National Highways - Green Cover Index

Remote Sensing-Based Assessment and Monitoring of Green Cover along National Highways

Annual Report - 2025-26

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Ministry of Road Transport & Highways. Government of India
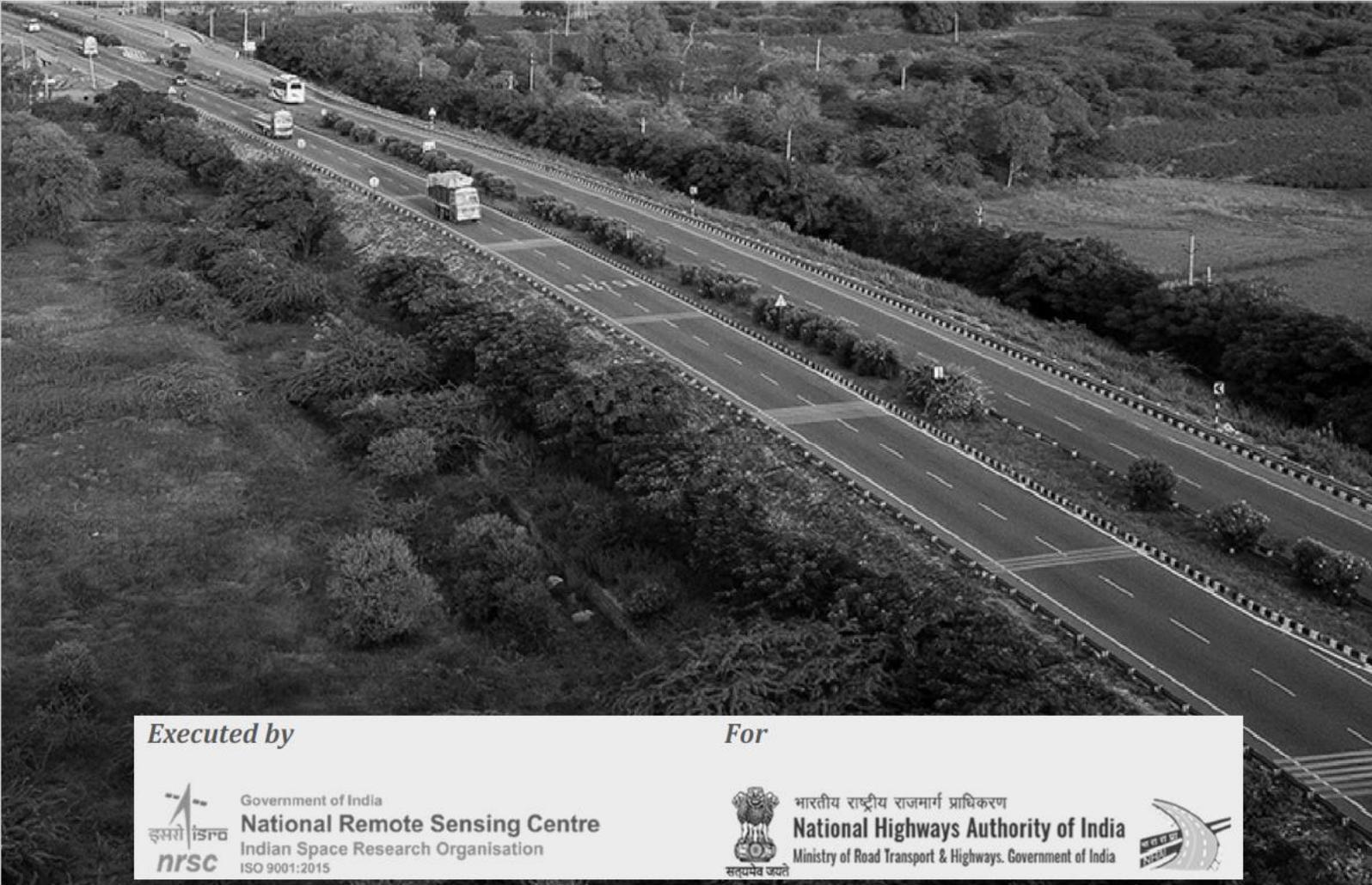सत्यमेव जयते

National Remote Sensing Centre
Indian Space Research Organisation
Dept. of Space, Govt. of India
Hyderabad

November 2025

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संतोष कुमार यादव,आईएएस
अध्यक्ष
SANTOSH KUMAR YADAV,IAS
CHAIRMAN

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National Highways Authority of India
MINISTRY OF ROAD TRANSPORT & HIGHWAYS

सत्यमेव जयते

MESSAGE

The true value of a highway goes beyond reduced travel time, enhanced economic growth and connectivity. It also lies in the benefits it brings to society—through carbon restoration, and the visual and environmental comfort it provides to commuters. Since the launch of the Green Highways Policy in 2015, the National Highways Authority of India (NHAI) has ensured greening of highways as a core objective while construction or maintenance thereof.

This report marks our first satellite-based audit of that commitment. In collaboration with ISRO-NRSC, we now have a detailed, kilometre-by-kilometre satellite view of the living canopy along our National Highways network. Covering approximately 30,000 kilometres of highways under the Operation and Maintenance (O&M) phase across 24 states, this study includes assessments taken before and after the monsoon season. Ground validation shows that our Green Cover Index (GCI) aligns with field photographs in nearly 90% of cases—giving us high confidence in the data's reliability.

This is NHAI's first comprehensive attempt to quantify and map the green cover along its highways. The GCI maps not only highlight well-vegetated stretches but also pinpoint canopy gaps on the left and right sides of the stretches. These insights will guide targeted interventions to ensure the objective. Further, the dedicated NH-GCI portal on ISRO's Bhuvan geo-platform provides every Regional Office and Project Implementation Unit with easy access to customized reports and allows for tracking trends across assessment cycles.

Together, this initiative has enabled us to measure and monitor the impact of our plantation efforts, establishing a clear and accountable benchmark for environmental performance. It will help focus efforts on some of underperforming stretches, facilitate comparative rankings of highways, and ensure timely, informed greening interventions. Most importantly, it reaffirms our belief that India's highways can—and must—grow not just longer, but greener.

(Santosh Kumar Yadav)

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Distinguished Scientist & Director

Message

The growing emphasis on sustainable infrastructure has brought environmental considerations to the forefront of large-scale development initiatives such as the expansion of National Highways. Among these, the systematic monitoring of green cover along highways stands out as a key indicator of ecological integration within infrastructure planning.

This report, the outcome of a biannual assessment conducted, highlights the effective use of Resourcesat-2 and 2A LISS-IV MX satellite datasets (5m resolution) in generating accurate and reliable information on green cover. The partnership between the National Remote Sensing Centre (NRSC) and the National Highways Authority of India (NHAI) under the Memorandum of Understanding (MoU) has enabled a structured and technologically sound framework for tracking vegetation growth and changes over time.

The use of high-resolution satellite imagery not only ensures consistency and spatial continuity but also allows for near-objective evaluation of plantation activities and their outcomes. By enabling biannual analysis, this project supports timely interventions, accountability, and policy feedback, thereby reinforcing the importance of environmental monitoring in infrastructure governance.

I laud the teams from NRSC and NHAI, as well as the scientists, and survey personnel who have contributed to this important work. Their coordinated efforts exemplify how cross-disciplinary collaboration and scientific innovation can contribute to a greener, more resilient infrastructure network.

This report is a step forward in aligning development goals with ecological stewardship, and I hope it will guide future decisions and inspire further integration of space-based monitoring in environmental evaluation efforts.

August 08, 2025

(Prakash Chauhan)

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16 **Abstract (with Keywords):**

The National Highways Authority of India (NHAI), in collaboration with the National Remote Sensing Centre (NRSC), has implemented a satellite-based monitoring system to assess green cover along India's National Highways. This initiative, under the Green Highways Policy, introduces the Green Cover Index (GCI), derived from high-resolution (5 m) Resourcesat-2/2A LISS-IV imagery and validated with Cartosat-2S data and ground truth observations. The project covers ~30,000 km of highways in the Operation & Maintenance phase across 24 states, with biannual monitoring. Pilot studies in Rajasthan, Punjab, Odisha, and Telangana established a robust methodology using NDVI thresholds to classify vegetation at 1 km intervals along highway corridors. A dedicated web GIS portal on Bhuvan enables interactive visualisation, UPC-wise reporting, and integration of field photos for validation. Results show a high correlation (~90%) between satellite-derived GCI and field observations, supporting its reliability for policy and management. Future plans include automation through AI/ML, seasonal trend monitoring, and integration with carbon estimation models to support sustainable infrastructure development.

Keywords: Green Cover Index (GCI), NDVI, National Highways, Remote Sensing, Resourcesat-2, Bhuvan GIS, Vegetation Monitoring

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List of Abbreviations

NRSC	:	National Remote Sensing Centre
ISRO	:	Indian Space Research Organisation
DoS	:	Department of Space
NHAI	:	National Highways Authority of India
MoRTH	:	Ministry of Road Transport & Highways
MoU	:	Memorandum of Understanding
NH	:	National Highway
GCI	:	Green Cover Index
UPC	:	Unique Project Code
RO	:	Regional Office
PIU	:	Project Implementation Units
NDVI	:	Normalized Difference Vegetation Index
IRS	:	Indian Remote Sensing
LISS-IV	:	Linear Imaging Self Scanner – IV
L4MX	:	LISS-4 Multispectral
C2S	:	Cartosat-2 Series
RS2	:	RESOURCESAT-2
RS2A	:	RESOURCESAT-2A
DEM	:	Digital Elevation Model
ToA	:	Top of Atmosphere
GCP	:	Ground Control Points
ROW	:	Right of Way
CL	:	Centre Line
CH	:	Chainage
GCS	:	Geographic Coordinate System
UTM	:	Universal Transverse Mercator
GIS	:	Geographic Information System
GPS	:	Global Positioning System

Executive Summary

Under India's 2015 Green Highways Policy, NHAI must not only plant trees along highway corridors but also ensure their survival. Traditionally, plantation health has been monitored by field teams. To scale this, NHAI partnered with ISRO's NRSC to develop a satellite-based Green Cover Index (GCI) for all National Highways. In early 2023, NRSC and NHAI piloted the approach on 100 km stretches in Rajasthan and Punjab (and a 50 km stretch in Odisha). Ground truth validation showed the Rajasthan results "matching ground reality", and after refining methods (addressing some geometric issues in Punjab), an MoU was signed in January 2024 to expand the program. The project formally began in Nov 2024 with a dedicated team.

The National Highways' Green Cover Index (NH-GCI) project uses 5 m-resolution Resourcesat-2/2A LISS-IV imagery to estimate green cover along NHAI-managed highways. It currently covers about 30,000 km of National Highways in the Operation & Maintenance (O&M) phase (across 24 states). Both avenue plantations (left and right sides) and median plantations are analysed wherever feasible. Monitoring is done biannually. Future expansions are planned to include highways transitioning out of construction and roads under other MoRTH wings, as requested under the NRSC–NHAI MoU.

The methodology was developed through detailed pilots. In Phase-1, selected stretches (~100 km in Rajasthan and Punjab; 50 km in Odisha) were analysed to derive a segment-wise GCI. After signing the MoU, Phase-2 (Telangana) covered 17 project units (~1,121 km) using precise inputs (centre lines, right-of-way, chainages). The workflow proceeds as follows: high-resolution LISS-IV scenes are pre-processed and orthorectified (using DEMs and GCPs), then divided by the highway centreline into 1 km segments. For each 1 km segment (and separately for left-side, right-side, and median polygons), NDVI is computed from the NIR and red bands. A scene-specific NDVI threshold then classifies vegetated vs non-vegetated pixels: pixels ≥threshold are "pure vegetation," those ≤(mean–2σ) are non-vegetation, with linear weighting for intermediate values. The fraction of vegetation pixels yields the Green Cover Index for each 1 km segment. For every 1 km segment, GCI values is computed separately for LHS and RHS in such a way that the GCI % represents the % of land within that 1 km segment which is covered by green cover. In this way, every highway is represented by a series of per-kilometre GCI values and statistics.

Primary data comes from IRS Resourcesat-2/2A LISS-IV multispectral imagery (5 m). To improve accuracy, NDVI thresholds derived from LISS-IV were cross-checked against higher-resolution Cartosat-2S imagery. Image preprocessing and orthorectification are performed with specialist software (Rolta GXL and Geomatica), which use DEMs and GCPs to correct geometry. The final analysis and dissemination use NRSC's open-source Bhuvan web GIS platform. A dedicated mobile app was also developed: field surveyors use it to capture geo-tagged photographs along the highway, providing ground-truth for later validation.

Pilot analyses yielded detailed GCI maps for the case-study corridors. For example, the 102 km Punjab stretch was segmented into 102 one-kilometre "chips," each with calculated NDVI and GCI. In two illustrative chips, mean GCI values were ~71% versus 35%, reflecting dense versus sparse vegetation. Equivalent products were generated for Rajasthan and Odisha and delivered to NHAI for validation. In Telangana (Phase 2), six highways (17 UPCs, 1,120.84 km total) were analysed using LISS-IV data (Jan–Jun 2023). The GCI results (e.g., NH-365, UPC N/08002/06003/TS) show kilometre-by-kilometre LHS/RHS green cover (see Figure 27). Satellite-based GCI agrees well with independent data: NDVI thresholds were calibrated using fine-scale Cartosat data. Crucially, a manual field-photo validation found ~90% agreement between the satellite-derived GCI and on-ground vegetation in the sampled locations, confirming the remote-sensing accuracy.

All outputs are published via a custom NH-GCI web portal on Bhuvan. The portal provides interactive maps and reports tailored to NHAI needs. Users can filter and navigate by highway, state or project code; switch between base satellite layers; and overlay the right-of-way, left-side and right-side plantation zones (in false-colour) along with the computed GCI layer. Clicking on any 1 km segment brings up its detailed statistics (mean NDVI, GCI, etc.). The system also classifies segments by green cover rank to aid monitoring. For formal reporting, the portal generates standardized UPC-wise templates: each report includes highway details, assessment period, current and previous GCI avenue plantation (LHS/RHS), trend arrows, and satellite data metadata (see Tables 7–10). These reports and charts are automatically produced and shared with NHAI officials.

Given that the project has been carried out for the very first time, a few caveats are submitted. At 5 m resolution, small tree crowns may only partially occupy a pixel, and geolocation error (~±5 m) can affect GCI for narrow strips. By design, the GCI reflects canopy cover; mixed vegetation (e.g., grass vs trees) and partial pixels are represented fractionally, so the index estimates the percentage of crown cover within each pixel. NDVI thresholds were determined empirically: areas of dense green were used to set the maximum threshold, and canopy-edge values set the minimum (mixed soil-vegetation) threshold. In practice these scene-specific thresholds were iteratively tuned (and checked against high-resolution imagery) to best separate vegetation. Users should note these assumptions when interpreting GCI values. During the assessment period from July to December 2024, LISS IV data may be unavailable for certain UPCs due to persistent cloud cover. In such cases, Sentinel data is utilized for the affected UPCs. It may also be noted, that the aggregated GCI values estimated at NH/State/RO/PIU-level are subject to various factors such as (a) no. of NH packages evaluated under the NH-GCI project; (b) their stage of maintenance; (c) timing of plantation activities; (d) less availability of ROW especially in hilly terrains etc.

Planned enhancements include automation and richer monitoring. Machine learning models will be developed to auto-classify vegetation and optimize NDVI thresholds, reducing manual intervention. Change-detection algorithms will be added to generate alerts on vegetation loss or gain between cycles. The team will integrate multi-season (year-round) satellite data to capture temporal dynamics of growth and harvest, and establish systematic protocols for continuous ground-truth collection to further validate results. Longer-term, GCI outputs may be linked to carbon/biomass models to estimate sequestration along green corridors, and the findings will inform highway greening policies and sustainable infrastructure planning.

1 Introduction

National Highways Authority of India (NHAI) was set up by an act of the Parliament, NHAI Act, 1988 "An Act to provide for the constitution of an Authority for the development, maintenance and management of national highways and for matter connected therewith or incidental thereto". Initially, NHAI was entrusted with National Highways Development Project (NHDP) which inter-alia included GQ, NSEW Corridors along with other projects. Presently, NHAI is mandated for implementation of a large component of the Bharatmala Pariyojna Program.

NHAI's vision is to meet the Nation's need for provision and maintenance of National Highways network to global standards and to meet the user's expectations in the most time-bound and cost-effective manner, within the strategic policy framework set by the Government of India and thus promote economic well-being and quality of life of the people.

National Remote Sensing Centre (NRSC) is one of the primary centres of Indian Space Research Organisation (ISRO) under Department of Space (DOS), Govt. of India. NRSC has the mandate for establishment of ground stations for receiving satellite data, generation of data products, dissemination to the users, and development of techniques for remote sensing applications including disaster management support, geospatial services for good governance and capacity building for professionals, faculty and students.

With the inception of the Green Highways Policy in 2015, greening of Highway Corridors with community participation has been prioritized by Ministry of Road Transport & Highways, Government of India (MoRTH) and NHAI. As part of the project lifecycle, it is now essential for contractually engaged Agencies to not only plant/ transplant trees in the avenues and medians but also bear the responsibility of their health and survival.

At present, monitoring of plantations is performed through site visits by the Project Implementation Units (PIUs) along the National Highways (NHs). To complement this in-situ data collection and to augment the on-going mechanism of plantation management and performance audits conducted by the Green Highways Division of NHAI, a pan-India estimation of green cover along the National Highways using high resolution satellite imageries was proposed. This approach would be robust and reliable mechanism to provide a time-saving and cost-effective solution.

NHAI team submitted a draft proposal to develop a Green Cover Index for National Highways of India. In this regard NRSC and NHAI had discussions on 04-Jan-2023 and decided to carry out a pilot study over Punjab and Rajasthan National Highways over 100 km stretch each. The results were presented to NHAI on 3-Mar-2023. Later, thorough Ground truth validation was carried out by NHAI team. The validated results were presented by NHAI team on 27-Jun-2023 and it was found that the remote sensing-based results over Rajasthan were appreciable and matching with ground reality. However, the results for Punjab showed geometric inaccuracies and therefore affected the accuracy of the assessment. Based on further discussions between NHAI and NRSC officials, the requirements for assessment of green cover along the national highway were finalized and a project proposal was formulated. Accordingly, a Memorandum of Understanding (MoU) was signed between NRSC and NHAI on 3-Jan-2024 in the august presence of Hon'ble Minister, Shri Nitin Jairam Gadkari, Road Transport & Highways (RT&H).

The project was initiated on 1-Nov-2024 with the recruitment of 4 Project Scientists and 4 Technical Support Personnel.

MoU Signing on 3-Jan-2024 between NRSC and NHAI in Presence of
Hon'ble Minister, Shri Nitin Jairam Gadkari, Road Transport & Highways (RT&H)

2 Scope of Work

The project aims to estimate green cover along India's National Highways using high-resolution (5 m) multi-spectral satellite imagery from the LISS-IV Mx sensor. The current scope encompasses highways entrusted to the National Highways Authority of India (NHAI) that are in the Operation and Maintenance (O&M) phase, where plantation activities have been completed or are underway. This includes approximately 30,000 km of road network across 24 states. The assessment covers both avenue plantations (on the left and right sides of the highway) and median plantations, wherever applicable, with a biannual monitoring cycle. In the future, the scope may be expanded to include highways transitioning from construction to O&M phase.

3 Methodology

To meet the objectives of this project—estimating green cover along the National Highways—a pilot study was conducted in Phase-1 over selected highway stretches. Three National Highways, each approximately 100 km long, were chosen in Punjab, Rajasthan, and ~50 km in Odisha, representing diverse terrains across the country, as shown in Figure 1. Ground truth validation was carried out, and the results showed good correlation, leading to the signing of an MoU with NHAI. Following the MoU, further analysis was conducted for the state of Telangana, covering 17 Unique Project Codes (UPCs) in Phase 2, where actual inputs such as Centre Lines, Right of Way (RoW) and Chainages were provided by NHAI. Based on these pilot studies, methodology was fine-tuned to accurately calculate the Green Cover Index (GCI) for every 1 km segment along the UPCs.

3.1 Pilot Study

To understand the feasibility of the project, a pilot study was conducted in two phases, as detailed in the following sections:

3.1.1 Pilot Study – Phase-1

A detailed study was conducted over selected highway stretches — a 100 km segment each in Rajasthan and Punjab, and a 50 km stretch in Odisha — to derive the Green Cover Index (GCI). The objective was to estimate the percentage of area covered with green vegetation along every 1 km segment of the National Highways, focusing on both avenue and median plantations.

The study utilized IRS Resourcesat-2 LISS-IV Mx imagery with a 5-m spatial resolution. Given the typical tree crown radius of 1–5 m or more, the imagery often contained mixed pixels

representing a combination of vegetation and background features. Accurate identification of these mixed pixels was critical for reliable GCI estimation.
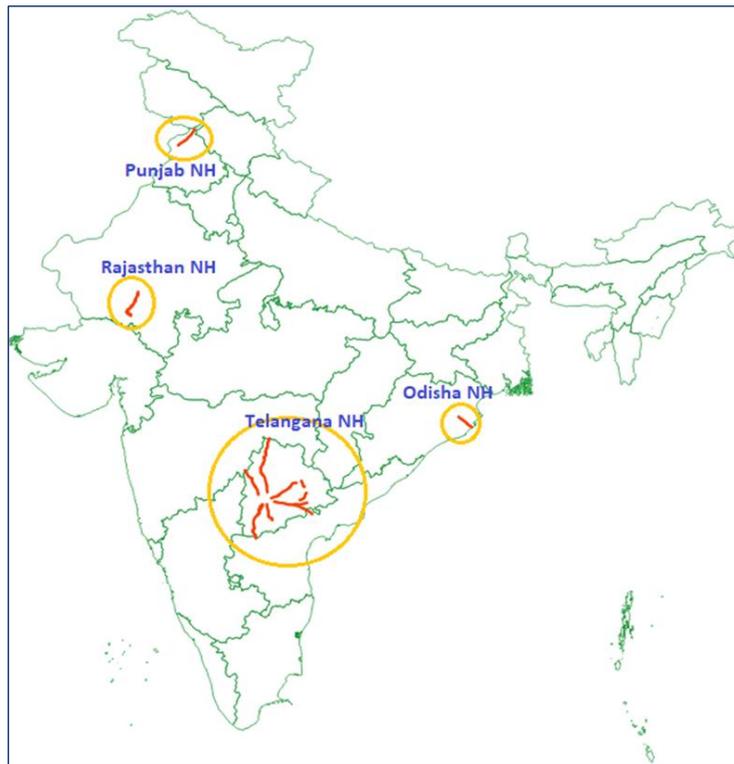
Figure 1 States Covered in Pilot Studies- Phase1 and Phase2

3.1.2 Selection of Vegetation Index

Vegetation indices derived from satellite data primarily require measurements from specific parts of the electromagnetic spectrum, typically the visible and near-infrared (NIR) regions. Therefore, to estimate green cover, high-resolution multispectral imagery (VNIR bands) is essential. The most used index is the Normalized Difference Vegetation Index (NDVI), which has been chosen to generate the Green Cover Index.

Normalized Difference Vegetation Index (NDVI) is a widely used Vegetation Index in agriculture, forestry, environmental monitoring to assess vegetation health, vegetation cover over time. The NDVI is estimated using the reflectance of vegetation in the Red and NIR bands as given below.

$$NDVI = (NIR - Red) / (NIR + Red)$$

where

NIR is the reflectance in Near Infrared band,

Red is the reflectance in red band

NDVI values typically range from -1 to +1, where:

- Values close to +1 indicate dense, healthy vegetation.
- Values close to 0 represent non-vegetated areas
- Values close to -1 usually indicate water bodies or barren areas.

Normalised Difference Vegetation Index (NDVI) values were used as a key parameter to identify and segregate mixed pixels. Negative NDVI values, which represent non-vegetated areas, were set

to zero, while NDVI values greater than zero were considered for extracting vegetated areas. The underlying assumption was that lower NDVI values indicate reduced green richness, thereby suggesting the presence of mixed pixels. It is acknowledged that NDVI values can vary depending on vegetation species and geographic location. Therefore, NDVI thresholds derived from RESOURCESAT-2 LISS-IV Mx imagery were cross-verified using NDVI values from higher-resolution Cartosat-2S merged products to ensure accurate detection of mixed pixels.

3.1.3 Deriving NDVI Thresholds

A systematic analysis was carried out to establish NDVI thresholds corresponding to varying degrees of greenness. Vegetated areas were extracted from LISS-IV Mx imagery across different terrains, and their NDVI histograms, mean, standard deviations, 1σ, 2σ, and 3σ values were analysed. NDVI values beyond 2σ (considered statistical outliers) were excluded from the analysis.

Table 1 Vegetation Class: Mean and Standard Deviation Across 4 States

State	Year of Satellite Data	Mean	Std. dev	1 Sigma	2 Sigma	3 Sigma
Assam	RS2 L4Mx ToA 2024	0.456	0.052	0.404	0.352	0.300
Telangana	RS2 L4Mx ToA 2023	0.317	0.043	0.268	0.225	0.182
Rajasthan	L4Mx ToA 2022	0.301	0.063	0.238	0.175	0.112
Punjab	RS2A L4Mx ToA 2023	0.431	0.056	0.376	0.320	0.265
Odisha	RS2A L4Mx ToA 2023	0.420	0.066	0.355	0.289	0.224
			Average	0.328	0.272	0.216

$$Mean\ NDVI\ = \frac{\sum_i NDVI_i}{N},$$

Summation is over all the pixels excluding background in the segment

NDVI$_i$ = NDVI at each pixel

N = number of pixels in the segment

As shown in the Table 3, NDVI thresholds vary from terrain to terrain and also change with the seasons. Currently, these thresholds have been accurately identified from each scene using traditional methods. A visual tool "Vegetation Extraction in RS2/2A L4Mx" was designed and developed to extract minimum and maximum thresholds.

Based on this analysis:

- **NDVI at 2σ** (~0.27) was designated as the threshold for mixed pixels, assigned **50% weightage** — representing partial greenness with the remaining contribution attributed to background elements such as soil, settlements, or water. This threshold is defined as **minimum threshold.**

- **NDVI at 1σ** (~0.32) and above was considered indicative of pure vegetation, assigned **100% weightage**. This threshold is defined as **maximum threshold.**

- For NDVI values between the **minimum and maximum thresholds**—0.27 and 0.32—a linear weighting approach was applied, scaling from **50% to 100%.**

This calibrated weighting system enabled a more accurate estimation of green cover, accounting for the mixed pixel effect inherent in medium-resolution satellite imagery.

Table 2 Pseudo Colour for the NDVI Value Ranges

NDVI	Pseudo Colour	GCI (Weights)
< 0.27 (min threshold)		0%
0.27 to 0.32 (min to max threshold)		50% to 100%
>= 0.32 (max threshold)		100%

The Green Cover Index (GCI) — though not universally standardized like NDVI — has been used in various studies and operational monitoring to assess vegetation cover, including in the context of urban greening, landscape monitoring, and roadside vegetation assessment.

Green Cover Index (GCI) for a given segment is calculated as

$$GCI = \frac{\sum_i GCI_i}{N}$$

where

Summation is over all the pixels excluding background in the segment:

GCI_i *=The fraction of Greenery at each pixel*

N = number of pixels in the stretch

3.1.4 Validation of GCI with High Resolution Data

The results were rigorously compared with Cartosat-2S merged high-resolution datasets, which offer a finer spatial resolution of 0.6 m and contain significantly fewer mixed pixels. A pan-sharpening algorithm was used to generate the Cartosat-2S merged product, ensuring that the mean and standard deviation of the merged product match those of the Cartosat-Mx data, while incorporating the spatial details from the Cartosat-PAN imagery. NDVI derived from the lower-resolution Resourcesat-2/2A imagery was cross-verified with NDVI values from high-resolution Cartosat-2S merged data. To align these datasets more effectively, normalization techniques are applied. Additionally, to avoid duplicative values when up sampling low-resolution (LR) data to high-resolution (HR), the HR datasets are down sampled to match the LR resolution.

3.1.5 Pilot Study-Phase2

An analysis was carried out for the state of Telangana across six National Highways, covering 17 UPCs with a total length of 1120.84 km, using LISS-IV data from the first half of 2023 (January to June). The analysis utilised actual ancillary inputs (vector data) – such as Centre Lines, Right of Way (RoW), and Chainages – shared by NHAI. Based on these case studies, methodologies were fine-tuned to accurately calculate the Green Cover Index (GCI) for every 1km segment along the UPCs.

To calculate the GCI for National Highways covering ~30,000 km across 24 States, following workflow was adopted: Satellite data preparation, Vector data preparation, GCI calculation, Web GIS Application and Mobile Application development followed by Validation and Analysis.
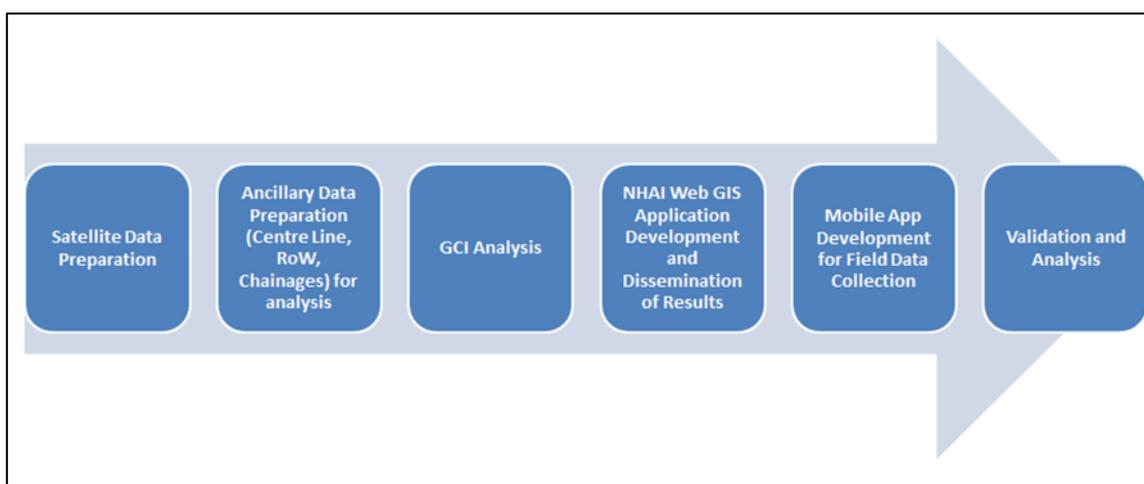
Figure 2 Workflow to calculate Green Cover Index along the National Highways

3.2 Satellite Data Preparation

This section provides a comprehensive overview of the satellite data utilized throughout the project. It describes the types and sources of the data, as well as the techniques employed to ensure the highest level of accuracy in the product, enabling precise and meaningful results for the project's objectives.

3.2.1 Satellite Data Used

The Indian Remote Sensing (IRS) mission's optical sensors, specifically Resourcesat-2/2A (RS2/2A) LISS-IV, provide 5m resolution multi-spectral data with a 48-day revisit cycle (Table 3). This enables consistent monitoring and assessment of vegetation along highway corridors, allowing analysis of changes over time. Collectively, RS2/2A LISS-IV Mx sensors provide around 12 to 16 coverage cycles across India each year.

Table 3 Specifications of Resourcesat-2/2A satellites

Satellite	Sensor	Spatial Resolution	Swath	Repetivity	Spectral Bands (µm)
Resourcesat-2/ Resourcesat-2A	LISS-IV	~5m	70 km	48 Days	Green: 0.52-0.59 Red: 0.62-0.68 NIR: 0.77-0.86

3.2.2 High Resolution Satellite Data for Validation

Very high-resolution data from the Cartosat-2 Series merged product (0.6 m resolution) was leveraged to validate the methodology wherever feasible, and its application was subsequently extended to additional geographic regions. The sensor specifications are given below in Table 4.

Table 4 Specifications of Cartosat-2E satellite

Sensor	Spatial Resolution	Radiometric Resolution	Swath	Spectral Bands (µm)
HRMX - High Resolution Multi Spectral	1.6 m	11 bits	10 km	B1: 0.45 - 0.52 B2: 0.52 - 0.59 B3: 0.62 - 0.68 B4: 0.77 - 0.86
PAN Panchromatic Camera	0.6 m	11 bits	10 km	PAN: 0.50 - 0.85

3.2.3 Satellite Data Preparation

Orthorectification is the process of geometrically correcting satellite images to remove sensor, satellite motion, and terrain-induced distortions (Figure 3). A rigorous math model and a digital elevation model (DEM) are used to correct distortions in raw images. The quality of the orthorectified image is directly dependent on the accuracy of both the mathematical model and the DEM.
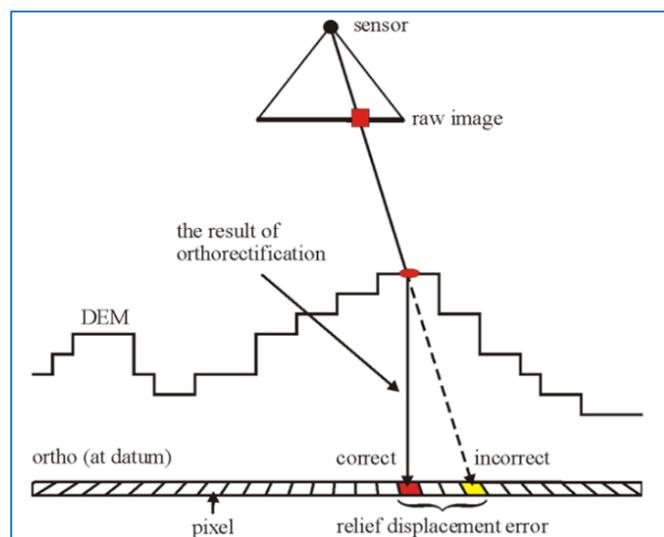
Figure 3 Principles of orthorectification

The objectives of the orthorectification process for this project is

- To eliminate geometric distortions caused by terrain relief and sensor tilt.
- To align LISS-IV Mx data with a standard Spatial Reference System (SRS: EPSG:4326).
- To generate an accurate planimetric representation of the Earth's surface.

