DAYANANDA SAGAR UNIVERSITY

Devarakaggalahalli, Harohalli
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Bachelor of Technology in
COMPUTER SCIENCE AND ENGINEERING

Major Project Phase-II Report

ENVIRONMENTAL IMPACT ANALYSIS USING SATELLITE IMAGE PROCESSING : A CASE STUDY ON NH 948

Batch: 24

By

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(2024-2025)

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CERTIFICATE

This is to certify that the Phase-II project work titled **"Environmental Impact Analysis Using Satellite Image Processing: A Case Study On NH 948"** is carried out by **Arman N V(ENG21CS0054), Ashlesh B (ENG21CS0056), Ayush Udayakumar Nair (ENG21CS0062), Bariya Tushar Singh (ENG21CS0067),** bonafide students of Bachelor of Technology in Computer Science and Engineering at the School of Engineering, Dayananda Sagar University, Bangalore in partial fulfillment for the award of degree in Bachelor of Technology in Computer Science and Engineering, during the year **2024-2025**.

Dr. Rajesh T M	**Dr. Girisha G S**	**Dr. Udaya Kumar Reddy K R**
Associate Professor Dept. of CS&E, School of Engineering Dayananda Sagar University	Chairman CSE School of Engineering Dayananda Sagar University	Dean School of Engineering Dayananda Sagar University
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Name of the Examiner	**Signature of Examiner**
1.	
2.	

DECLARATION

We, **Arman N V(ENG21CS0054), Ashlesh B (ENG21CS0056), Ayush Udayakumar Nair (ENG21CS0062), Bariya Tushar Singh (ENG21CS0067),** are students of eighth semester B. Tech in **Computer Science and Engineering**, at School of Engineering, **Dayananda Sagar University**, hereby declare that the Major Project Stage-II titled **"Environmental Impact Analysis Using Satellite Image Processing: A Case Study On NH 948"** has been carried out by us and submitted in partial fulfilment for the award of degree in **Bachelor of Technology in Computer Science and Engineering** during the academic year **2024-2025**.

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We would like to thank one and all who directly or indirectly helped us in the Project work.

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LIST OF ABBREVIATIONS

NH	National Highway
LULC	Land Use and Land Cover
ISRO	Indian Space Research Organisation
USGS	United States Geological Survey
QGIS	Quantum Geographic Information System
SCP	Semi-Automatic Classification Plugins
OLI	Operational Land Imager
TIRS	Thermal Infrared Sensor
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
SVM	Support Vector Machines

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ABSTRACT

Our study plans to conduct a thorough before-and-after analysis of land use and land cover (LULC) alterations in the area surrounding the construction of NH 948, focusing on the environmental implications associated with highway construction. NH 948 will be the focal point for our investigation, allowing us to gain insights into the transformation of the landscape. Our primary objective is to identify the significant changes that have occurred in the area in the recent years. Through a comprehensive examination, we aim to gather the impacts on LULC patterns, emphasizing the need for sustainable development practices. By delving into the complex dynamics of land use alterations, we seek to inform urban planners, policymakers, and stakeholders about the broader implications of highway construction on the environment. This research aligns with the goal of promoting sustainable urban development and underscores the importance of considering environmental factors in the planning and execution of infrastructure projects.

CHAPTER 1 INTRODUCTION

Highway construction plays a vital role in development, contributing to improved connectivity and economic growth. However, these constructions often bring about significant changes to the natural landscape. This study aims to comprehensively investigate Land Use and Land Cover (LULC) changes from the construction of NH 948. By understanding the nature and extent of alterations caused by these constructions, we can better address their environmental impact.

In this study, we will employ remote sensing techniques and supervised classification methods to analyze satellite imagery before and after the highway construction. The primary objectives of our investigation include evaluating forest clearance, assessing changes in water bodies, analyzing alterations in land use and investigating the impact on agriculture.

The process of highway construction almost always has diverse effects on the landscape, ranging from alterations in the distribution of vegetation to changes in water bodies and land use patterns. Through our upcoming study, we aspire to shed light on these transformations, providing valuable insights that can inform future construction practices and contribute to sustainable development. By anticipating and understanding these changes, we aim to pave the way for a balanced approach to infrastructure development—one that prioritizes progress while safeguarding the environment. This study endeavors to explore the multifaceted impacts of highway construction, laying the groundwork for informed decision-making and responsible development practices.

1.1. OBJECTIVE

The primary objective of this study is to comprehensively assess the socio-environmental impacts associated with the highway project.

Specifically, our objectives are as follows:

1. **Agricultural Impact Assessment:** To quantify the extent of agricultural land affected by the project and assess potential crop yield losses.
2. **Land Use Changes:** To measure and analyze changes in land use patterns resulting from the construction of the highway, considering implications for urban expansion and future land development.

3. **Forest Clearance Evaluation:** To determine the amount of forested land slated for clearance.

4. **Water Body Assessment:** To identify the number of water bodies impacted by the highway project.

1.2. SCOPE

The primary purpose of this project is to understand and study the changes happening to the land around NH 948 due to the construction of the highway. The target is to understand how the environment has been affected before and after the highway construction. The main goal is to figure out the impact of this construction on nature and to, in the future, find ways to build infrastructure in a sustainable manner.

Environmental Impact:

1. Construction of highways can lead to a major loss of forest, agricultural land, water bodies and our study can quantify and assess these impacts.

2. Assessing land cover changes can provide insights on how much natural land has been converted into infrastructure. This can be crucial for sustainable land management and urban planning.

CHAPTER 2 PROBLEM DEFINITION

Highway construction often leads to deforestation, conversion of natural landscapes and alterations in hydrological systems, which can result in adverse effects such as increased runoff and habitat loss.

Furthermore, these changes may impact local communities by affecting their access to resources, livelihoods, and overall quality of life.

The solution is to quantify the LULC changes in the areas that underwent highway construction. Our analysis will employ remote sensing techniques and supervised classification methods to perform the study in NH 948.

The results of this study will provide a valuable resource for urban planners, environmental managers, and policymakers involved in infrastructure development.

CHAPTER 3 LITERATURE REVIEW

Land Classification Analysis using Geospatial approach in Nanjangud Taluk of Karnataka State, India. Specific group of land categorization on a satellite image is a fundamental task to determine the spatial knowledge and its importance. Several image classification techniques are produced to create standardized Land use and Land cover (LULC) maps that facilitate analysis on ecological processes and human activities. Mapping land use/land cover changes at regional scales is essential for a wide range of applications including landslide, erosion, land planning, global warming etc. [1]

Hadi, Prayoga & Wasanta, Tilaka & Santosa, Wimpy. (2021). Land use change due to road construction. Roads is one of the main infrastructures to support the realization of economic development. This study conducted to analyze the effect of road construction on the rate of land use change. The results of this classification are then used for land use change analysis. The analysis carried out shows that there is a change in land use rate growth for building classification before and after road construction. Land use for growth for building classification is developed faster when a new road is built than before a road is built. [2]

Akyürek, D Lulc Detection Using Multi–Temporal Satellite Dataset: A Case Study In Istanbul New Airport. With an advanced space technologies including remote sensing, environmental consequences due to Land Use/Land Cover changes (LULC) can be monitored and determined efficiently. The aim of this paper is to analyse LULC changes especially in the forest areas and water bodies by using two different satellite image dataset. In this context, supervised classification method and different spectral indices are applied to both Landsat-8 (2013–2017) and Sentinel 2A (2015–2017) image datasets to demonstrate the total and annual changes during the construction of the first phase. [3]

S. Feng Et Al., "Quantification Of The Environmental Impacts Of Highway Construction Using Remote Sensing Approach" highways provide key social and economic functions but generate a wide range of environmental consequences that are poorly quantified and understood. Results showed that land cover composition experienced large changes in the 0–100 m and 100– 500 m buffers while that in the 500–1000 m buffer was relatively stable. In the 0–100m buffer. Although the mean values of ndvi, ndmi, and lst in the 500–1000 m buffer remained relatively stable during the study period, their spatial variabilities increased significantly after highway construction.. The approach proposed in this study can be readily applied to other regions to quantify the spatial and temporal changes of disturbances of highway systems and subsequent recovery. [4]

Roy, Parth & Roy, Arijit. (2010). Land Use and Land Cover Change: A Remote Sensing & GIS Perspective. The temporal information on land use and land cover helps identify the areas of change in a region. This has helped scientists to quantify these tools and to predict various scenarios. This article gives a overview of the current trends in land use and land cover changes along with two case studies on the same subject, one case study on geospatial LULC change modeling and one on agent based land use and land cover change modeling. [5]

Paper & Author Name	Technology Used	Results	Inference
M.C. Manjunatha and H.T. Basavarajappa, "Land Classification Analysis using Geospatial approach in Nanjangud Taluk of Karnataka State, India,"	The study uses IRS-1D LISS-III, to perform land classification analysis in Nanjangud Taluk of Karnataka, India.	The study classifies the land into three levels of detail: include agricultural land, built-up land, forest, water bodies, wastelands, and others	They identify specific cropping seasons and double-cropped areas. This information is valuable for environmental monitoring, land planning, and resource management, sustainable development and ecosystem conservation.
Hadi, Prayoga & Wasanta, Tilaka & Santosa, Wimpy. (2021). Land use change due to road construction	They use geographic information systems (GIS) and satellite imagery from Google Earth to carry out LULC classification on 3 different ring roads.	Conversion of nonresidential land into residential areas increased in all three cases.	After the operation of the new road, the increase in land use was significantly faster.
Akyürek, D Lulc Detection Using Multi–Temporal Satellite Dataset: A Case Study In Istanbul New Airport.	(LULC) changes in the vicinity of Istanbul Grand Airport (IGA). Using two satellite image datasets: Landsat-8 and Sentinel2A. Spectral indices like NDVI, BI & NDSI are used.	The study's results show that the most significant change occurred in the vegetation cover, with large areas transitioning from "highly vegetated areas" to "construction areas."	The findings highlight the substantial negative impact on vegetation and coastal regions in the study area, emphasizing the ecological consequences of such largescale infrastructure projects

S. Feng Et Al., "Quantification Of The Environmental Impacts Of Highway Construction Using Remote Sensing Approach"	BDACI-RS method with remote sensing to assess spatial and temporal environmental impacts before, during, and after Wujing Highway construction.	Model assesses highway's impact on environment using NDVI, NDMI, LST, terrain data. Poor quality increased during construction but improved after.	BDACI-RS assesses highway impacts, applicable to projects, and combines remote sensing and field data. Reveals postconstruction recovery and uneven road impact distribution.
Roy, Parth & Roy, Arijit. (2010). Land Use and Land Cover Change: A Remote Sensing & GIS Perspective	Agent-based model blends, Cellular Automata, factors like population, terrain, rainfall to predict land use dynamics in Goa.	Model forecasts 2027 land use trends in Goa, emphasizing dynamic categories, aiding informed decision-making on land use and cover.	Study demonstrates agentbased modeling's effectiveness in understanding land changes in Goa, stressing the role of human and environmental factors for sustainable land management.

Table 3.1 Literature review

3.1 Challenges with Existing Data Accessibility and Timeliness

While remote sensing and GIS offer powerful tools for environmental impact analysis, a significant challenge lies in the accessibility and timeliness of readily available land use data. Many government and public domain datasets, while valuable, are often outdated, hindering accurate "before-and-after" analyses for rapidly changing landscapes due to infrastructure projects.

For instance, publicly available agricultural data might show "Net Area Sown" and "Gross Cropped Area" statistics that are several years old, such as data from 1990-91, 2000-01, 2010-11, 2016-17, 2017-18, and 2018-19. Similarly, "Forest Area" data might also be from earlier periods like 1980-81, 1990-91, 2000-01, 2017-18, 2018-19, and 2019-20. Such temporal discrepancies make it difficult to ascertain the most recent environmental conditions and the immediate impacts of recent construction projects. This highlights the necessity for projects like ours, which utilize current satellite imagery for timely and precise LULC analysis, enabling more accurate environmental impact assessments. Our approach leverages recent satellite data to overcome the limitations of outdated general statistics, providing a more relevant and validated understanding of the landscape transformations.

	Agriculture		1990-91	2000-01	2010-11	2016-17	2017-18	2018-19
24	Net Area Sown	'000 Ha.	10381	10410	10523	9855	9895	10664
25	Gross Cropped Area	-do-	11759	12284	13062	11779	11994	13551
26	Gross Irrigated Area	-do-	2598	3271	4279	3548	3639	4745
27	Gross Irrigated Area to Gross Cropped Area	Percentage	22.09	26.63	32.76	30.12	30.34	35.01

	Forest		1980-81	1990-91	2000-01	2017-18	2018-19	2019-20
53	Forest Area	'000 Ha.	3838	3872	3828	4338	4342	4159

CHAPTER 4 PROJECT DESCRIPTION

DESIGN AND PROJECT DESCRIPTION

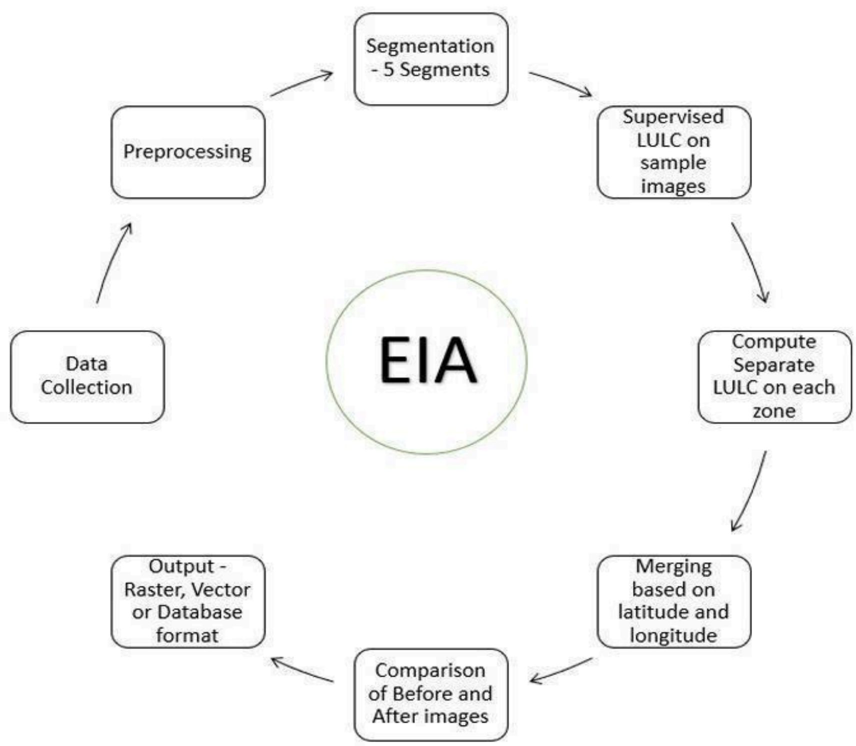

Fig 4.1 Design Flowchart

a. Data Collection:

i. Satellite Imagery Sources: Acquire high-resolution satellite images from:

