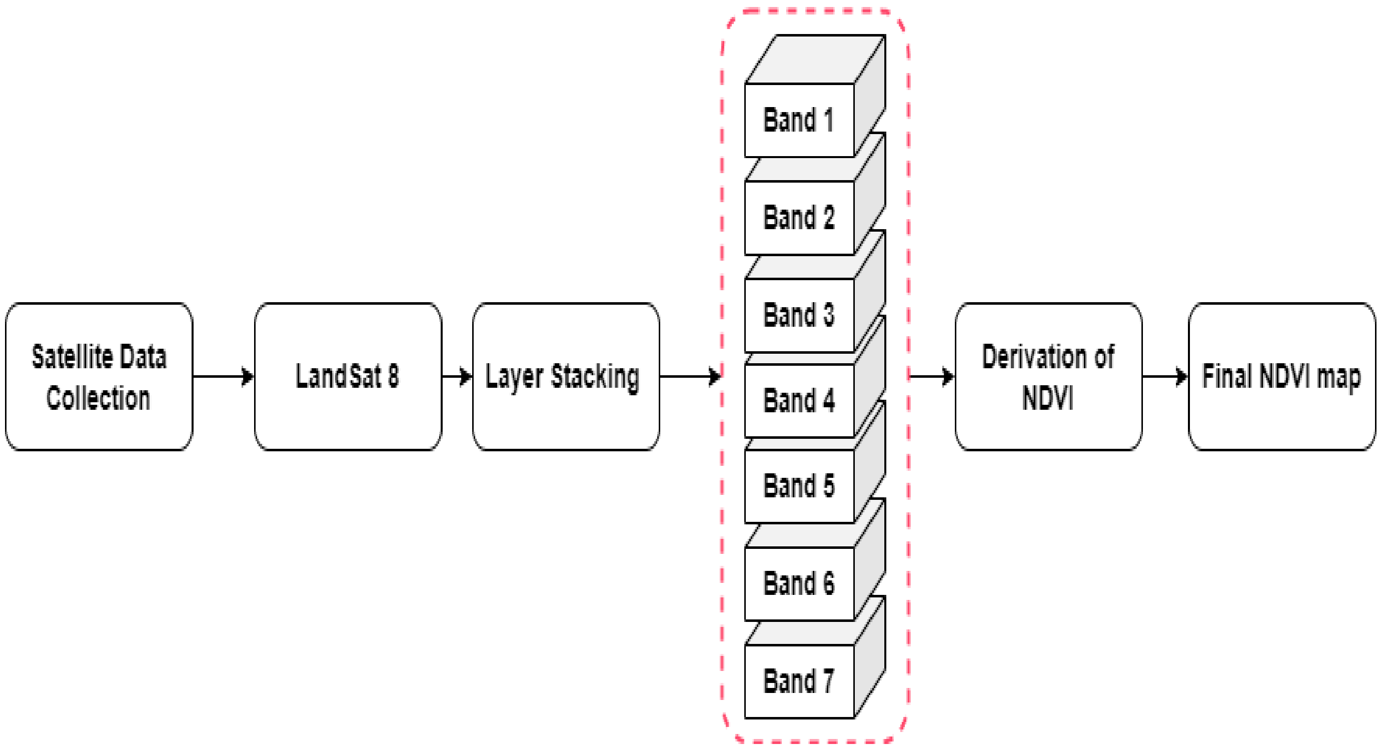
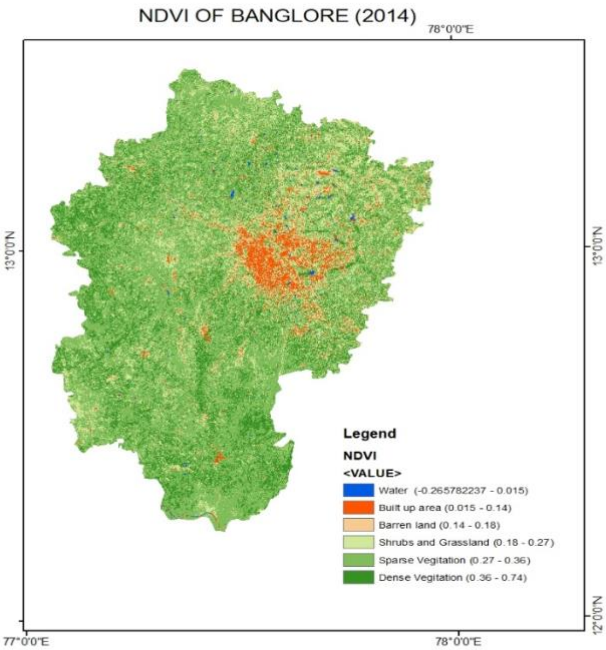



**Fig 1: Block Diagram of the model**

Clearly define the geographical extent and boundaries of the study area. Collect relevant data, including satellite imagery, aerial photographs, topographic maps, and other remote sensing data. Preprocess remote sensing data to correct for atmospheric effects, sensor distortions, and other artifacts. Use image classification techniques to categorize land cover types. Common methods include supervised, unsupervised, and object-based classification.