Resourcesat2/2A LISS-IV data ordering through the Bhoonidhi portal is performed manually to ensure cloud-free, non-duplicate images with minimal overlap. This manual process is essential for selecting high-quality satellite imagery and is time-consuming due to the need for careful inspection and selection based on these criteria.

Ground Control Points (GCPs) are collected from the NRSC/ISRO High-Resolution Satellite Image Reference. To improve accuracy, GCPs are evenly distributed across the image, covering a range of elevations and areas where images overlap. Additionally, the quality of the GCPs influences the number required to achieve the desired level of accuracy.

Tie points are identified from the overlapping regions of two or more satellite images. These points serve as common reference features used for image alignment and geometric correction. The selected tie points ensure spatial consistency between overlapping scenes and support accurate image stitching and analysis.

DEM is used in orthorectification to correct geometric distortions in satellite imagery caused by terrain elevation differences and sensor geometry. By incorporating elevation data from the DEM, the process adjusts the image to a uniform scale and corrects spatial displacements, resulting in a geometrically accurate, map-ready image where features are properly aligned to their true

ground positions. For LISS-IV imagery, CartoDEM with a resolution of 30 m is utilized to correct terrain-induced distortions and enhance geometric accuracy during orthorectification.
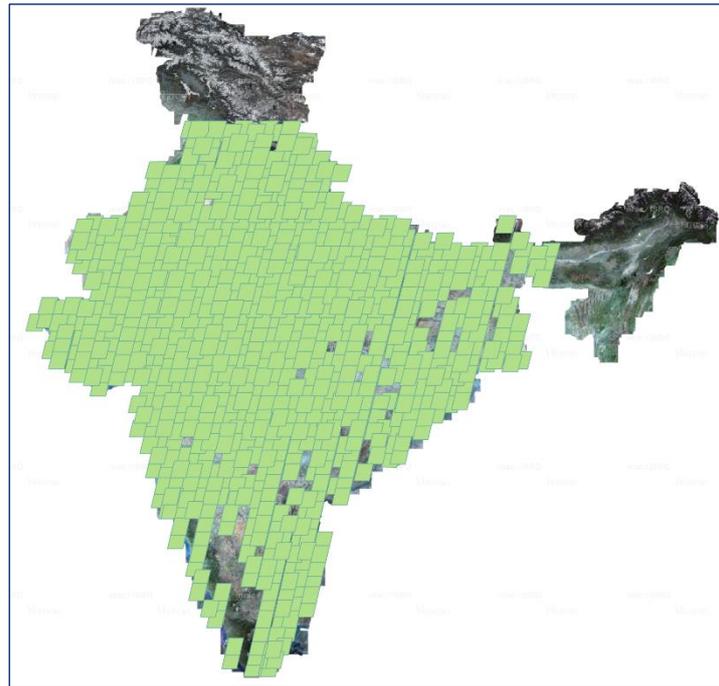
Figure 4 Footprint map showing spatial coverage of LISS-IV MX scenes used for NH-GCI project

Orthorectification of satellite imagery requires specialized geospatial software capable of performing geometric corrections using elevation data and sensor metadata. Rolta GXL and Geomatica software are used for orthorectification tasks, particularly when integrated with Digital Elevation Models (DEMs) and Ground Control Points (GCPs).

Orthorectification Process

The orthorectification workflow consists of a series of steps that integrate raw satellite imagery, elevation data, and the collection and refinement of Ground Control Points (GCPs) and tie points through the Bundle Block Adjustment (BBA) method. BBA serves as a critical pre-processing step for datasets with multiple overlapping images, refining sensor orientation and image positioning by minimizing the reprojection errors of tie points and GCPs across the image block. This significantly enhances geometric accuracy and ensures consistent image alignment, both of which are essential for generating high-quality orthorectified products. Following BBA, orthorectification algorithms and sensor models—such as Rational Polynomial Coefficient (RPC) models—are applied. The process concludes with image resampling and output generation, after which the orthorectified imagery undergoes rigorous accuracy assessment to verify geometric precision.

Ingest of Data

The LISS-IV Mx scenes are ingested into the GXL software environment, where the raw image data is converted into the **PIX** file format. During this process, the software automatically reads the source folder containing the raw LISS-IV scenes and creates a dedicated data ingest instance for each scene. This ingest procedure includes stacking the multispectral bands, extracting and embedding relevant metadata (such as acquisition date, sensor parameters, and georeferencing information), and preparing the data for subsequent orthorectification steps. The conversion to

PIX format ensures compatibility with the downstream processing modules and facilitates efficient handling of large datasets.

Ground Control Point Selection and Refinement

For each scene, a set of well-distributed GCPs are collected to establish a reliable geometric reference framework. These GCPs are selected carefully across the entire image extent to ensure uniform spatial coverage. Following initial collection, the GCPs undergo a refinement process where inaccurate or erroneous points are identified and discarded based on residual pixel errors. This iterative verification improves the positional accuracy of the remaining GCPs, minimizing the overall geometric distortion.

Tie Point Collection and Refinement

Tie points, which are image features that match between overlapping scenes or reference data, are identified and refined to enhance the geometric alignment. This help improve relative positioning within the imagery, complementing GCPs to achieve higher spatial accuracy.

DEM Integration

Cartosat-1 30m is incorporated to correct for terrain-induced distortions. The DEM is pre-processed and aligned with the image coordinate system to accurately model terrain relief effects during orthorectification.

Model Used (Orthorectification Algorithm)

Using refined RPC sensor models, the imagery is transformed into a planimetrically accurate coordinate system. The orthorectification algorithm applies the DEM and BBA results to remove distortions caused by sensor tilt, terrain relief, and satellite motion.

Resampling and Output Generation

The corrected imagery is resampled using methods such as nearest neighbour, bilinear interpolation, or cubic convolution to generate the final orthorectified product. The output is typically saved ERDAS .img format with an appropriate map projection (ESPG: 4326).

Accuracy Assessment

The orthorectified image is validated using independent check points to compute Root Mean Square Error (RMSE) and ensure the geometric accuracy meets the required standards, usually within one pixel of spatial resolution (~5.8 m for LISS-IV). These products exhibit geometric location accuracy within ±10 m

Quantity of data processed

The orthorectification of LISS-IV Mx data using GCPs and high-resolution Digital Elevation Models ensures geospatially accurate datasets suitable for precision mapping and analysis. Approximately 1,000 scenes, totalling around 1.5 TB of LISS-IV Mx data acquired between July and December 2024, were orthorectified and generated for the NHAI project.

3.2.4 Top-of-Atmosphere Products

The ortho-rectified products were further processed for Top of Atmospheric corrections. Top-of-Atmosphere (TOA) reflectance product generation is a two-step process.

1. Convert Digital Number (DN) to Radiance

   Radiance (L_λ) = SaturateRadiance* DN + Offset

2. Convert Radiance to TOA Reflectance

$$\rho = (\Pi . L_\lambda . d^2) / (E_0 . \cos\theta_s)$$

ρ = TOA Reflectance
L_λ = Spectral Radiance at the sensor's aperture
d = Earth-Sun distance in astronomical units
E_0 = Mean Solar exo-atmospheric irradiances
θ_s = Solar zenith angle in degrees

3.3 Highway Vector Data Preparation

This section outlines the ancillary data provided by NHAI and describes the process of preparing vector data for the project. It details the steps taken to enhance analytical accuracy, including cleaning, formatting, and spatial alignment of vector layers with ortho-rectified satellite imagery.

3.3.1 Ancillary Field Data

NHAI provided essential ancillary data related to National Highways, including the following vector datasets:

1. Shapefiles of

   a. Right Of Way (ROW) (Polygon)
   b. Centre Line of National Highways (Line)
   c. Chainage points (Point)

2. Along with shapefiles, following data were shared for each UPC

   a. Number of Lanes
   b. Unique Project Code (UPC)
   c. Project Implementation Unit (PIU)
   d. Regional Office (RO)
   e. State
   f. Other attributes required for analysis and report generation.

These shapefiles were aligned with ortho-rectified satellite data to ensure accurate Green Cover Index (GCI) estimation. In cases of mismatch, manual and programmatic corrections were made. The overall methodology involves structured vector processing steps to standardize geometry and schema, ensuring the data is ready for downstream geospatial analysis.

3.3.2 Vector Data Reprojection

All shapefiles (centreline, chainage, LHS, RHS, median, and RoW) received from NHAI (Figure 5) were originally in the Geographic Coordinate System (GCS). To enable precise distance calculations for 1 km segment-level analysis, these files were reprojected into their appropriate UTM zones (42N to 47N), based on geographic location.
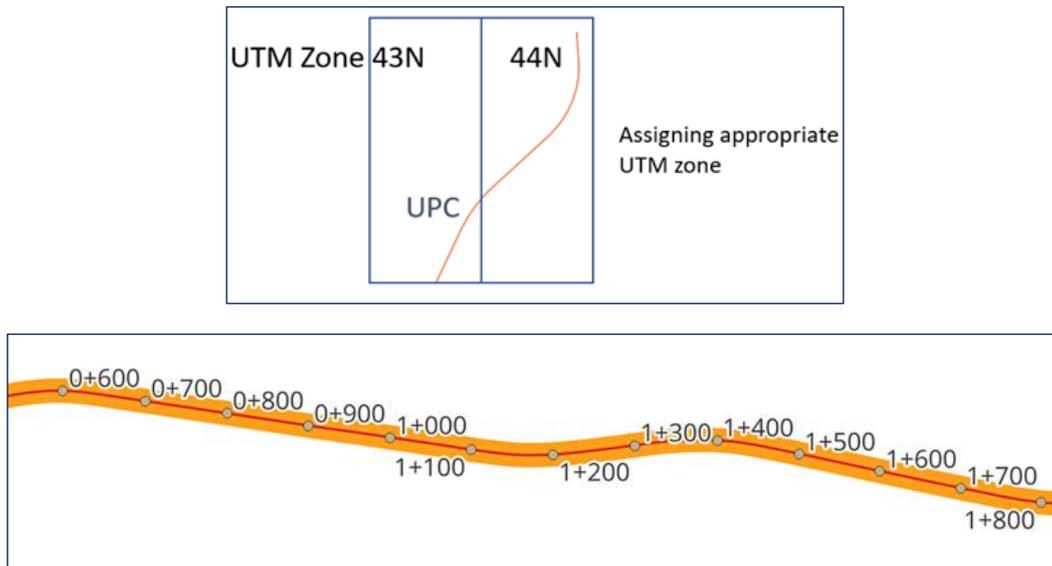
Figure 5 Road shapefiles – ROW, centreline, and chainage

3.3.3 Attributes Generalisation to Common Schema

After reprojection, attribute tables within the shapefiles were standardised to a consistent schema (Figure 6). This included unifying field names, data types, and value formats to ensure smooth integration across systems. The aim was to avoid schema mismatches and enable seamless interoperability in data processing and web portal display.
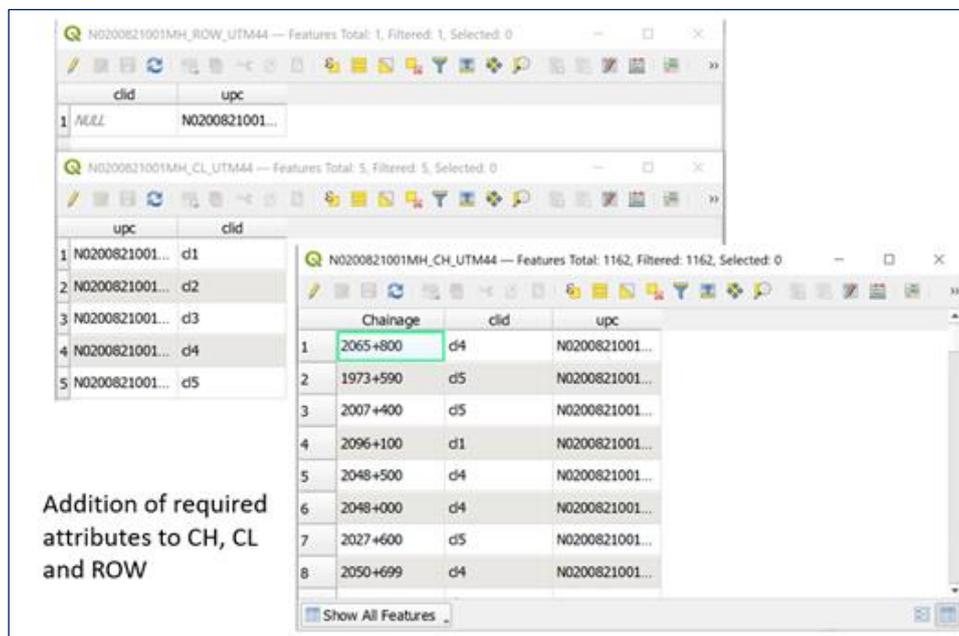
Figure 6 Attribute tables of the vector shapefiles standardized to a consistent schema

3.3.4 Clipping of Centre Line to 1-km Chip

As per NHAI's requirement, statistics are to be generated for each 1 km segment ("chip"). Due to existing challenges—such as repeated chainage values, missing data, and non-uniform spacing—combined with the presence of multiple parallel centrelines, a revised methodology was adopted. Rather than relying solely on chainage values to split segments, the centreline was divided into uniform 1 km lengths. For each 1 km segment, the minimum and maximum chainage values were

assigned accordingly. The process of mapping segments to chainages was implemented iteratively to ensure logical and accurate assignment, particularly in complex configurations like ring roads, diverging routes, and merging corridors.

This segmentation of the road centreline into 1 km intervals, implemented using a Python-based logic, allows for consistent spatial buffering and localized green cover analysis. Each segment is tagged with a unique ID and corresponding chainage values are mapped, enabling traceability. Any segment shorter than 0.1 m is discarded to maintain data integrity.

3.3.5 Clipping of ROW to 1-km

The Right of Way (RoW) was similarly split into 1 km segments, with each segment assigned a segment ID corresponding to the 1 km centreline segment. Once the CL was segmented, RoW polygons were clipped accordingly using buffers slightly wider than the maximum RoW width. These buffers were created using flat cap and bevel join styles. To avoid overlaps, intersections were resolved by subtracting shared areas, resulting in clean, non-overlapping RoW segments.

3.3.6 Median Buffer Generation at 1-km

Median buffers were created along the centreline for each 1 km segment. These were based on predefined road widths and lane configurations and serve as the reference for analysing green cover in the median area.

3.3.7 LHS and RHS Generation from ROW

The Right of Way (RoW) was divided into Left-Hand Side (LHS) and Right-Hand Side (RHS) segments based on the ordering of chainage values. LHS, RHS, and median (MED) shapefiles were validated to ensure uniform extent and geometric consistency at the 1 km level.

LHS and RHS buffers are derived from the RoW layer by subtracting the road buffer, which is generated from the centreline (CL) based on predefined lane-to-width mappings. Unlike the medians, LHS and RHS buffers are not initially segmented into 1 km units. Instead, both sides are initially stored together within a single shapefile.

To separate the LHS and RHS into distinct shapefiles, a geometric classification process is applied. First, the chainage (CH) points are read, sorted, and connected to form a continuous LineString, referred to as the "CH line." For each polygon in the combined shapefile, its centroid is computed and its spatial relationship to the CH line is determined using a cross-product calculation. This determines whether the centroid lies to the left (LHS), right (RHS), or directly on the CH line.

A majority-voting mechanism is then used to assign the correct label to each shapefile. If one shapefile contains most features on the RHS, it is labelled as RHS, and the other is designated as LHS. These assignments are subsequently verified through validation checks to ensure geometric and logical consistency (Figure 7).
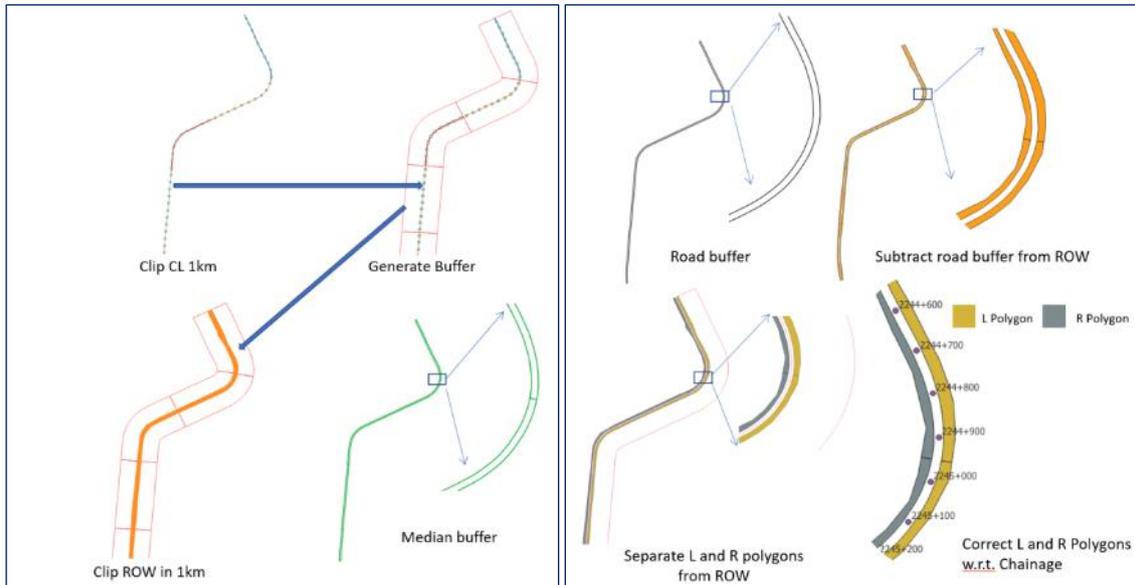
Figure 7 Separating LHS, RHS from RoW

3.3.8 Additional Vector Editing

In areas where multiple road segments are close and non-parallel, side buffers may overlap or be incorrectly labelled. Manual inspection was used to adjust segment IDs, correct 1 km splits, and resolve duplication errors (Figure 8).
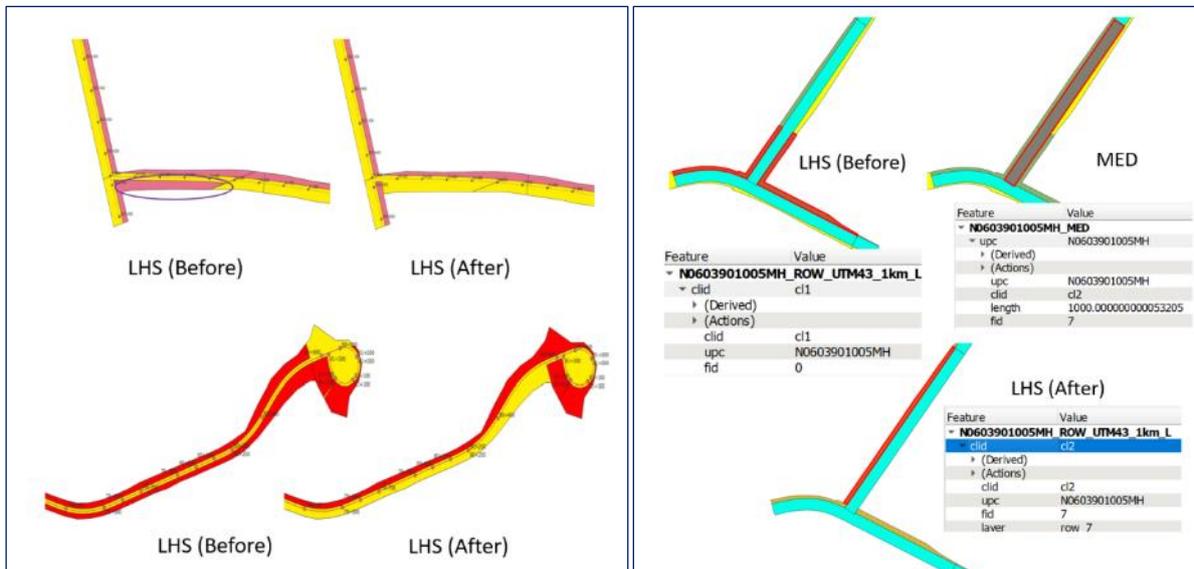
Figure 8 Vector Editing to separate LHS and RHS

3.3.9 Vector Alignment Shifting

To ensure accurate alignment with satellite imagery and improve the precision of Green Cover Index (GCI) calculations, geometric adjustments are performed on the vector data—particularly the Centre Line (CL), Right of Way (RoW), and Chainage (CH) layers. Discrepancies between the CL and satellite imagery are addressed by manually shifting the CL geometry w.r.t to reference Satellite layer. Subsequently, the associated RoW and CH layers are programmatically adjusted using the same transformation logic to maintain spatial consistency (Figure 9).

For manually correcting the CL alignments w.r.t to Satellite scenes QGIS, an open-source GIS software is used internally. During the CL correction, the original point structure is preserved, enabling automatic propagation of the shift to dependent layers. In cases of complex curves, excess vertices are simplified to reduce redundancy, while segments with insufficient detail are enhanced using a Python-based `segmentize` function. If the CL requires complete reprocessing, the CH points are reconnected, and the entire editing and segmentation workflow is repeated.

For RoW adjustment, a consistency check is carried out to verify that the point sequence in the CL remains unchanged before and after shifting. Any mismatches are logged and flagged for manual review in an Excel sheet. The original point IDs and segment IDs are retained. Elevation (Z-axis) data is removed to maintain 2D consistency, and specific logic is applied to handle both LineString and MultiLineString geometries. Offsets between old and new CL points are computed and stored as latitude-longitude differences. If RoW components (LHS, RHS, or median) lack sufficient boundary definition, they are densified using the same `segmentize` function.

Each polygon or multipolygon is then updated individually. For every boundary vertex, the nearest CL point with the same segment ID is identified, and the corresponding offset is applied to realign its location. The modified vertices are used to reconstruct the polygon geometry, and the final shapefiles are saved while preserving the original attribute table structure.

CH points are also mapped to segment IDs to maintain accurate chainage intervals. This is achieved using spatial left joins within incrementally increasing buffers (up to 10 meters). Unassigned CH points are flagged for manual inspection. The mapping initially references the unshifted CL to determine boundaries, after which the CH points are snapped to the corrected CL geometry. In cases where no geometric shift is required, only schema alignment is performed across CL, RoW, and CH files to ensure consistency.

UPC - N0800902001GJ
Lat/Lon - 21.1002629,70.1648838

- CL Before Shift
- CL After Shift

N0901601002RJ
Mismatch found: refer file

	A	B	C
1	fid	old	new
2	10	11	13
3	16	5	6
4			
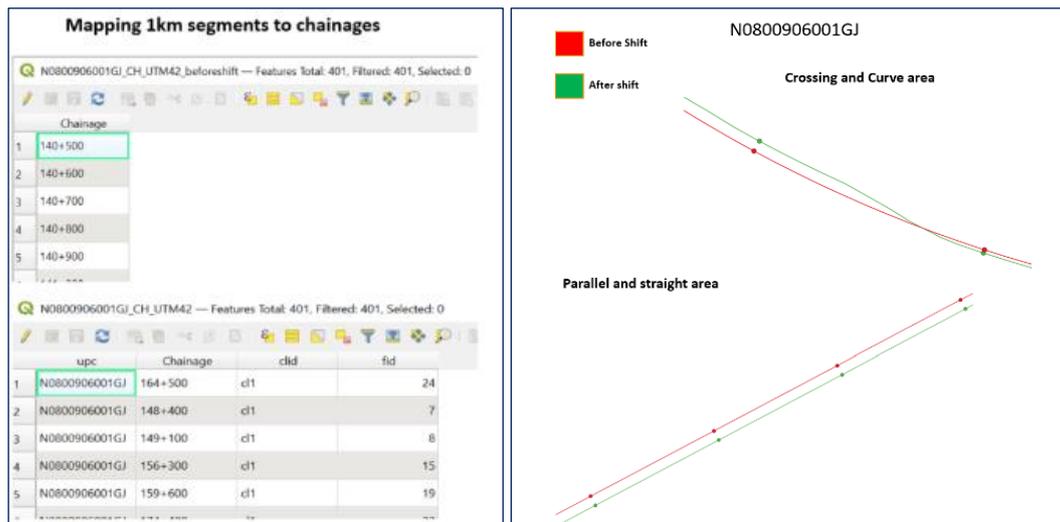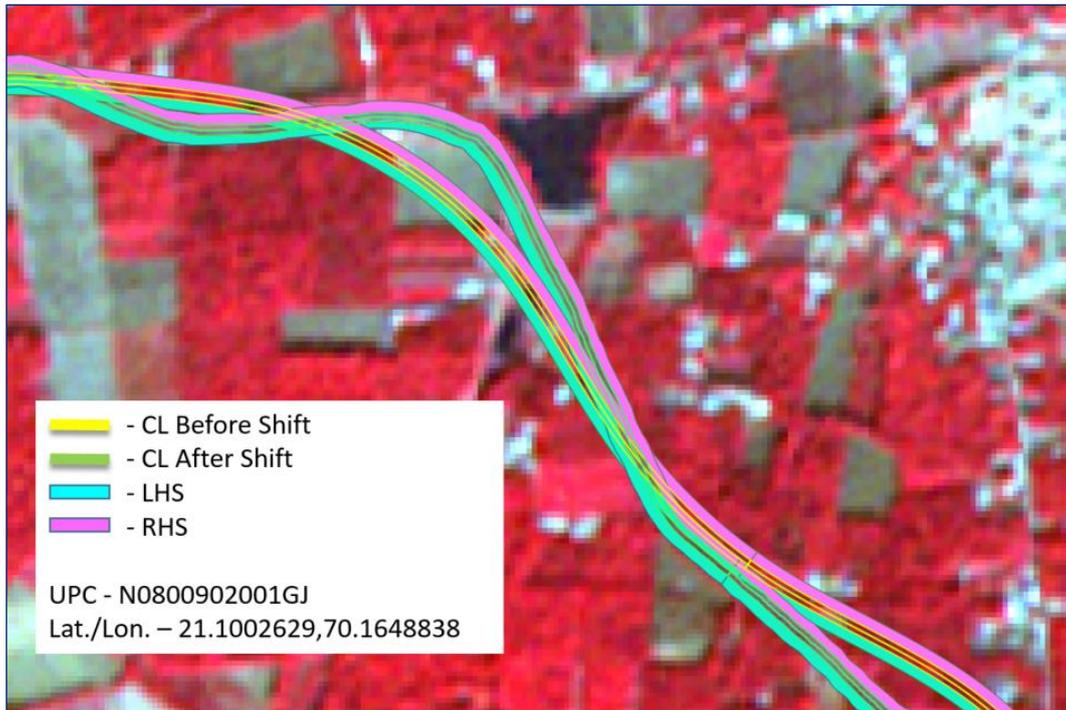
Figure 9 Shifting RoW and Chainage IDs with reference to the corrected Centre Line

3.3.10 Vector Files Preparation for Online Publishing

Finalized vector files were validated, cleaned, and exported in a web-compatible Geographic Coordinate System (GCS). Schema conformity checks were applied, and corrected LHS, RHS, and median polygons were merged to reconstruct the complete RoW (Figure 10).

For portal integration:

- CL, CH, and polygon layers were reprojected and renamed consistently.
- Chainage data was grouped by CL and segment ID.
- A right join ensured all segments were included, even if CH data was missing—default placeholders (e.g., '9998+999') were assigned for such cases.

This preparation ensured reliable, structured data for Green Cover Index (GCI) computation and display on the web portal.

Merge LHS, MED and RHS features to get RoW

L Polygon

M Polygon

R Polygon

Reproject LHS, MED and RHS to GCS for portal

fid	length (km)	clid	min_ch	max_ch
0	1	cl1	2083+400	2084+300
1	1	cl1	2084+400	2085+300
2	1	cl1	2085+400	2086+300
3	1	cl1	2086+400	2087+300
4	1	cl1	2087+400	2088+300
5	1	cl1	2088+400	2089+300
6	1	cl1	2089+400	2090+300
7	1	cl1	2090+400	2091+300
8	1	cl1	2091+400	2092+300

Mapping 1km segments to chainages

Figure 10 Vectors in format compatible for integration to the portal

3.4 Green Cover Index (GCI) Estimation

To derive Green Cover Index (GCI) statistics at a 1 km segment level, outputs from Sections 3.2 and 3.3 are used. Section 3.2 provides orthorectified LISS-IV scenes, while Section 3.3 supplies 1 km-wise shapefiles for Left-Hand Side (LHS), Right-Hand Side (RHS), and Median (MED). The following subsections outline the subsequent processing steps involved in GCI computation (Figure 11).
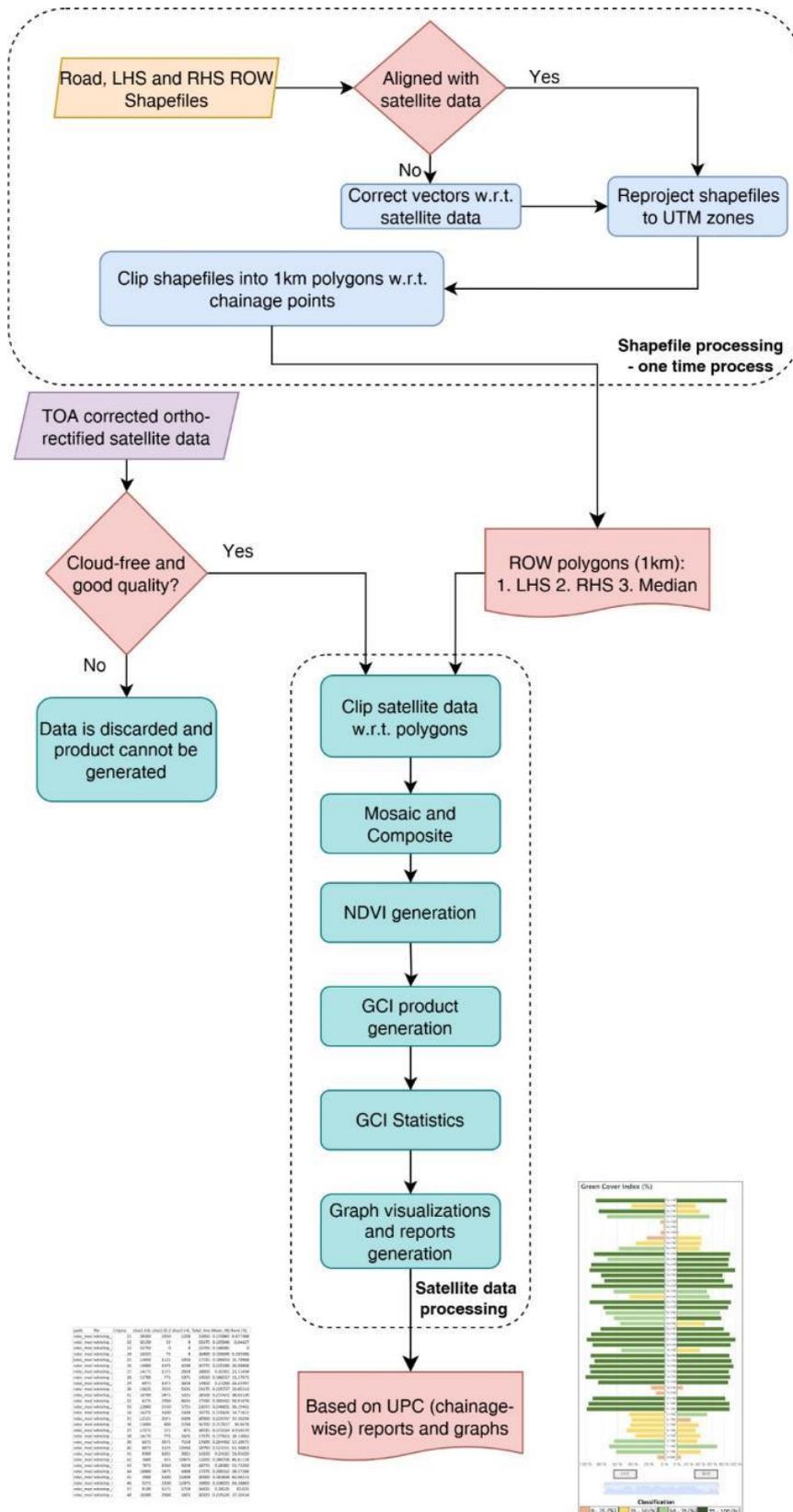
Figure 11 Flow Chart for the GCI computation

3.4.1 Raster Minimization

Following orthorectification, bound shapefiles of satellite scenes are intersected with the highway centreline shapefiles to identify which LISS-IV scenes correspond to each UPC. Raster minimization is then performed by visually inspecting the scenes for cloud cover, image quality, and optimal coverage with minimal scene overlap (Figure 12).
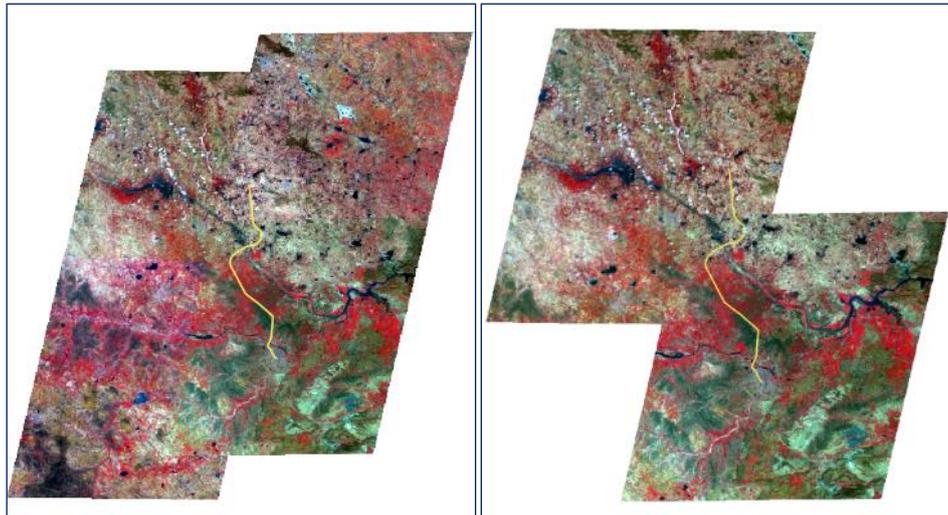
Figure 12 Satellite scenes: After intersection (left) After scene minimization (right)

3.4.2 Reprojection of Raster Datasets

Since the analysis is conducted at a 1 km resolution, both vector and raster datasets are reprojected to the Universal Transverse Mercator (UTM) coordinate system. This ensures that all spatial measurements are in metres, facilitating precise segment-wise analysis.