1. USGS (United States Geological Survey) – Landsat 8-9 for historical and recent images.
2. Bhuvan (ISRO) – Resourcesat series for high-resolution data specific to India.

ii. Resolution and Spectral Bands: Use images with resolutions between 10–30 meters and multiple spectral bands (including visible and near-infrared) for detailed analysis of Land Use and Land Cover (LULC).

b. Preprocessing:
   i. Conversion: Transform satellite data to compatible formats for analysis.
   ii. Geometric Correction: Adjust for distortions to maintain geographic accuracy. iii. Atmospheric Correction: Minimize atmospheric effects for more precise results.
   iv. Normalization and Calibration: Standardize pixel values across images to facilitate accurate comparisons.
   v. Region of Interest (ROI) Definition: Crop data to focus specifically on the NH 948 corridor.

c. Segmentation and Buffer Zones:
   i. Highway Segmentation: Divide NH 948 into distinct segments to focus on varied landscape impacts:
      1. Example: Create segments based on key intersections, settlements, and agricultural zones along NH 948.
   ii. Buffer Zones: Define 5km buffer zone surrounding NH 948

d. Supervised Classification for LULC Analysis:
   i. LULC Classification: Classify land cover in each buffer zone into categories such as:
      1. Urban/Built-up Areas
      2. Vegetation Cover
      3. Barren Land
      4. Water Bodies
      5. Agricultural land ii. Supervised Training: Use QGIS and the Semi-Automatic Classification Plugin to mark training samples for each LULC class and apply machine learning classifiers, such as Support Vector Machines (SVM), to categorize entire images.

e. Change Detection and Analysis:
   i. Comparison of Pre- and Post-Construction Images: Use pixel-based change detection techniques to highlight alterations between images taken before and after the construction phase.
   ii. Environmental Metrics: Calculate Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), and other relevant indices to assess vegetation health, water body changes, and land degradation over time.
   iii. Land Use Metrics: Measure shifts in agricultural areas, deforestation, and urban expansion across buffer zones to quantify the impact of highway construction.

f. Data Integration and Analysis:
   i. Spatial Merging: Use QGIS to merge and align data layers based on latitude and longitude.
   ii. Statistical Analysis: Calculate the extent of land cover changes and environmental degradation, providing quantitative data for urban planning and policy recommendations.

g. Output Generation and Reporting:
   i. Visualization: Create maps and visual overlays to display LULC changes across buffer zones.
   ii. Data Export: Save processed data and analysis results in formats such as GeoTIFF (for raster data) and Shapefile (for vector data).

CHAPTER 5 REQUIREMENTS

5.1 Software Requirements:

1. Modern multi-core processor (e.g., Intel Core i5)
2. 4 GB RAM (8 GB recommended)
3. Several gigabytes of free disk space
4. Graphics card with OpenGL 3.3 support
5. QGIS Software
6. Semi-Automatic Classification Plugin
7. USGS and Copernicus Satellite Images

5.2 Hardware Requirements:

1. Python
2. QGIS Software
3. SCP and Semi-Automatic Classification Plugins
4. Internet connection for online data access.
5. Storage: Program requires about 100 MB of storage space.

CHAPTER 6 METHODOLOGY

1. Data Collection:

- **Bhoonidhi/Bhuvan :**Bhuvan and Bhoonidhi are significant geospatial platforms developed by the Indian Space Research Organisation (ISRO) for mapping, data visualization, and related services.
- Bhoonidhi stands for Bhuvan Indian Space Data Hub. It is an integrated geospatial data distribution system launched by ISRO to make satellite imagery and spatial data more accessible
- Bhuvan is an Indian satellite-based geoportal launched by ISRO in 2009. It provides 2D and 3D geospatial data visualization services.

Steps to Collect data from Bhoonidhi:

1. URL: https://bhoonidhi.nrsc.gov.in/bhoonidhi/index.html use this URL to open the bhoonidhi portal.

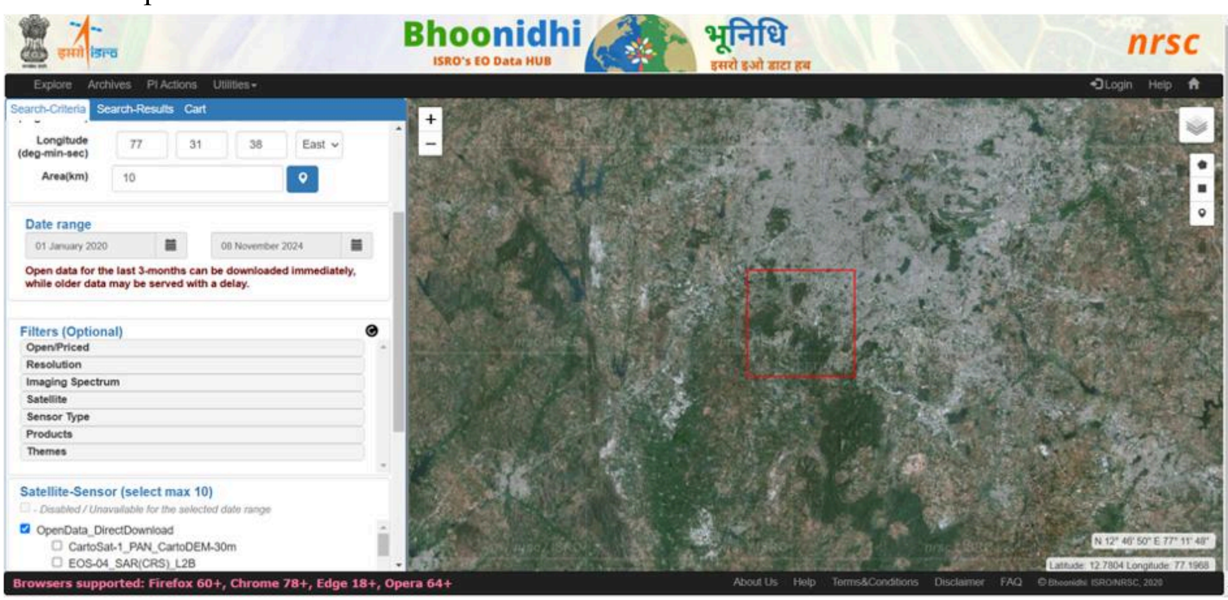

Fig 6.1 Bhoonidhi Website

2. on Search-Criteria Tab need to fill Following details

Area of Interest :

Location - we used Latitudes and Longitudes of as well as Used Map

Date Range: 1 January 2020 - 2024

Filters : -Open/Priced : Open_Data

-Resolution : Medium

-Imaging Spectrum : Optical/Microwave/Non_Imaging

-Satellite : LandSat 8 -9

-Sensor Type : OLI+TIRS

-Product : Level-1/Level-2

-Themes : Agriculture,Forestry,Urban Studies,Water Resources

Satellite-Sensor : OpenData_DirectDownload(sub needed sensor LandSat_OLI+TIRS_L1/LandSat_OLI+TIRS_L2 /ect.)

3. Submit and move on to Search-Results tab

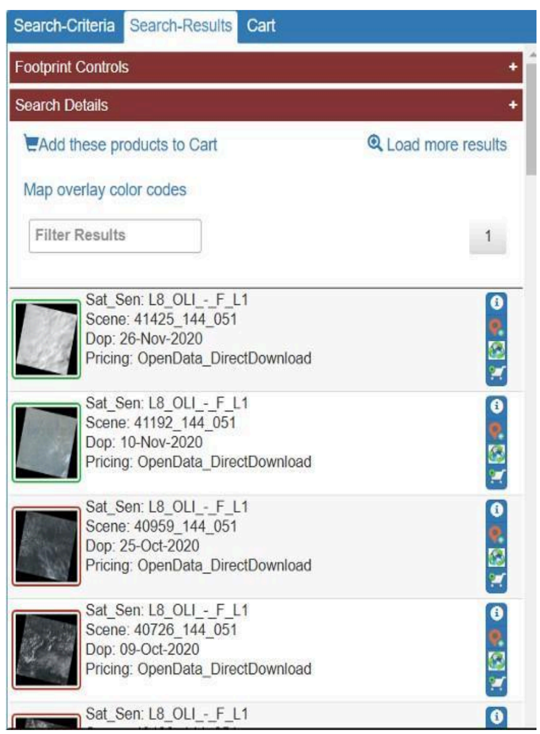

Fig 6.2 Search-results

4. then Data Add in Cart
5. Confirm the Added data and Download

- **Earthexplorer(USGS) :**EarthExplorer is a web-based tool provided by the United

States Geological Survey (USGS) that allows users to search, download, and view Earth science data. It is widely used for remote sensing, environmental monitoring, and research purposes.

Steps to Collect data from Earthexplorer(USGS):

1) URL:https://earthexplorer.usgs.gov/ use this URL to open the Earthexplorer(USGS**)** portal.

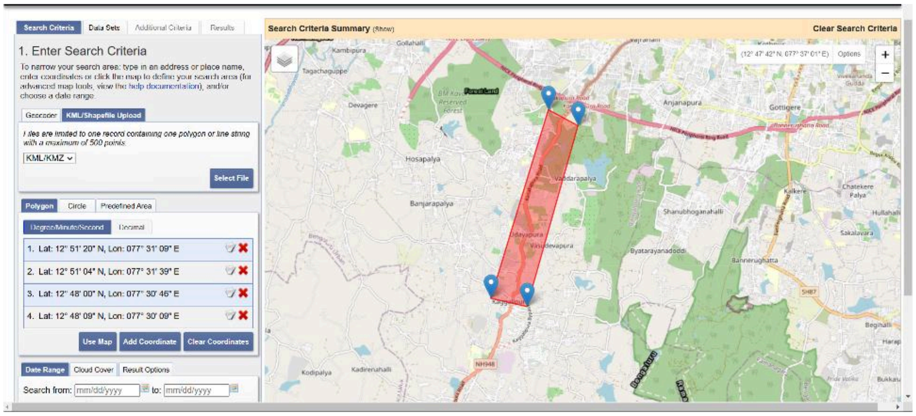

Fig 6.3 Earthexplorer website

2) on Search-Criteria Tab need to fill Following details in KML/shapefile

-Polygon : we used Add Coordinate of as well as Used Map

-Date Range: 1 January 2020 - 2024

3) Next Go to Data Sets, select the LandSat .
4) In LandSat ,Select LandSat Collection Level-1/Level-2 in its specify LandSat 8-9 OLI/TIRS C2 L1

Fig 6. 4 Earthexplorer Results Tab

5) then go to Results and Download the needed file ❖ **Coordinates Used :**

Silk institute : 12°51'27"N 77°31'38"E

Kagalipura :12°48'16"N 77°30'16"E

Harohalli :12°40'58"N 77°28'15"E

Kanakapura : 12°32'40"N 77°25'19"E

2. Classifying Landsat data in QGIS Steps :

1. Load the landsat data (different bands) on workshop using browser in QGIS
2. Creating an roster of band set using SCP
3. Getting an star roster image (RGB=4-3-2)
4. Getting training input using SCP dock panel
5. Band processing (classification)
6. Final Result Processed data(classification Report)

CHAPTER 7 EXPERIMENTATION

First test using 11 January 2020 Landsat data

❖ Creating Raster of Band Set

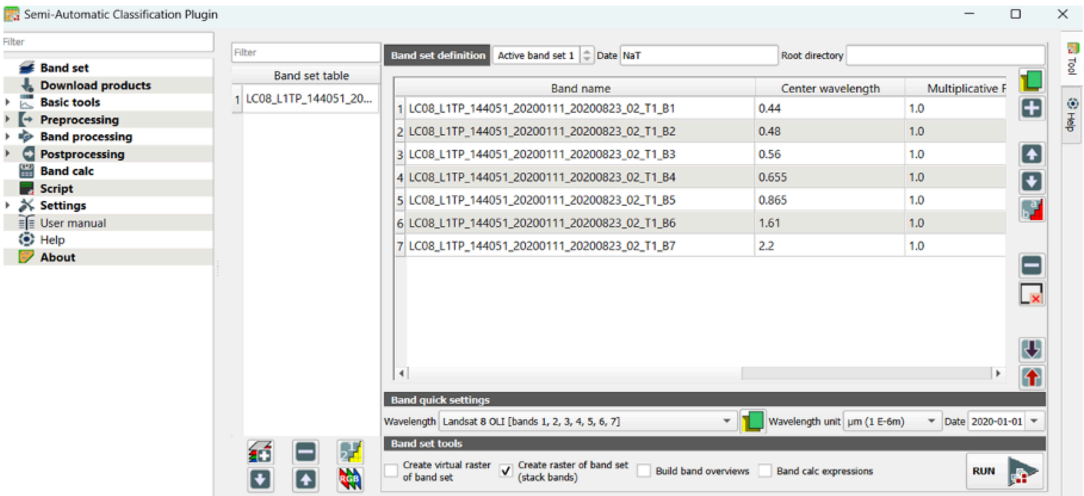

Fig 7.1 .Band set in SCP

-Using 7 bands from Landsat 8 Data in SCP >>Band Set to create Stack Raster Image.

-Setting Wavelength to Landsat 8 OLI.

-Wavelength Unit to E-6m.