# Chapter 4

## RESULT ANALYSIS



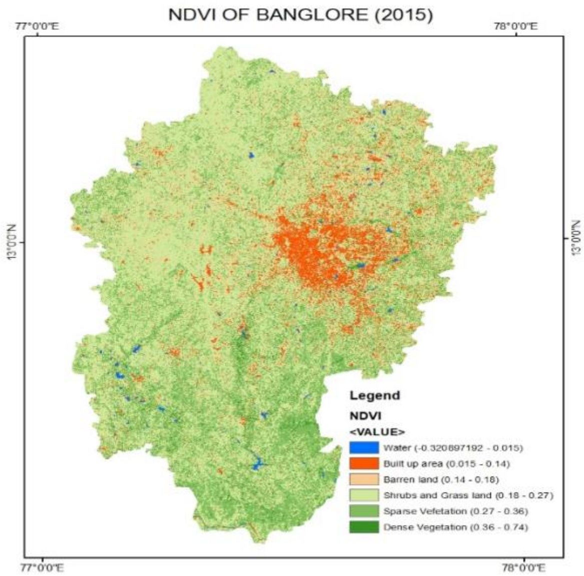




**Fig 4.1,4.2: NDVI (2014) & (2015)**

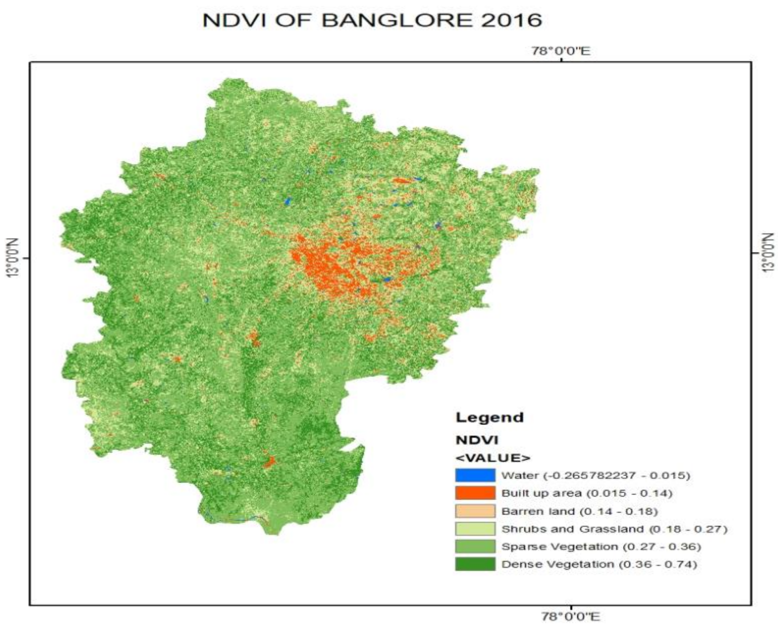



**Fig 4.3: NDVI (2016)**

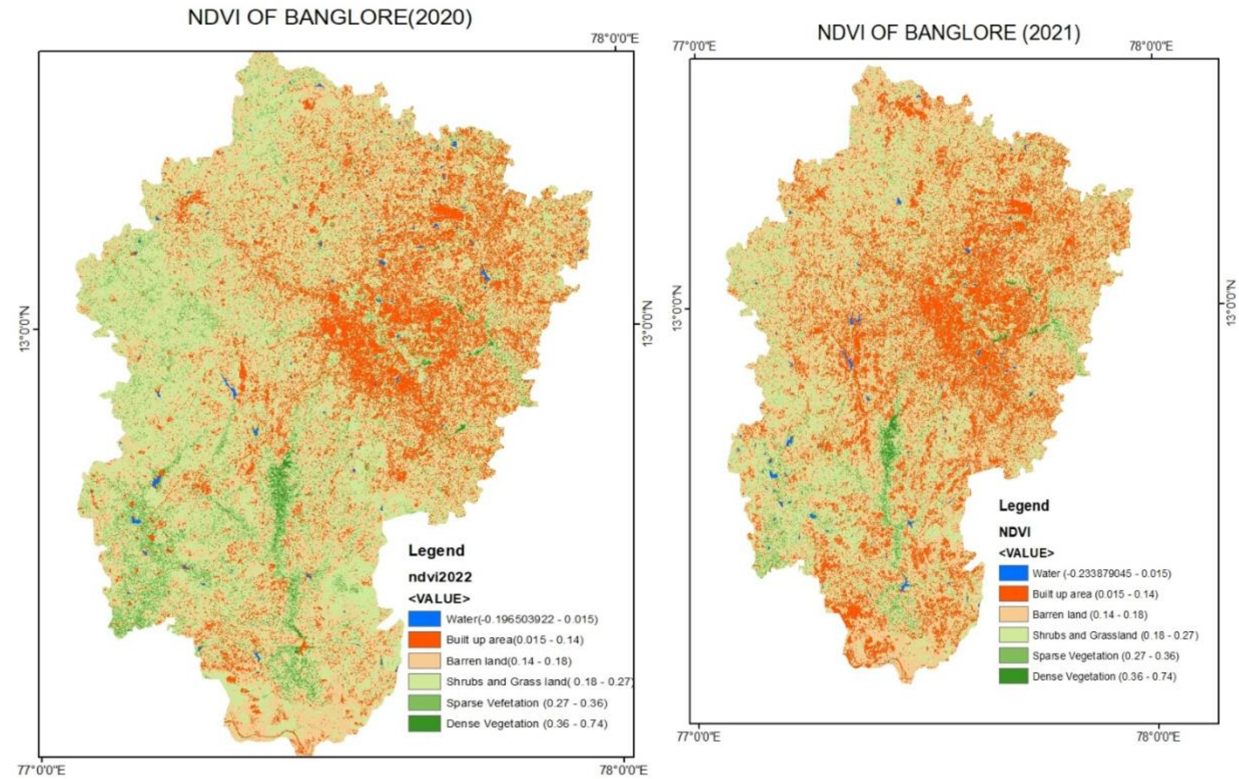



**Fig 4.4,4.5: NDVI (2021) & (2020)**

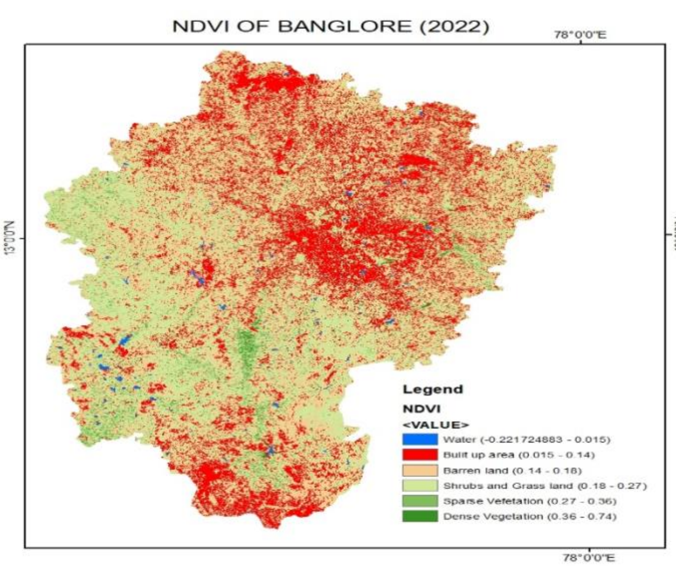



**Fig 4.6: NDVI (2022)**

# NDVI:

NDVI means normalized difference vegetation index a tool used to calculate changes occurred in vegetation land. And analyze environmental changes .We are going to focus on vegetation health and abundance. This chapter delves into the output of NDVI estimation. We will examine the spatial and temporal patterns observed in NDVI values, assess their implications for environmental trends.

## NDVI Values and Patterns:

In our NDVI estimation values ranging from [-1] (representing non-vegetated areas like water bodies and bare soil) to [1.0] (indicating dense vegetation cover). These values displayed distinct patterns in the form of colours for different ranges offering valuable clues about the distribution and health of vegetation across the study area. Which can be seen virtually and see the difference in our study map observing some maps from different years.