3.4.3 Clipping the Satellite Data to 1-km

Using the 1 km vector shapefiles for LHS, MED, and RHS, the satellite imagery is clipped to generate corresponding raster segments. Each segment is tagged with a unique segment ID and scene reference for tracking and validation purposes (Figure 13).
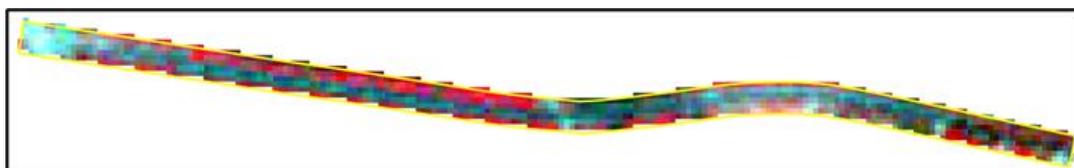
Figure 13 LISS-IV Mx data clipped w.r.t. 1km LHS, RHS and median polygons

3.4.4 Filling the Satellite Data Chips

To ensure completeness, each raster segment is further processed by verifying whether the centre coordinate of each pixel falls inside the respective polygon. Pixel values are retrieved from the original LISS-IV scenes based on this spatial criterion. The result is a more consistent and continuous raster dataset, as illustrated in Figure 14.
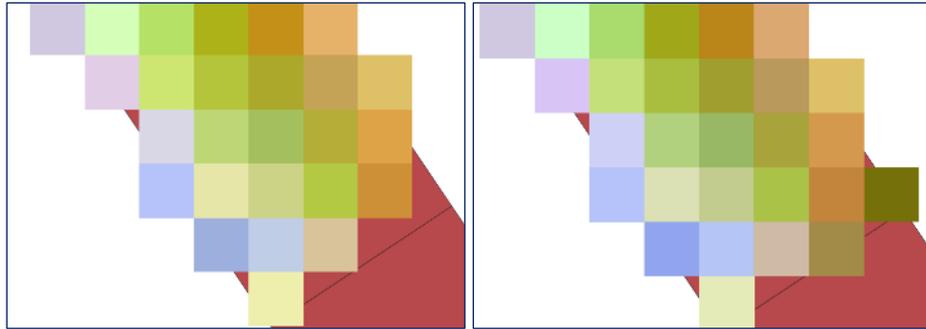
Figure 14 GCI image before clip filling (left) and after clip filling (right)

3.4.5 Mosaicking

After filling, a composite mosaic is created to eliminate cloud-covered areas and ensure the best quality data is retained. Where no single scene fully covers a 1 km segment, a pixel-wise mosaic is generated using partial scenes (Figure 15).
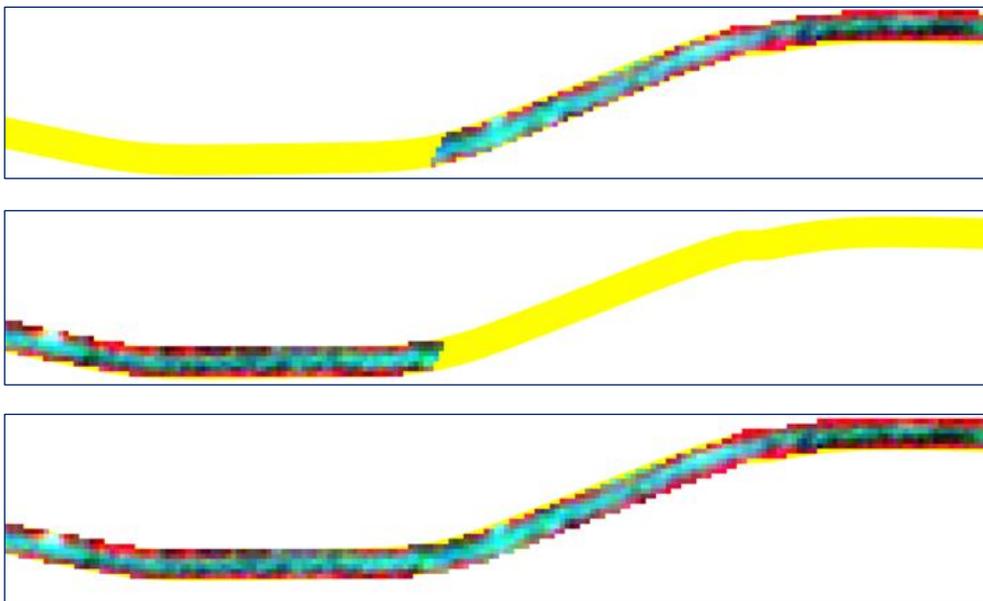
Figure 15 When a 1km segment spans two LISS-IV scenes, mosaics are created for analysis

3.4.6 NDVI Generation

NDVI values are computed for each 1 km raster segment using the standard formula:

$$NDVI = (NIR - RED) / (NIR + RED)$$

Negative NDVI values are set to zero before proceeding. Figure 16 presents the NDVI image corresponding to a satellite scene.

Figure 16 NDVI image of satellite image shown in Figure 13

3.4.7 Vegetation Thresholds Selection

To distinguish vegetation from non-vegetated areas, a thresholding mechanism is applied to NDVI images. A Gaussian-based approach is used to derive scene-specific thresholds, supported by the in-house "Vegetation Extraction in Resourcesat-2/2A L4Mx" tool (Figure 17).

Pixels with NDVI values greater than or equal to the threshold are classified as vegetation, while those below are marked as non-vegetation. The **maximum threshold** is set at Mean - 1σ (pure vegetation), and the **minimum threshold** at Mean - 2σ (non-vegetated). Pixels falling between these thresholds are assigned weights linearly to represent mixed vegetation. Accordingly, three classes of vegetation cover are generated and assigned pseudo colour as given in Table 5. Examples of results using these thresholds are shown in Figure 18.
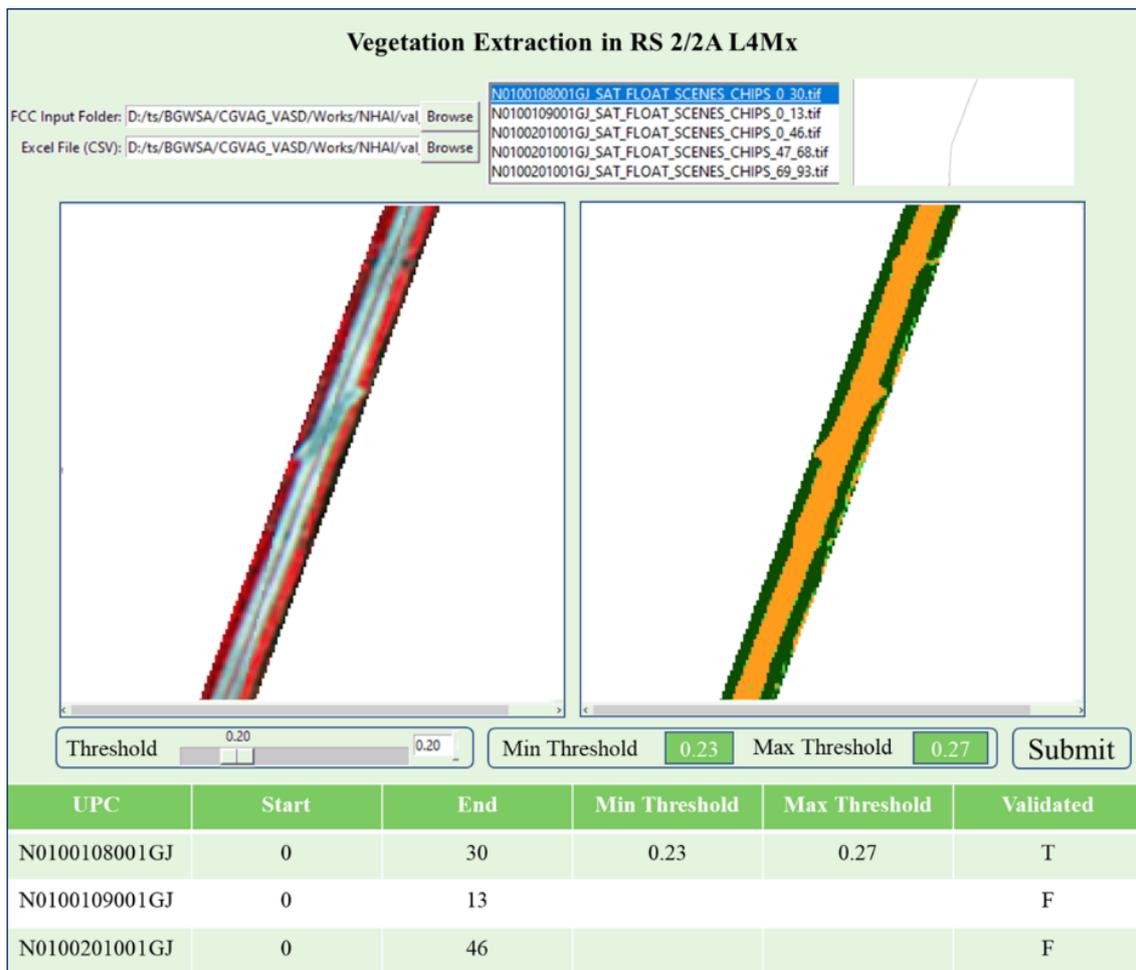
Figure 17 Vegetation Extraction in RS 2/2A L4Mx Tool to extract vegetation cover

Table 5 Pseudo colour used for different ranges of NDVI values

NDVI	Pseudo Color	Weights
< min threshold		0%
min to max (start)		50% to 100% (linear)
>= max		100%
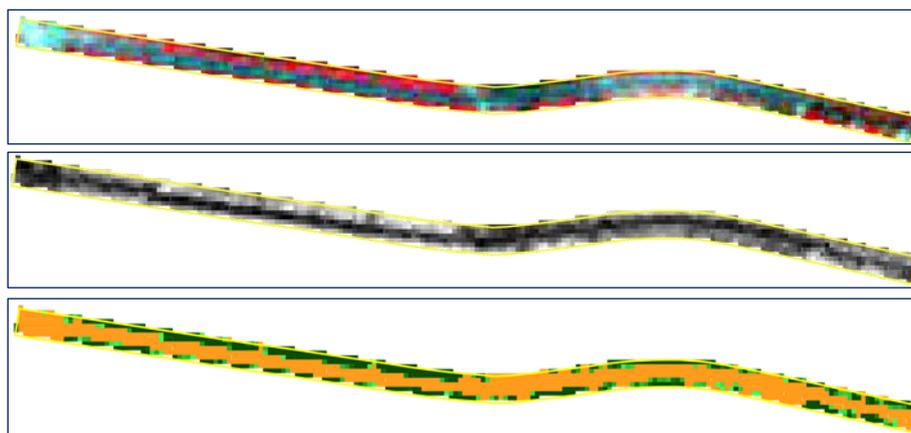
Figure 18 1km satellite data chip, corresponding NDVI and GCI product

3.4.8 Raster Files Preparation for Online Publishing

The 1km satellite image FCC and GCI products are mosaicked at UPC level, converted to byte format with appropriate min-max stretching in case of FCC, and pseudo-color in case of GCI product, and reprojected and exported to a web-compatible Geographic Coordinate System (GCS).

3.4.9 GCI Statistics Generation

Using the NDVI values and derived thresholds, GCI statistics are computed for each 1 km segment. These statistics can be aggregated at multiple levels—including UPC, Project Implementation Unit (PIU), Regional Office (RO), State, or National Highway. Additionally, LHS and RHS values can be combined to estimate avenue-level green cover.

A template of per-segment GCI statistics is presented in Table 6 Template of Statistics generated per 1km segment: Mean NDVI and GCI Table 6. It includes fields such as segment ID, chainage range, NDVI values, and GCI class for each side of the road.

Table 6 Template of Statistics generated per 1km segment: Mean NDVI and GCI

Cl-Id	Seg-Id	Min Chainage	Max Chainage	Length	LHS							MEDIAN							RHS							QF
					R1	R2	R3	Area	Mean NDVI	GCI	Class	R1	R2	R3	Area	Mean NDVI	GCI	Class	R1	R2	R3	Area	Mean NDVI	GCI	Class	
cl1	0	47+700	48+600	1.0	825	1800	7225	9850	0.35	87.14	4	6900	2700	575.00	10175	0.27	24.05	1	1025	2550	6425	10000	0.34	84.82	4	T
cl1	1	46+700	47+600	1.0	5325	1550	3075	9950	0.29	41.95	2	8450	1250	400.00	10100	0.24	12.90	1	6175	2275	1600	10050	0.27	32.19	2	T
cl1	2	45+700	46+600	1.0	1500	800	7550	9850	0.34	83.65	4	7625	1550	925.00	10100	0.25	20.65	1	5425	2250	2175	9850	0.27	38.83	2	T
cl1	3	44+700	45+600	1.0	2350	1475	6250	10075	0.34	73.00	3	7075	2225	625.00	9925	0.25	22.34	1	4125	1350	4550	10025	0.31	55.57	3	T
cl1	4	43+700	44+600	1.0	9650	450	225	10325	0.18	5.44	1	9950	0	0.00	9950	0.15	0.00	1	9600	125	50	9775	0.16	1.48	1	T

3.4.10 GCI-based Classification of National Highway's Segments

Each highway segment is categorized based on its GCI value into the following classes:

- **Poor**: 0–25%
- **Moderate**: 25–50%
- **Good**: 50–75%
- **Very Good**: 75–100%

This classification aids in understanding green cover status across the corridor and facilitates comparison with historical or future assessments.

3.5 Bhuvan NH-GCI Web GIS Portal

Spatial Information System for Monitoring of Green Cover Index along National Highways

A dedicated web-based GIS portal, 'Spatial Information System for Monitoring of Green Cover Index along NH', has been designed and developed using open-source solutions to meet the specific requirements of end users. The application will be hosted on Bhuvan under NRSC/ISRO and will be accessible to NHAI officials.

The portal facilitates customized reporting and data visualization to support administrative decision-making, specifically for monitoring green cover along National Highways. It includes filter options like National Highway name, State, and Unique Project Code (UPC) to visualize data effectively. The system architecture leverages PostgreSQL with PostGIS for storing geospatial data, supporting both vector and raster data types. GeoServer is used for serving vector layers, while Map Server manages raster data such as satellite imagery. This architecture enables detailed, real-time visualization and analysis of environmental data along highways.

Currently, the portal relies on HTML, CSS, PHP and OpenLayers which can lead to slower performance and less interactive user experiences, especially with large datasets. To address these limitations, the portal is migrating to a React based web application. React Native offers faster load times, improved performance, and more dynamic, real-time updates. Its component-based structure and cross-platform capabilities will enhance the user experience and scalability, ensuring more efficient handling of complex data and better decision-making support for administrative tasks. This migration aligns with the goal of adopting modern technologies for a more responsive and future-ready platform.

Key features of the portal include:

- Satellite Base Layers: Option to switch between high-resolution satellite base layers (in Natural Color Composite) from archived datasets.
- Overlay Capabilities: Ability to overlay spatial data including Right of Way (ROW), Left-Hand Side (LHS), and Right-Hand Side (RHS) plantation vectors in False Color Composite, along with the corresponding Green Cover Index (GCI) product, which shows the pixel-wise fraction of green coverage.
- Segment Visualization: Users can click on a segment in the graph to directly view the corresponding 1 km stretch.
- Green Cover Statistics: For every 1 km segment, the portal provides statistical summaries such as Mean NDVI and Green Cover Index, separately for median, LHS, and RHS plantations (wherever applicable).
- Monitoring & Classification: Based on the GCI statistics, the system classifies and ranks stretches of highway according to the extent of green cover in relation to the ROW. This serves as a valuable metric for ongoing monitoring and assessment of greenery along the highway corridors.
- Visualizing Geo-tag Points for Ground Truth Verification: Displays geo-tagged points submitted by surveyors on the web portal, along with associated photographs and green cover ratings. This enables reviewers to validate the authenticity and accuracy of on-ground data through visual and locational evidence.

High-Level Architecture Diagram

Browser (End User)

Web-Portal

Developed in HTML, CSS, PHP, OpenLayers

Application Layer

HTTPS (GET/ POST requests), FTP requests

Web Server

Geo-Server
- Vector Data Rendering (LHS, RHS, ROW. Etc)
- Shapefiles with EPSG: 4326.

Map Server
- Raster Data Rendering (NDVI/ FCC).
- .Tiff files

Database Server
- Postgres Database/ PostGIS.
- Statistics Data Rendered through Postgres/ PostGIS.

Storage (sas)

Figure 19 High Level Architecture diagram of Bhuvan NHAI Web-Portal
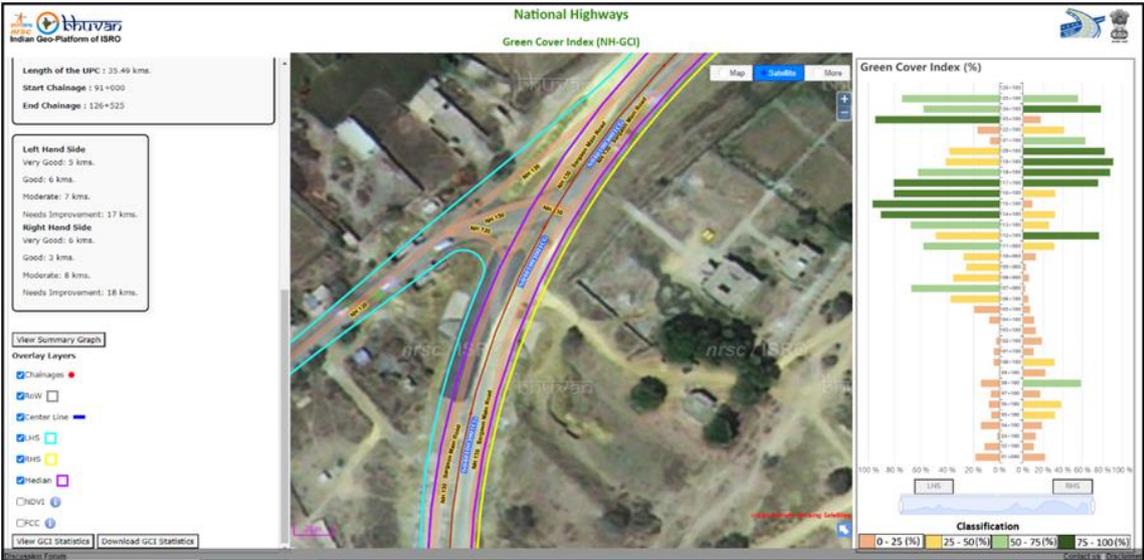
Figure 20 Snapshot showing the NH-GCI portal

(LHS, RHS, Median, RoW, Centre line, Chainage geometry and Chainage-wise GCI statistics depicted here for UPC: N/04010/03001/CG)
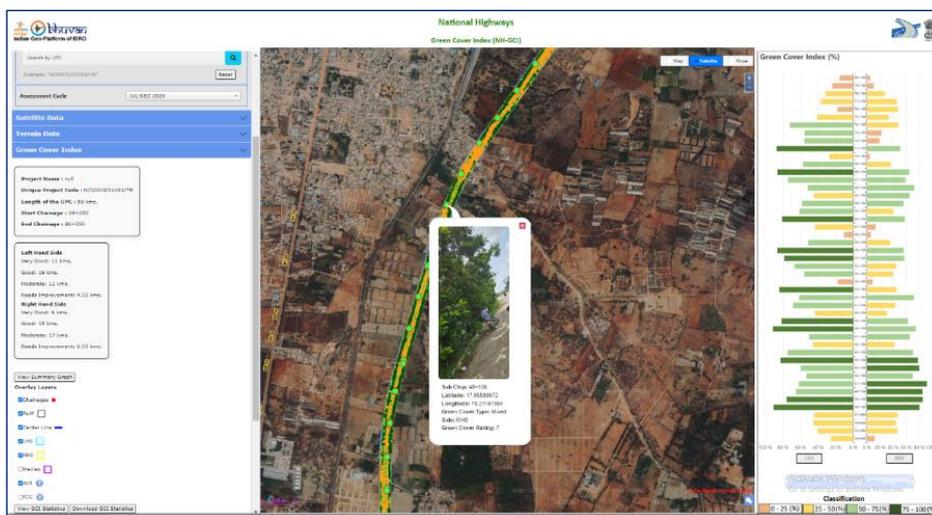
Figure 21 NH-GCI portal: Geo-tag points, photo and details. For UPC: N/02010/01001/TS.

3.5.1 Report Generation

After generation of the GCI Statistics, detailed report gets generated for each National Highway stretch (UPC) wise. Following is the template designed for sharing the GCI UPC wise.

Statistics on Green Cover Index for every UPC is reported under 04 tables representing - Project details, Summary of Green Cover Index, Satellite data details and per-km GCI statistics as illustrated in Table 6, 7, 8, and 9 below.

Report attribute details are given in Annexure 1: Report Template Details

Assessment Period – July to December 2024

Table 7 UPC (National Highway stretch) package details template

NH Package Details (Source: NHAI)			
UPC	Length (km)	Lanes	
State	RO	PIU	
Project Type	Current Project Stage	Cumulative Physical Progress (%)	

Table 8 Summary of the GCI values of UPC

Summary of Green Cover Index					
UPC	Overall GCI value	Total GCI (LHS)	Total GCI (RHS)	Total GCI (MEDIAN)	Overall GCI Classification

Table 9 Satellite Data details under for analysis template under Report

Satellite Data Details				
Satellite/Sensor	Date of Pass	Product Id	Path	Row

National Highway stretch (UPC) wise statistics based on 1km segments (mapped with Chainages) are provided as per the following template.

Table 10 National Highway (UPC) 1km wise GCI Statistics Report template

Cl-Id	Seg-Id	Min Chainage	Max Chainage	Length	LHS							MEDIAN							RHS							QF
					R1	R2	R3	Area	Mean NDVI	GCI	Class	R1	R2	R3	Area	Mean NDVI	GCI	Class	R1	R2	R3	Area	Mean NDVI	GCI	Class	

3.5.2 Graphical Representation

Along with the statistics for each National Highway stretch (UPC), a graph is also generated for visual representation of GCI each km wise for LHS and RHS (mapped with Chainage ids).

- Kilometre-wise GCI Classification: The Green Cover Index (GCI) values computed for each kilometre were classified into predefined categories, and all relevant fields were accordingly populated.
- GCI Percentage Display: The actual GCI percentage (%) for each kilometre was displayed, with cells color-coded to represent the GCI- Poor, Moderate, Good, or Very Good.
- Interactive Grid and Map Toggle: Each cell in the grid was made clickable, allowing users to toggle between the Grid View and the Map View interchangeably for better spatial analysis.

Figure 22 1km wise GCI for LHS and RHS

3.5.3 Temporal Analysis

The changes in green cover along National Highways can be effectively monitored through bi-annual statistical reports, which serve as a valuable tool for tracking vegetation dynamics over time. By analysing data collected at regular intervals, it becomes possible to identify trends in vegetation growth or decline, assess seasonal variations, and detect anomalies caused by human interventions such as construction, encroachments, or afforestation activities. Additionally, these reports help in understanding the impact of natural events like droughts, floods, or wildfires on roadside greenery. This systematic monitoring enables evidence-based decision-making for policy formulation, maintenance planning, and implementation of corrective or enhancement measures to promote environmental sustainability along highway corridors.

For UPCs where data is available is for two assessment cycles viz. Jan-Jun 2024 and Jul-Dec 2024, a comparative chart as illustrated in Table 11 is also calculated.

Table 11 Comparative Analysis of UPC for 2 Cycles

Change Detection for Assessment Cycles - 2024 (Jan -Jun 2024 & Jul- Dec 2024)									
Chainage	LHS			RHS			MEDIAN		
	Jan-Jun	Jul-Dec	Change	Jan-Jun	Jul-Dec	Change	Jan-Jun	Jul-Dec	Change
100+800	13.63	14.69	↑	0.56	44.53	↑	1.48	2.56	↑
101+800	56.32	58.15	↑	37.45	85.71	↑	5.86	12.00	↑
102+800	65.74	68.17	↑	31.53	76.22	↑	5.21	11.30	↑
103+800	60.63	70.20	↑	7.93	78.23	↑	22.42	11.43	↓
104+800	75.16	61.82	↓	4.98	76.07	↑	16.28	7.07	↓
105+800	47.00	36.62	↓	10.67	56.87	↑	10.15	2.22	↓
106+800	15.68			0.40			1.90		
107+800	4.63			0.00			0.00		
108+800	6.61			0.00			0.00		
22+800	21.39	28.68	↑	2.69	33.87	↑	1.05	2.15	↑
23+800	38.80	55.00	↑	3.07	44.08	↑	7.09	3.71	↓
24+800	67.67	82.07	↑	27.32	36.61	↑	13.71	22.11	↑
25+800	44.49	47.42	↑	21.66	18.68	↓	4.35	5.08	↑
26+800	27.92	23.55	↓	4.47	3.07	↓	3.74	0.98	↓
27+800	61.03	56.70	↓	29.73	46.83	↑	15.90	6.08	↓
Showing 1-15 of 87 rows					Page Size 15 ⌄	First Prev	1 2 3 4 5	Next	Last

3.6 Mobile App

Mobile App for Ground Truth Verification of Green Cover Index along National Highways

The process of field data collection has witnessed a dramatic transformation over the past few decades. Traditionally, surveyors relied on manual methods such as pen and paper to record observations, followed by later transcription into spreadsheets or databases on desktop computers. This method was not only time-consuming but also prone to human error, delays, and duplication of work. Surveyors had to carry separate handheld GPS devices for recording location coordinates and digital cameras for photographic evidence. Integrating all this data post-fieldwork into a centralized system posed additional challenges. As technology advanced, tablets and laptops were introduced for field data entry, but these too had limitations such as poor GPS accuracy, cumbersome interfaces, and lack of real-time connectivity.

Today, with the widespread use of smartphones and tablets integrated with high-precision GPS, in-built cameras, gyroscopes, accelerometers, and powerful processors, the landscape of field data collection has been revolutionized. Modern mobile devices now offer capabilities such as live geo-tagging, instant photo capture, audio and video recording, secure data storage, and offline access. Features such as responsive touch screens, map-based visualization, real-time location tracking, and intuitive user interfaces enhance both the speed and accuracy of data collection. Additionally, functionalities like offline data capture, push notifications, secure login and seamless

database integration make mobile applications the most preferred tool for field surveys. These innovations allow for efficient, accurate, and scalable data collection operations.

In response to these technological advancements, multiple cross-platform mobile development frameworks have emerged, including Apache Cordova, Flutter, Xamarin, and React Native. Among these, React Native, an open-source framework developed by Meta, has become a popular choice for developers aiming to create high-performance mobile applications for both Android and iOS platforms using a single codebase. React Native offers several advantages—it provides near-native performance, supports hot reloading (for faster development and testing), offers pre-built and customizable UI components, and allows smooth integration with third-party APIs and native device features. Moreover, the strong developer community and growing ecosystem make it a reliable and future-ready technology. These strengths have made React Native the preferred technology for organizations aiming to develop robust mobile applications in minimal time without compromising on user experience or functionality.

Harnessing the capabilities of React Native, the Bhuvan–NHAI Mobile App was developed by the National Remote Sensing Centre (NRSC), ISRO to support the National Highways Authority of India (NHAI) in monitoring green cover along highways. The app is designed to assist field surveyors in the ground truth verification of the Green Cover Index (GCI) using modern mobile tools. It seamlessly integrates with the Bhuvan Web GIS platform, ensuring real-time synchronization of field data with the centralized servers hosted by NRSC. Through the mobile app, users can perform secure registration, select their relevant Project Implementation Unit (PIU) and Unique Project Code (UPC), and access pre-loaded chainage points (markers) for ground verification. These chainages are mapped precisely along highway alignments and loaded dynamically within the app's map component, helping surveyors navigate directly to the field location for data collection and geo-tagging.

A crucial backend component of this system is the GeoServer, an open-source platform used to store and disseminate geospatial data. All major vector layers such as Left-Hand Side (LHS), Right-Hand Side (RHS), Median, Centre Line, and Right of Way (ROW) are hosted on the GeoServer using the EPSG:4326 coordinate system (WGS 84). These layers are created and managed using SQL views to optimize data delivery and performance. GeoServer supports standard OGC (Open Geospatial Consortium) services such as WMS (Web Map Service), WFS (Web Feature Service), allowing real-time access and rendering of spatial data across both mobile and web platforms. The use of GeoServer ensures seamless integration and the ability to visualize complex geospatial datasets efficiently.

In addition to vector data, the application also leverages raster imagery datasets such as NDVI (Normalized Difference Vegetation Index) and FCC (False Colour Composite) to assess the quality and extent of green cover. NDVI is a satellite-derived vegetation index that uses red and near-infrared bands to quantify vegetation health. It is particularly useful in identifying areas with healthy green cover versus regions with sparse or degraded vegetation. Similarly, FCC imagery, which combines visible and near-infrared wavelengths, is used to distinguish between land cover types, helping in the identification of vegetative versus non-vegetative zones. These datasets are stored in the Bhuvan Ras2 MapServer, a high-performance raster server that supports real-time rendering and overlay of raster imagery on top of vector maps within the Bhuvan platform. By combining these analytical tools with on-ground verification.

The Bhuvan–NHAI mobile app is thoughtfully designed to support real-world field operations. After a secure, one-time registration, the surveyor is presented with an interactive map interface that includes India base maps, satellite maps, and hybrid maps, sourced from the Bhuvan platform. The app identifies the user's current GPS location and displays relevant chainage

markers within a defined buffer radius. Each marker represents a specific location where field verification is required. On reaching the location, the surveyor can geo-tag the point, capture photo. In case of poor or unavailable network connectivity, the app supports a "Send Later" feature, allowing users to store data offline securely on their device and upload it once internet access is restored. This feature is vital for ensuring uninterrupted data collection in remote or rural regions where network coverage may be unreliable.

Once the user successfully submits the data, the application confirms submission with an on-screen message: "Geo-tag data sent successfully." All submitted data, including photos, coordinates, and green cover rating, are automatically uploaded to the NRSC central server and made available for visualization on the Bhuvan Web GIS Portal. This enables project administrators, analysts, and government stakeholders to monitor survey progress, verify green cover indices, and take necessary interventions based on ground realities.