-Set Create raster of band set

❖ Stack Raster Image

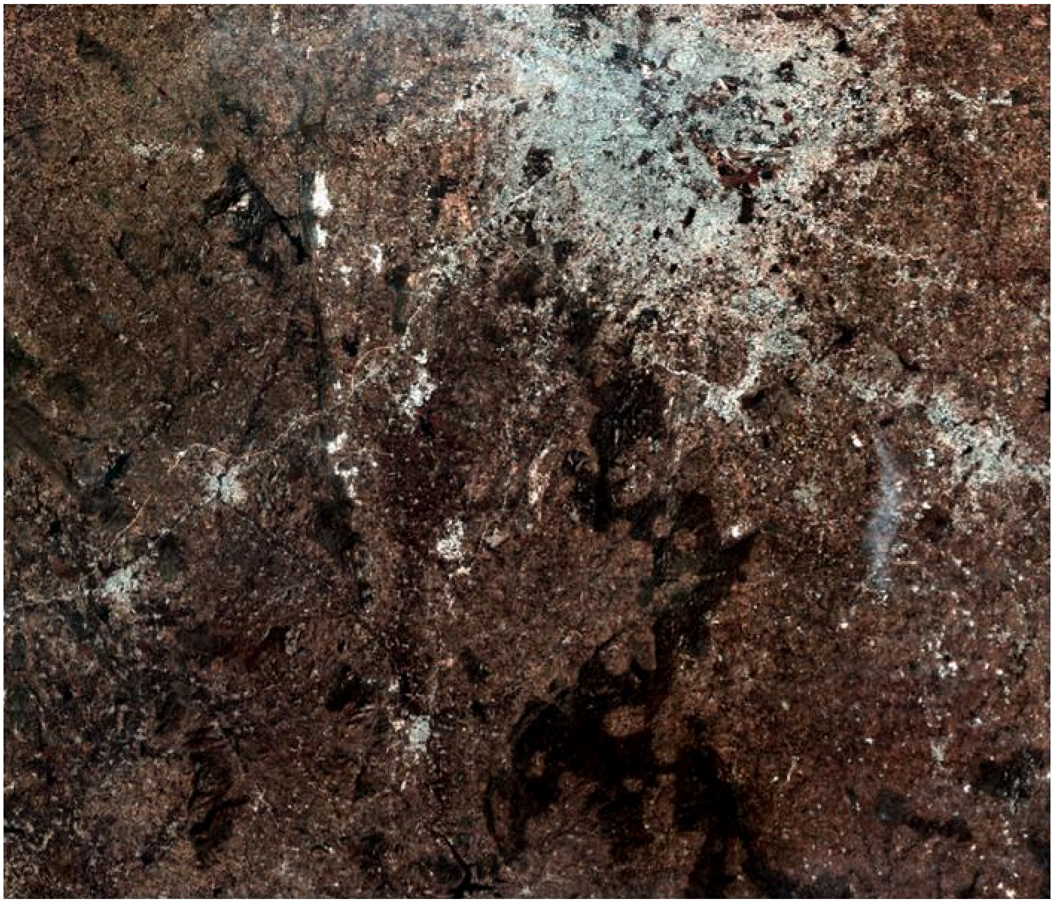

Fig 7.2 Stack Raster Image

❖ Supervised LULC Land Use and Land Cover (LULC) classification of satellite images involves categorizing Earth's surface into different classes

1. Waterbodies
2. Vegetation
3. Barren land
4. Buildings
5. Agricultural land

Supervised training is done by selecting appropriate ROIs(Region of interest) using the Semi-Automatic Classification Plugin of QGIS.

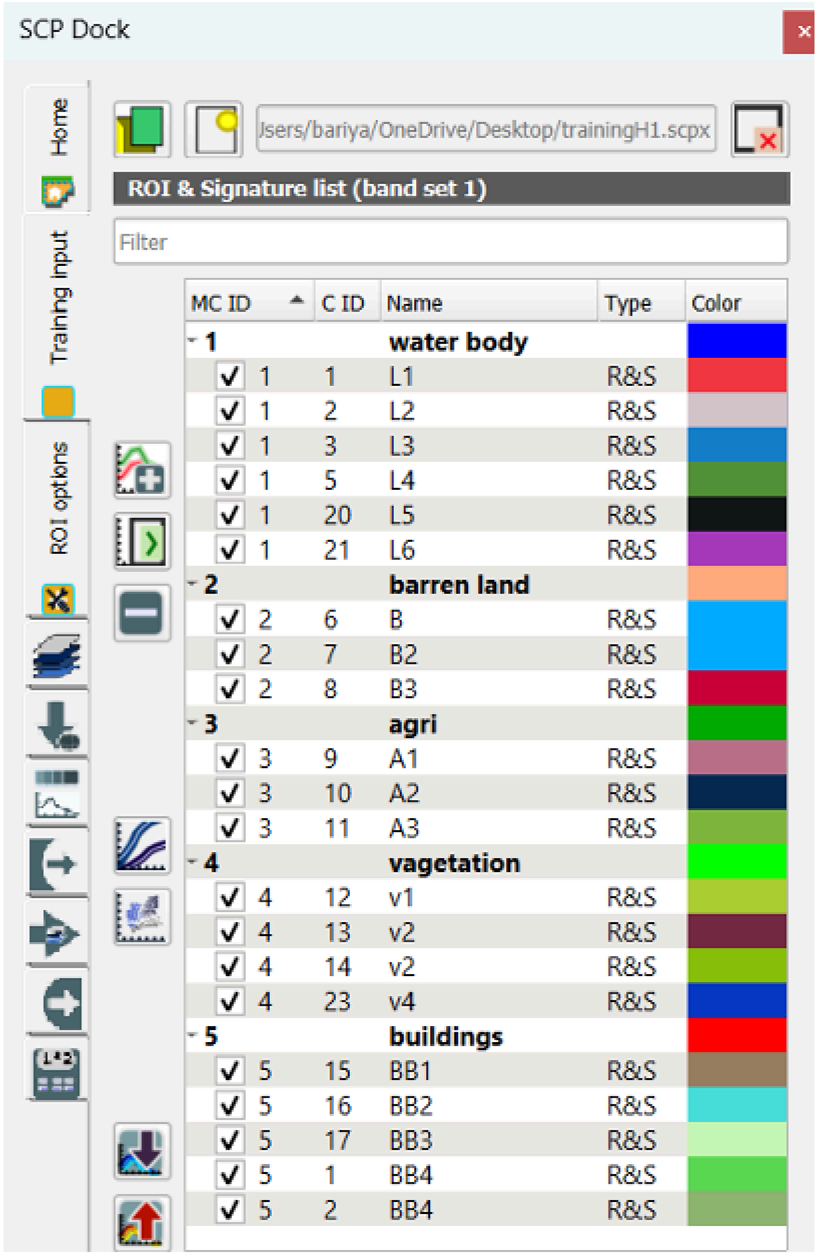

Fig 7.3 SCP Dock Panel

- ❖ Band Processing (Classification)
- ❖ Use of Training data : Macroclass ID as well Class ID
- ❖ Algorithm : Maximum Likelihood