## Spatial Patterns:

● High NDVI zones: the values near to +1 Areas are meant to have dense vegetation, such as [list specific vegetation types, e.g., tropical forests, wetland ecosystems], consistently exhibited high NDVI values, exceeding [threshold value]. This pattern reflects the abundant photosynthetic activity occurring in these regions.

● Low NDVI zones: values near to -1 areas are an indication of water bodies and 0 + value Regions indication of sparse vegetation cover, including [list specific examples, e.g., arid landscapes, urban areas], displayed consistently low NDVI values, often falling below [threshold value]. This indicates limited plant growth and photosynthetic activity in these areas.

## Coloured Patterns:

Colours can be allotted to certain range of values for better understanding of the area of vegetation, water bodies, built up area accordingly.

Comparison of vegetation health from the past years can be seen with the help of coloured areas accordingly whether growth of vegetation area is increasing or decreasing.

## Changes occurred over multiple years:

By comparing our study map of 2014 and 2022 areas in Bangalore map we can observe many changes occurec in the past 10 years of span red colour (built up area) has been increased and green colour (vegetation ) land has been decreasing over the past years and there has been changes in the NDVI values these are some noticeable changes while comparing NDVI map of different years.

## Change Detection and Environmental Implications

By comparing NDVI values across different time periods, we can gain valuable insights into changes in vegetation cover and their potential environmental consequences.

● **Areas of Vegetation Growth:** Regions experiencing increases in NDVI values over time suggest [positive changes, e.g., reforestation efforts, improved land management practices, natural restoration]. This can lead to [list beneficial environmental impacts, e.g., enhanced carbon sequestration, reduced soil erosion, improved water quality].

● **Areas of Vegetation Loss:** Conversely, regions exhibiting decreases in NDVI values indicate [negative changes, e.g., deforestation, agricultural expansion, land degradation]. These changes can have significant adverse impacts, including [list potential consequences, e.g., loss of biodiversity, increased greenhouse gas emissions, soil erosion, disruption of water cycles].{ keep 2014 and 2022 map}.

## NDVI as a Tool for Environmental Change Analysis

The NDVI holds immense potential for various environmental change analysis applications due to its unique advantages:

● **Quantitative Measure**: NDVI provides a quantitative measure of vegetation health and abundance, enabling objective comparisons across different locations and time periods. This facilitates robust scientific analysis and informed decision-making.

● **Early Warning System:** NDVI fluctuations can serve as an early warning system for potential environmental degradation. Detecting sudden drops in NDVI can alert us to ongoing deforestation, land-use changes, or impending threats to ecosystems, allowing for timely intervention and mitigation strategies.

● **Spatiotemporal Monitoring:** NDVI data acquired from satellite imagery allows us to monitor vegetation cover changes over large areas and extended periods. This provides invaluable insights into long-term trends, enabling us to assess the cumulative impact of human activities or natural disturbances on ecosystems.

## Limitations and Future Considerations

**Factors Affecting NDVI:** Certain factors like soil type, topography, and atmospheric conditions can influence NDVI values, requiring careful interpretation and consideration of additional data sources for accurate analysis. NDVI time series prediction, and each study area has different topography, climate, vegetation cover, agro-ecosystems, and multiple emergencies, such as wild fire, flood, and landslide.

# Chapter 5

## CONCLUSION AND FUTURE SCOPE

In conclusion, this land use and land cover project successfully employed advanced remote sensing techniques, primarily utilizing Landsat 8 satellite imagery, to comprehensively analyze and map the spatial dynamics of the designated study area. Through a meticulous methodology involving data acquisition, preprocessing, and classification, we identified and classified distinct land cover categories. The integration of vegetation indices and Land Surface Temperature (LST) provided a nuanced understanding of the intricate relationships within the landscape. The findings of this study are poised to provide critical insights into the delicate balance required for fostering sustainable urban growth while preserving the ecological integrity that defines the city's identity.

This chapter deals with the review of Environmental Changes Using Remote Sensing and GIS approach Environmental Conservation: Understanding LULC changes helps in assessing environmental impacts, like deforestation, urbanization, and their consequences on biodiversity, ecosystems, and climate change.

Urban Planning: With increasing urbanization, city planners and policymakers rely on LULC data to make informed decisions about infrastructure development, resource allocation, and managing urban sprawl.

Agriculture and Food Security: Monitoring land use changes aids in optimizing agricultural practices, predicting crop yields, and ensuring food security by identifying suitable areas for farming.

Climate Change Mitigation: It contributes to understanding the carbon cycle, land degradation, and assessing the impact of climate change, allowing for better adaptation and mitigation strategies.

**Chapter 6**

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