Key features of the app include:

- User Registration: One-time simple registration process where users select State, RO, and PIU from dropdowns fetched via backend services.
- Field Data Collection: Fetches UPC, chainage, and geo-tag co-ordinates dynamically from backend services. Supports geo-tagging, location capture, photo capture, and geo-fencing for accurate data entry.
- Map Visualization: Displays NDVI/FCC layers, chainage points, and user's current location on the map. Includes zoom-to-feature and filtering options for quick navigation to specific areas.
- Data Submission: Allows users to save data offline and send it when connectivity is available. Ensures reliable syncing of collected data to the central server.
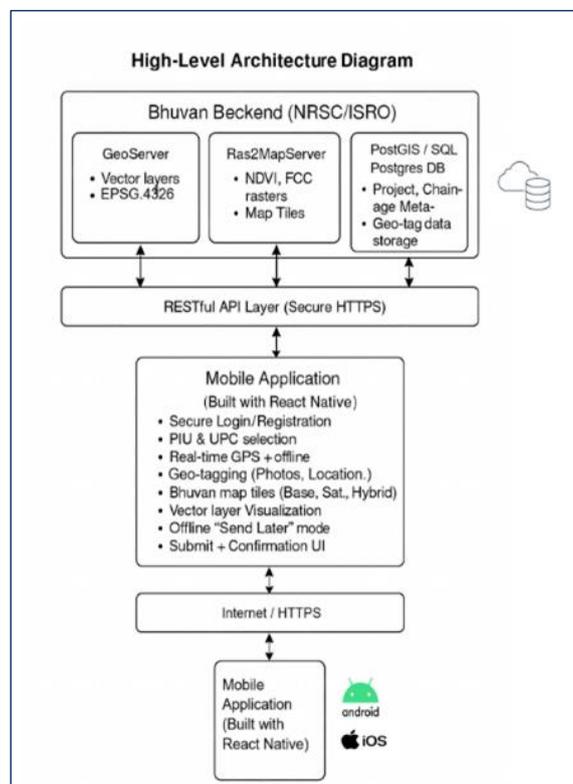
Figure 23 High Level Architecture diagram of Bhuvan NHAI Mobile App
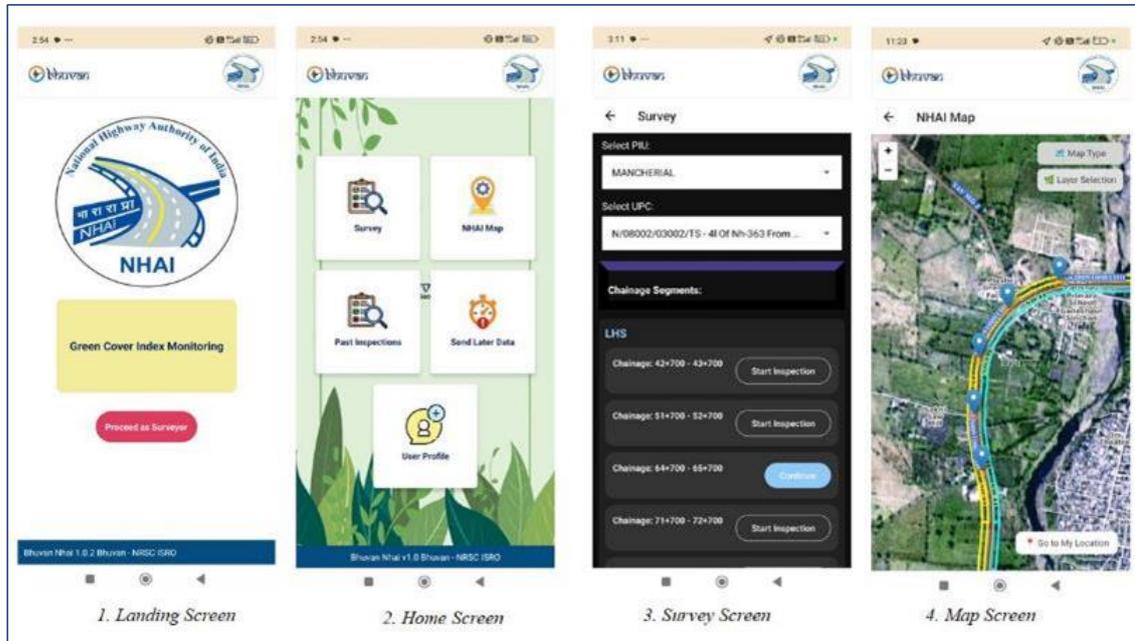
Figure 24 Sample Screenshots of Bhuvan NHAI Mobile Application
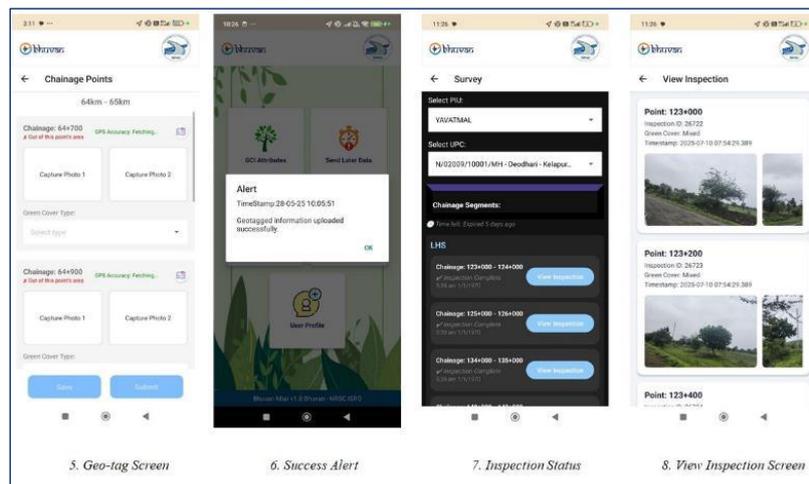
Figure 25   Sample Screenshots of Bhuvan NHAI Mobile Application

4 Results and Discussions

4.1 Results of Pilot Study Phase-1

For Punjab and Rajasthan two sets of GCI products have been generated, first set using First Half of 2022 (Jan to Jun2022) and second set using First half of 2023 (Jan to Jun2023) and Odisha using First Half of 2023 LISS-IV data sets. Phase1 products have been delivered to NHAI for Ground Truth validation.

The Punjab region, spanning 102 km, is divided into 1-kilometer segments, totalling 102 chips. Mean NDVI and GCI values are computed for each chip and depicted on a graph, with Mean NDVI represented by blue lines and GCI by red lines. Satellite imagery showcases NDVI chips for Chip 98 and Chip 102, with Mean NDVI and GCI values of 0.29 and 71% for Chip 98, and 0.17 and 35% for Chip 102, respectively. GCI values provide clear insight into the percentage of Green Coverage within each chip, while Mean NDVI indicates vegetation health and species type present in each 1km stretch.
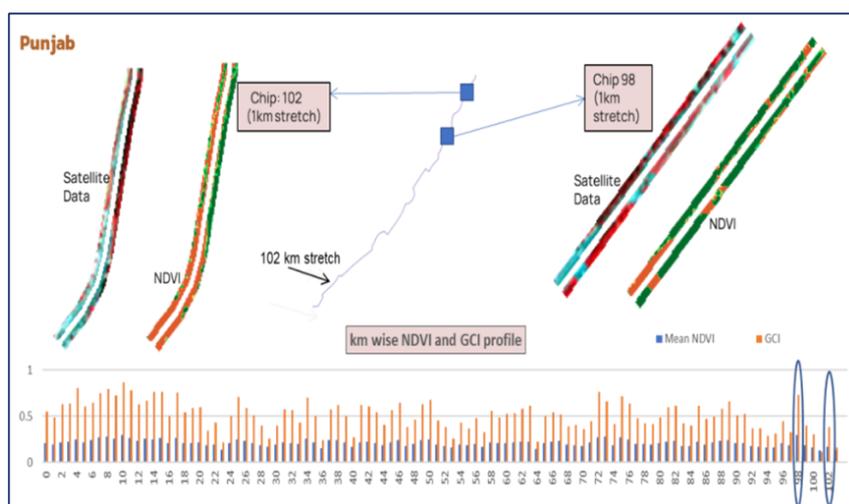
Figure 26 GCI of 2 Chips of Punjab region and details

Table 12 Mean NDVI and GCI values

Chip No.	NDVI ranges – corresponding area (sqm) in 1km chip			Total area (LHS + RHS)	Mean NDVI	GCI
	<0.27	**0.27-0.32**	**>0.32**			
Chip 98	17700	5900	26375	49975	0.29	71%
Chip 102	37850	6575	5525	49950	0.17	35%

4.2 Results of Phase 2

An analysis was carried out for the state of Telangana on six National Highways, covering 17 UPCs with a total length of 1120.84 km, using LISS-IV data from the first half of 2023 (January to June). The Green Cover Index (GCI) was generated accordingly. The result for one of the UPCs (N0800206003) is shown in Figure 28, with a graph illustrating the GCI values kilometre-wise, separately for the left-hand side (LHS) and right-hand side (RHS) of the UPC.

The list of UPCs of Telangana State under case study are given in the Table 13.

Table 13 UPCs details under case study

National Highways	Unique Project Code Number	Length (km)	Start Place	End Place
NH-161	N0400511001TS	49	Mangloor	Degloor (TG-MH Border)
	N0400512001TS	46.8	Ramsanpalle	Mangloor
	N0400513002TS	40	Kandi	Ramsanpalle
NH-163	N0600301001TS	36	Ghatkesar	Raigiri
	N0600302001TS	99.1	Raigiri	Warangal
NH-365	N0800206003TS	33	Mallampalle	Budharaopet
NH-365BB	N0501101001TS	58.62	Suryapet	Khammam
NH-65	N0400714001TS	182	Malkapur	Nandigam
NH-765	N0905501001TS	85.8	Mankhal	Dindi
NH-44	N0200914001TS	55	Ichoda	Pimpalkhuti (TG-MH Border)
	N0200915001TS	53	Nirmal	Ichoda
	N0200916001TS	30.9	Armur	Nirmal

	N0200917001TS	60	Kamareddy	Armur
	N0200918001TS	103	Medchal	Kamareddy
	N0201001001TS	58	Kothur	Jadcherla
	N0201002001TS	56	Jadcherla	Kothakota
	N0201003001TS	74.62	Kothakota	Kurnool

Length = 33kms	N0800206003TS - NH 365
GCI (%): LHS: 64.66; RHS: 56.64	Mallampalle - Budharaopet
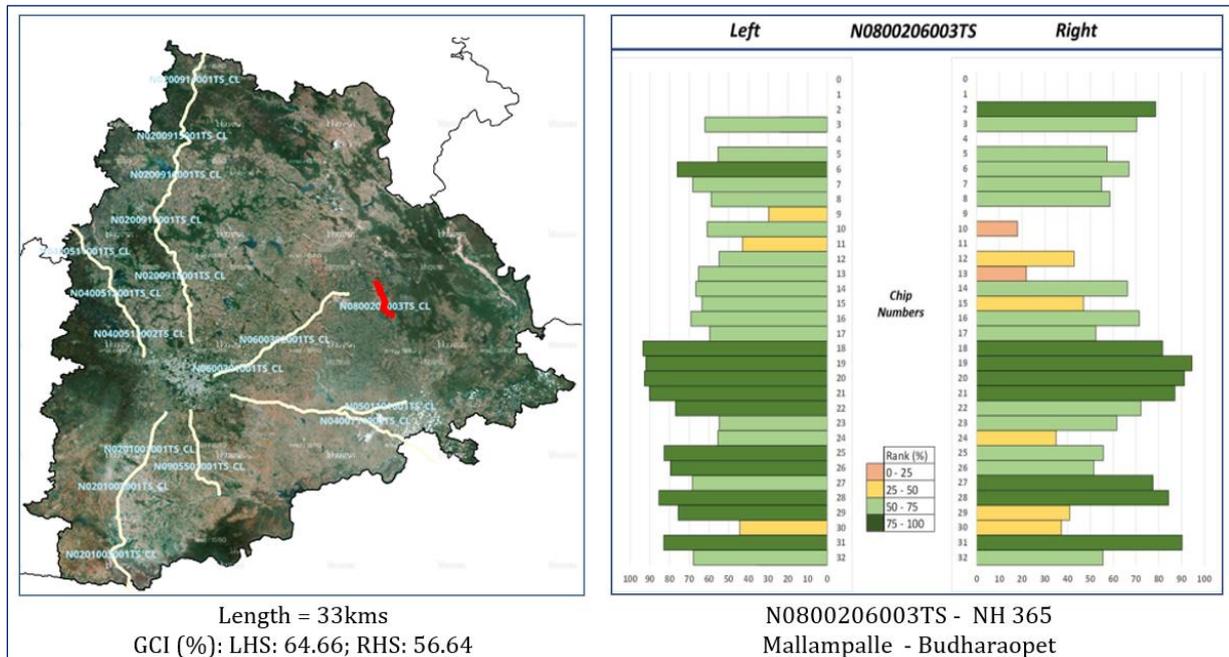
Figure 27 NH over Telangana (left), km-wise GCI graph of a UPC for Jan-Jun 2023 (right)

4.3 Cross-Verification with High Resolution Data

To validate the reliability of NDVI values derived from Resourcesat-2/2A LISS-IV (L4Mx) imagery, a rigorous cross-verification was conducted using high-resolution Cartosat-2S (C2S) datasets, which offer a spatial resolution of 0.6 m and contain significantly fewer mixed pixels. This comparison helped assess the accuracy of green cover estimation over 1 km segments of National Highways.

NDVI values from L4Mx (lower-resolution) imagery were compared with those derived from C2S (higher-resolution) data after appropriate pre-processing. To align both datasets, **normalization techniques** were applied. Specifically, to avoid duplication during up-sampling, the C2S data were **down-sampled** to match the spatial resolution of the L4Mx data.

Aligning NDVI Thresholds Between LR and HR

To normalize high-resolution NDVI values for compatibility with lower-resolution NDVI values, **gain** and **offset** parameters were computed based on the mean and standard deviation of both datasets, as shown below:

$$\text{gain} = (\text{LR\_StdDev}) / (\text{HR\_StdDev})$$

$$\text{offset} = \text{LR\_Mean} - (\text{gain} * \text{HR\_Mean})$$

Using these parameters, the normalized Cartosat-2S NDVI values were brought in line with the L4Mx NDVI scale. This enabled direct comparison of NDVI values for the same location, acquired

on near-identical dates. The comparative analysis revealed **high correlation** between the two sources, thus supporting the robustness of the GCI estimation methodology.

Example:

The table below shows the statistical comparison of NDVI values for a selected chip (Chip 48):

Table 14 Chip 48 Mean NDVI and GCI values of L4Mx and Normalized C2S

Chip	Sensor	R-1 <=0.27	R-2 0.27-0.32	R-3 >0.32	Area	Mean NDVI	GCI %	Date of Pass	Remarks
48	C2S Normalized	37466	1897	10676	50039	0.155	26.46	16-10-2022	Good Comparison
	L4Mx	46075	3225	725	50025	0.158	27.19	15-04-2022	

The histograms in Figure 28 illustrate the distribution of NDVI values before and after normalization of the C2S data, using the computed gain (0.8562) and offset (0.1654). A visual comparison of the same 1 km stretch from both sensors is presented in Figure 29, showing the FCC (False Colour Composite) and pseudo-coloured NDVI outputs from Resourcesat-2A LISS-IV (left) and Cartosat-2S Mx (right).

These results demonstrate strong agreement between normalized high-resolution and standard-resolution NDVI values, validating the efficacy of the proposed methodology for estimating green cover along National Highways.
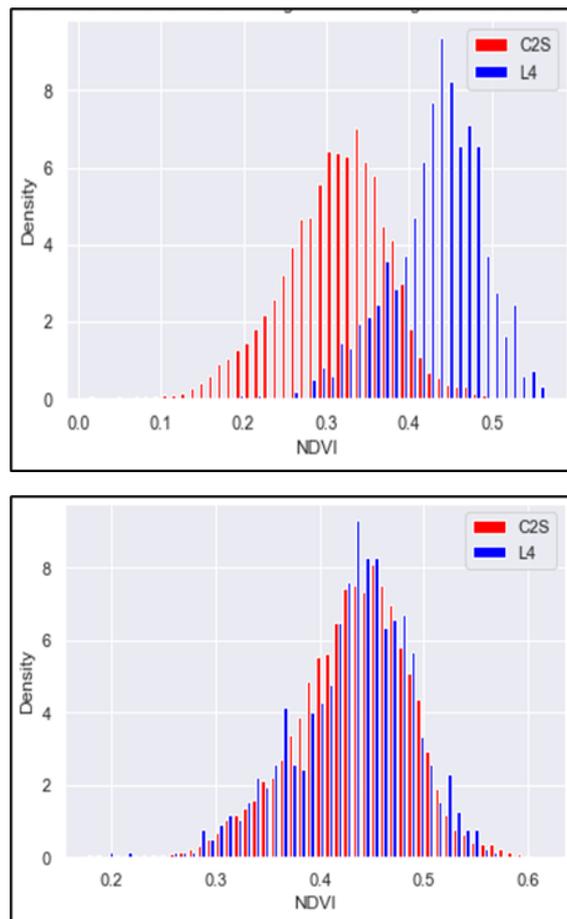
Figure 28 Histograms before and after Normalizing C2S with Gain=0.856 Offset = 0.165
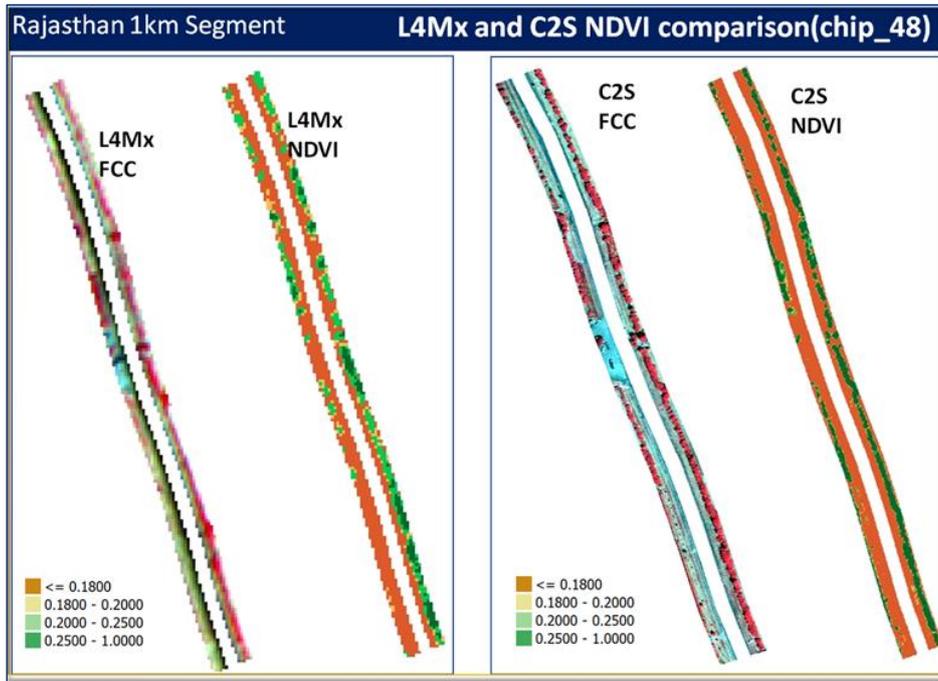
Figure 29 FCC, pseudo colour NDVI, Resourcesat-2A LISS-IV (left), Cartosat-2S Mx data (right)

4.4 Ground Truth Validation of Project under PoC

The NHAI team conducted thorough ground truth validation of the GCI products covering parts of NH-14 (Beawar–Pali–Pindwara, Rajasthan) and NH-54 (Pathankot–Amritsar, Punjab) during Phase 1 for two periods: the first half of 2022 and 2023. This validation aimed to assess the accuracy and reliability of the applied procedures and metrics. The GCI products showed good correspondence with the actual vegetation observed on the ground. Ground truth images are provided in the subsequent subsections.

4.4.1 Observations of Beawar-Pali-Pindwara, Rajasthan (NH-14) Validation

Good correlation is observed between the Green Cover Index values provided by NRSC and plantations observed during the Ground Truth validations along the Beawar-Pali-Pindwara, Rajasthan (NH-14) ROW.

Figure 30 GCI values correspond with LHS plantations at Chainage 161+200 to 161+300

33
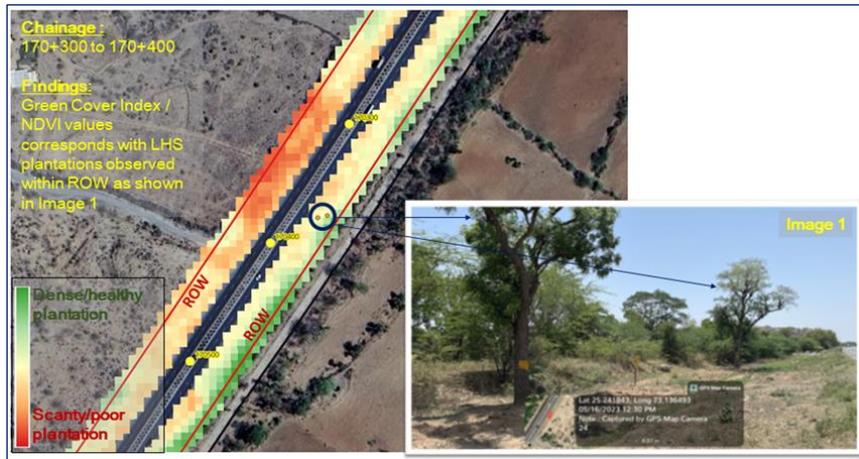
Figure 31 GCI values findings match with LHS plantations at Chainage 170+300 to 170+400

4.4.2 Observations of Pathankot-Amritsar, Punjab (NH-54) Validations

Figure 32 71% GCI indicates accurate green cover at Chainage 88+200 to 88+800
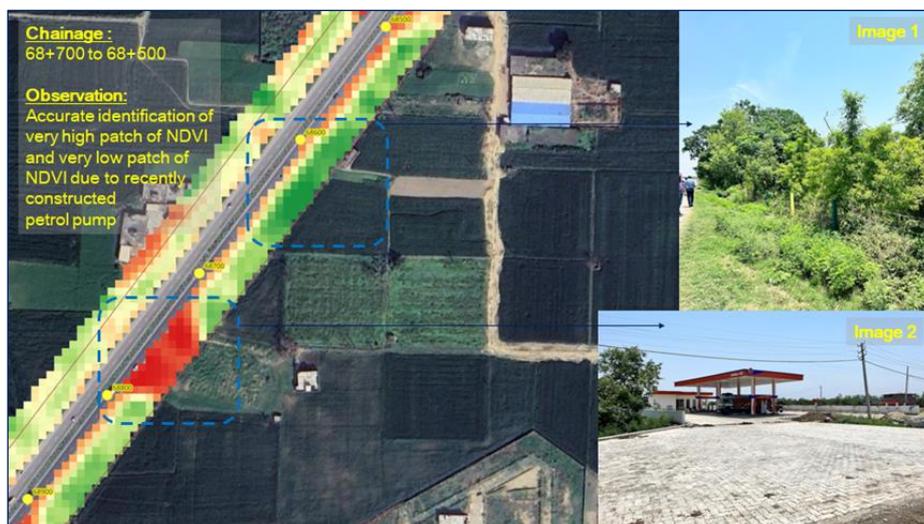
Figure 33 Low NDVI due to a petrol pump, high NDVI nearby at Chainage 68+700 to 68+500

4.5 NH wise GCI Results

One of the main rationales behind the NH-GCI project has been to identify the status of green cover across the various NHs spread across the country. The following table lists all the NHs (numbered sequentially) with their GCI values reported as well as their state-wise break downs.

Table 15 NW wise GCI Values

National Highway	No. of Projects (UPCs)	Length (km)	GCI (NH)	States Covered	No. of Projects (UPCs) in States	State-wise length (km)	% Length in State	GCI (Of NH within State)
3	5	207.79	31.58	Himachal Pradesh	3	102.71	49.43	13.54
				Punjab	2	105.08	50.57	38.17
5	7	312.27	37.55	Haryana	1	27.53	8.82	54.33
				Punjab	6	284.74	91.18	35.37
6	1	61.72	38.38	Meghalaya	1	61.72	100	38.38
7	8	333.91	37.14	Haryana	1	19.12	5.73	65.28
				Punjab	7	314.79	94.27	34.6
7, SH-10	1	37.89	31.46	Punjab	1	37.89	100	31.46
9	7	426.27	41.84	Delhi	1	8.72	2.05	9.7
				Haryana	3	307.23	72.07	45.32
				Punjab	1	22.5	5.28	32.82
				Uttarakhand	2	87.82	20.6	37.5
9, 530, 30	1	121.03	26.62	Uttar Pradesh	1	121.03	100	26.62
11	4	366.79	42.32	Haryana	2	45.34	12.36	31.79
				Rajasthan	2	321.45	87.64	44.27
11/148B	2	86.07	33.4	Haryana	2	86.07	100	33.4
12	1	6.09	26.85	West Bengal	1	6.09	100	26.85
16	22	1462.37	39.21	Andhra Pradesh	13	876.17	59.91	37.64
				Odisha	6	345.12	23.6	29.34
				Tamil Nadu	1	10.4	0.71	11.27
				West Bengal	2	230.68	15.77	55.11
19	10	740.63	28.87	Delhi	1	4.58	0.62	16.97
				Jharkhand	2	81.21	10.96	35.12
				Uttar Pradesh	4	514.66	69.49	29.7
				West Bengal	3	140.18	18.93	26.4
20	2	88.59	29.93	Bihar	1	47.23	53.31	32.64
				Jharkhand	1	41.36	46.69	27.73
21	3	210.84	41.49	Rajasthan	3	210.84	100	41.49
23	1	101.03	50.01	Rajasthan	1	101.03	100	50.01
23 & 148	1	83.16	36.86	Rajasthan	1	83.16	100	36.86
24	2	82.24	22.41	Uttar Pradesh	2	82.24	100	22.41
25	3	269.59	46.64	Rajasthan	3	269.59	100	46.64
25, 162, 62	1	244.8	41.53	Rajasthan	1	244.8	100	41.53
27	32	2472.77	42.26	Assam	7	301.99	12.21	53.16
				Bihar	6	480.43	19.43	38.32
				Gujarat	7	744.43	30.11	39.71

National Highway	No. of Projects (UPCs)	Length (km)	GCI (NH)	States Covered	No. of Projects (UPCs) in States	State-wise length (km)	% Length in State	GCI (Of NH within State)
				Rajasthan	4	411.64	16.65	45.39
				Uttar Pradesh	6	497.41	20.12	40.04
				West Bengal	2	36.87	1.49	21.46
28	2	119.02	25.66	Uttar Pradesh	2	119.02	100	25.66
30	7	387.43	38.18	Madhya Pradesh	5	306.97	79.23	39.05
				Uttar Pradesh	2	80.46	20.77	34.21
31	5	294.42	38.48	Bihar	2	110.85	37.65	42.32
				Uttar Pradesh	3	183.57	62.35	33.95
33	2	114.96	41.62	Bihar	2	114.96	100	41.62
34	5	391.31	34.92	Madhya Pradesh	1	80.87	20.67	31.19
				Uttar Pradesh	4	310.44	79.33	36.43
34 & 334	1	39.2	26.62	Uttarakhand	1	39.2	100	26.62
35	1	33.97	35.81	Uttar Pradesh	1	33.97	100	35.81
35, 135	1	47.59	44.43	Uttar Pradesh	1	47.59	100	44.43
36	2	132.85	31.11	Tamil Nadu	2	132.85	100	31.11
38	2	218.64	42	Tamil Nadu	2	218.64	100	42
39	2	71.88	35.28	Madhya Pradesh	2	71.88	100	35.28
41	2	128.07	21.3	Gujarat	2	128.07	100	21.3
43	3	138.07	38.7	Jharkhand	3	138.07	100	38.7
44	48	2785.01	43.26	Andhra Pradesh	1	251.16	9.02	42.02
				Haryana	2	81.24	2.92	26.17
				Jammu and Kashmir	5	185.04	6.64	32.11
				Karnataka	2	96.06	3.45	37.46
				Madhya Pradesh	7	318.2	11.43	43.89
				Maharashtra	9	260.82	9.37	55.02
				Punjab	2	416.44	14.95	35.03
				Tamil Nadu	9	572.01	20.54	52.49
				Telangana	8	472.29	16.96	39.88
				Uttar Pradesh	3	131.75	4.73	45.61
45	2	90.92	47.67	Madhya Pradesh	1	52.45	57.69	52.45
				Tamil Nadu	1	38.47	42.31	36.41
46	4	310.03	45.46	Madhya Pradesh	4	310.03	100	45.46
47	5	339.77	47.05	Gujarat	2	205.31	60.43	53
				Madhya Pradesh	1	30.59	9	42.02
				Tamil Nadu	2	103.87	30.57	35.78
48	21	1799.27	31.06	Gujarat	4	281.83	15.66	36.27
				Karnataka	7	520.8	28.95	28.93
				Maharashtra	2	147.07	8.17	23.63
				Rajasthan	7	701.03	38.96	33.02
				Tamil Nadu	1	148.54	8.26	16.37
49	4	350.57	32.51	Odisha	3	294.92	84.13	27.65
				West Bengal	1	55.65	15.87	42.41

National Highway	No. of Projects (UPCs)	Length (km)	GCI (NH)	States Covered	No. of Projects (UPCs) in States	State-wise length (km)	% Length in State	GCI (Of NH within State)
50	1	98.47	48	Karnataka	1	98.47	100	48
51	5	333.46	48.89	Gujarat	5	333.46	100	48.89
52	13	1033.6	39.88	Madhya Pradesh	3	302.41	29.26	42.35
				Maharashtra	3	235.35	22.77	42.83
				Punjab	1	57	5.51	37.68
				Rajasthan	6	438.84	42.46	36.23
52 & 58	1	154.57	30.1	Rajasthan	1	154.57	100	30.1
53	6	514.28	31.99	Chhattisgarh	4	294.89	57.34	27.61
				Gujarat	1	131.39	25.55	46.1
				Odisha	1	88	17.11	27.5
54	5	312.68	43.21	Haryana	1	34.8	11.13	31.32
				Punjab	4	277.88	88.87	44.57
56	1	85.34	42.04	Rajasthan	1	85.34	100	42.04
58	2	199	40.22	Rajasthan	2	199	100	40.22
60	1	119.72	47.96	Maharashtra	1	119.72	100	47.96
60 & 160	1	59.95	35.85	Maharashtra	1	59.95	100	35.85
61	3	162.16	46.55	Maharashtra	3	162.16	100	46.55
64	1	103.74	37.98	Gujarat	1	103.74	100	37.98
65	3	356.764	26.45	Karnataka	1	145.03	40.65	40.78
				Maharashtra	2	211.73	59.35	21.93
66	4	125.49	49.62	Karnataka	1	89.86	71.61	54.42
				Kerala	3	35.63	28.39	31.94
67	1	97.84	42.14	Andhra Pradesh	1	97.84	100	42.14
68	1	38.06	50.35	Rajasthan	1	38.06	100	50.35
69	2	96.51	37.66	Andhra Pradesh	1	48.04	49.78	61.88
				Karnataka	1	48.47	50.22	21.22
70	1	273.55	49.41	Rajasthan	1	273.55	100	49.41
73	2	109.57	30.41	Karnataka	2	109.57	100	30.41
75	1	76.52	37.19	Karnataka	1	76.52	100	37.19
81	1	31.54	29.81	Tamil Nadu	1	31.54	100	29.81
83	2	96.7	42.17	Tamil Nadu	2	96.7	100	42.17
109	1	49.81	42.17	Uttarakhand	1	49.81	100	42.17
122	1	107.33	40.21	Bihar	1	107.33	100	40.21
123	1	74.97	42.94	Rajasthan	1	74.97	100	42.94
125	1	135.92	57.4	Rajasthan	1	135.92	100	57.4
128	1	148.6	36.69	Uttar Pradesh	1	148.6	100	36.69
130	1	35.52	23.8	Chhattisgarh	1	35.52	100	23.8
131A	1	49	48.67	Bihar	1	49	100	48.67
135	1	43.59	20.15	Uttar Pradesh	1	43.59	100	20.15
135B	2	32.31	33.98	Uttar Pradesh	2	32.31	100	33.98
139	1	33.61	27.59	Jharkhand	1	33.61	100	27.59
143	1	28.97	27.72	Odisha	1	28.97	100	27.72
148	1	62.44	56.42	Rajasthan	1	62.44	100	56.42

National Highway	No. of Projects (UPCs)	Length (km)	GCI (NH)	States Covered	No. of Projects (UPCs) in States	State-wise length (km)	% Length in State	GCI (Of NH within State)
148C	1	53.82	58.71	Rajasthan	1	53.82	100	58.71
148D	2	282.93	39.14	Rajasthan	2	282.93	100	39.14
148NA	2	50.1	26.12	Haryana	2	50.1	100	26.12
149B	1	38.28	30.43	Chhattisgarh	1	38.28	100	30.43
150A	2	107.65	30.06	Karnataka	2	107.65	100	30.06
151	2	140.08	35.47	Gujarat	2	140.08	100	35.47
151A	2	122.27	48.56	Gujarat	2	122.27	100	48.56
152	2	84	29.95	Haryana	1	51.45	61.25	30.39
				Punjab	1	32.55	38.75	28.98
152 & 52	1	166.87	30.19	Haryana	1	166.87	100	30.19
152D	8	226.94	54.33	Haryana	8	226.94	100	54.33
160	3	209.61	38.79	Maharashtra	3	209.61	100	38.79
161	6	265.43	41.76	Maharashtra	3	129.51	48.79	49.88
				Telangana	3	135.92	51.21	33.78
163	2	135.07	53.2	Telangana	2	135.07	100	53.2
166	1	41.21	33.72	Maharashtra	1	41.21	100	33.72
205	2	56.95	39.85	Punjab	2	56.95	100	39.85
205 & 05	1	10.08	14.44	Punjab	1	10.08	100	14.44
248A	2	21.82	15.69	Haryana	2	21.82	100	15.69
307 & 344	1	53.09	36.61	Uttarakhand	1	53.09	100	36.61
316	3	123.54	42.58	Odisha	3	123.54	100	42.58
319	1	54.53	53.74	Bihar	1	54.53	100	53.74
319D & 31	1	32.18	74.14	Uttar Pradesh	1	32.18	100	74.14
320	1	78.02	34.42	Jharkhand	1	78.02	100	34.42
327E	1	48.98	35.83	Bihar	1	48.98	100	35.83
330A	1	61.01	17.14	Uttar Pradesh	1	61.01	100	17.14
333B	1	13.73	25.64	Bihar	1	13.73	100	25.64
334	1	37.48	40.67	Uttarakhand	1	37.48	100	40.67
334B	3	173.48	31.17	Haryana	3	173.48	100	31.17
335	1	115.97	27.04	Uttar Pradesh	1	115.97	100	27.04
344	1	51.67	42.53	Uttar Pradesh	1	51.67	100	42.53
344A	1	80.8	45.26	Punjab	1	80.8	100	45.26
344M	1	9.86	29.83	Delhi	1	9.86	100	29.83
344P	1	29.59	30.14	Delhi	1	29.59	100	30.14
347, 547	1	382.29	50.24	Madhya Pradesh	1	382.29	100	50.24
348	2	25.87	32.71	Maharashtra	2	25.87	100	32.71
348A	1	11.11	45.88	Maharashtra	1	11.11	100	45.88
352	2	154.01	36.68	Haryana	2	154.01	100	36.68
352A	1	50.5	35.35	Haryana	1	50.5	100	35.35
354	2	96.62	55.49	Punjab	2	96.62	100	55.49
361	4	273.13	57.13	Maharashtra	4	273.13	100	57.13
363	1	52.6	44.59	Telangana	1	52.6	100	44.59
365	2	81.5	56.39	Telangana	2	81.5	100	56.39