CHAPTER 8 TESTING AND RESULTS

❖ Final Result

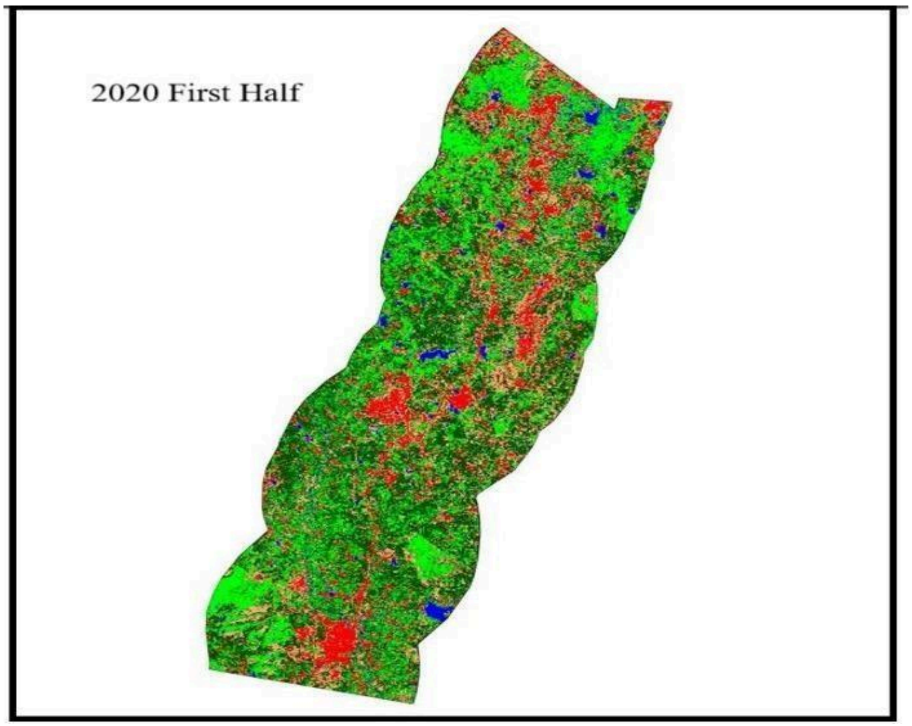

Fig 8.1 a) Final Processed Image 2020 First Half

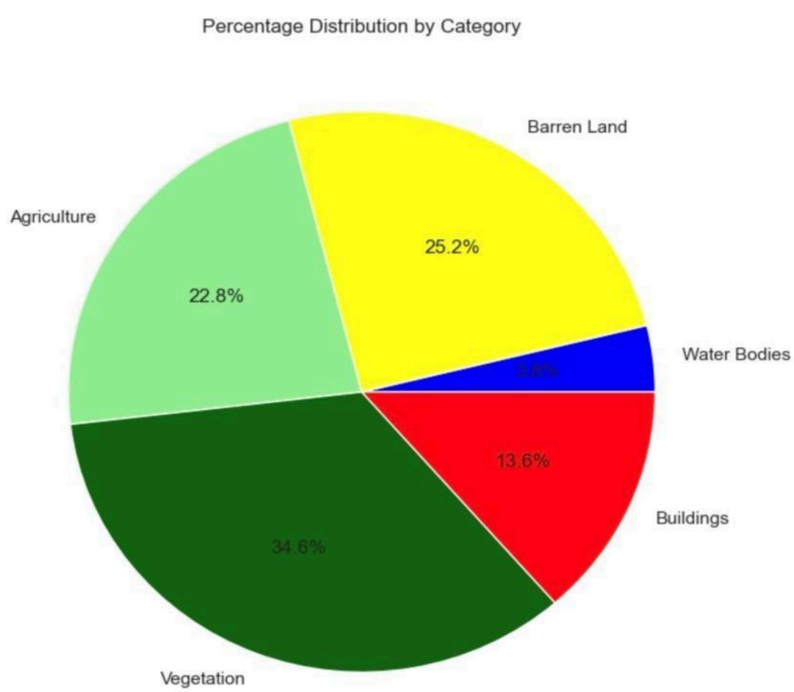

Fig 8.1 b)Percentage Distribution By Category For 2020 First Half

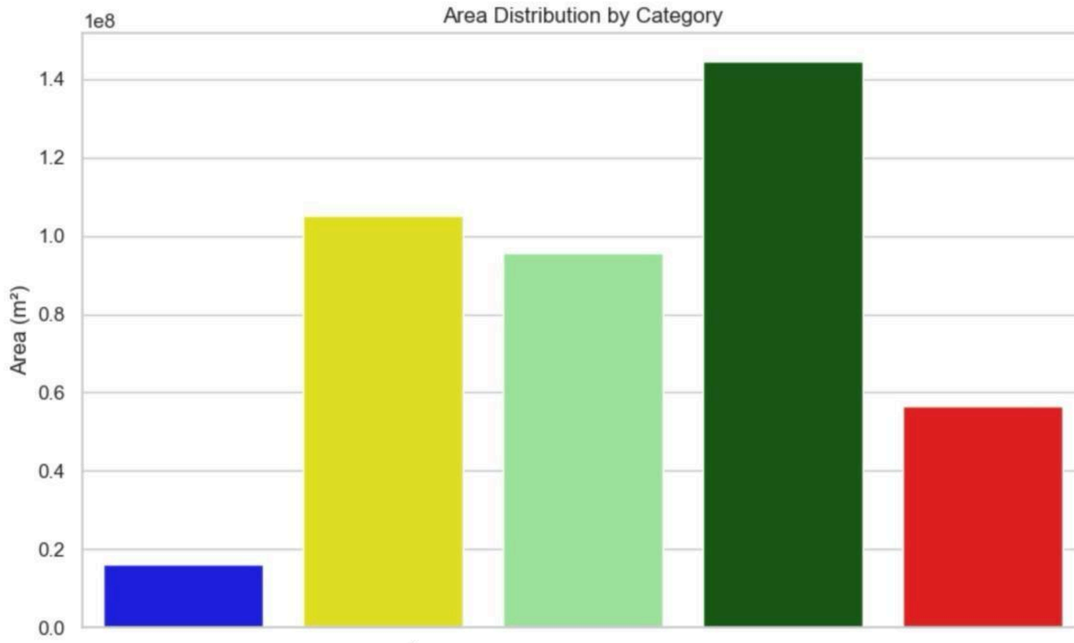

Fig 8.1 c) Area Distribution By Category For 2020 First Half

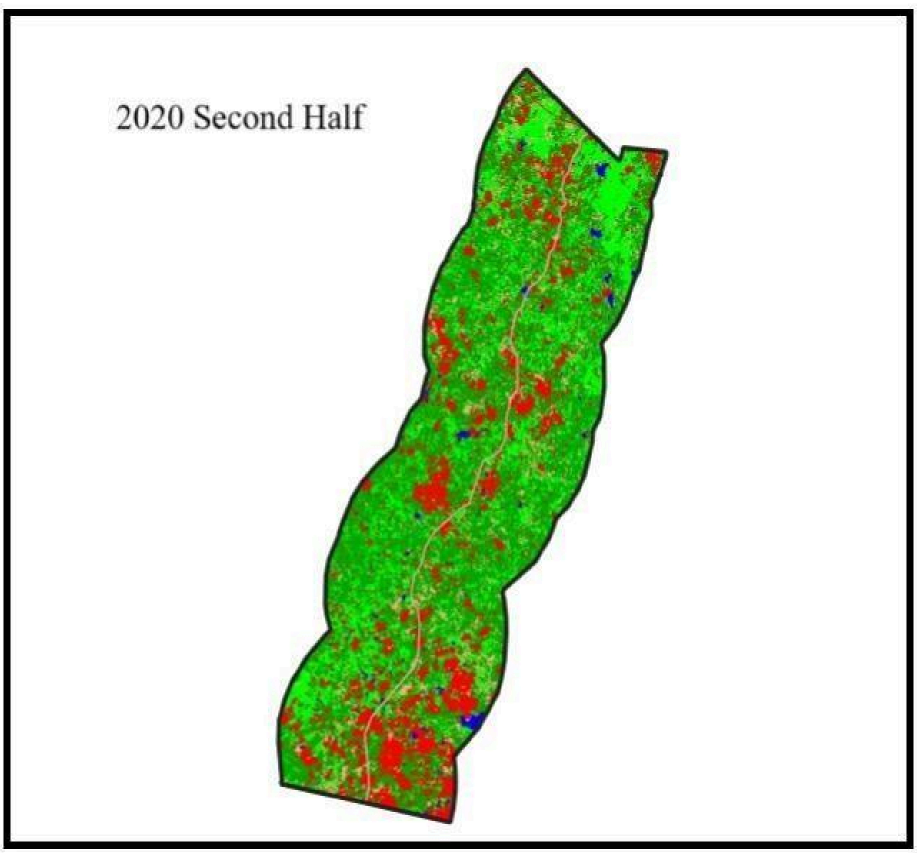

Fig 8.2 a) Final Processed Image 2020 Second Half

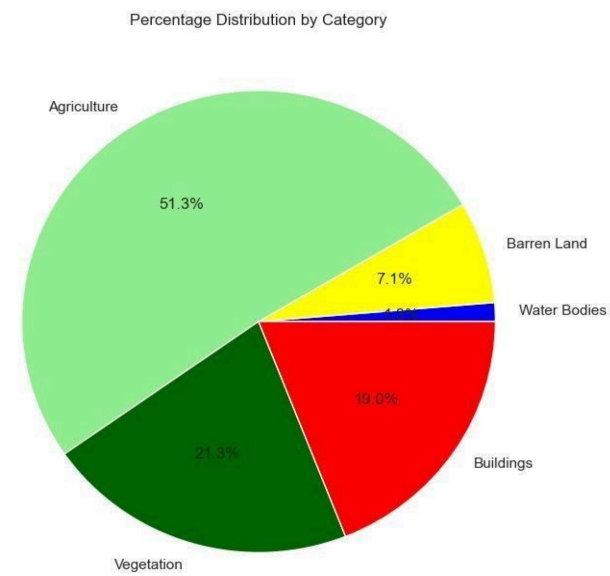

Fig 8.2 b) Percentage Distribution By Category For 2020 Second Half

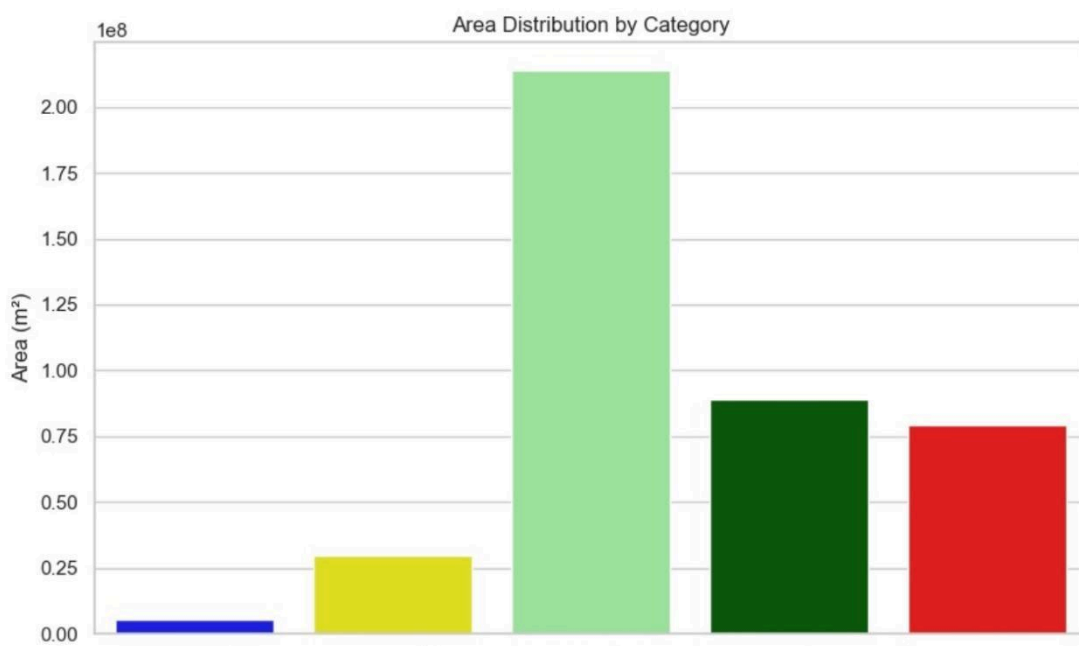

Fig 8.2 c) Area Distribution By Category For 2020 Second Half

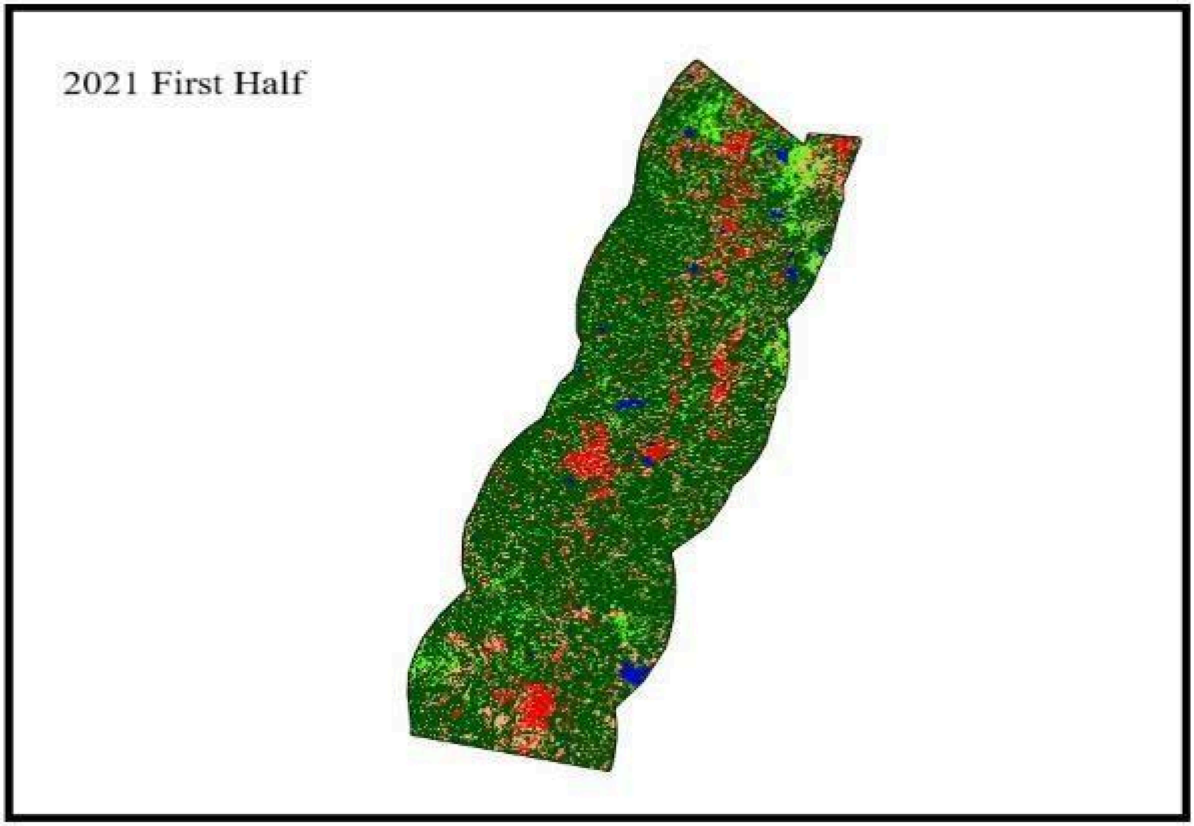

Fig 8.3 a) Final Processed Image 2021 First Half

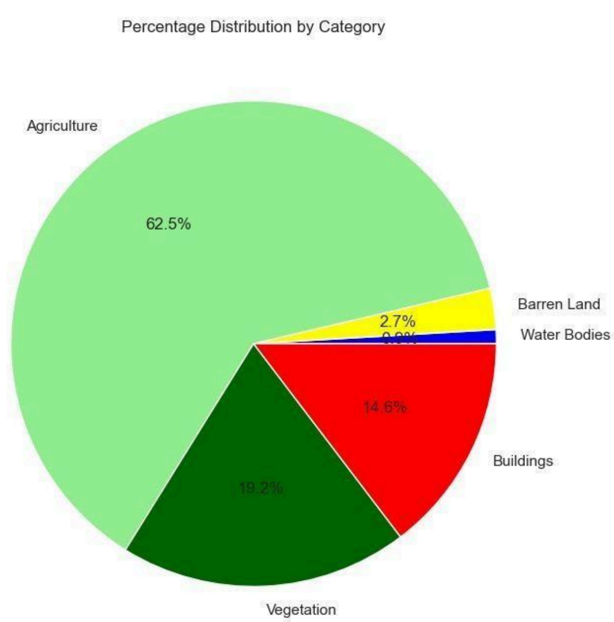

Fig 8.3 b) Percentage Distribution By Category For 2021 First Half

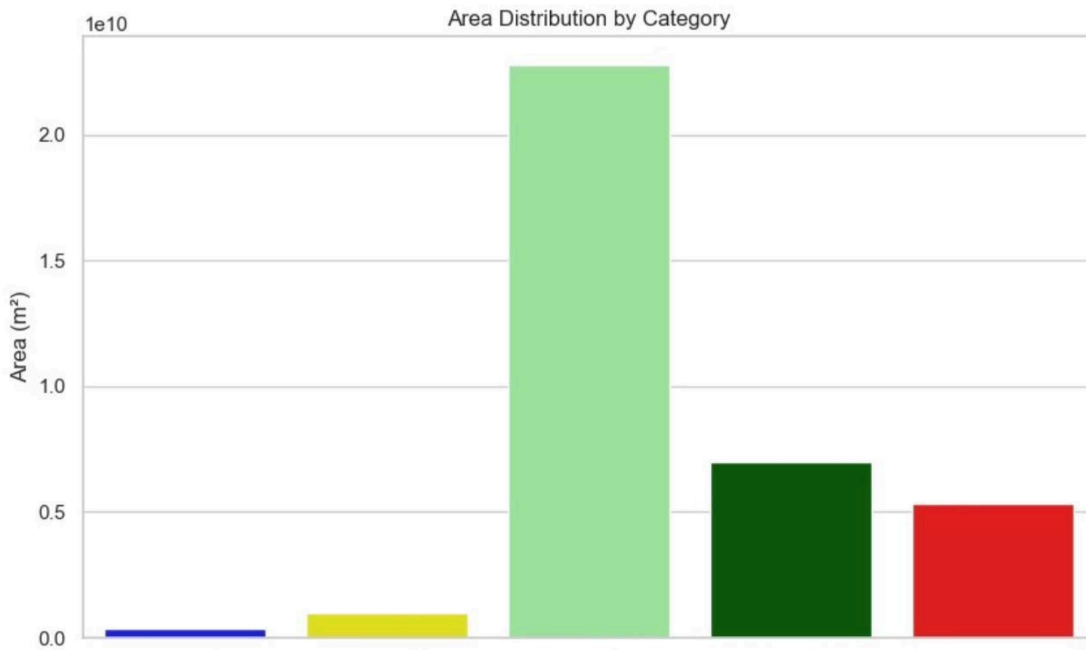

Fig 8.3 c) Area Distribution By Category For 2021 First Half

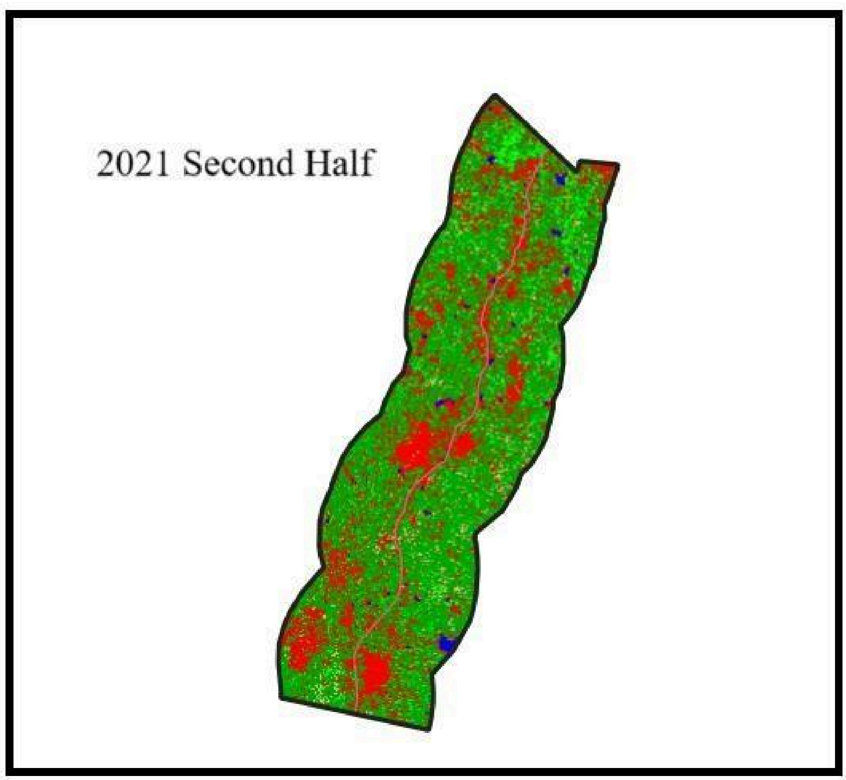

Fig 8.4 a) Final Processed Image 2021 Second Half

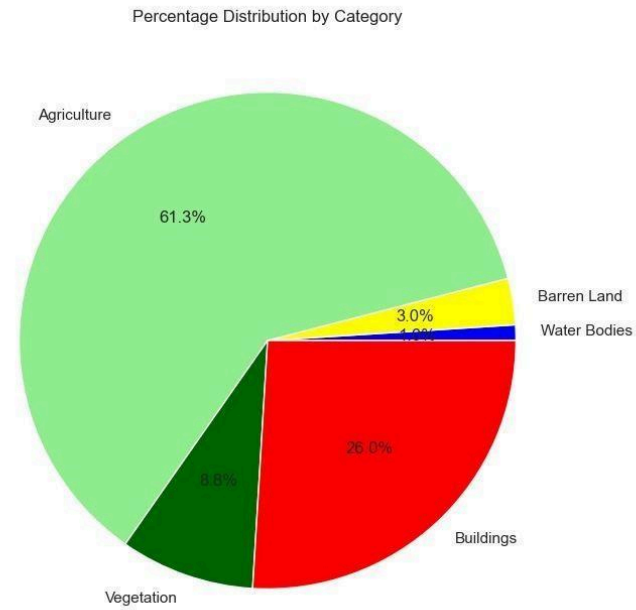

Fig 8.4 b) Percentage Distribution By Category For 2021 Second Half

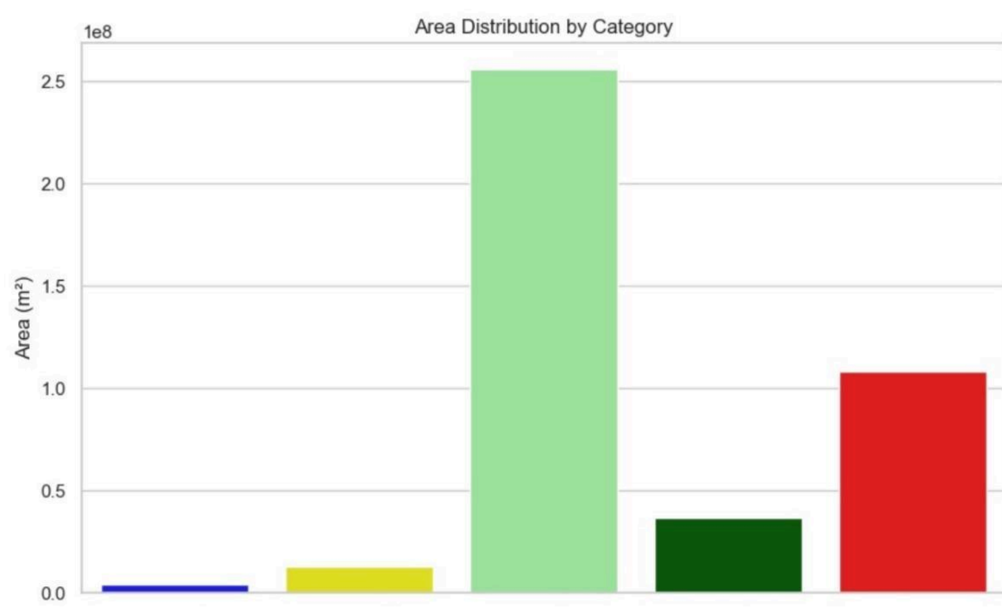

Fig 8.4 c) Area Distribution By Category For 2021 Second Half