National Highway	No. of Projects (UPCs)	Length (km)	GCI (NH)	States Covered	No. of Projects (UPCs) in States	State-wise length (km)	% Length in State	GCI (Of NH within State)
365BB	1	58.63	38.18	Telangana	1	58.63	100	38.18
444A	2	31.78	63.95	Haryana	2	31.78	100	63.95
448 & 58	1	92.19	34.2	Rajasthan	1	92.19	100	34.2
458	2	182.55	40.4	Rajasthan	2	182.55	100	40.4
509	1	77.93	24.2	Uttar Pradesh	1	77.93	100	24.2
520	3	97.12	24.85	Odisha	3	97.12	100	24.85
544	2	109.33	18.79	Kerala	1	54.42	49.78	23.9
				Tamil Nadu	1	54.91	50.22	15.41
547E	1	28.89	25.91	Maharashtra	1	28.89	100	25.91
552	1	66.78	51.1	Rajasthan	1	66.78	100	51.1
565	1	66.53	52.28	Andhra Pradesh	1	66.53	100	52.28
566	1	13.07	32.35	Goa	1	13.07	100	32.35
703	1	146.05	27.93	Punjab	1	146.05	100	27.93
709	1	81.29	58	Haryana	1	81.29	100	58
709A	2	145.14	37.45	Haryana	2	145.14	100	37.45
722	1	73.54	24.22	Bihar	1	73.54	100	24.22
731	1	63.3	33.56	Uttar Pradesh	1	63.3	100	33.56
734	1	100.6	50.48	Uttarakhand	1	100.6	100	50.48
751	1	33.5	39.43	Gujarat	1	33.5	100	39.43
754K	22	618.68	44.23	Gujarat	2	62.11	10.04	44.4
				Rajasthan	20	556.57	89.96	44.22
758	2	154.78	42.99	Rajasthan	2	154.78	100	42.99
765	1	86.08	39.6	Telangana	1	86.08	100	39.6
785	1	26.11	43.62	Tamil Nadu	1	26.11	100	43.62
911	1	162.38	37.91	Rajasthan	1	162.38	100	37.91
911 & 911A	1	216.44	34.13	Rajasthan	1	216.44	100	34.13
919	1	6.1	13.11	Haryana	1	6.1	100	13.11
922	2	91.8	63.63	Bihar	2	91.8	100	63.63
925 & 925A	1	197.02	53.74	Rajasthan	1	197.02	100	53.74
927	3	146.79	40.55	Uttar Pradesh	3	146.79	100	40.55
930	1	18.24	69.76	Maharashtra	1	18.24	100	69.76
965	3	117.31	25.63	Maharashtra	3	117.31	100	25.63
965G	1	41.37	35.09	Maharashtra	1	41.37	100	35.09
966A	1	17.13	58.73	Kerala	1	17.13	100	58.73
Jodhpur Ring Road	1	74.89	33.34	Rajasthan	1	74.89	100	33.34
Lucknow Outer Ring Road	4	94.42	21.87	Uttar Pradesh	4	94.42	100	21.87
NE-1	1	93.39	67.98	Gujarat	1	93.39	100	67.98
NE-2	1	135.04	47.62	Haryana	1	135.04	100	47.62
NE-3	3	74.9	28.04	Delhi	3	74.9	100	28.04
NE-4	22	608.02	46.06	Gujarat	5	121.82	20.04	79.45
				Haryana	1	18.46	3.04	68.89
				Madhya Pradesh	9	244.54	40.22	36.32
				Rajasthan	7	223.2	36.71	38.98

National Highway	No. of Projects (UPCs)	Length (km)	GCI (NH)	States Covered	No. of Projects (UPCs) in States	State-wise length (km)	% Length in State	GCI (Of NH within State)
NE-7	3	77.09	21.9	Karnataka	3	77.09	100	21.9
Nagpur Outer Ring Road	1	33.5	55.72	Maharashtra	1	33.5	100	55.72
Ranchi Ring Road	1	26.16	46.27	Jharkhand	1	26.16	100	46.27
Shillong Bypass	1	47.94	28.81	Meghalaya	1	47.94	100	28.81

4.6 State-wise GCI Results

In the current cycle of assessment viz July-Dec 2024, 24 states have been evaluated for green cover under the NH-GCI Project. Following table shows the state-wise segregation of no. of projects evaluated; their length; and respective LHS, RHS and Avenue GCI as cumulative values.

Table 16 State-wise GCI values

State	No. of Projects (UPCs)	Length (km)	Area Analysed (sq.km)	LHS GCI	RHS GCI	Avenue GCI (LHS + RHS)
Andhra Pradesh	17	1339.74	66.58	39.34	41.1	40.23
Assam	7	301.99	17.28	53.48	52.85	53.16
Bihar	19	1192.38	57.92	44.09	41.41	42.77
Chhattisgarh	6	368.69	19.96	23.38	32.25	27.82
Delhi	7	127.65	8.9	26.01	24.61	25.37
Goa	1	13.07	0.67	32.05	32.68	32.35
Gujarat	35	2501.4	147.51	49.35	44.39	46.91
Haryana	40	1914.31	123.75	41.5	40.06	40.78
Himachal Pradesh	3	102.71	2.8	13.15	13.94	13.54
Jammu and Kashmir	5	185.04	9.84	24.57	38.19	32.11
Jharkhand	9	398.43	18.72	37.21	34.08	35.61
Karnataka	21	1369.52	85.01	31.97	33.11	32.54
Kerala	5	107.18	4.69	33.13	34.38	33.75
Madhya Pradesh	34	2100.23	124.06	41.5	41.65	41.57
Maharashtra	42	2126.554	118.18	43.93	40.6	42.28
Meghalaya	2	109.66	4.36	33.48	34.97	34.34
Odisha	17	977.67	53.66	30.18	30.32	30.25
Punjab	32	1939.37	103.69	37.98	35.99	37.01
Rajasthan	77	6069.78	321.24	40.99	40.45	40.72
Tamil Nadu	23	1434.04	70.09	43.83	40.86	42.38
Telangana	18	1022.09	62.83	45.42	41.72	43.57
Uttar Pradesh	46	2989.91	138.18	36.24	32.75	34.5
Uttarakhand	7	368	22.82	39.27	40.31	39.78
West Bengal	9	469.47	34.35	41.84	40.79	41.32

The following map shows the state-wise number of projects evaluated and the classification of projects (UPCs) based on the Avenue GCI (LHS + RHS) values into four categories (0-25%, 25-50%, 50-75%, 75-100%), with appropriate colour coding represented in the pie chart.
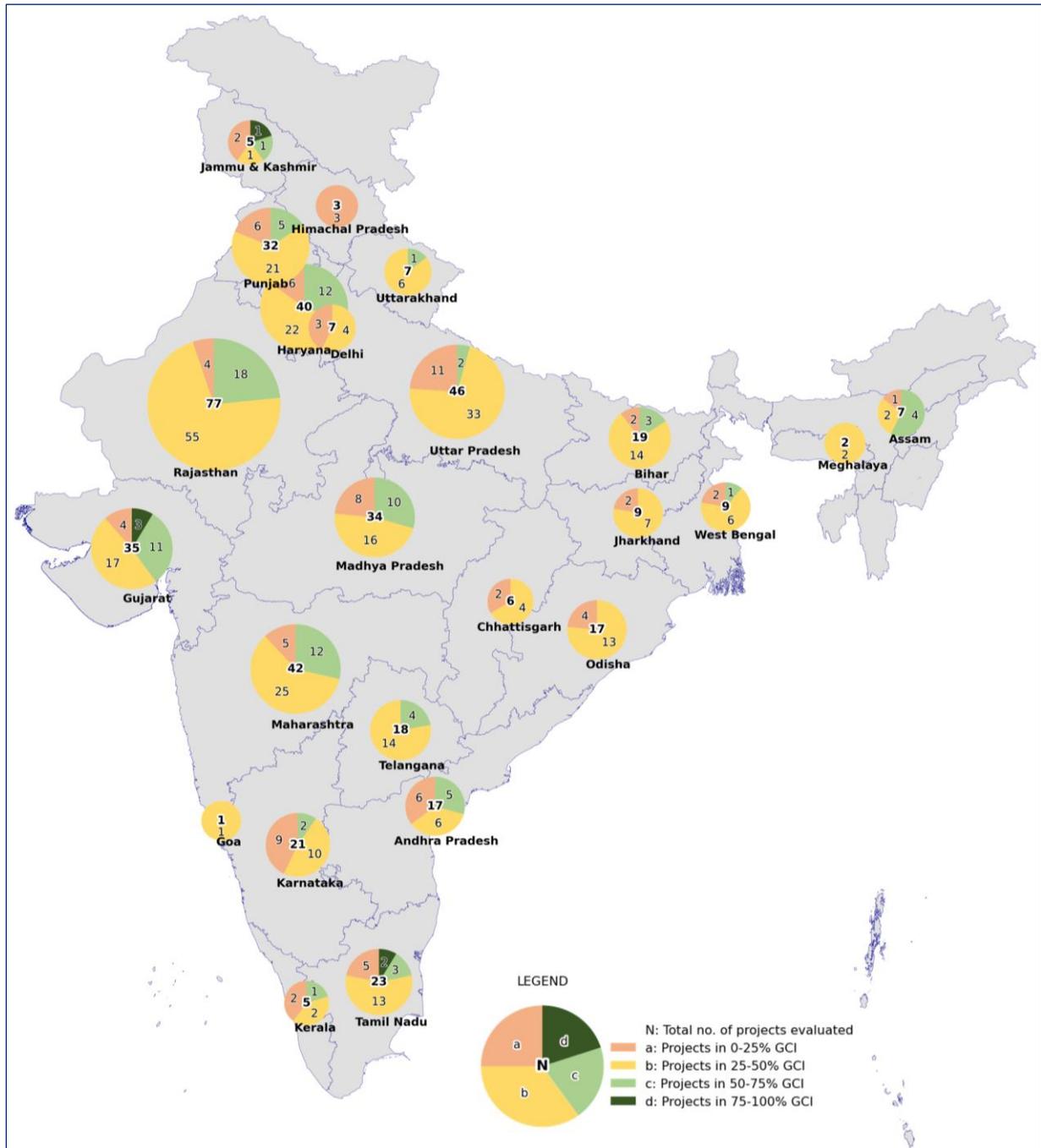
Figure 34 State-wise representation of no. of projects classified as per GCI values

4.7 Field Validation of GCI using survey Photographs

The Green Cover Index (GCI), derived from satellite datasets, was validated using field photographs collected by surveyors. For validation, an area of interest (AOI) was clipped from the GCI product (Green Colour Bounding Box) by centring on the surveyor's location (Marked with Red colour, annotated "POS") and applying a 20 m buffer on either side and covering the avenue plantation (The extreme pixels are pointed with blue colour). An example of such an extracted AOI patch is illustrated in the Figure 35. Within each extracted AOI, the surveyor's photograph was visually compared against any 3×3 pixel segment, then classified as either "Matched" or "Not Matched" depending on whether the satellite-derived GCI corresponded with the field photograph. In this example the AOI patch is highlighted with yellow box where the photograph is highly matched. Based on these assessments, the overall correlation between the GCI and field photographs was found to be high, with an agreement of approximately 90% (Annexure 3: Field Validation of GCI using survey Photographs)
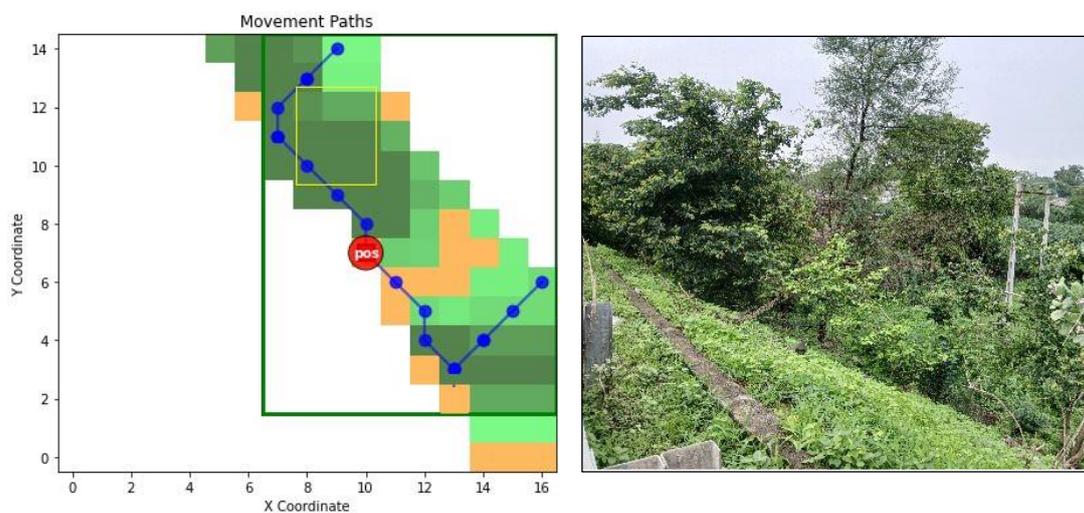
Figure 35 Field validation of GCI with reference to Surveyor field photographs

5 Limitations and Assumptions

The following are the limitations in this study.

- Since the satellite data (L4Mx) has a 5m resolution, the geometric accuracy may vary by ±5m, which can affect the GCI values.
- If the shape files of National Highways do not precisely align with satellite imagery, GCI results may be inaccurate.
- GCI cannot be generated in the following scenarios.
  - In cases where cloud persists even after compositing
  - For non-availability of satellite datasets
- GCI will not differentiate Trees and its Look-alikes (Grass, Shrubs etc.)
- Since the product grid size is provided at a 5m interval, the GCI represents only the tree crown area coverage. If the tree crown partially covers a grid, the GCI estimates the approximate percentage of green cover within that 5m grid.

The following assumptions are made during this study.

- The minimum and maximum NDVI thresholds used for vegetation classification are derived through visual interpretation of satellite imagery.

- The **maximum threshold** is identified in regions exhibiting dense or contiguous vegetation cover.
- The **minimum threshold** is determined at the transitional edges of dense vegetation areas, based on the assumption that these pixels represent a mixture of vegetation and bare soil (i.e., mixed pixels).

6 Future Scope of Work

- Automated Classification: Develop and deploy machine learning models for automated classification and threshold optimization, reducing manual intervention. Scene based green cover thresholds (Max and Min) using AIML.
- Change Detection and Alerts: Incorporate change detection algorithms for periodic alerts on vegetation loss or gain, enabling proactive planning and mitigation. Change Detection (Identifying Green Cover variations) using AIML.
- Cloud and Shadow mask for Quality layer generation.
- L4Mx Registration (Aligning with sub-pixel level using Jul_Dec2024 as reference).
- Validation Tool, thereby correcting the thresholds, to validate GCI product and validate GCI product w.r.t reference.
- Road Extraction and post processing to retrieve centre line.
- Jan-Jun2024, Jan-Jun2025 and Jul-Dec2025 GCI product Generation.
- Seasonal Monitoring: Integrate multi-seasonal satellite datasets to monitor temporal variations in vegetation and improve the accuracy of GCI assessments.
- Ground-Truth Data Integration: Establish a structured mechanism for continuous ground-truth data collection and validation to enhance model robustness.
- Carbon Sequestration Estimation: Link GCI outputs with biomass and carbon models to estimate carbon sequestration potential along green corridors.
- Policy Support: Provide scientific inputs for green cover improvement strategies, contributing to sustainable infrastructure and environmental planning.

Disclaimers

The Green Cover Index (GCI) and NDVI threshold values presented in this report are derived based on satellite data interpretation and visual analysis. The estimations may be subject to variation due to factors such as sensor resolution, geometric accuracy, seasonal conditions, and mixed-pixel effects. Iterative ground-truth validations have shown good correlation with the satellite-derived results; however, these should still be interpreted with caution for operational or decision-making purposes. Additional ground verification is recommended for critical applications.

References

1. Anatoly A. Gitelson, Yoram J. Kaufman, Robert Stark, Don Rundquist, (2002). Novel algorithms for remote estimation of vegetation fraction, Remote Sensing of Environment, Volume 80, Issue 1, Pages 76-87, ISSN 0034-4257. https://doi.org/10.1016/S0034-4257(01)00289-9.
2. Baret, F., Clevers, J. G. P. W., & Steven, M. D. (1995). The robustness of canopy gap fraction estimates from the red and near infrared reflectance: a comparison of approaches. *Remote Sensing of Environment*, *54*, 141-151. https://doi.org/10.1016/0034-4257(95)00136-O
3. Gutman, G., & Ignatov, A. (1998). The derivation of the green vegetation fraction from NOAA/AVHRR data for use in numerical weather prediction models. *International Journal of Remote Sensing*, *19*(8), 1533–1543. https://doi.org/10.1080/014311698215333

4. Kenneth McGwire, Timothy Minor, Lynn Fenstermaker, (2000). Hyperspectral Mixture Modeling for Quantifying Sparse Vegetation Cover in Arid Environments, Remote Sensing of Environment, Volume 72, Issue 3, Pages 360-374, ISSN 0034-4257. https://doi.org/10.1016/S0034-4257(99)00112-1.
5. https://www.sciencedirect.com/science/article/pii/S2212017312006196
6. https://link.springer.com/article/10.1007/s11676-020-01155-1
7. https://isprs-archives.copernicus.org/articles/XLI-B8/1061/2016/isprs-archives-XLI-B8-1061-2016.pdf

Annexures

Annexure 1: Report Template Details

1. Green Cover Index will be calculated for each UPC bi-annually for 2 years (total of 4 times).
2. This is the template proposed for capturing the UPC wise GCI statistics based on the 1km Segments. For each UPC 4 tables will be used for providing the Statistics. Table-1 for package details of UPC, Table-2 for Summary of GCI values of UPC, Table-3 Satellite Data used for analysis, Table-4 for 1km wise (Mapping with Min and Max Chainages) GCI values and their categorization.
3. R-1, R-2, R-3 indicates total area of pixels categorized based on NDVI values (e.g., R1: 0 – th_1, R2: th_1 – th_2, R3: th_2 and above; th_1 and th_2 will be derived scene-wise). Based on the ranges used for R1, R2, R3 calculation, weights will be assigned and GCI will be computed.
4. Weight assignment for GCI calculation is done such that R1 is 0, R2 is assigned linear weights from 50-100 and R3 is 100.
5. Class is based on the GCI (%) and it has four categories like Very Good, Good, Moderate, Poor.
6. Each Segment will be of 1km length, for the segment lying in the either ends, distance used may be varying (like 210+486 to 211+000 ~514 meters).
7. Satellite Data details table will comprise of all the Scenes used for analysis of each UPC.
8. For each Segment GCI will be calculated for 3 different regions Left Hand Side, Right Hand Side, Median.
9. GCI will be calculated for LHS, RHS based on the ROW provided and GCI for Median will be calculated based on the road width w.r.t. of number of lanes provided by NHAI.
10. Total area of the ROW considered for the 1km stretch will be summation of Total area (R-1 + R-2 + R-3) of LHS, RHS and Median.
11. In GCI table, summation of all Area columns provided under 3 subsections (R-1, R-2, R-3) will give fair idea of widths of the LHS, RHS and Median.
12. 'Q' column in the GCI Statistics table denotes the Quality flag based on the Cloud/Partial coverage of the Scene.
13. Q values are True/False, True indicates full coverage without any data issues. False indicates segment with partial coverage/cloud/data issues. To the extent possible, scenes without any issues will be considered for analysis. There may be issues with coverage in certain locations, in such cases this Q flag comes in to picture.
14. Q column will be marked as F is (Total Area of No Data pixels) exceeds 5% of Total Area considered for 1km stretch.

    Q will be F if Sum (No Data Area LHS+ No Data Area RHS+ No Data Area Median)/Total Area (Sum of LHS+RHS+Median Area) > 5%.

Annexure 2: State-wise GCI Results

Andhra Pradesh GCI Analysis:

For the state of Andhra Pradesh, 17 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 17.

GCI Results:

Cumulative results of Andhra Pradesh: Cumulative GCI of entire State having 17 no. of projects is 40.23 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:

Table 17 UPC wise statistics for Andhra Pradesh

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0200425001AP	RO-Vijayawada	Vijayawada	3L	16	2.47	3.03	2.93	2.98
N0200426001AP	RO-Vijayawada	Amravati (AP)	6L	16	83.11	15.42	10.24	12.86
N0200415001AP	RO-Vijayawada	Visakhapatnam	6L	16	49.26	16.51	18.72	17.63
N0200423002AP	RO-Vijayawada	Vijayawada	6L	16	27.42	20.79	19.74	20.26
N0200435001AP	RO-Vijayawada	Vijayawada	4L	16	23.51	23.65	17.08	20.39
N0200413002AP	RO-Vijayawada	Visakhapatnam	4L	16	96.7	20.24	28.48	24.35
N0200421002AP	RO-Vijayawada	Rajamahendravaram	4L	16	72.44	28.21	31.41	30.04
N0201004001AP	RO-Vijayawada	Anantapur	4L	44	251.16	41.26	42.78	42.02
N0909501002AP	RO-Vijayawada	Nellore	2L PS	67	97.84	46.38	37.91	42.14
N0200420003AP	RO-Vijayawada	Rajamahendravaram	4L	16	49.2	36.36	48.77	43.00
N0200418003AP	RO-Vijayawada	Rajamahendravaram	4L	16	88.65	35.18	53.91	43.64
N0200429002AP	RO-Vijayawada	Nellore	4L	16	111.03	45.15	50.38	47.77
N0905102001AP	RO-Vijayawada	Nellore	2L PS	565	66.53	57.03	47.43	52.28
N0200428001AP	RO-Vijayawada	Ongole	6L	16	183.43	55.51	51.78	53.50
N0200419003AP	RO-Vijayawada	Rajamahendravaram	4L	16	71.78	54.31	59.22	56.90
N0200428005AP	RO-Vijayawada	Nellore	4L	16	17.17	61.23	56.58	58.93
N0402703001AP	RO-Vijayawada	Tirupati	4L	69	48.04	62.91	60.86	61.88

Figure 36 Bar chart depicting UPC wise LHS, RHS GCI values of Andhra Pradesh
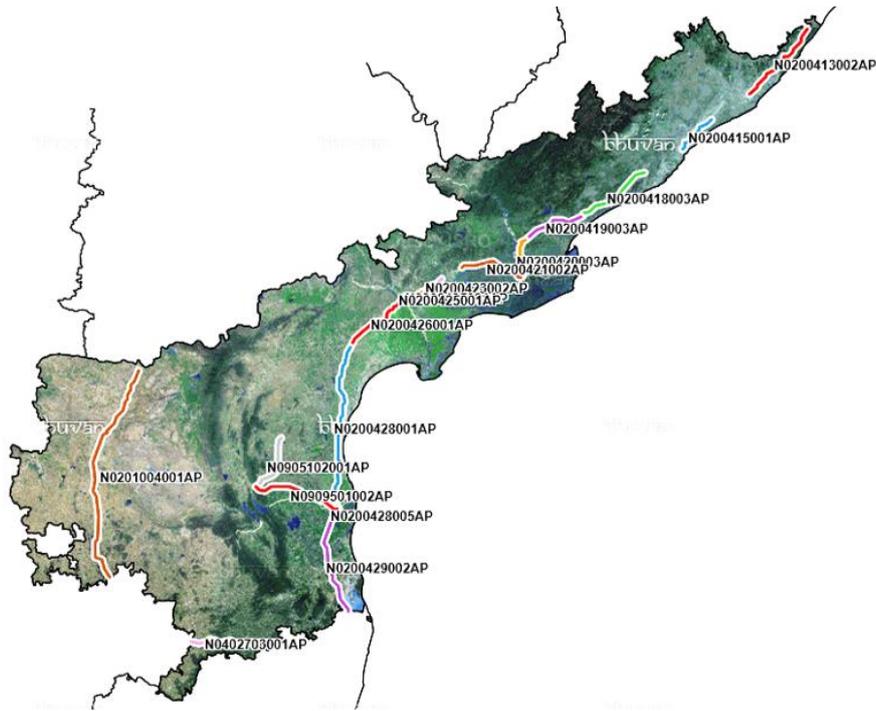
Figure 37 Satellite view of Andhra Pradesh with 17 UPCs overlaid

Table 18 Satellite data details used for GCI analysis of Andhra Pradesh

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-08-23	102	64	A
RS2/L4	2024-09-16	102	64	B
RS2/L4	2024-09-16	102	61	D
RS2/L4	2024-09-21	103	60	D
RS2/L4	2024-09-21	103	61	B
RS2/L4	2024-10-29	101	62	D
RS2/L4	2024-10-29	101	63	B
RS2/L4	2024-10-29	101	64	B
RS2/L4	2024-10-29	101	62	B
RS2/L4	2024-11-13	104	60	B
RS2/L4	2024-11-18	105	59	D
RS2/L4	2024-11-22	101	63	A
RS2/L4	2024-11-22	101	64	A
RS2/L4	2024-12-07	104	60	C
RS2/L4	2024-12-12	105	59	C
RS2/L4	2024-12-30	99	62	D
RS2/L4	2025-01-28	100	63	C
RS2A/L4	2024-08-11	102	63	A
RS2A/L4	2024-08-11	102	63	C
RS2A/L4	2024-08-11	102	62	C
RS2A/L4	2024-08-11	102	61	C
RS2A/L4	2024-10-03	103	61	A
RS2A/L4	2024-11-06	105	60	A
RS2A/L4	2024-12-23	100	62	A
RS2A/L4	2025-02-28	99	63	B
Sentinel-2A/MSI (Level-2A)	2024-12-30	119		T44PMC
Sentinel-2A/MSI (Level-2A)	2024-12-30	119		T44QMD
Sentinel-2A/MSI (Level-2A)	2024-12-30	119		T44QND

Assam GCI Analysis:

For the state of Assam, 7 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed under in Table 19.

GCI Results:

Cumulative results of Assam: Cumulative GCI of entire State having 7 no. of projects is 50.49 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
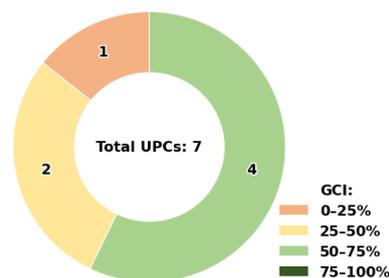
Table 19 UPC wise statistics for Assam

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0202701003AS	RO-Guwahati	Guwahati	6L	27	16.73	7.25	10.04	8.65
N0202714002AS	RO-Guwahati	Haflong	4L	27	25.75	39.30	38.94	39.12
N0202605004AS	RO-Guwahati	Bongaigaon	4L	27	53.96	47.81	44.66	46.23
N0202607004AS	RO-Guwahati	Bongaigaon	4L	27	51.99	49.44	51.40	50.42
N0202602001AS	RO-Guwahati	Bongaigaon	4L	27	29.99	51.47	54.91	53.19
N0202604003AS	RO-Guwahati	Bongaigaon	4L	27	62.41	61.91	61.09	61.50
N0202706003AS	RO-Guwahati	Haflong	4L	27	61.16	70.96	67.43	69.19
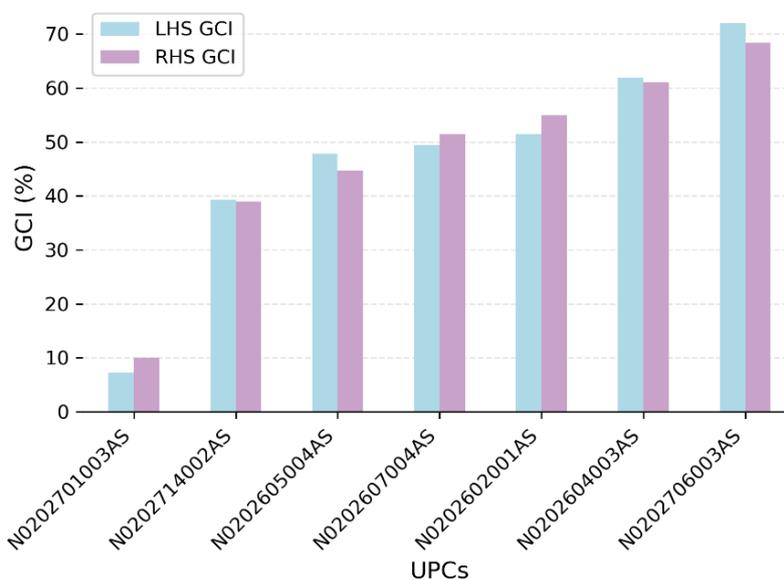
Figure 38 Bar chart depicting UPC wise LHS, RHS GCI values of Assam
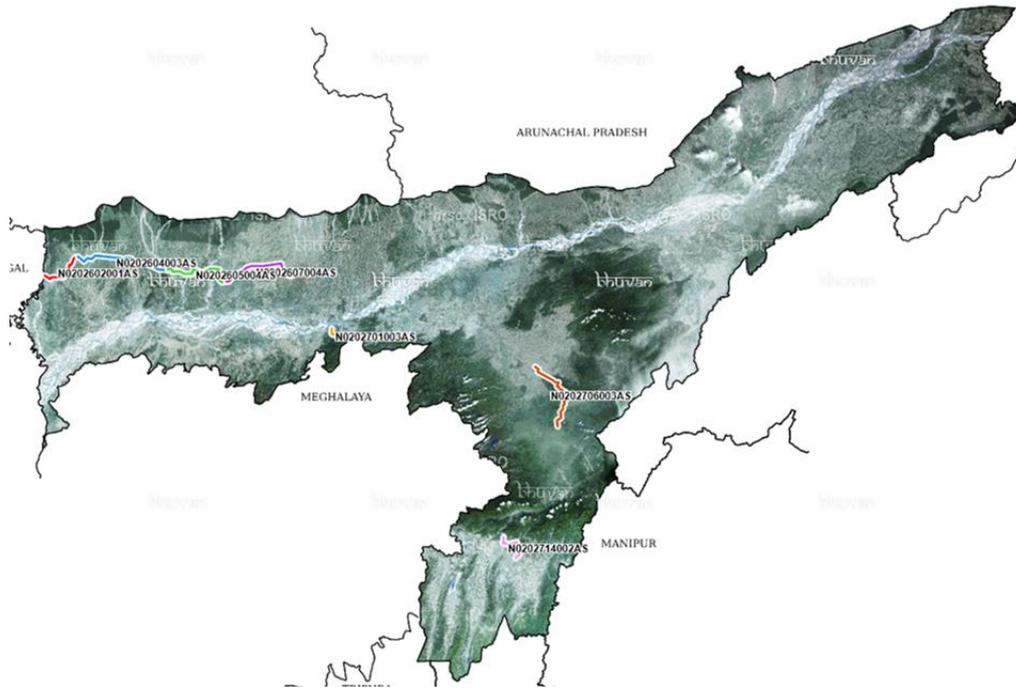
Figure 39 Satellite view of Assam with 7 UPCs overlaid

Table 20 Satellite data details used for GCI analysis of Assam

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-10-21	109	53	A
RS2A/L4	2024-11-07	110	53	A
RS2A/L4	2024-11-21	108	53	B
RS2A/L4	2024-11-26	109	53	B
Sentinel-2A/MSI (Level-2A)	2024-12-28	90		T46RDN
Sentinel-2A/MSI (Level-2A)	2024-12-28	90		T46RDP
Sentinel-2A/MSI (Level-2A)	2024-12-28	90		T46REP
Sentinel-2B/MSI (Level-2A)	2024-12-26	133		T46RCP

Bihar GCI Analysis:

For the state of Bihar, 19 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed under in Table 21.

GCI Results:

Cumulative results of Bihar: Cumulative GCI of entire State having 19 no. of projects is 42.77 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
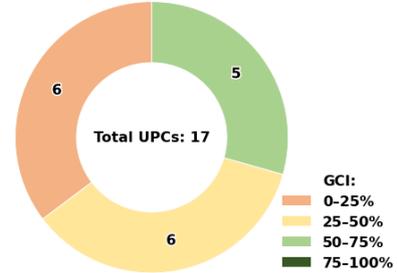
Table 21 UPC wise statistics for Bihar

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0202303001BR	RO-Patna	Purnea	2L	27	3.39	8.36	10.55	9.45
N0803401001BR	RO-Patna	Chhapra	2L PS	722	73.54	20.72	27.72	24.22
N0907701001BR	RO-Patna	Munger	2L	333B	13.73	27.40	23.90	25.64
N0802501003BR	RO-Patna	Gaya	4L	20	47.23	37.21	27.66	32.64
N0202301002BR	RO-Patna	Darbhanga	4L	27	79.69	34.55	33.13	33.84
N0301202001BR	RO-Patna	Purnea	4L	327E	48.98	40.29	30.60	35.83
N0202302002BR	RO-Patna	Darbhanga	4L	27	275.58	41.79	32.84	37.32
N0202401001BR	RO-Patna	Purnea	4L	27	36.29	43.18	33.33	38.26
N0202302001BR	RO-Patna	Darbhanga	4L	27	10.5	39.47	39.12	39.29
N0801701001BR	RO-Patna	Patna	4L	31	50.65	39.43	39.60	39.51
N0601101001BR	RO-Patna	Darbhanga	2L PS	122	107.33	42.77	37.64	40.21
N0907501001BR	RO-Patna	Gaya	2L PS	33	54.45	35.50	45.25	40.37
N0803801001BR	RO-Patna	Munger	2L	33	60.51	45.30	40.57	42.82
N0801704001BR	RO-Patna	Begusarai	4L	31	60.2	42.94	46.73	44.81
N0907601001BR	RO-Patna	Purnea	4L	131A	49.0	42.06	55.87	48.67
N0202202004BR	RO-Patna	Darbhanga	4L	27	74.98	48.86	49.35	49.11
N0505601002BR	RO-Patna	Sasaram	4L	319	54.53	57.05	50.44	53.74
N0806703001BR	RO-Patna	Patna	4L PS	922	47.62	59.00	57.15	58.09
N0806702001BR	RO-Patna	Patna	4L PS	922	44.18	71.42	67.44	69.50
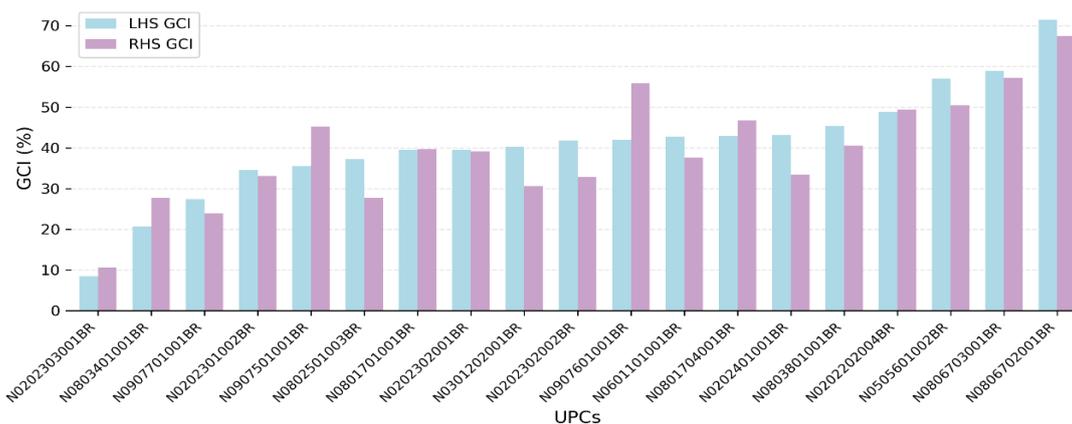
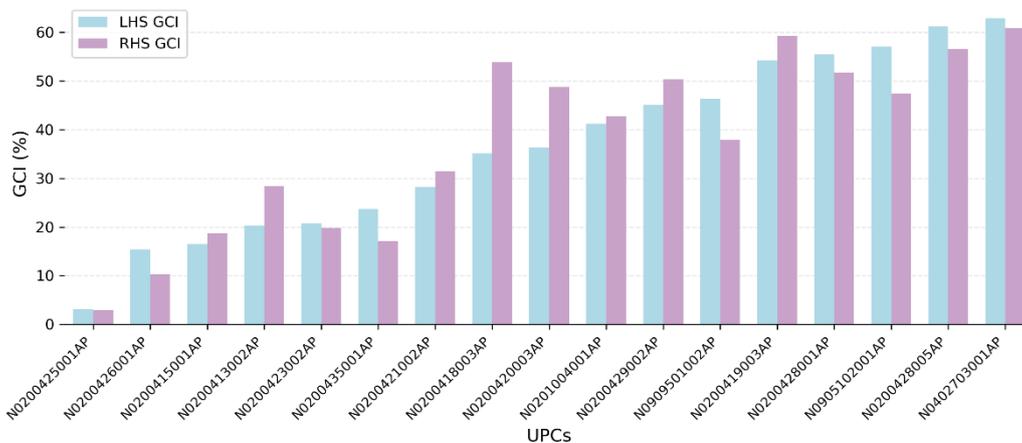*Figure 40 Bar chart depicting UPC wise LHS, RHS GCI values of Bihar*

Figure 41 Satellite view of Bihar with 19 UPCs overlaid

Table 22 Satellite data details used for GCI analysis of Bihar

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-08	103	053	B
RS2/L4	2024-11-08	103	054	B
RS2/L4	2024-11-18	105	053	B
RS2/L4	2024-11-18	105	054	B
RS2/L4	2024-11-23	106	053	C
RS2/L4	2024-11-28	107	053	C
RS2/L4	2024-11-28	107	053	A
RS2/L4	2024-12-12	105	053	C
RS2/L4	2024-12-12	105	054	C
RS2/L4	2024-12-12	105	054	A
RS2/L4	2024-12-26	103	053	D
RS2A/L4	2024-11-01	104	053	A
RS2A/L4	2024-11-01	104	053	C
RS2A/L4	2024-11-01	104	054	A
RS2A/L4	2024-11-25	104	053	B
RS2A/L4	2024-11-25	104	053	D
RS2A/L4	2024-11-25	104	054	B
RS2A/L4	2024-12-05	106	054	B
RS2A/L4	2024-12-05	106	053	D
RS2A/L4	2024-12-29	106	054	A

Chhattisgarh GCI Analysis:

For the state of Chhattisgarh, 06 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 23.

GCI Results:

Cumulative results of Chhattisgarh: Cumulative GCI of entire State having 06 no. of projects is 27.82 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
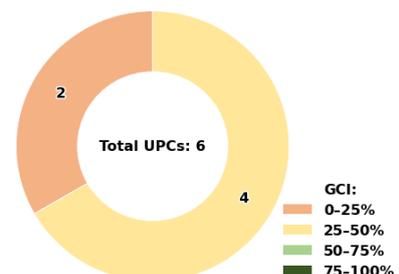
Table 23 UPC wise statistics for Chhattisgarh

| UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0400119001CG	RO-Raipur	Raipur	4L	53	43.51	11.59	19.60	15.60
N0401003001CG	RO-Raipur	Bilaspur	4L	130	35.52	22.30	25.33	23.80
N0400121001CG	RO-Raipur	Raipur-I	4L	53	150.49	23.26	30.57	26.88
N0908201001CG	RO-Raipur	Korba	4L	149B	38.28	24.97	35.57	30.43
N0400117001CG	RO-Raipur	Raipur-II	4L	53	82.6	25.96	37.86	31.99
N0400118001CG	RO-Raipur	Raipur-II	4L	53	18.29	30.52	36.82	33.64

Figure 42 Bar chart depicting UPC wise LHS, RHS GCI values of Chhattisgarh

Figure 43 Satellite view of Chhattisgarh with 6 UPCs overlaid

Table 24 Satellite data details used for GCI analysis of Chhattisgarh

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-03	102	57	D
RS2/L4	2024-11-08	103	57	D
RS2/L4	2024-11-22	101	57	C
RS2/L4	2024-11-27	102	57	C
RS2A/L4	2024-10-22	102	57	B
RS2A/L4	2024-11-20	103	57	A
RS2A/L4	2024-11-20	103	57	C
RS2A/L4	2024-11-20	103	56	C
RS2A/L4	2024-12-04	101	57	D

Delhi GCI Analysis:

For Delhi, 07 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 25.

GCI Results:

Cumulative results of Delhi: Cumulative GCI of entire State having 07 no. of projects is 25.37 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:

Total UPCs: 7
3
4
GCI:
0–25%
25–50%
50–75%
75–100%
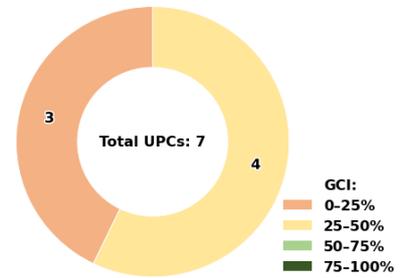
Table 25 UPC wise statistics for Delhi

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0100701001DL	RO-Delhi	Ghaziabad	6L	9	8.72	13.38	5.48	9.70
N0100702001DL	RO-Delhi	Ghaziabad	6L	NE-3	18.75	13.50	6.13	9.81
N0200501003DL	RO-Delhi	CMU Mathura	6L	19	4.58	17.40	16.53	16.97
N0200119004DL	RO-Delhi	Dwarka	6L	344M	9.86	28.94	30.72	29.83
N0200119005DL	RO-Delhi	Sonipat-DL	4L	344P	29.59	30.05	30.36	30.14
N0100704001DL	RO-Delhi	Ghaziabad	6L	NE-3	32.56	26.94	52.05	39.21
N0100703001DL	RO-Delhi	Ghaziabad	6L	NE-3	23.59	47.33	37.76	42.76
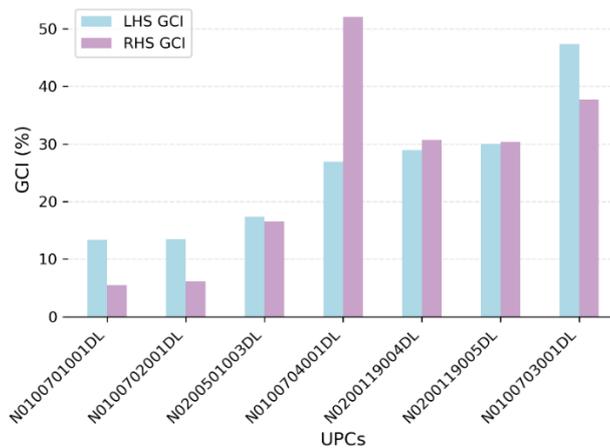
Figure 44 Bar chart depicting UPC wise LHS, RHS GCI values of Delhi
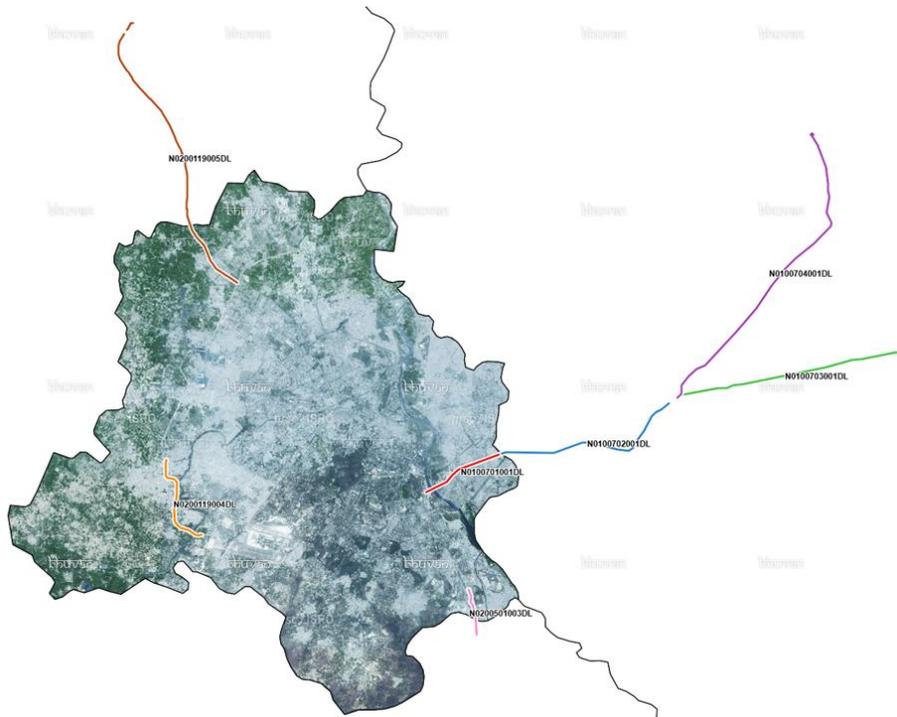
Figure 45 Satellite view of Delhi with 7 UPCs overlaid

Table 26 Satellite data details used for GCI analysis of Delhi

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-21	96	51	C
RS2/L4	2024-11-21	96	51	A
RS2/L4	2024-12-15	96	51	B

Goa GCI Analysis:

For the state of Goa, 01 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 27.

GCI Results:

Cumulative results of Goa: Cumulative GCI of entire State having 01 project is 32.35 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:

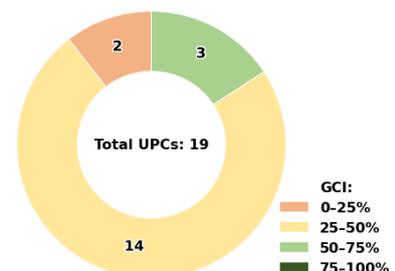*Table 27 UPC wise statistics for Goa*

| UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0400225002GA	RO-Mumbai	Goa	4L	566	13.07	32.05	32.68	32.35
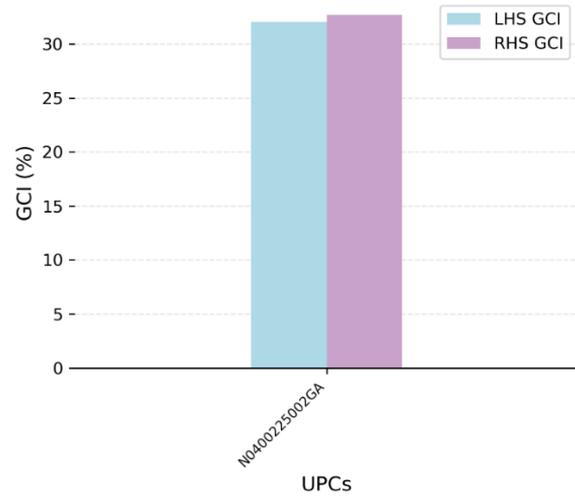
Figure 46 Bar chart depicting UPC wise LHS, RHS GCI values of Goa

Figure 47 Satellite view of Goa with 1 UPC overlaid

Table 28 Satellite data details used for GCI analysis of Goa

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-21	96	62	C

Gujarat GCI Analysis:

For the state of Gujarat, 35 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 29.

GCI Results:

Cumulative results of Gujarat: Cumulative GCI of entire State having 35 no. of projects is 46.91 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:


Total UPCs: 35

GCI:
- 0-25%
- 25-50%
- 50-75%
- 75-100%

Table 29 UPC wise statistics for Gujarat

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0400601001GJ	RO-Gandhinagar	Gandhidham	6L	41	57.08	13.51	25.66	19.68
N0201402005GJ	RO-Gandhinagar	Rajkot	4L	27	73.86	21.36	25.91	23.63
N0603501003GJ	RO-Gandhinagar	Gandhidham	4L	41	70.99	29.07	18.64	24.06
N0400313002GJ	RO-Gandhinagar	Palanpur	6L	754K	30.11	18.53	30.38	24.46
N0201502003GJ	RO-Gandhinagar	Gandhidham	4L	27	71.02	22.49	31.44	26.62
N0201503002GJ	RO-Gandhinagar	Gandhidham	4L	27	52.74	28.40	28.44	28.42
N0200116003GJ	RO-Gandhinagar	Surat	6L	48	118.35	33.01	27.49	30.25
N0200114001GJ	RO-Gandhinagar	Surat	4L/6L	48	65.69	32.66	31.41	32.05
N0806302001GJ	RO-Gandhinagar	Rajkot	4L	151	21.43	37.93	30.11	34.05
N0806301002GJ	RO-Gandhinagar	Rajkot	4L	151	118.65	41.84	31.18	36.51
N0200112001GJ	RO-Gandhinagar	Ahmedabad	6L	64	103.74	50.06	24.87	37.98
N0201601008GJ	RO-Gandhinagar	Palanpur	4L	27	261.73	43.94	33.82	38.95
N0200111001GJ	RO-Gandhinagar	Ahmedabad	6L	48	15.47	34.72	43.99	39.33
N0402604001GJ	RO-Gandhinagar	Bhavnagar	4L	751	33.5	45.36	28.32	39.43
N0800909001GJ	RO-Gandhinagar	Bhavnagar	4L PS	51	48.05	37.27	44.30	40.86
N0800901001GJ	RO-Gandhinagar	Rajkot	4L	51	111.85	54.86	33.56	44.21
N0800902001GJ	RO-Gandhinagar	Rajkot	2L PS	51	91.66	36.51	54.92	45.66
N0409901001GJ	RO-Gandhinagar	Surat	4L/6L	53	131.39	51.32	40.87	46.10
N0702401001GJ	RO-Gandhinagar	Rajkot	4L	151A	71.82	49.33	45.14	47.24
N0200113002GJ	RO-Gandhinagar	Ekta Nagar	6L	48	82.32	53.73	44.48	49.53
N0400314001GJ	RO-Gandhinagar	Rajkot	4L	151A	50.45	47.72	52.05	49.87
N0201704001GJ	RO-Gandhinagar	Palanpur	4L	27	64.47	52.91	47.16	50.01
N0201401002GJ	RO-Gandhinagar	Rajkot	4L	27	114.98	54.86	45.28	50.06
N0201601009GJ	RO-Gandhinagar	Palanpur	4L PS	27	105.63	48.81	50.98	50.07
N0400603001GJ	RO-Gandhinagar	Ahmedabad	4L	47	118.22	52.61	47.90	50.26
N0100105005GJ	RO-Gandhinagar	Godhra	8L	NE-4	22.09	43.80	62.95	52.81
N0400604001GJ	RO-Gandhinagar	Godhra	4L	47	87.09	58.82	54.42	56.72
N0800905001GJ	RO-Gandhinagar	Bhavnagar	4L PS	51	41.95	61.09	53.07	57.08
N0800906001GJ	RO-Gandhinagar	Bhavnagar	4L PS	51	39.95	59.61	61.23	60.42
N0400313003GJ	RO-Gandhinagar	Palanpur	6L	754K	32.0	64.45	61.83	63.16
N0100201001GJ	RO-Gandhinagar	Ahmedabad	4L	NE-1	93.39	75.96	60.07	67.98
N0100109001GJ	RO-Gandhinagar	Surat	8L	NE-4	13.01	71.98	76.16	74.06
N0100106001GJ	RO-Gandhinagar	Godhra	8L	NE-4	23.72	76.32	78.54	77.47
N0100108001GJ	RO-Gandhinagar	Godhra	8L	NE-4	31.0	95.21	96.49	95.85
N0100107001GJ	RO-Gandhinagar	Godhra	8L	NE-4	32.0	96.48	96.63	96.56
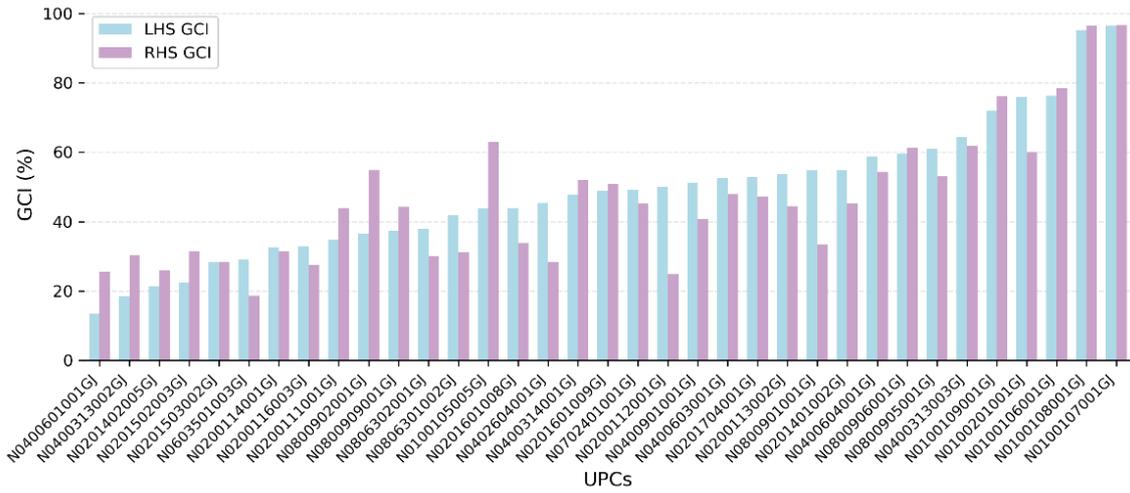
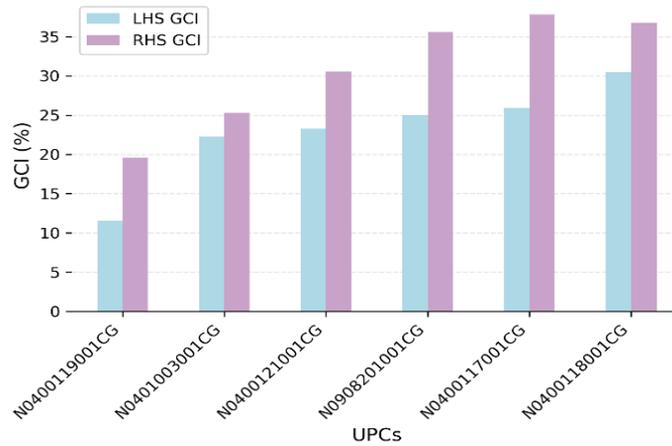*Figure 48 Bar chart depicting UPC wise LHS, RHS GCI values of Gujarat*

Figure 49 Satellite view of Gujarat with 35 UPCs overlaid

Table 30 Satellite data details used for GCI analysis of Gujarat

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-15	90	57	B
RS2/L4	2024-11-15	90	56	D
RS2/L4	2024-11-15	90	56	B
RS2/L4	2024-12-10	95	56	A
RS2A/L4	2024-10-25	93	54	C
RS2A/L4	2024-10-25	93	57	C
RS2A/L4	2024-10-25	93	56	A
RS2A/L4	2024-10-25	93	57	A
RS2A/L4	2024-10-25	93	55	A
RS2A/L4	2024-11-03	90	56	C

RS2A/L4	2024-11-03	90	57	A
RS2A/L4	2024-11-08	91	55	C
RS2A/L4	2024-11-08	91	56	A
RS2A/L4	2024-11-08	91	57	C
RS2A/L4	2024-11-08	91	56	C
RS2A/L4	2024-11-08	91	57	A
RS2A/L4	2024-11-13	92	54	C
RS2A/L4	2024-11-13	92	55	A
RS2A/L4	2024-11-13	92	55	C
RS2A/L4	2024-11-13	92	56	C
RS2A/L4	2024-11-23	94	56	B
RS2A/L4	2024-11-23	94	57	D
RS2A/L4	2024-12-02	91	56	B
RS2A/L4	2024-12-02	91	57	B
RS2A/L4	2024-12-02	91	57	D
RS2A/L4	2024-12-02	91	55	D
RS2A/L4	2024-12-02	91	56	D
RS2A/L4	2024-12-07	92	57	D
RS2A/L4	2024-12-07	92	55	B
RS2A/L4	2024-12-12	93	56	D
RS2A/L4	2024-12-12	93	57	B
RS2A/L4	2024-12-12	93	57	D
RS2A/L4	2024-12-12	93	56	B
RS2A/L4	2024-12-17	94	58	A
RS2A/L4	2024-12-17	94	57	A
RS2A/L4	2024-12-17	94	56	A
RS2A/L4	2024-12-17	94	58	C
RS2A/L4	2024-12-17	94	57	C
RS2A/L4	2024-12-17	94	56	C
RS2A/L4	2024-12-31	92	58	A

Haryana GCI Analysis:

For the state of Haryana, 40 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 31.

GCI Results:

Cumulative results of Haryana: Cumulative GCI of entire State having 40 no. of projects is 40.78 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
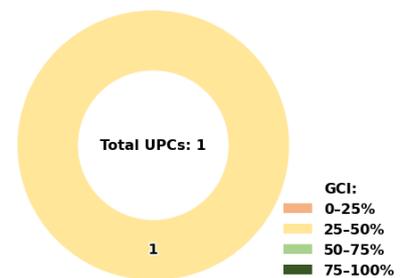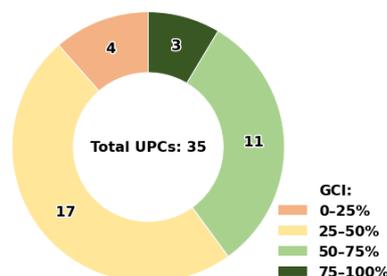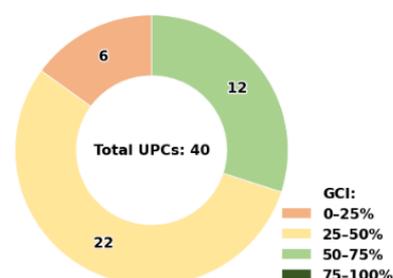

Table 31 UPC wise statistics for Haryana

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0300301001HR	RO-Delhi	Rewari	6L	248A	8.94	7.10	13.75	10.74
N0807403002HR	RO-Delhi	Rewari	4L	919	6.1	10.27	15.92	13.11
N0805801001HR	RO-Chandigarh (HR)	Sonipat-CHD-HR	4L	334B	40.23	15.25	13.00	14.13
N0300201003HR	RO-Delhi	CMU Mathura	6L	148NA	24.04	16.67	15.70	16.19
N0300302001HR	RO-Delhi	Rewari	6L	248A	12.88	14.07	21.41	17.79
N0200709001HR	RO-Chandigarh (HR)	Ambala	6L	44	10.0	19.27	19.39	19.33
N0800403001HR	RO-Chandigarh (HR)	Hissar	4L PS	152 & 52	166.87	30.87	29.49	30.19

| N0800401002HR	RO-Chandigarh (HR)	Ambala	4L	152	51.45	27.43	33.36	30.39
N0200710001HR	RO-Chandigarh (HR)	Sonipat-CHD-HR	8L	44	71.24	29.74	31.68	30.71
N0500601003HR	RO-Delhi	Rewari	4L	11	30.45	21.50	42.47	30.82
N0400309001HR	RO-Chandigarh (HR)	Hissar	6L	54	34.8	29.75	32.91	31.32
N0500601001HR	RO-Delhi	Rewari	4L/6L	11/148B	45.21	33.72	30.48	32.09
N0500601004HR	RO-Delhi	Rewari	4L	11	14.89	30.16	36.81	33.54
N0500601002HR	RO-Delhi	Rewari	4L/6L	11/148B	40.86	32.70	36.20	34.47
N0300201004HR	RO-Delhi	CMU Mathura	6L	148NA	26.06	39.45	29.63	34.55
N0300805001HR	RO-Chandigarh (HR)	Sonipat-CHD-HR	2L PS	352A	50.5	29.35	41.35	35.35
N0805402001HR	RO-Chandigarh (HR)	Bhiwani-CHD-HR	2L PS	709A	85.3	33.70	38.07	35.88
N0300804001HR	RO-Chandigarh (HR)	Hissar	4L PS	352	69.75	35.67	37.46	36.57
N0502102001HR	RO-Chandigarh (HR)	Sonipat-CHD-HR	4L	352	84.26	37.62	36.46	37.04
N0805803001HR	RO-Chandigarh (HR)	Bhiwani-CHD-HR	2L PS	334B	97.74	31.73	44.70	38.23
N0300901005HR	RO-Delhi	Bhiwani-DL	6L	152D	28.0	48.70	31.05	38.82
N0403203002HR	RO-Chandigarh (HR)	Hissar	4L PS	9	144.6	35.67	42.56	39.11
N0300901007HR	RO-Delhi	Bhiwani-DL	6L	152D	33.92	52.85	30.11	41.48
N0805802001HR	RO-Chandigarh (HR)	Sonipat-CHD-HR	4L	334B	35.51	39.63	44.65	42.20
N0300901004HR	RO-Delhi	Bhiwani-DL	6L	152D	24.0	48.13	38.21	42.66
N0805401001HR	RO-Chandigarh (HR)	Bhiwani-CHD-HR	2L PS	709A	59.84	44.20	49.85	47.04
N0100501009HR	RO-Delhi	Ghaziabad	6L	NE-2	135.04	54.45	40.51	47.62
N0403202002HR	RO-Chandigarh (HR)	Hissar	4L	9	99.14	44.81	52.67	48.73
N0805601001HR	RO-Chandigarh (HR)	Ambala	4L	444A	14.85	55.63	44.65	50.15
N0300901008HR	RO-Delhi	Bhiwani-DL	6L	152D	35.0	61.52	40.96	52.29
N0403201001HR	RO-Chandigarh (HR)	Sonipat-CHD-HR	4L/6L	9	63.49	53.22	53.94	53.57
N0807101001HR	RO-Chandigarh (HR)	Chandigarh	4L	5	27.53	57.82	51.86	54.33
N0300901009HR	RO-Delhi	Bhiwani-DL	6L	152D	27.02	65.99	48.78	57.93
N0502101001HR	RO-Chandigarh (HR)	Sonipat-CHD-HR	4L	709	81.29	57.87	58.11	58.00
N0603701001HR	RO-Chandigarh (HR)	Chandigarh	4L	7	19.12	64.83	65.73	65.28
N0300901002HR	RO-Delhi	Bhiwani-DL	6L	152D	23.0	69.59	61.80	65.69
N0300901006HR	RO-Delhi	Bhiwani-DL	6L	152D	23.0	76.01	55.81	66.21
N0300901003HR	RO-Delhi	Bhiwani-DL	6L	152D	33.0	63.63	73.44	68.35
N0603703001HR	RO-Chandigarh (HR)	Chandigarh	4L	444A	16.93	71.56	65.60	68.58
N0100101001HR	RO-Delhi	Sohna	8L	NE-4	18.46	68.36	69.37	68.89
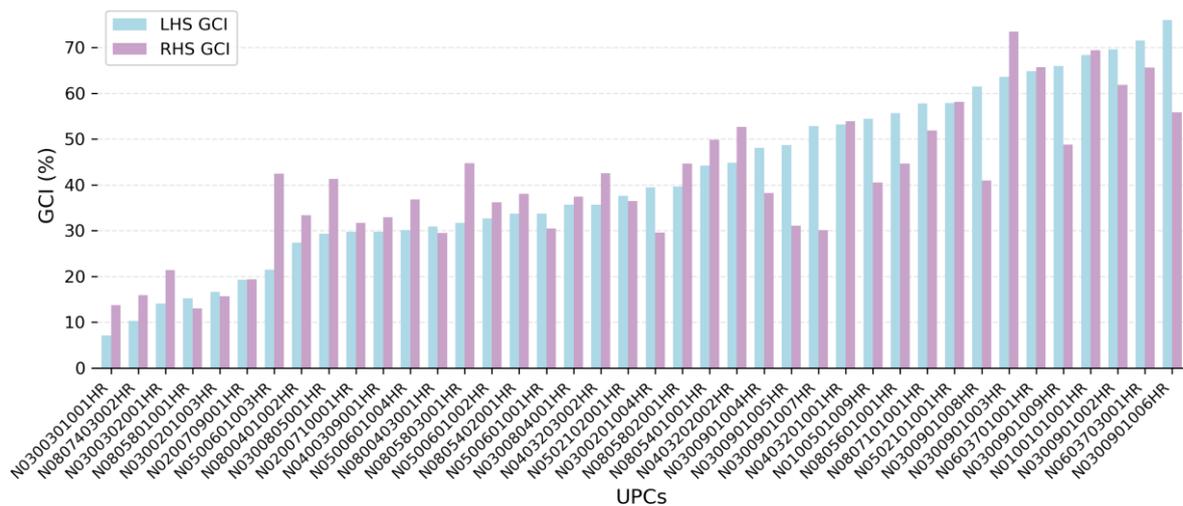
Figure 50 Bar chart depicting UPC wise LHS, RHS GCI values of Haryana

Figure 51 Satellite view of Haryana with 40 UPCs overlaid

Table 32 Satellite data details used for GCI analysis of Haryana

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-11	94	51	B
RS2/L4	2024-11-21	96	51	C
RS2/L4	2024-11-21	96	51	A
RS2/L4	2024-12-10	95	50	A
RS2/L4	2024-12-10	95	52	A
RS2/L4	2024-12-10	95	51	A
RS2/L4	2024-12-10	95	50	C
RS2/L4	2024-12-15	96	51	B
RS2/L4	2024-12-15	96	51	D
RS2A/L4	2024-10-11	95	51	B
RS2A/L4	2024-10-11	95	49	D
RS2A/L4	2024-10-11	95	52	B
RS2A/L4	2024-10-11	95	51	D
RS2A/L4	2024-10-11	95	50	D
RS2A/L4	2024-10-11	95	50	B
RS2A/L4	2024-11-23	94	50	D
RS2A/L4	2024-11-23	94	51	B
RS2A/L4	2024-11-28	95	51	B
RS2A/L4	2024-12-12	93	50	B
RS2A/L4	2024-12-17	94	50	C

Himachal Pradesh GCI Analysis:

For the state of Himachal Pradesh, 03 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 33.