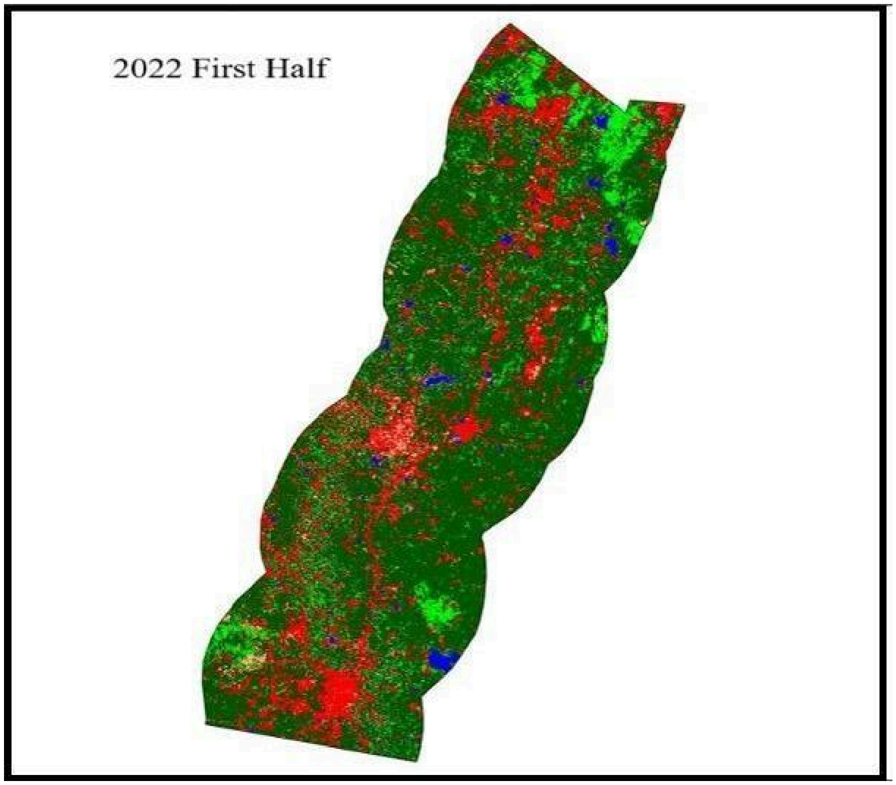

Fig 8.5 a) Final Processed Image 2022 First Half

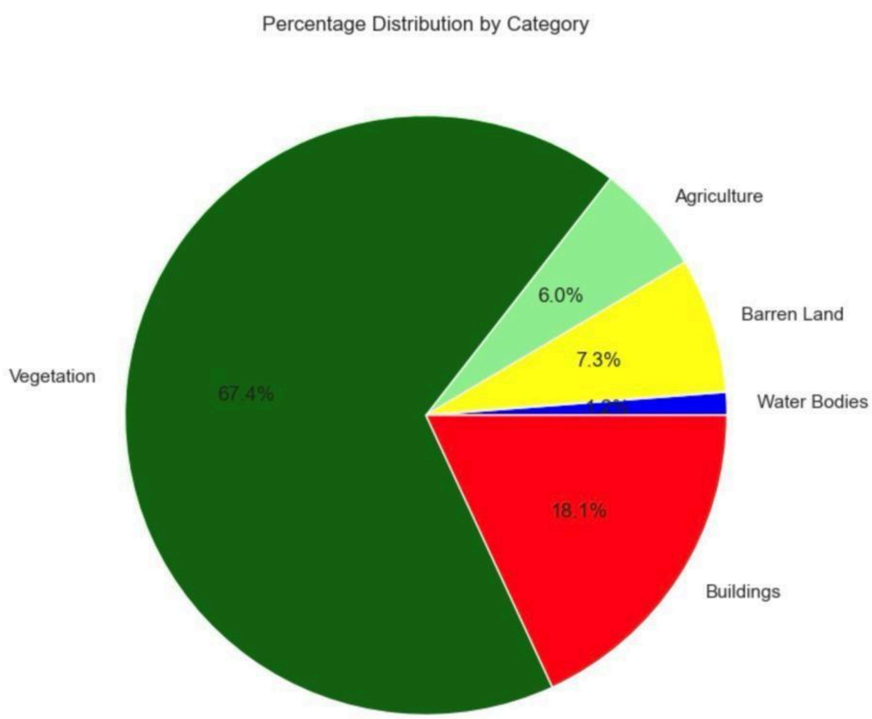

Fig 8.5 b) Percentage Distribution By Category For 2022 First Half

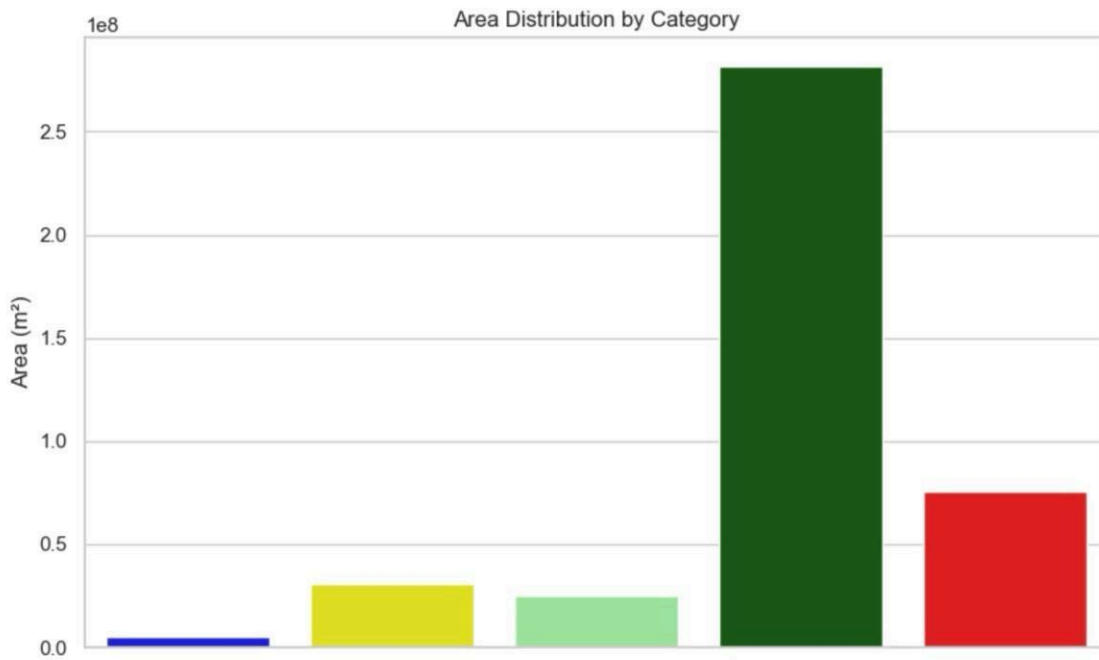

Fig 8.5 c) Area Distribution By Category For 2022 First Half

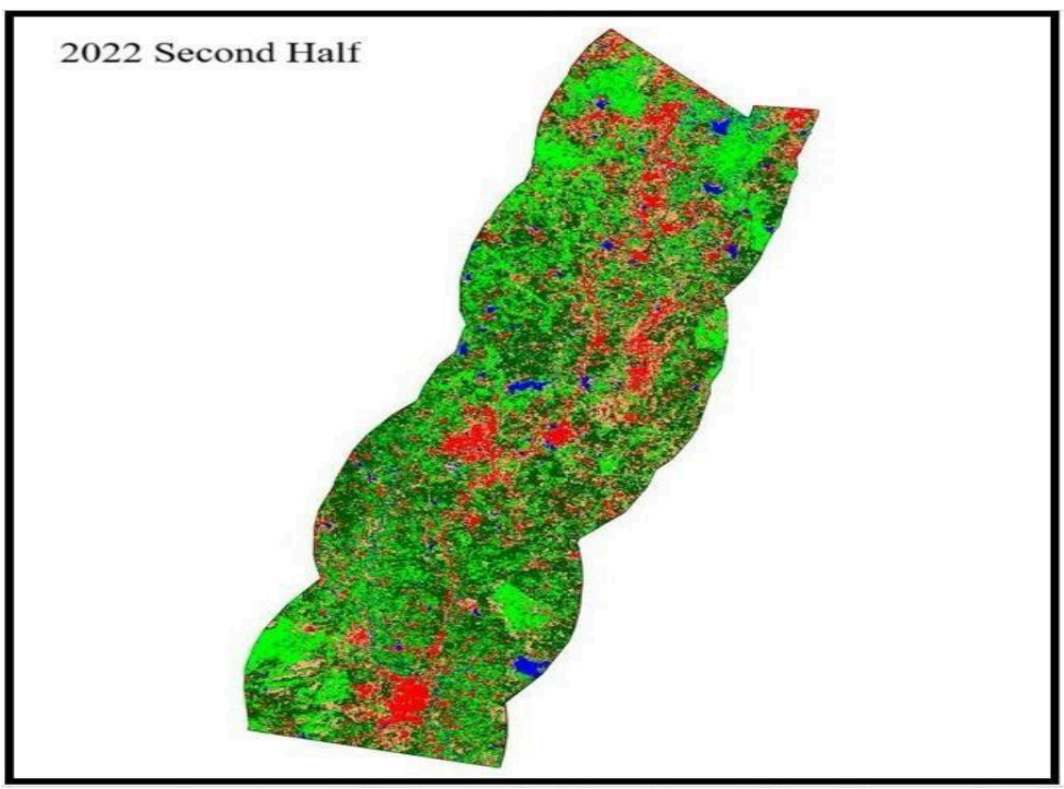

Fig 8.6 a) Final Processed Image 2022 Second Half

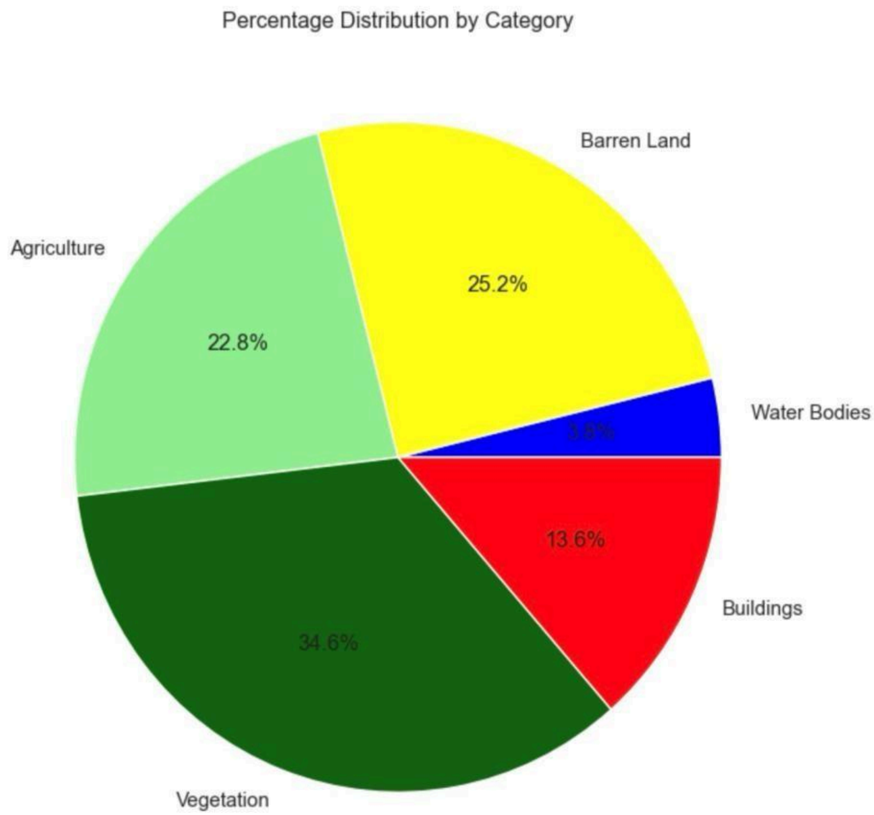

Fig 8.6 b) Percentage Distribution By Category For 2022 Second Half

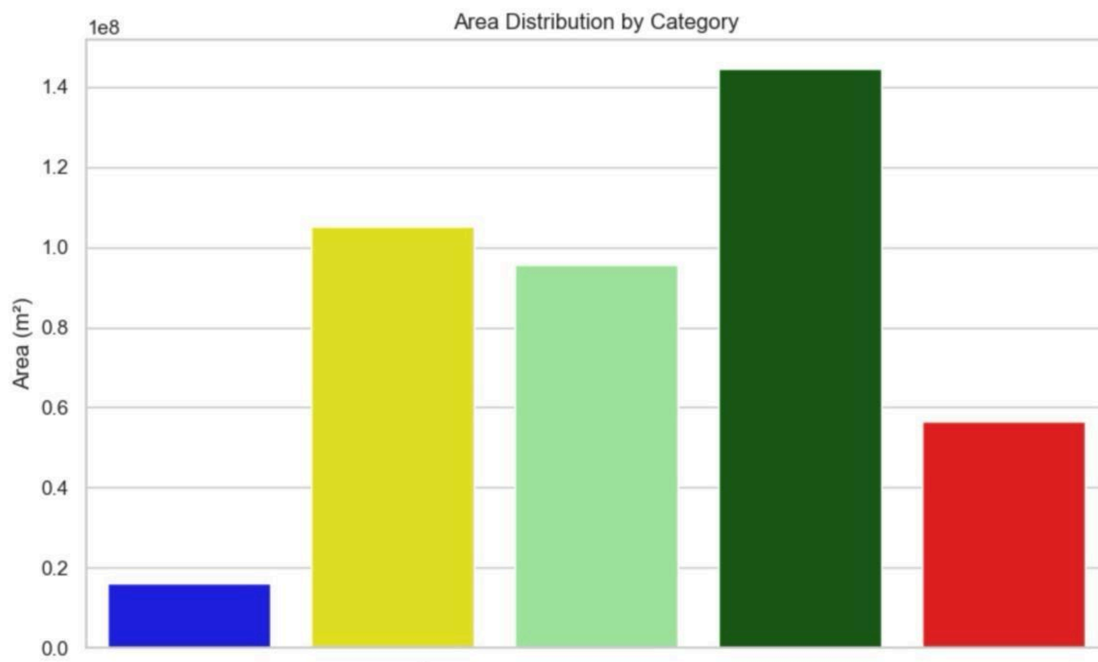

Fig 8.6 c) Area Distribution By Category For 2022 Second Half

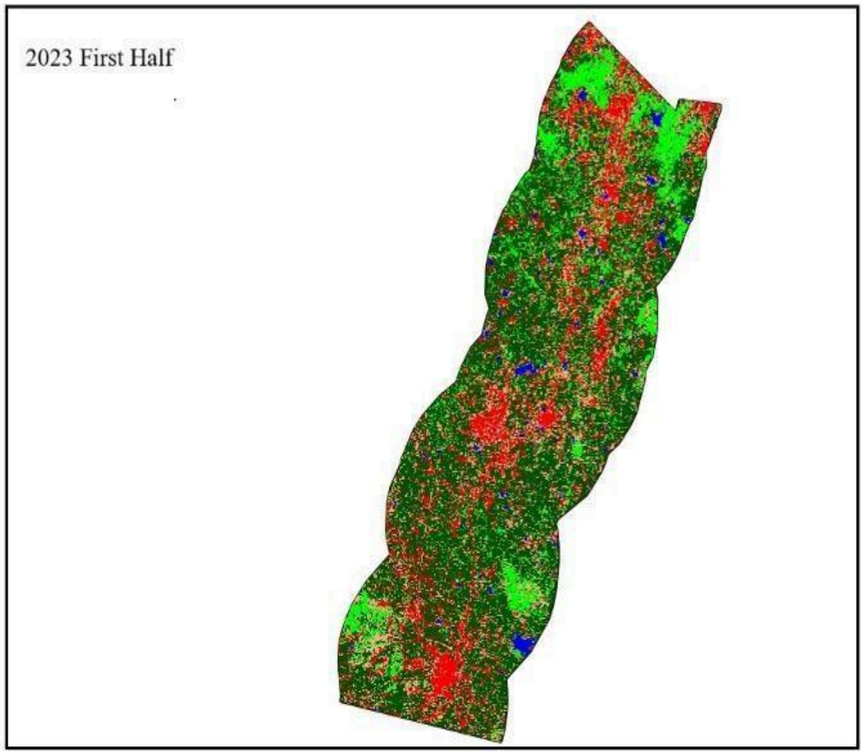

Fig 8.7 a) Final Processed Image 2023 First Half

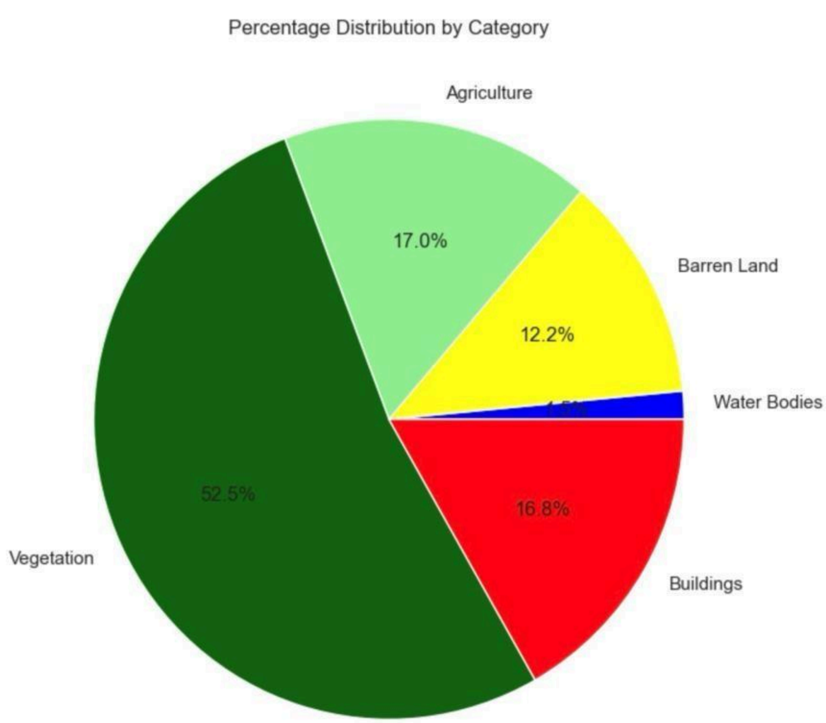

Fig 8.7 b) Percentage Distribution By Category For 2023 First Half

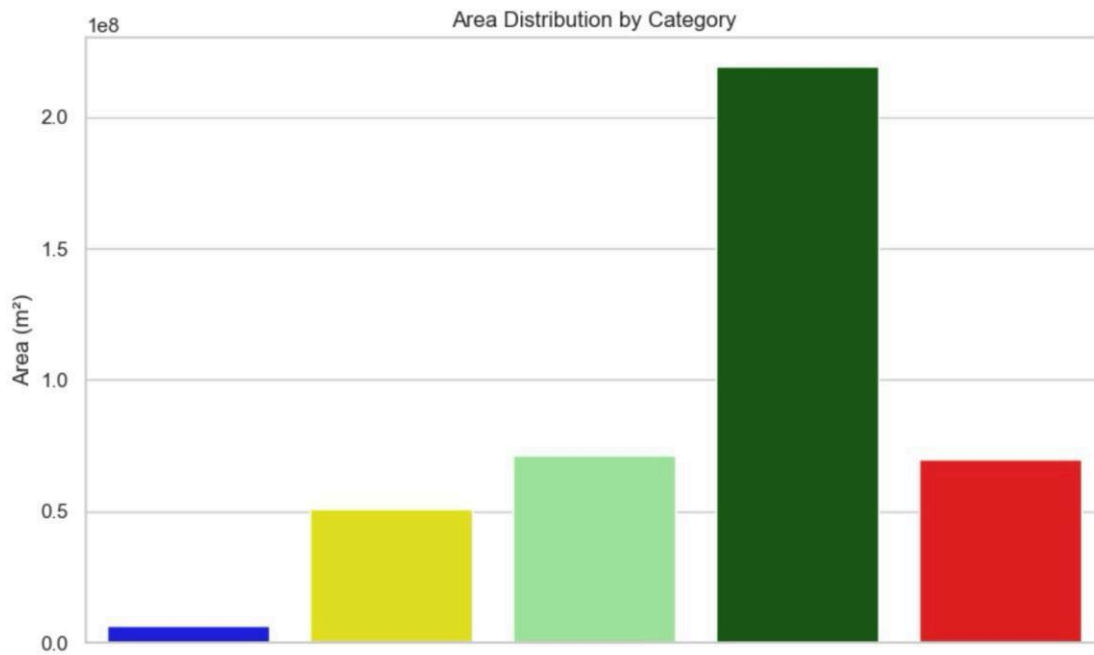

Fig 8.7 c) Area Distribution By Category For 2023 First Half

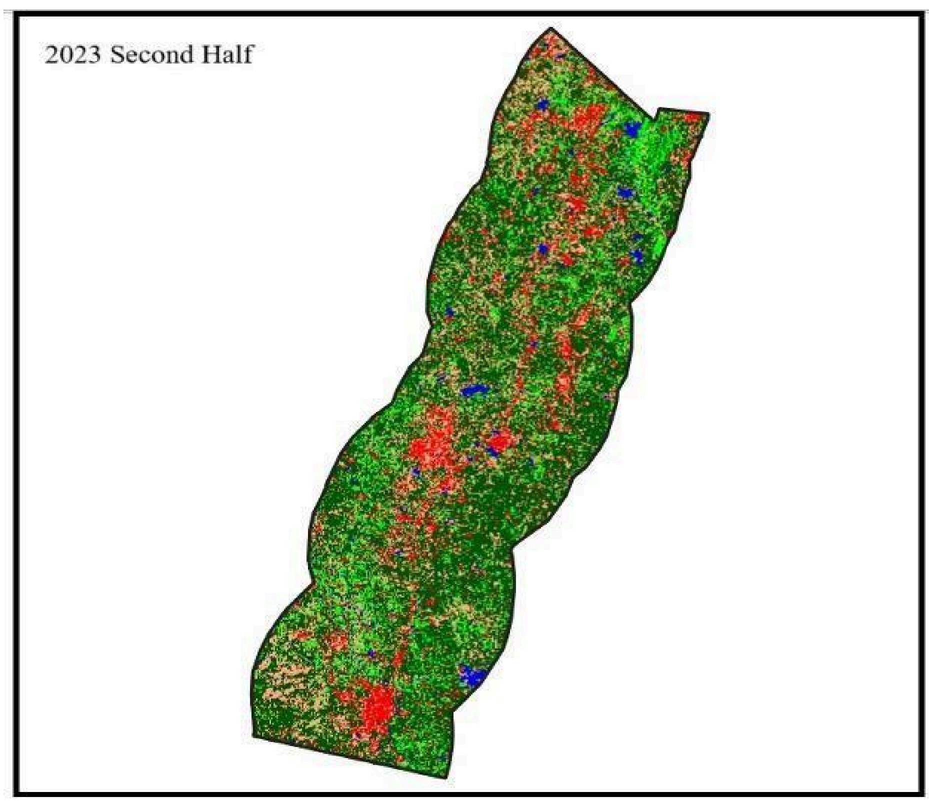

Fig 8.8 a) Final Processed Image 2023 Second Half

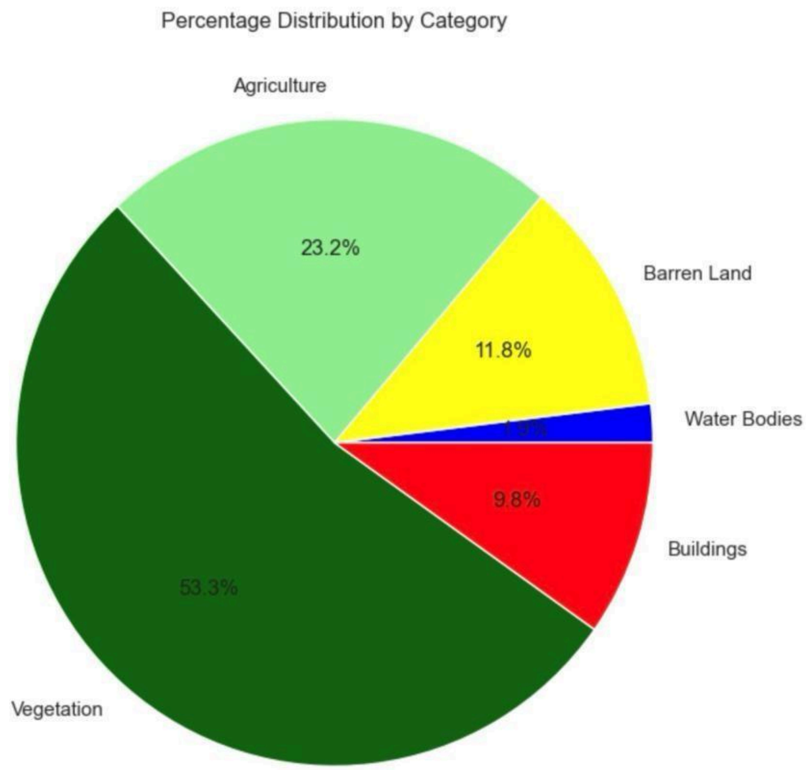

Fig 8.8 b) Percentage Distribution By Category For 2023 Second Half

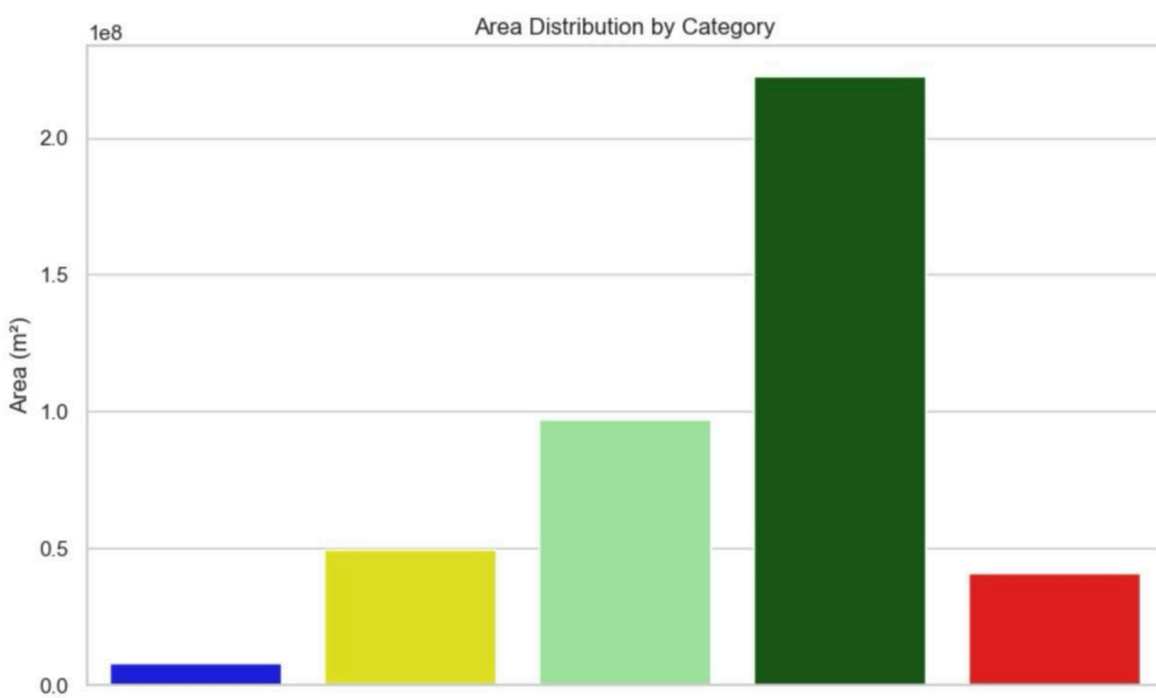

Fig 8.8 c) Area Distribution By Category For 2023 Second Half

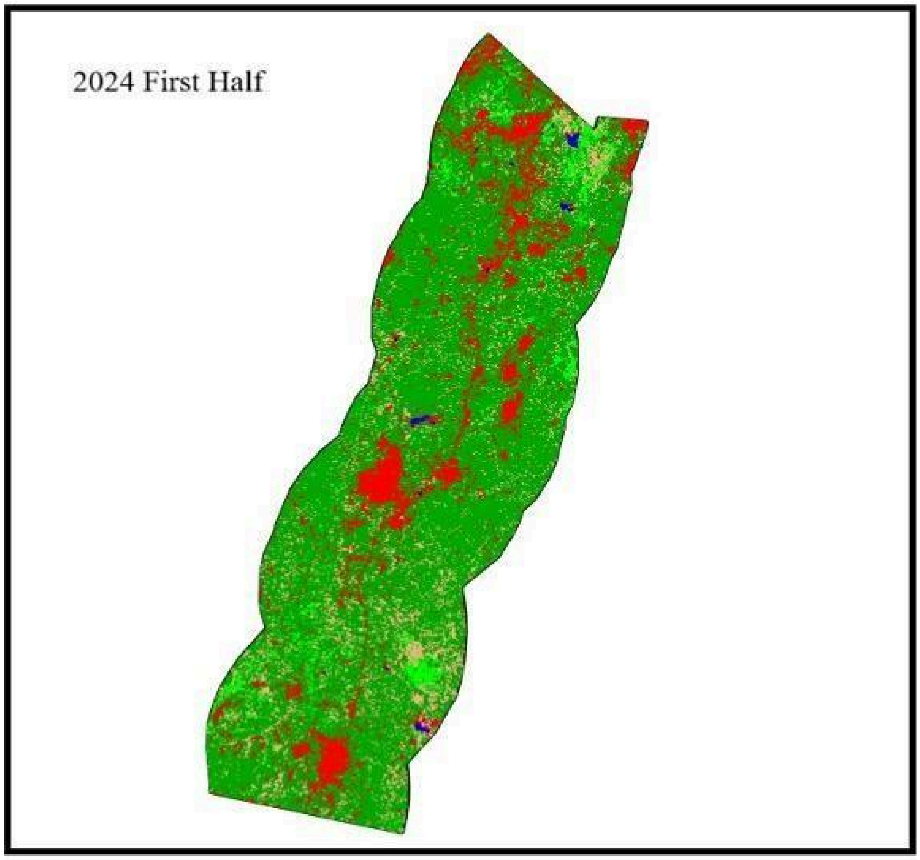