GCI Results:

Cumulative results of Himachal Pradesh: Cumulative GCI of entire State having 03 no. of projects is 13.54 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:


Total UPCs: 3

GCI:
0–25%
25–50%
50–75%
75–100%
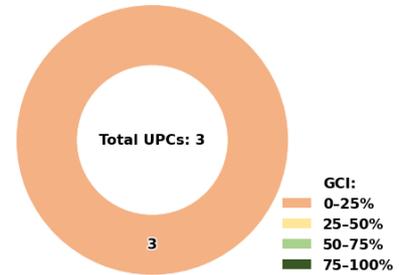
Table 33 UPC wise statistics for Himachal Pradesh state

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0802105001HP	RO-Shimla	Mandi	4L	3	36.59	0.03	0.06	0.04
N0802107001HP	RO-Shimla	Mandi	2L	3	37.18	14.05	12.83	13.44
N0802106001HP	RO-Shimla	Mandi	4L	3	28.94	15.48	16.86	16.19
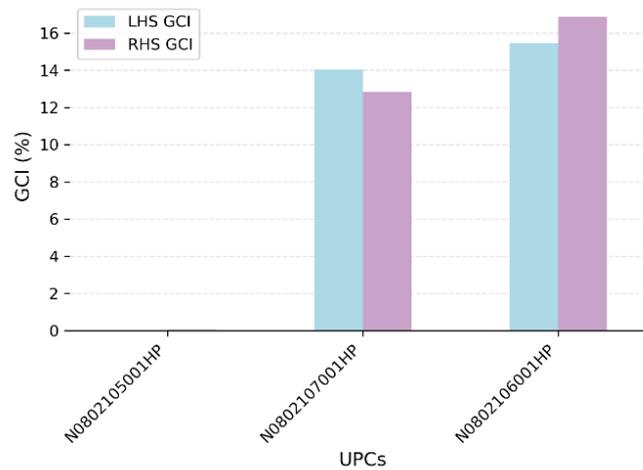
Figure 52 Bar chart depicting UPC wise LHS, RHS GCI values of Himachal Pradesh
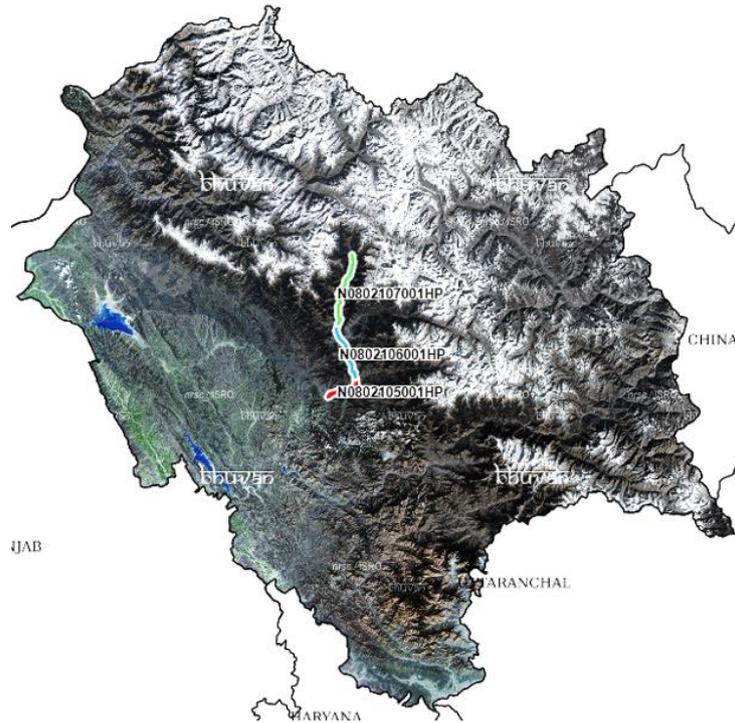
Figure 53 Satellite view of Himachal Pradesh with 3 UPCs overlaid

Table 34 Satellite data details used for GCI analysis of Himachal Pradesh

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-12-10	95	48	C

Jammu and Kashmir GCI Analysis:

For Jammu and Kashmir, 5 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 35.

GCI Results:

Cumulative results of Jammu and Kashmir: Cumulative GCI of entire State having 5 no. of projects is 32.11 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
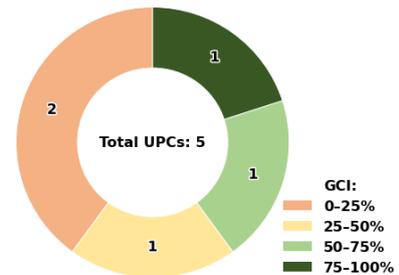
Table 35 UPC wise statistics for Jammu and Kashmir

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0200602003JK	RO-Jammu	Srinagar	4L	44	3.9	10.21	11.87	11.04
N0200602001JK	RO-Jammu	Srinagar	4L	44	66.97	19.39	25.55	22.46
N0200607001JK	RO-Jammu	Udhampur	4L	44	64.29	28.99	27.06	28.05
N0200606001JK	RO-Jammu	Udhampur	2L/4L	44	10.8	58.98	76.60	73.05
N0200606002JK	RO-Jammu	Udhampur	4L	44	39.08	0.00	76.60	76.54
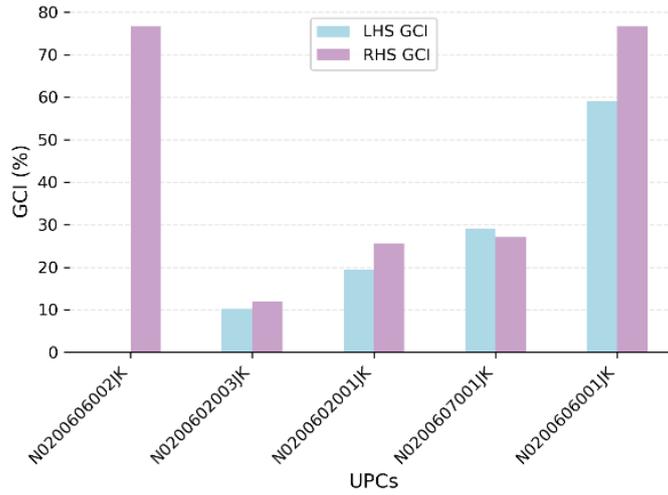
Figure 54 Bar chart depicting UPC wise LHS, RHS GCI values of Jammu and Kashmir
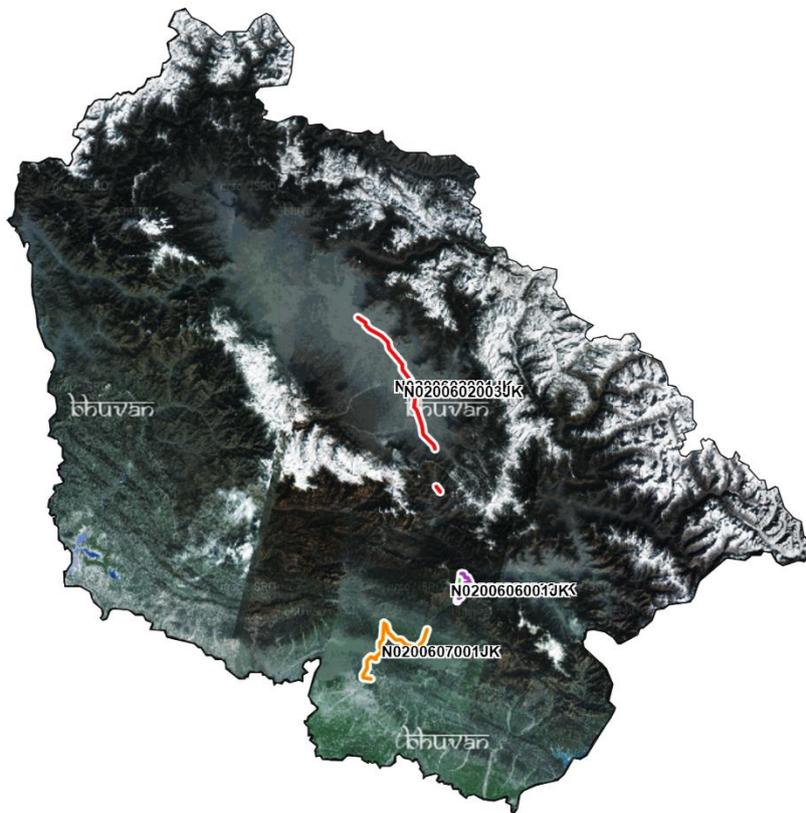
Figure 55 Satellite view of Jammu and Kashmir with 5 UPCs overlaid

Table 36 Satellite data details used for GCI analysis of Jammu and Kashmir

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2A/L4	2024-10-25	93	47	C
RS2A/L4	2024-10-25	93	48	A
Sentinel-2A/MSI (Level-2A)	2024-10-03	5		T43SDT
Sentinel-2A/MSI (Level-2A)	2024-10-03	5		T43SET
Sentinel-2A/MSI (Level-2A)	2024-10-13	5		T43SES

For the state of Jharkhand, 09 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 37.

GCI Results:

Cumulative results of Jharkhand: Cumulative GCI of entire State having 09 no. of projects is 35.61 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:

Table 37 UPC wise statistics for Jharkhand

| UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0500404004JH	RO-Ranchi	Jamshedpur	4L	43	16.06	23.86	15.36	19.60
N0500404005JH	RO-Ranchi	Jamshedpur	4L/6L	43	44.56	28.43	19.31	23.93
N0907001001JH	RO-Ranchi	Daltonganj	4L	139	33.61	27.14	28.05	27.59
N0802505001JH	RO-Ranchi	Hazaribagh	4L	20	41.36	30.06	25.60	27.73
N0200515001JH	RO-Ranchi	Dhanbad	6L	19	40.48	29.78	28.09	29.00
N0401015002JH	RO-Ranchi	Dhanbad	2L/4L	320	78.02	32.77	36.05	34.42
N0200516001JH	RO-Ranchi	Dhanbad	6L	19	40.73	45.61	32.61	39.56
N0500404002JH	RO-Ranchi	Ranchi	4L	Ranchi Ring Road	26.16	41.37	51.56	46.27
N0500404003JH	RO-Ranchi	Ranchi	4L	43	77.45	50.57	44.04	46.82
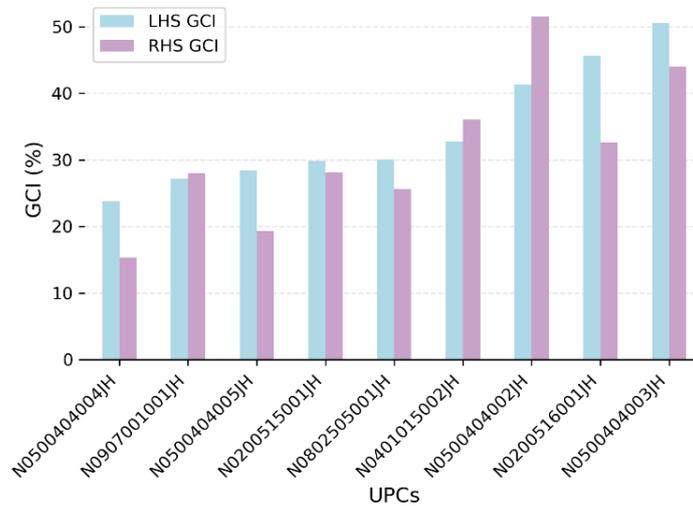
Figure 56 Bar chart depicting UPC wise LHS, RHS GCI values of Jharkhand
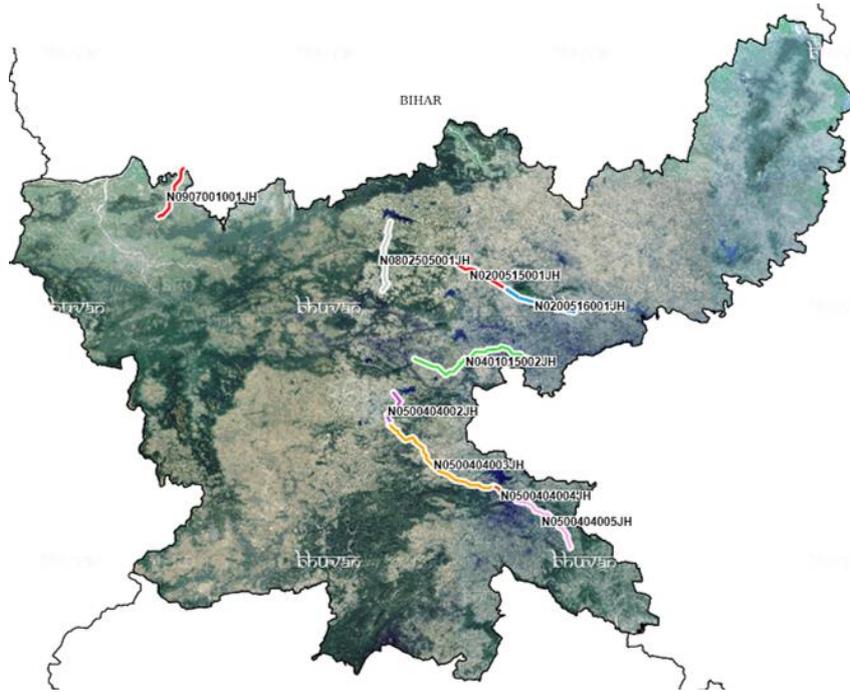
Figure 57 Satellite view of Jharkhand with 9 UPCs overlaid

Table 38 Satellite data details used for GCI analysis of Jharkhand

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-08	103	054	D
RS2/L4	2024-11-08	103	055	B
RS2/L4	2024-11-18	105	055	B
RS2/L4	2024-11-18	105	056	B
RS2/L4	2024-11-18	105	055	D
RS2/L4	2024-11-23	106	055	C
RS2/L4	2024-11-23	106	055	A
RS2/L4	2024-11-23	106	056	C
RS2/L4	2024-12-12	105	055	C
RS2/L4	2024-12-12	105	055	A
RS2A/L4	2024-12-29	106	056	A

Karnataka GCI Analysis:

For the state of Karnataka, 21 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 39.

GCI Results:

Cumulative results of Karnataka: Cumulative GCI of entire State having 21 no. of projects is 32.54 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:


66
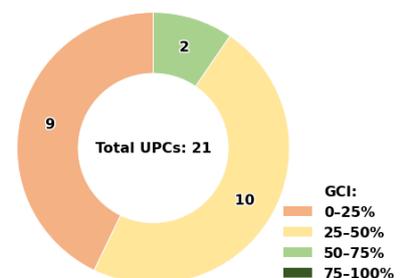
UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0200209001KA	RO-Bengaluru	Dharwad	4L	48	77.81	5.58	9.84	7.72
N0200304001KA	RO-Bengaluru	Bangalore-Expressway	6L	44	24.12	16.25	4.60	10.51
N0100301001KA	RO-Bengaluru	Bangalore-Expressway	4L	NE-7	27.09	12.23	13.15	12.72
N0803604002KA	RO-Bengaluru	Tumakuru	4L	69	48.47	20.82	21.63	21.22
N0200215001KA	RO-Bengaluru	Chitradurga	6L	48	79.47	20.32	24.84	22.60
N0402508001KA	RO-Bengaluru	Chitradurga	4L	150A	49.95	26.10	19.24	22.67
N0200217001KA	RO-Bengaluru	Chitradurga	6L	48	114.44	20.50	28.11	23.82
N0100302001KA	RO-Bengaluru	Bangalore-Expressway	4L	NE-7	32.50	16.18	31.54	23.84
N0200218001KA	RO-Bengaluru	Tumakuru	4L	48	32.06	24.20	23.58	23.88
N0803603001KA	RO-Bengaluru	Tumakuru	4L	73	56.66	21.39	32.32	26.74
N0200214001KA	RO-Bengaluru	Dharwad	6L	48	64.09	31.08	25.43	28.30
N0803602001KA	RO-Bengaluru	Tumakuru	4L	73	52.91	29.35	39.35	34.36
N0402507001KA	RO-Bengaluru	Hospet	4L	150A	57.70	34.49	38.50	36.42
N0402902001KA	RO-Bengaluru	Hassan	4L	75	76.52	35.68	38.70	37.19
N0200216001KA	RO-Bengaluru	Chitradurga	6L	48	73.56	31.09	43.55	37.35
N0100302002KA	RO-Bengaluru	Bangalore-Expressway	4L	NE-7	17.5	39.26	37.06	38.16
N0400712003KA	RO-Bengaluru	Gulbarga	4L	65	145.03	49.53	31.88	40.78
N0200212001KA	RO-Bengaluru	Dharwad	6L	48	79.37	43.79	38.08	40.93
N0800703001KA	RO-Bengaluru	Hospet	4L/6L	50	98.47	46.96	48.85	48.00
N0201005001KA	RO-Bengaluru	Bengaluru	4L/6L	44	71.94	52.44	53.64	53.04
N0400203001KA	RO-Bengaluru	Mangalore	4L	66	89.86	55.91	52.92	54.42
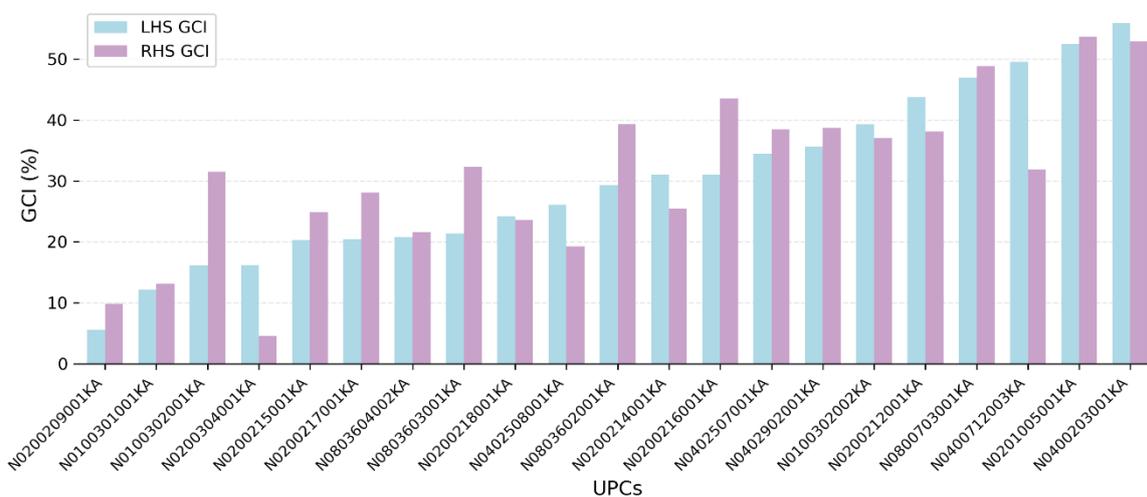
Figure 58 Bar chart depicting UPC wise LHS, RHS GCI values of Karnataka

Figure 59 Satellite view of Karnataka with 21 UPCs overlaid

Table 40 Satellite data details used for GCI analysis of Karnataka

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-08-13	100	64	B
RS2/L4	2024-08-13	100	64	D
RS2/L4	2024-11-21	96	61	C
RS2/L4	2024-11-26	97	62	A
RS2/L4	2024-11-26	97	62	C
RS2/L4	2024-12-15	96	61	D
RS2/L4	2024-12-15	96	62	B
RS2/L4	2024-12-30	99	64	B
RS2A/L4	2024-09-18	100	64	C
RS2A/L4	2024-10-26	98	60	D
RS2A/L4	2024-10-26	98	63	B
RS2A/L4	2024-11-10	101	64	C
RS2A/L4	2024-11-24	99	60	D
RS2A/L4	2024-12-18	99	60	C
RS2A/L4	2024-12-18	99	63	C
Sentinel-2A/MSI (Level-2A)	2024-11-06	62		T43PFT
Sentinel-2A/MSI (Level-2A)	2024-12-16	62		T43PGQ
Sentinel-2B/MSI (Level-2A)	2024-12-08	19		T43PGR
Sentinel-2B/MSI (Level-2A)	2024-12-11	62		T43PDQ
Sentinel-2B/MSI (Level-2A)	2024-12-31	62		T43PER
Sentinel-2B/MSI (Level-2A)	2024-12-31	62		T43PES
Sentinel-2B/MSI (Level-2A)	2024-12-31	62		T43PFQ
Sentinel-2B/MSI (Level-2A)	2024-12-31	62		T43PFR
Sentinel-2B/MSI (Level-2A)	2024-12-31	62		T43PFS
Sentinel-2B/MSI (Level-2A)	2024-12-31	62		T43PGS

Kerala GCI Analysis:

For the state of Kerala, 5 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 41.

GCI Results:

Cumulative results of Karnataka: Cumulative GCI of entire State having 5 no. of projects is 33.75 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
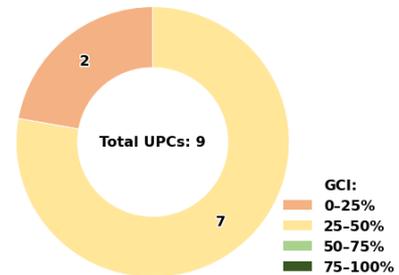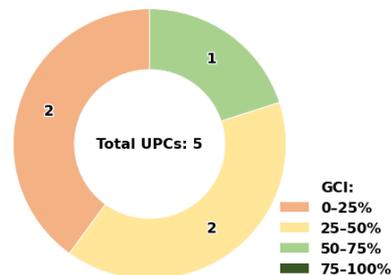

Table 41 UPC wise statistics for Kerala

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0400220002KL	RO-Thiruvananthapuram	Thiruvananthapuram	4L	66	2.83	9.76	17.47	13.67
N0201308001KL	RO-Thiruvananthapuram	Palakkad	4L	544	54.42	22.91	24.88	23.90
N0400221001KL	RO-Thiruvananthapuram	Thiruvananthapuram	4L	66	16.2	37.61	13.02	25.37
N0400215002KL	RO-Thiruvananthapuram	Cochin-II	4L	66	16.6	42.74	36.98	39.87
N0201313002KL	RO-Thiruvananthapuram	Cochin-II	4L	966A	17.13	48.34	69.16	58.73
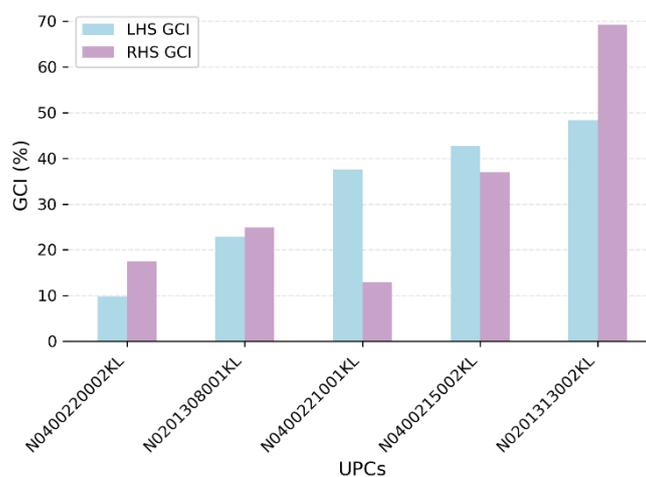
*Figure 60 Bar chart depicting UPC wise LHS, RHS GCI values of Kerala*
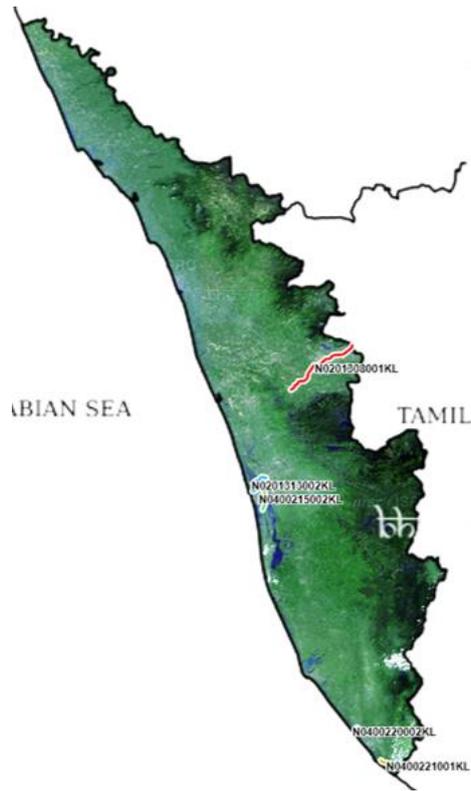
Figure 61 Satellite view of Kerala with 5 UPCs overlaid

Table 42 Satellite data details used for GCI analysis of Kerala

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-12	99	66	D
RS2A/L4	2024-11-24	99	67	B
RS2A/L4	2024-12-23	100	66	C
Sentinel-2A/MSI (Level-2A)	2024-12-23	19		T43PGK
Sentinel-2B/MSI (Level-2A)	2024-12-28	19		T43PGK

Madhya Pradesh GCI Analysis:

For the state of Madhya Pradesh, 34 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 43.

GCI Results:

Cumulative results of Madhya Pradesh: Cumulative GCI of entire State having 34 no. of projects is 41.57 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
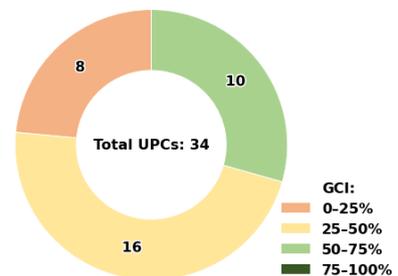
Table 43 UPC wise statistics for Madhya Pradesh

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0100104009MP	RO-Bhopal	Ratlam	8L	NE-4	21.02	1.06	7.57	4.27
N0100104010MP	RO-Bhopal	Ratlam	8L	NE-4	23.2	5.01	7.78	6.40
N0400405001MP	RO-Bhopal	Bhopal	4L	46	93.69	15.78	12.06	13.92

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N0200805001MP	RO-Jabalpur	Gwalior	4L	44	1.52	27.14	3.33	18.10
N0100104002MP	RO-Bhopal	Ratlam	8L	NE-4	32.0	20.45	16.89	18.58
N0907902001MP	RO-Jabalpur	Katni	4L	39	15.68	22.46	22.92	22.69
N0400403002MP	RO-Jabalpur	Gwalior	4L	46	12.35	28.51	17.37	23.06
N0100104008MP	RO-Bhopal	Ratlam	8L	NE-4	25.31	21.77	25.95	23.87
N0400411001MP	RO-Bhopal	Indore	4L	52	82.43	20.34	40.72	30.56
N0401901001MP	RO-Jabalpur	Jabalpur	4L PS	34	80.87	27.14	35.61	31.19
N0401902001MP	RO-Jabalpur	Jabalpur	4L PS	30	67.97	37.08	24.66	32.33
N0200808002MP	RO-Jabalpur	Gwalior	4L	44	82.51	34.25	30.59	32.42
N0401905001MP	RO-Jabalpur	Katni	4L	30	71.18	36.94	31.17	34.12
N0200804001MP	RO-Jabalpur	Gwalior	4L	44	95.04	37.01	34.73	35.87
N0907901001MP	RO-Jabalpur	Katni	2L	39	56.2	38.53	35.97	37.25
N0400409001MP	RO-Bhopal	Indore	4L	52	77.27	42.77	35.75	39.25
N0909101003MP	RO-Jabalpur	Jabalpur	2L	30	92.67	36.63	42.75	39.69
N0400401003MP	RO-Jabalpur	Gwalior	4L	44	42.03	40.16	42.14	41.15
N0402402002MP	RO-Bhopal	Harda	4L	47	30.59	41.46	42.55	42.02
N0100104004MP	RO-Bhopal	Ratlam	8L	NE-4	29.5	45.11	46.65	45.88
N0909101002MP	RO-Jabalpur	Jabalpur	2L	30	5.58	46.12	47.32	46.72
N0100104005MP	RO-Bhopal	Ratlam	8L	NE-4	25.31	49.99	44.86	47.51
N0401903001MP	RO-Jabalpur	Katni	4L	30	69.57	52.56	39.46	48.17
N0100104003MP	RO-Bhopal	Ratlam	8L	NE-4	33.0	50.47	47.77	49.26
N0301002002MP	RO-Jabalpur	Chhindwara	2L PS	347, 547	382.29	50.97	49.52	50.24
N0100104007MP	RO-Bhopal	Ratlam	8L	NE-4	25.01	47.03	56.30	51.17
N0400406001MP	RO-Bhopal	Indore	4L	52	142.71	50.65	52.09	51.37
N0402802001MP	RO-Jabalpur	Jabalpur	4L	45	52.45	44.36	60.57	52.45
N0200820001MP	RO-Jabalpur	Chhindwara	4L	44	29.29	43.30	59.98	52.50
N0400403001MP	RO-Jabalpur	Gwalior	4L	46	85.33	50.93	54.20	52.54
N0100104006MP	RO-Bhopal	Ratlam	8L	NE-4	30.19	49.74	58.52	53.62
N0400401006MP	RO-Jabalpur	Gwalior	4L	46	118.66	53.90	53.62	53.76
N0200819001MP	RO-Jabalpur	Chhindwara	4L PS	44	27.69	62.90	56.20	59.45
N0200817001MP	RO-Jabalpur	Chhindwara	4L PS	44	40.12	69.78	60.86	65.32
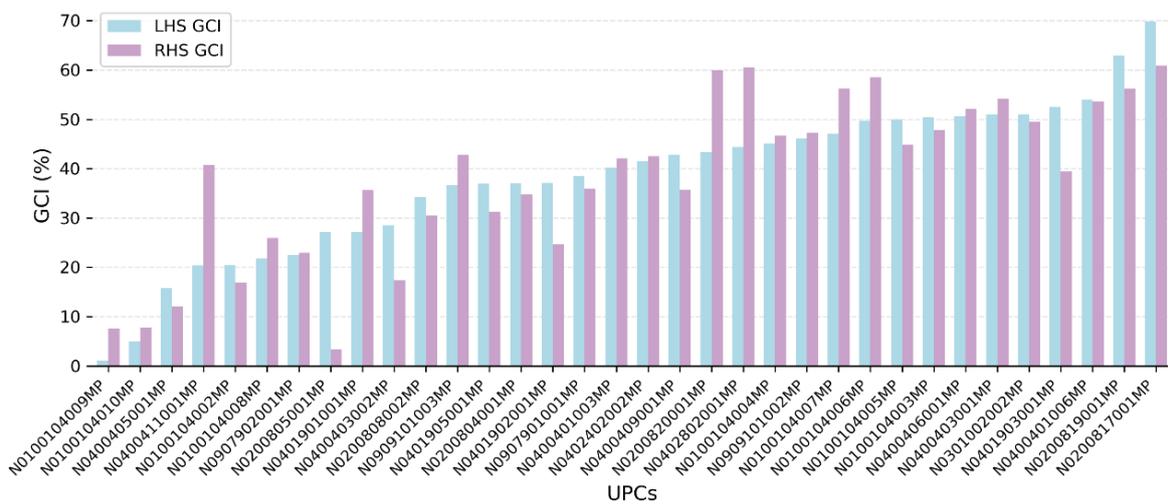
Figure 62 Bar chart depicting UPC wise LHS, RHS GCI values of Madhya Pradesh
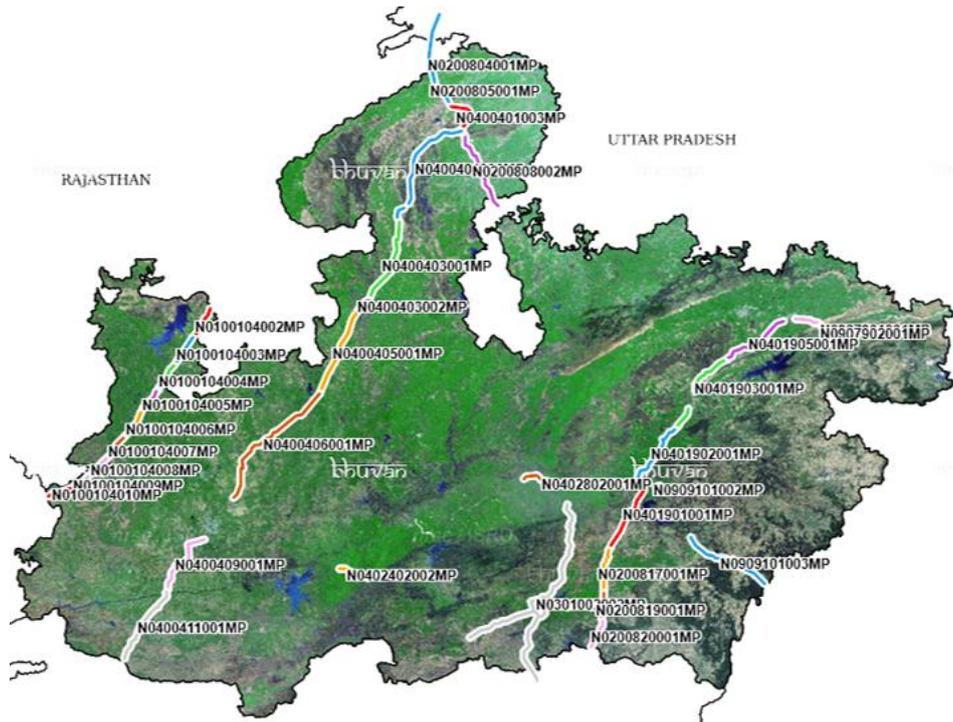
Figure 63 Satellite view of Madhya Pradesh with 34 UPCs overlaid

Table 44 Satellite data details used for GCI analysis of Madhya Pradesh

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-21	96	55	A
RS2/L4	2024-11-21	96	57	A
RS2/L4	2024-11-21	96	54	C
RS2/L4	2024-11-21	96	56	C
RS2/L4	2024-11-22	101	56	C
RS2/L4	2024-11-22	101	54	C
RS2/L4	2024-11-26	97	52	C
RS2/L4	2024-11-26	97	55	C
RS2/L4	2024-11-26	97	55	A
RS2/L4	2024-11-26	97	54	C
RS2/L4	2024-12-10	95	56	A
RS2/L4	2024-12-11	100	55	C
RS2/L4	2024-12-11	100	56	A
RS2/L4	2024-12-11	100	56	C
RS2/L4	2024-12-11	100	57	A
RS2/L4	2024-12-15	96	56	B
RS2/L4	2024-12-15	96	55	D
RS2A/L4	2024-10-31	99	56	A
RS2A/L4	2024-10-31	99	57	A
RS2A/L4	2024-11-10	101	55	A
RS2A/L4	2024-11-19	98	54	A
RS2A/L4	2024-11-19	98	53	C
RS2A/L4	2024-11-24	99	57	B
RS2A/L4	2024-11-24	99	56	B
RS2A/L4	2024-11-24	99	56	D
RS2A/L4	2024-11-28	95	55	B
RS2A/L4	2024-11-28	95	55	D
RS2A/L4	2024-11-29	100	55	B
RS2A/L4	2024-11-29	100	56	D

RS2A/L4	2024-11-29	100	55	D			
RS2A/L4	2024-12-04	101	54	D			
RS2A/L4	2024-12-08	97	53	B			
RS2A/L4	2024-12-08	97	54	B			
RS2A/L4	2024-12-08	97	56	D			
RS2A/L4	2024-12-08	97	53	D			
RS2A/L4	2024-12-08	97	54	D			

Maharashtra GCI Analysis:

For the state of Maharashtra, 42 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 45.