Fig 8.9 a) Final Processed Image 2024 First Half

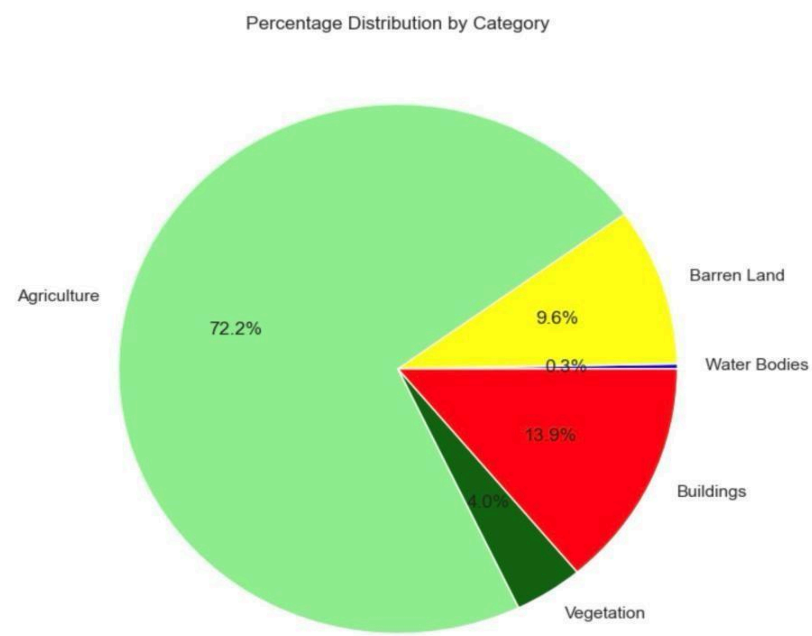

Fig 8.9 b) Percentage Distribution By Category For 2024 First Half

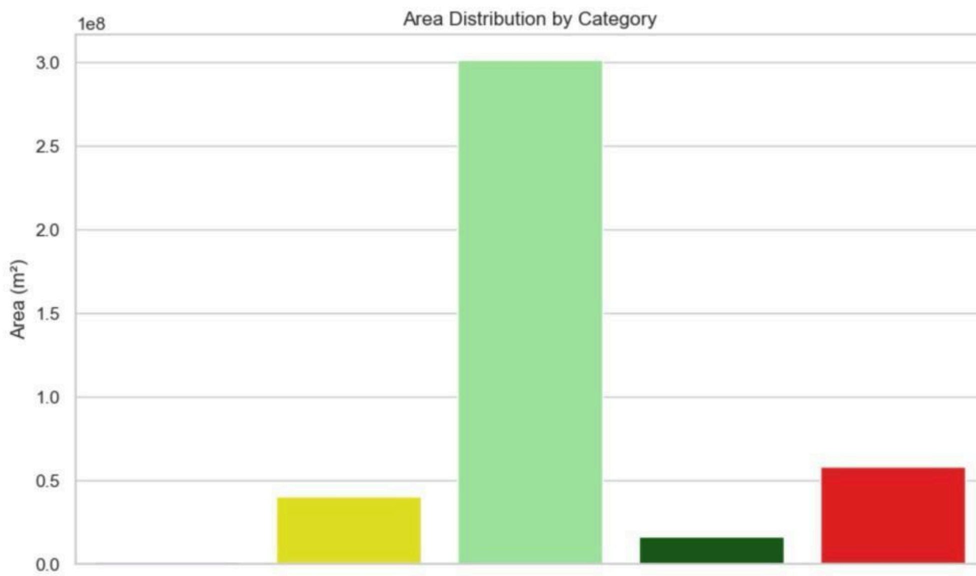

Fig 8.9 c) Area Distribution By Category For 2023 First Half

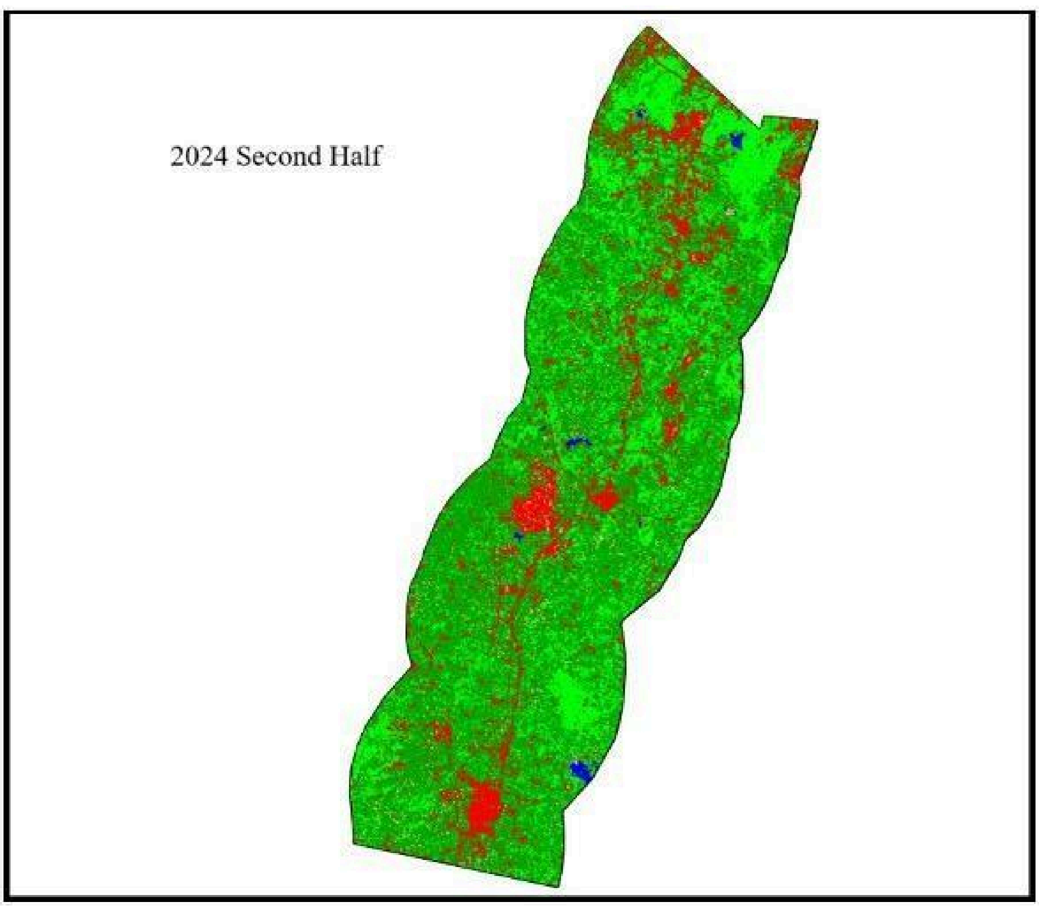

Fig 8.10 a) Final Processed Image 2024 Second Half

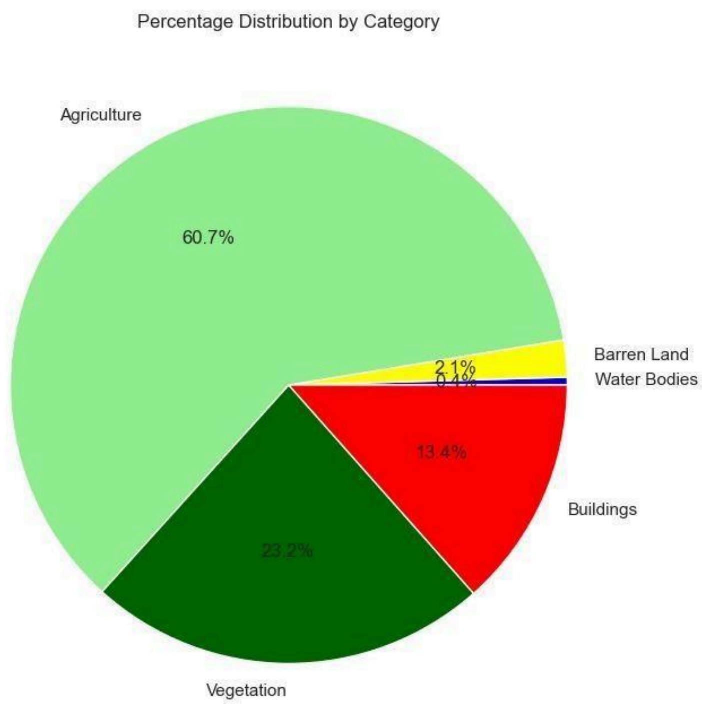

Fig 8.10 b) Percentage Distribution By Category For 2024 Second Half

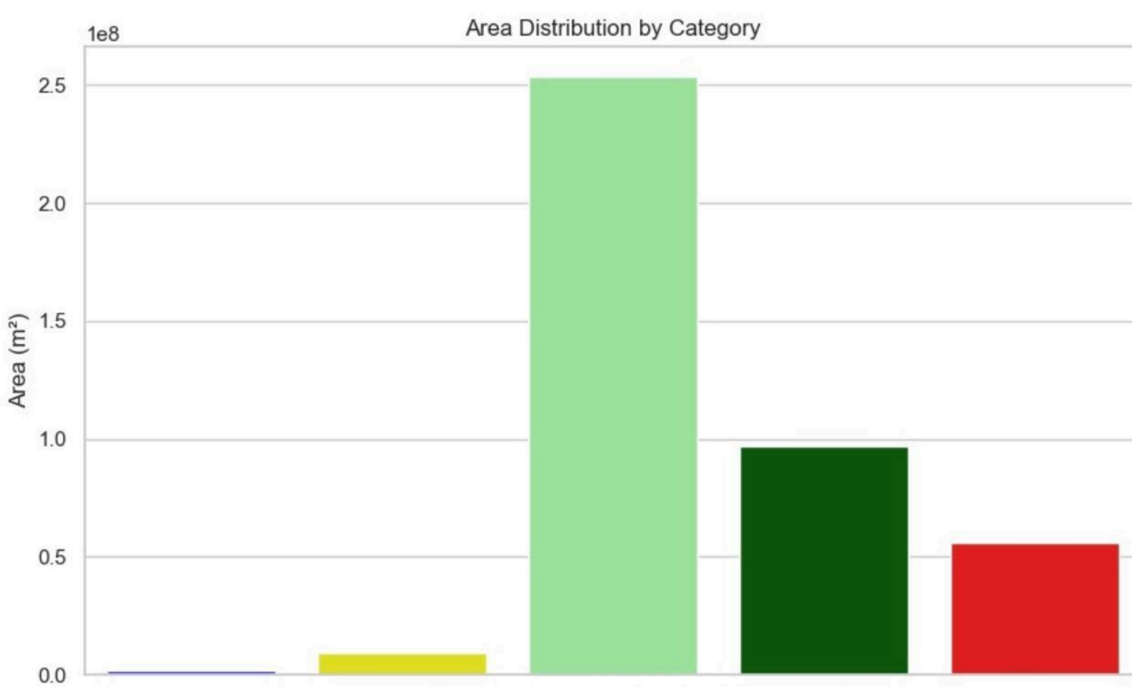

Fig 8.10 c) Area Distribution By Category For 2024 Second Half

ResNet18 Final Processed Images

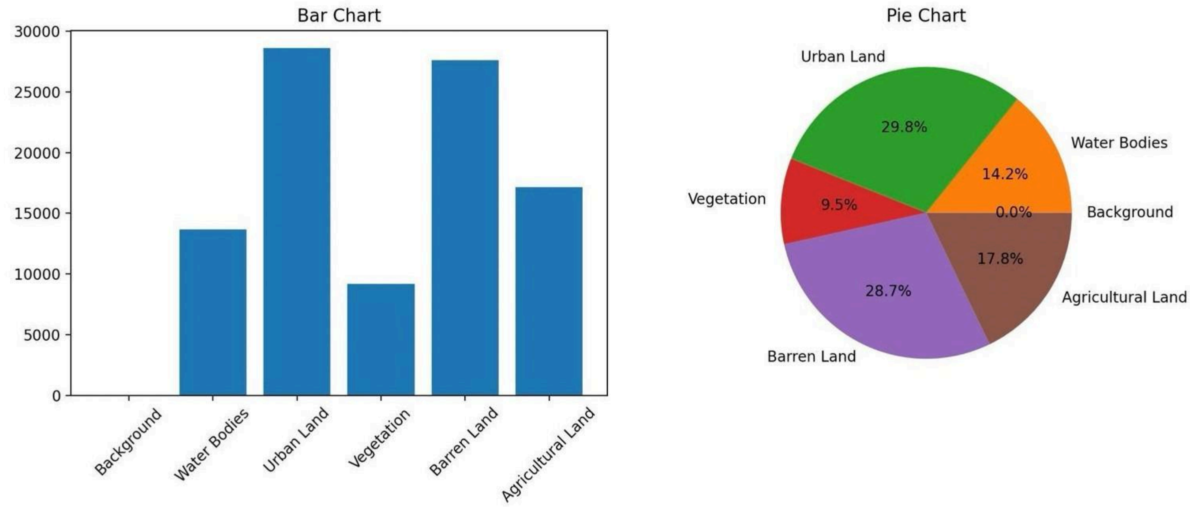

Fig 8.11 ResNet18 Final Processed Image 2020 Second Half

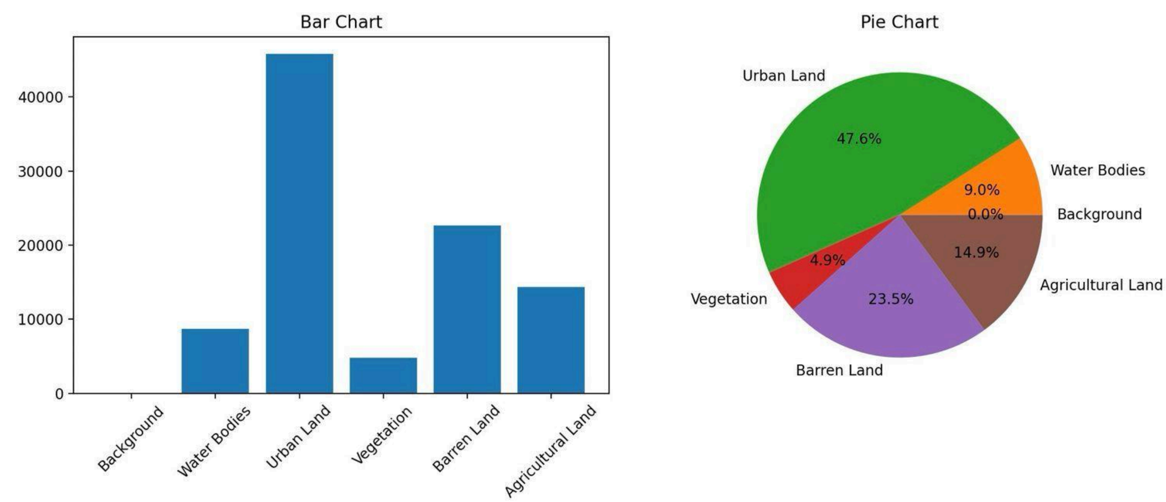

Fig 8.12 ResNet18 Final Processed Image 2024 Second Half

Mobile NetV2 Final Processed Images

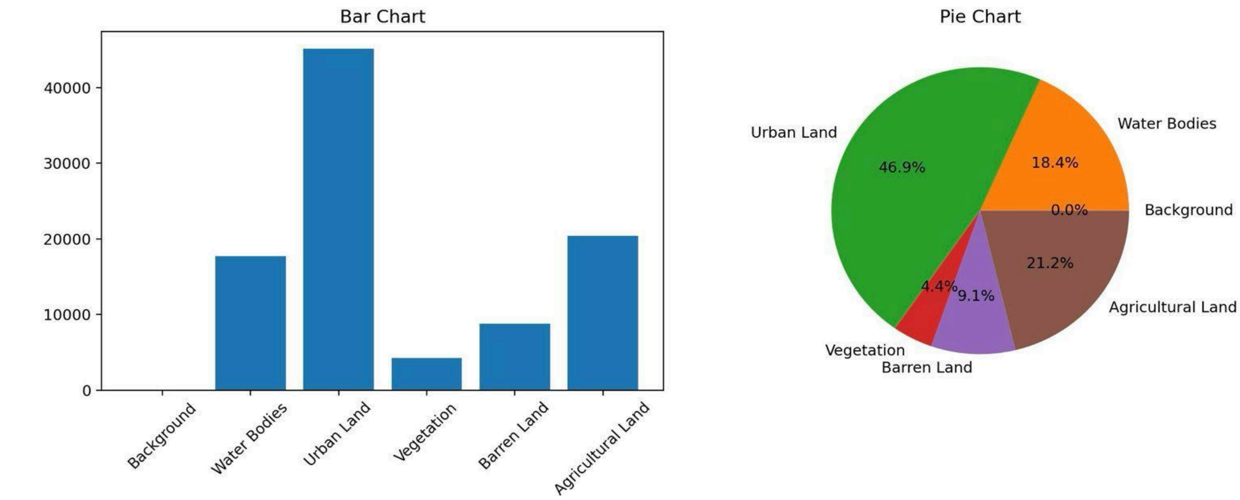

Fig 8.13 MoblieNetV2 Final Processed Image 2020 Second Half

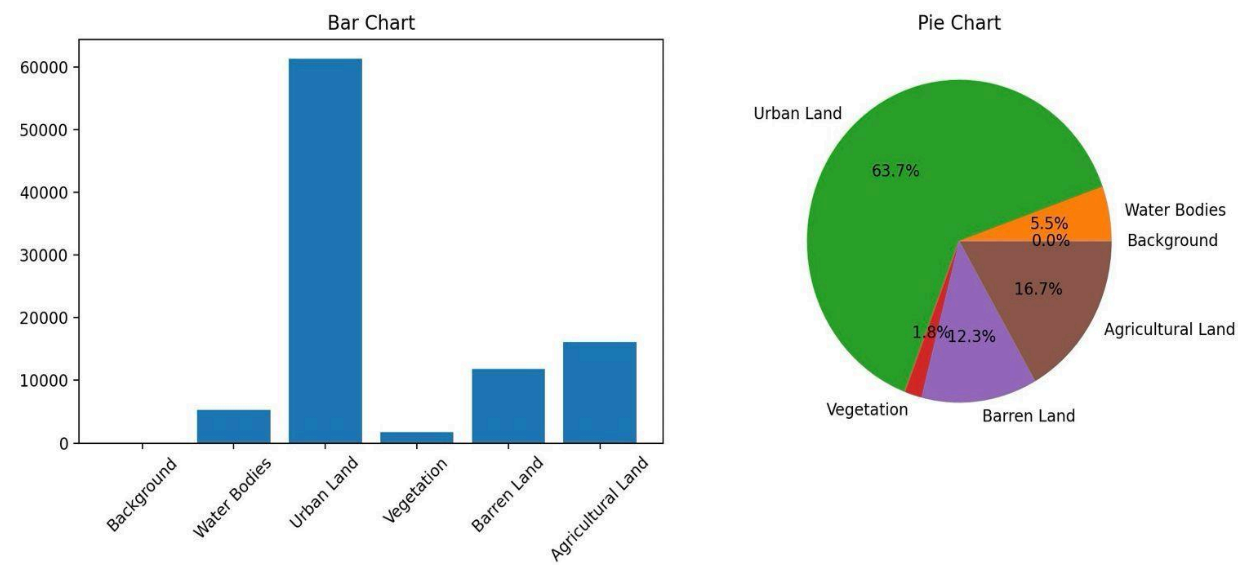

Fig 8.14 MoblieNetV2 Final Processed Image 2024 Second Half

ResNet18 And MoblieNetV2 Combination Model

Final Processed Images

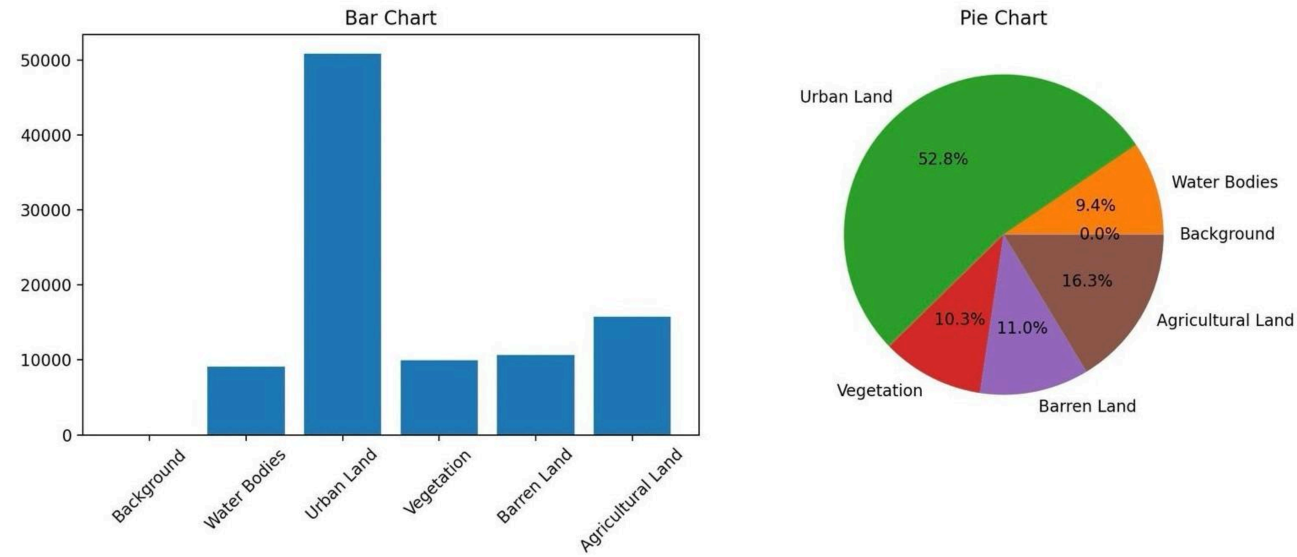

Fig 8.15 ResNet18 And MoblieNetV2 Combination Model Final Processed Image 2020 Second Half

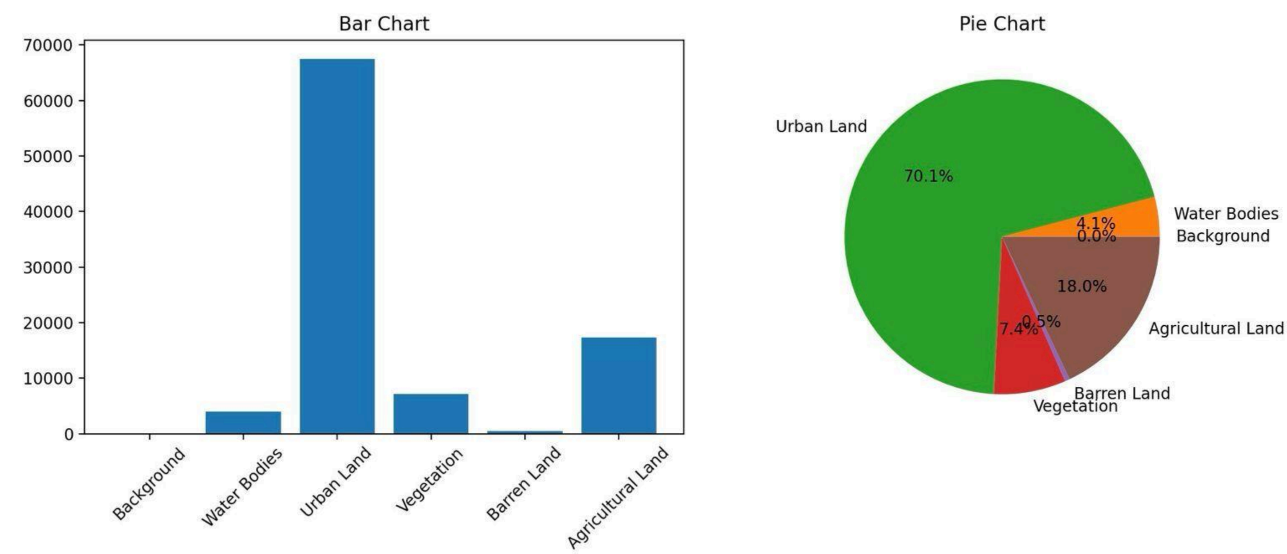

Fig 8.16 ResNet18 And MoblieNetV2 Combination Model Final Processed Image 2024 Second Half

CHAPTER 9 CONCLUSION AND FUTURE WORK

- Technical outputs: using QGIS for remote sensing analysis, the project will create a scalable system capable of processing large volumes of satellite imagery efficiently, allowing for future expansions to cover larger geographic areas or extended timeframes. A hybrid neural network was developed by integrating ResNet18 and MobileNetV2 as parallel feature extractors. The pretrained models' classifier heads were removed, and their pooled feature outputs were concatenated and passed through a fully connected layer for final classification into six classes. This combined model was trained using cross-entropy loss and the Adam optimizer, leveraging the strengths of both architectures to improve classification accuracy.

- Comprehensive understanding of LULC changes: the project aims to identify and analyze significant changes in land use and land cover (LULC) patterns around NH 948 due to highway construction. This includes assessing impacts on forests, water bodies, agriculture, and residential areas

- Social and agricultural impact assessment: it will evaluate the displacement of local populations, the effects on agricultural productivity, and potential economic losses for local farmers, providing insights that can guide policy for minimal social disruption.

- Quantification of environmental impacts: the study will quantify the extent of deforestation, water body changes, and land conversion, providing concrete data on the environmental impact. This can help in planning mitigative actions to preserve biodiversity and reduce adverse environmental effects.

- Policy and planning recommendations: by offering a detailed environmental assessment, the project will provide valuable insights to policymakers, urban planners, and environmental managers. It will inform sustainable infrastructure development practices, ensuring that future projects integrate environmental preservation.

CHAPTER 10 REFERENCES

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[3] Akyürek, D Lulc Detection Using Multi–Temporal Satellite Dataset: A Case Study In Istanbul New Airport.

[4] S. Feng Et Al., “Quantification Of The Environmental Impacts Of Highway Construction Using Remote Sensing Approach”.

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SAMPLE CODE

GitHub repository link: https://github.com/ayush-dsu/major-project