GCI Results:

Cumulative results of Maharashtra: Cumulative GCI of entire State having 42 no. of projects is 42.28 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
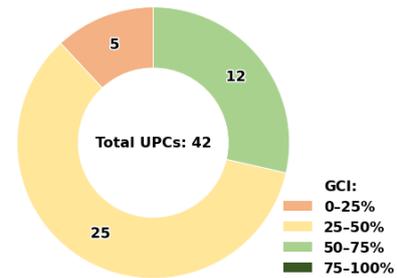
Table 45 UPC wise statistics for Maharashtra

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0200201001MH	RO-Mumbai	Pune	6L	48	2.23	15.51	11.43	14.12
N0400702001MH	RO-Mumbai	Solapur	4L PS	65	101.73	23.92	7.32	15.62
N0400707001MH	RO-Mumbai	Pandharpur	4L	965	39.2	21.54	25.20	23.31
N0200203001MH	RO-Mumbai	Pune	6L	48	144.84	26.83	21.43	24.15
N0200905001MH	RO-Nagpur	Nagpur (PD-1)	4L	44	1.71	2.77	52.56	24.87
N0400417002MH	RO-Mumbai	Nashik	6L	160	59.95	38.29	12.10	25.16
N0301005001MH	RO-Nagpur	Nagpur (PD-1)	4L	547E	28.89	22.04	29.64	25.91
N0400708001MH	RO-Mumbai	Pandharpur	4L	965	33.1	16.64	36.56	26.45
N0200908001MH	RO-Nagpur	Nagpur (PD-1)	4L	44	1.4	14.10	39.19	26.58
N0400709001MH	RO-Mumbai	Pandharpur	4L	965	45.01	21.64	32.02	26.97
N0400701001MH	RO-Mumbai	Pune	4L	65	110.004	32.52	21.57	27.05
N0603901005MH	RO-Mumbai	Panvel	8L	348	10.70	28.66	26.00	27.25
N0200821002MH	RO-Nagpur	Nagpur (PD-1)	4L	44	1.03	16.17	43.39	29.88
N0801104001MH	RO-Mumbai	Kolhapur	4L	166	41.21	32.78	34.65	33.72
N0402304001MH	RO-Nagpur	Aurangabad	4L	52	87.91	32.96	35.56	34.28
N0400102001MH	RO-Mumbai	Nashik	4L	160	97.63	34.00	35.26	34.63
N0902301001MH	RO-Mumbai	Pandharpur	4L	965G	41.37	36.28	33.89	35.09
N0400418001MH	RO-Mumbai	Nashik	6L	60 & 160	59.95	44.74	27.04	35.85
N0400412001MH	RO-Nagpur	Dhule	4L	52	89.19	33.59	46.01	40.03
N0400506001MH	RO-Nagpur	Washim	4L	161	44.99	43.60	38.01	40.87
N0200912001MH	RO-Nagpur	Yavatmal	2L	44	0.69	46.94	35.59	41.31
N0401401001MH	RO-Nagpur	Nanded	4L	361	67.41	39.92	45.01	42.45
N0902001003MH	RO-Mumbai	Ahmednagar	2L PS	61	50.09	46.80	38.43	42.60
N0401408001MH	RO-Nagpur	Yavatmal	4L	361	60.37	44.55	41.90	43.23
N0200910001MH	RO-Nagpur	Yavatmal	4L	44	30.01	41.78	49.36	45.57
N0603901004MH	RO-Mumbai	Panvel	6L/8L	348A	11.11	45.95	44.97	45.88
N0603901002MH	RO-Mumbai	Panvel	6L/8L	348	15.17	62.36	41.18	47.23
N0400415001MH	RO-Mumbai	Nashik	4L	60	119.72	47.77	48.16	47.96
N0902001002MH	RO-Mumbai	Ahmednagar	2L PS	61	60.41	50.89	46.28	48.58
N0902001004MH	RO-Mumbai	Ahmednagar	2L PS	61	51.66	58.44	40.50	49.47

N0400507001MH	RO-Nagpur	Washim	4L	161	42.93	64.87	39.18	51.79
N0601301001MH	RO-Mumbai	Nashik	4L	160	52.03	54.66	49.78	52.72
N0200909001MH	RO-Nagpur	Yavatmal	4L	44	29.01	62.79	47.69	55.24
N0200823001MH	RO-Nagpur	Nagpur (PD-1)	4L PS	Nagpur Outer Ring Road	33.5	57.27	54.06	55.72
N0200911001MH	RO-Nagpur	Yavatmal	4L	44	21.17	63.58	49.16	56.37
N0200821001MH	RO-Nagpur	Nagpur (PD-1)	4L	44	118.72	65.31	47.67	57.11
N0200906001MH	RO-Nagpur	Nagpur (PD-1)	4L	44	57.08	52.74	62.12	57.44
N0400508001MH	RO-Nagpur	Nanded	4L	161	41.59	57.49	59.32	58.39
N0402305001MH	RO-Nagpur	Aurangabad	4L/6L	52	58.25	63.59	62.86	63.22
N0401406001MH	RO-Nagpur	Yavatmal	4L	361	80.03	61.49	72.49	67.01
N0401407001MH	RO-Nagpur	Yavatmal	4L	361	65.32	66.65	70.81	68.73
N0903101001MH	RO-Nagpur	Chandrapur	4L	930	18.24	71.75	67.52	69.76
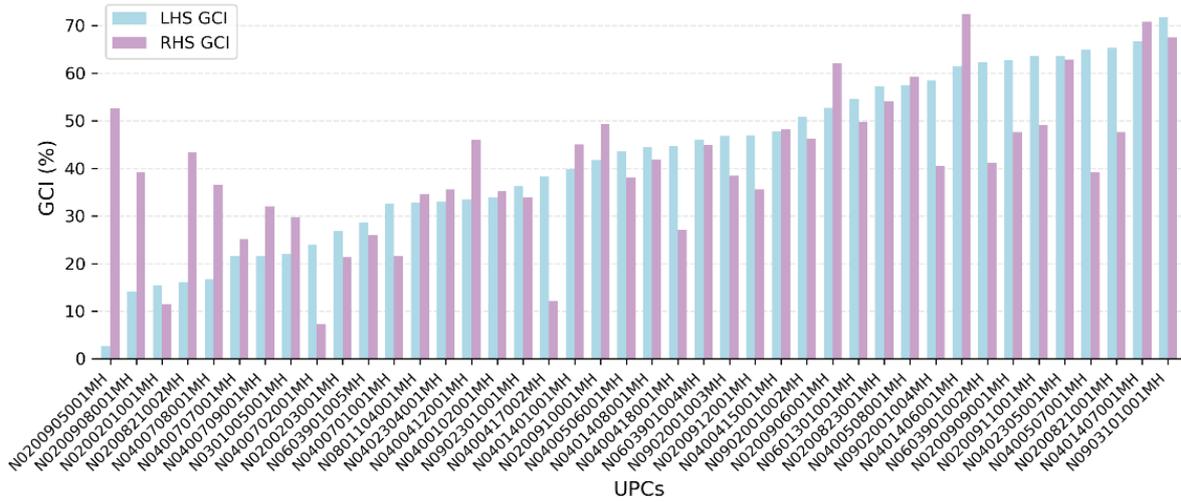
Figure 64 Bar chart depicting UPC wise LHS, RHS GCI values of Maharashtra
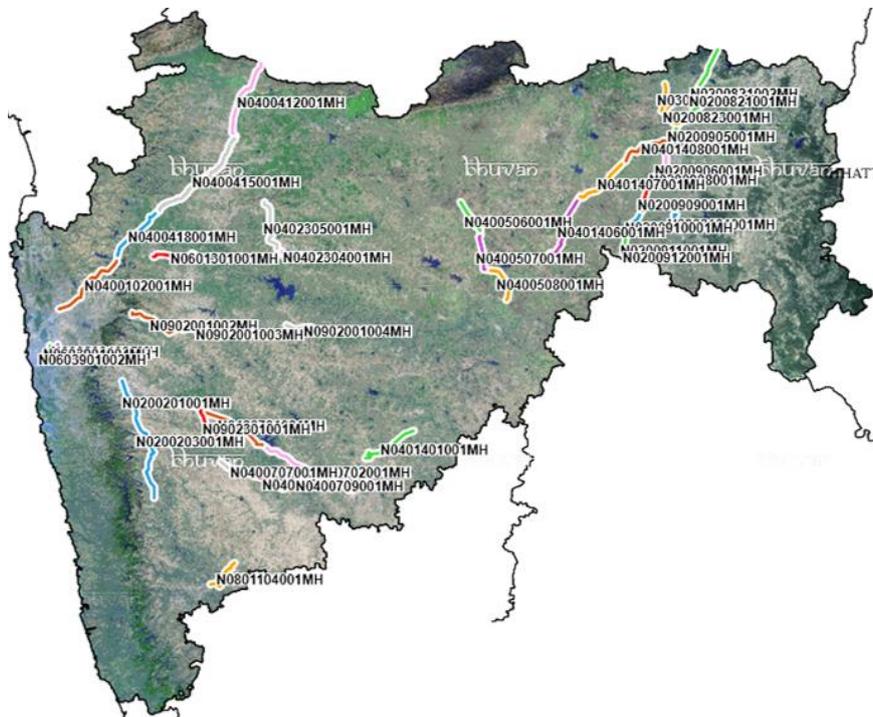
Figure 65 Satellite view of Maharashtra with 42 UPCs overlaid

Table 46 Satellite data details used for GCI analysis of Maharashtra

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-02	97	60	B
RS2/L4	2024-11-21	96	60	C
RS2/L4	2024-11-21	096	058	C
RS2/L4	2024-11-21	96	59	C
RS2/L4	2024-11-21	096	060	A
RS2/L4	2024-11-26	097	060	C
RS2/L4	2024-11-26	97	60	C
RS2/L4	2024-11-26	097	059	C
RS2/L4	2024-12-10	095	058	C
RS2/L4	2024-12-10	95	58	C
RS2/L4	2024-12-10	95	59	A
RS2/L4	2024-12-10	095	059	C
RS2/L4	2024-12-11	100	58	C
RS2/L4	2024-12-11	100	057	C
RS2/L4	2024-12-11	100	057	A
RS2/L4	2024-12-15	096	060	B
RS2/L4	2024-12-15	96	60	B
RS2/L4	2024-12-15	096	059	B
RS2/L4	2024-12-15	096	061	B
RS2/L4	2024-12-15	096	058	D
RS2/L4	2024-12-20	097	060	D
RS2A/L4	2024-10-06	094	059	D
RS2A/L4	2024-10-06	94	59	D
RS2A/L4	2024-10-26	98	59	B
RS2A/L4	2024-10-26	98	58	D
RS2A/L4	2024-10-31	99	58	C
RS2A/L4	2024-10-31	99	58	A
RS2A/L4	2024-11-19	98	60	A
RS2A/L4	2024-11-19	98	58	C
RS2A/L4	2024-11-23	094	059	B
RS2A/L4	2024-11-23	94	59	B
RS2A/L4	2024-11-24	099	058	B
RS2A/L4	2024-11-24	99	58	B
RS2A/L4	2024-11-24	099	058	D
RS2A/L4	2024-11-24	099	057	D
RS2A/L4	2024-11-24	99	57	D
RS2A/L4	2024-11-28	95	59	B
RS2A/L4	2024-11-28	095	057	B
RS2A/L4	2024-11-28	095	060	B
RS2A/L4	2024-11-28	95	58	D
RS2A/L4	2024-11-28	095	060	D
RS2A/L4	2024-11-28	095	057	D
RS2A/L4	2024-11-28	095	058	B

Meghalaya GCI Analysis:

For the state of Meghalaya, 2 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 47.

GCI Results:

Cumulative results of Meghalaya: Cumulative GCI of entire State having 2 no. of projects is 34.34 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:

Table 47 UPC wise statistics for Meghalaya

| UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0908302001ML	RO-Guwahati	Shillong	2L	Shillong Bypass	47.94	30.67	26.97	28.81
N0908301001ML	RO-Guwahati	Shillong	4L	6	61.72	36.28	39.60	38.38
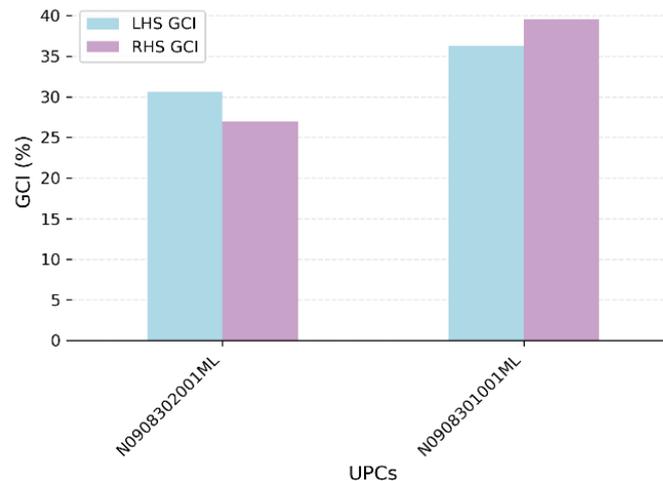
*Figure 66 Bar chart depicting UPC wise LHS, RHS GCI values of Meghalaya*
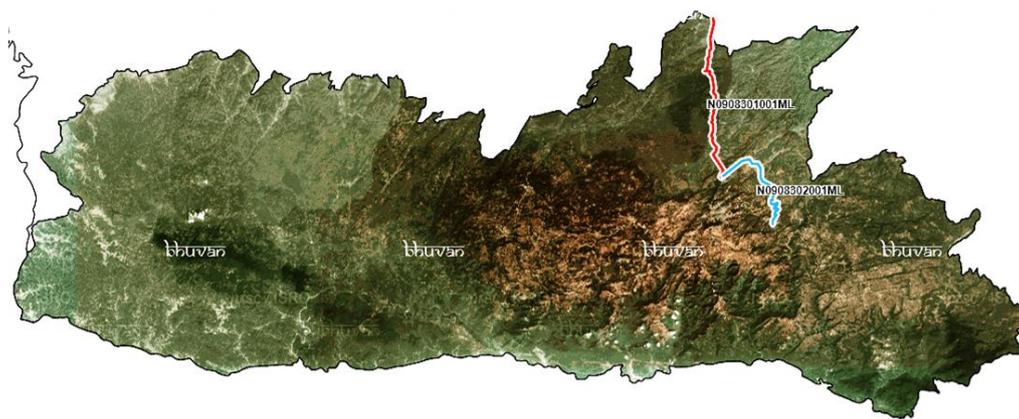
Figure 67 Satellite view of Meghalaya with 2 UPCs overlaid

Table 48 Satellite data details used for GCI analysis of Meghalaya

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
Sentinel-2B/MSI (Level-2A)	2024-12-26	133		T46RCP

Odisha GCI Analysis:

For the state of Odisha, 17 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 49.

GCI Results:

Cumulative results of Maharashtra: Cumulative GCI of entire State having 17 no. of projects is 30.25 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
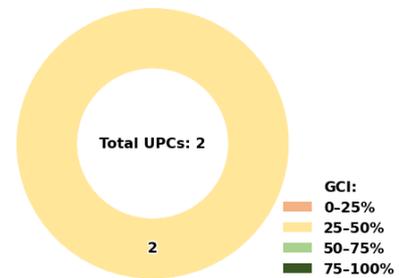

Table 49 UPC wise statistics for Odisha

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N02004080001OR	RO-Bhubaneswar	Dhenkanal	6L	16	2.27	13.20	11.47	12.21
N09059010001OR	RO-Bhubaneswar	Keonjhar	4L PS	520	43.22	14.56	22.34	18.61
N02004090001OR	RO-Bhubaneswar	Berhampur	6L	16	59.0	24.49	12.97	19.04
N02004040001OR	RO-Bhubaneswar	Chandikhole	6L	16	74.57	16.12	29.12	23.72
N04001280001OR	RO-Bhubaneswar	Chandikhole	4L PS	49	111.64	22.14	28.36	25.21
N04001250001OR	RO-Bhubaneswar	Keonjhar	4L PS	49	78.27	20.07	35.03	27.49
N04001220001OR	RO-Bhubaneswar	Sambalpur	4L	53	88.0	26.13	28.90	27.50
N08066010001OR	RO-Bhubaneswar	Keonjhar	4L PS	143	28.97	31.26	23.96	27.72
N09059010002OR	RO-Bhubaneswar	Keonjhar	6L	520	0.78	36.00	21.41	28.19
N02004050001OR	RO-Bhubaneswar	Bhubaneshwar	6L	16	67.06	30.23	26.59	28.47
N09059020001OR	RO-Bhubaneswar	Keonjhar	4L	520	53.12	31.32	29.01	30.16
N04001270001OR	RO-Bhubaneswar	Keonjhar	4L PS	49	105.01	26.14	42.36	34.27
N02004110002OR	RO-Bhubaneswar	Berhampur	4L	16	64.37	35.13	35.33	35.23
N02004100001OR	RO-Bhubaneswar	Berhampur	6L	16	77.85	37.00	34.25	35.60
N09060010002OR	RO-Bhubaneswar	Bhubaneshwar	4L	316	56.41	48.62	35.53	42.07
N09060010003OR	RO-Bhubaneswar	Bhubaneshwar	4L	316	56.41	48.62	35.53	42.07
N09060020001OR	RO-Bhubaneswar	Bhubaneshwar	4L PS	316	10.72	47.92	48.05	47.99
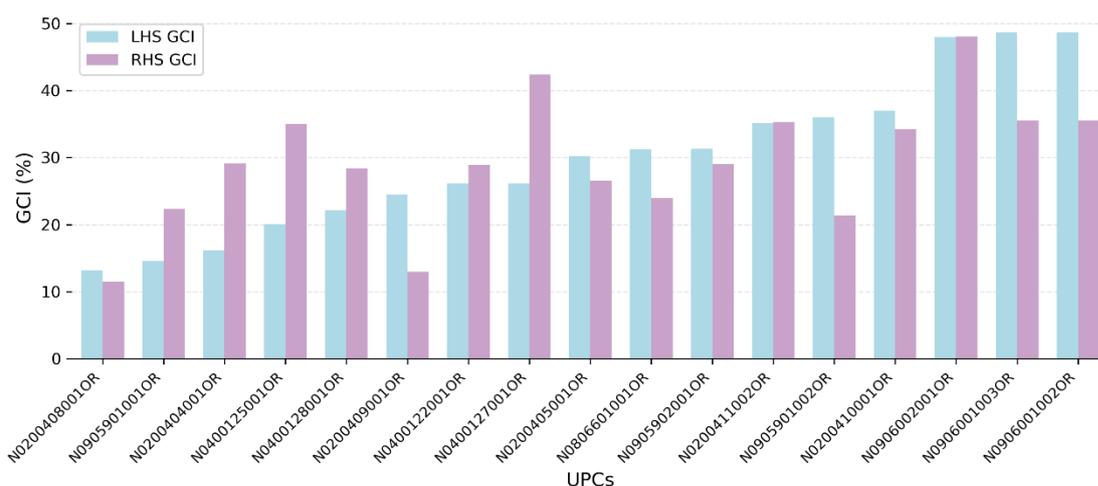
*Figure 68 Bar chart depicting UPC wise LHS, RHS GCI values of Odisha*
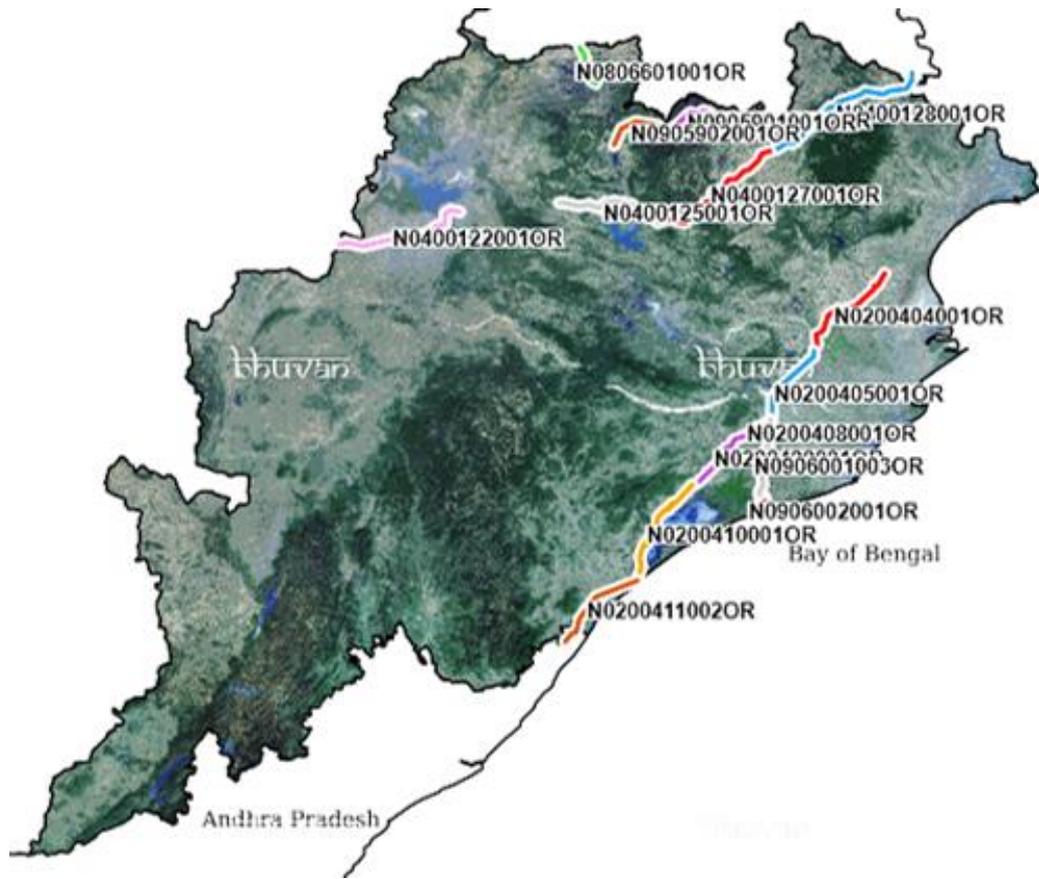
Figure 69 Satellite view of Odisha with 17 UPCs overlaid

Table 50 Satellite data details used for GCI analysis of Odisha

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-08	103	57	D
RS2/L4	2024-11-18	105	57	B
RS2/L4	2024-11-18	105	57	B
RS2/L4	2024-11-18	105	56	D
RS2/L4	2024-11-18	105	59	B
RS2/L4	2024-11-23	106	57	A
RS2/L4	2024-11-23	106	57	A
RS2/L4	2024-11-23	106	59	A
RS2/L4	2024-11-23	106	58	C
RS2/L4	2024-12-12	105	57	C
RS2/L4	2024-12-12	105	57	C
RS2/L4	2024-12-12	105	57	A
RS2/L4	2024-12-31	104	56	D
RS2A/L4	2024-11-01	104	57	C
RS2A/L4	2024-11-25	104	57	B
RS2A/L4	2024-12-05	106	58	B
RS2A/L4	2024-12-05	106	56	D
RS2A/L4	2024-12-05	106	57	D
RS2A/L4	2024-12-05	106	58	D

Punjab GCI Analysis:

For the state of Punjab, 32 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 51.

GCI Results:

Cumulative results of Punjab: Cumulative GCI of entire State having 32 no. of projects is 37.01 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
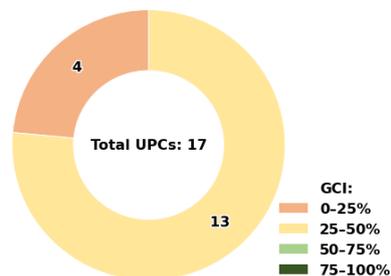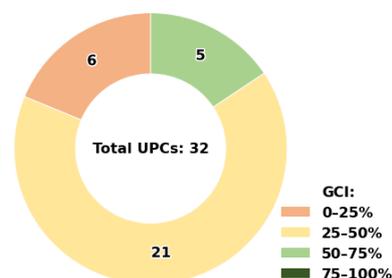

Table 51 UPC wise statistics for Punjab

| UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0200708001PB	RO-Chandigarh (PB)	Ludhiana	4L/6L	5	13.60	7.77	13.02	10.27
N0806101001PB	RO-Chandigarh (HR)	Chandigarh	4L	205&05	10.08	15.18	13.70	14.44
N0802101001PB	RO-Chandigarh (HR)	Chandigarh	4L	205	13.67	22.99	14.10	18.54
N0200707001PB	RO-Chandigarh (PB)	Ludhiana	4L	5	22.26	16.26	21.54	18.71
N0501204001PB	RO-Chandigarh (PB)	Bhatinda	4L PS	7	41.35	16.28	31.09	23.68
N0501201005PB	RO-Chandigarh (PB)	Chandigarh	4L	7	49.85	24.53	24.78	24.66
N0503101002PB	RO-Chandigarh (PB)	Jalandhar	4L	703	146.05	30.43	25.08	27.93
N0807301001PB	RO-Chandigarh (PB)	Amritsar	4L	54	103.09	28.49	28.85	28.67
N0601201001PB	RO-Chandigarh (HR)	Chandigarh	4L	152	32.55	36.52	21.47	28.98
N0900101010PB	RO-Chandigarh (PB)	Amritsar	4L/6L	3	68.96	36.07	25.30	30.88
N0100401007PB	RO-Chandigarh (PB)	Ludhiana Expressway	4L	7, SH-10	37.89	30.02	32.89	31.46
N0502502002PB	RO-Chandigarh (PB)	Bhatinda	4L	9	22.5	39.53	26.04	32.82
N0200706028PB	RO-Chandigarh (HR)	Ambala	6L	44	291.1	36.48	28.43	32.87
N0503501003PB	RO-Chandigarh (PB)	Ludhiana	4L PS	5	65.02	31.96	38.37	35.17
N0600801001PB	RO-Chandigarh (PB)	Bhatinda	4L	7	38.54	23.18	48.38	35.81
N0501202005PB	RO-Chandigarh (PB)	Chandigarh	4L	7	41.55	33.96	40.71	37.33
N0501203001PB	RO-Chandigarh (PB)	Bhatinda	4L PS	7	59.22	37.56	37.36	37.46
N0501202013PB	RO-Chandigarh (HR)	Chandigarh	4L	52	57.0	37.02	38.33	37.68
N0503501012PB	RO-Chandigarh (PB)	Ludhiana	4L PS	5	84.26	34.01	42.16	38.08
N0503502001PB	RO-Chandigarh (PB)	Ludhiana	4L	5	23.74	40.27	36.56	38.41
N0807801001PB	RO-Chandigarh (HR)	Chandigarh	4L/6L	5	75.86	32.93	46.99	39.95
N0600805001PB	RO-Chandigarh (PB)	Bhatinda	4L	7	64.99	45.33	35.45	40.46
N0501202004PB	RO-Chandigarh (PB)	Chandigarh	4L	7	19.29	58.46	27.67	43.05
N0200704001PB	RO-Chandigarh (PB)	Jalandhar	4L	44	125.34	42.97	45.56	44.27
N0806102001PB	RO-Chandigarh (PB)	Jalandhar	4L	344A	80.8	43.13	47.36	45.26
N0802102001PB	RO-Chandigarh (HR)	Chandigarh	4L	205	43.28	52.38	41.04	46.72
N0900201001PB	RO-Chandigarh (PB)	Amritsar	4L	3	36.12	55.15	43.42	49.29
N0400304001PB	RO-Chandigarh (PB)	Bhatinda	4L PS	54	62.1	55.47	50.85	53.17
N0400302003PB	RO-Chandigarh (PB)	Amritsar	4L	54	55.97	58.77	48.45	53.61
N0700101002PB	RO-Chandigarh (PB)	Amritsar	2L/4L PS	354	48.81	54.81	53.92	54.36
N0400303001PB	RO-Chandigarh (PB)	Bhatinda	4L PS	54	56.72	62.90	49.93	56.41
N0700103001PB	RO-Chandigarh (PB)	Amritsar	4L/2L PS	354	47.81	55.40	57.91	56.67
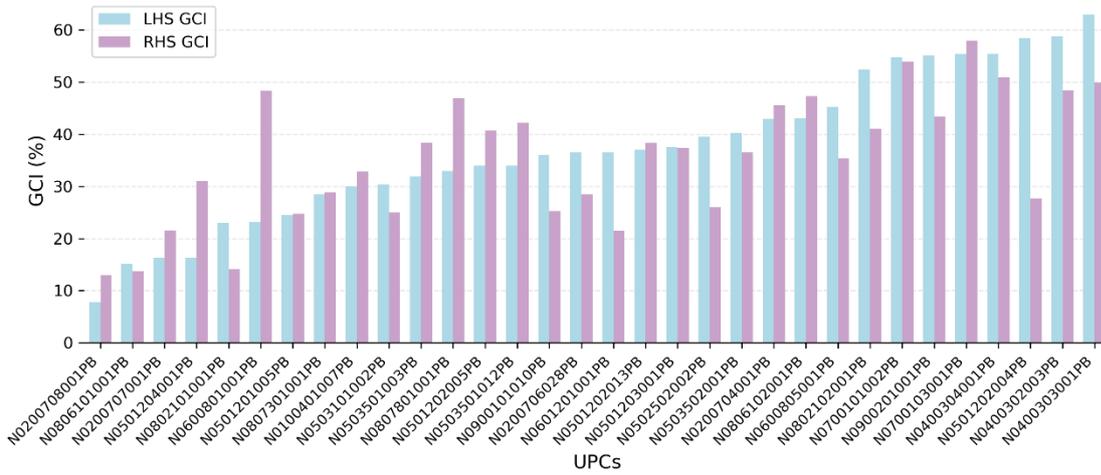
*Figure 70 Bar chart depicting UPC wise LHS, RHS GCI values of Punjab*

Figure 71 Satellite view of Punjab with 32 UPCs overlaid

Table 52 Satellite data details used for GCI analysis of Punjab

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-09-24	94	49	B
RS2/L4	2024-09-24	94	49	D
RS2/L4	2024-10-13	93	48	C
RS2/L4	2024-11-06	93	48	D
RS2/L4	2024-12-10	95	50	A
RS2/L4	2024-12-10	95	49	C
RS2/L4	2024-12-10	95	49	A
RS2A/L4	2024-10-01	93	48	C

RS2A/L4	2024-10-11	95	50	D			
RS2A/L4	2024-10-11	95	50	B			
RS2A/L4	2024-10-20	92	50	B			
RS2A/L4	2024-10-25	93	49	A			
RS2A/L4	2024-10-25	93	50	A			
RS2A/L4	2024-10-25	93	49	C			
RS2A/L4	2024-10-30	93	48	C			
RS2A/L4	2024-11-23	94	50	B			
RS2A/L4	2024-12-12	93	48	D			
RS2A/L4	2024-12-12	93	49	D			
RS2A/L4	2024-12-12	93	50	B			
RS2A/L4	2024-12-12	93	49	B			
RS2A/L4	2024-12-17	94	48	A			
RS2A/L4	2024-12-17	94	49	A			
RS2A/L4	2024-12-17	94	49	C			
RS2A/L4	2024-12-17	94	48	C			
RS2A/L4	2024-12-17	94	50	A			

Rajasthan GCI Analysis:

For the state of Rajasthan, 77 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 53.

GCI Results:

Cumulative results of Rajasthan: Cumulative GCI of entire State having 77 no. of projects is 40.72 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:

Total UPCs: 77

GCI:
- 0–25%
- 25–50%
- 50–75%
- 75–100%

Table 53 UPC wise statistics for Rajasthan

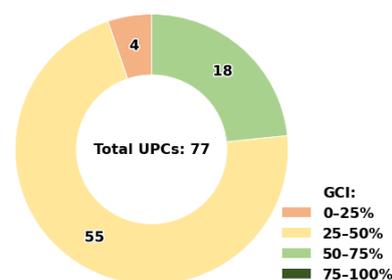| UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0400310003RJ	RO-Jaipur	Hanumangarh	6L	754K	24.3	15.05	19.77	16.88
N0503802001RJ	RO-Jaipur	Jaipur	2L PS	52	45.63	10.72	22.52	16.94
N0200102008RJ	RO-Jaipur	Jaipur	6L	48	161.12	23.08	19.85	21.46
N0100103010RJ	RO-Jaipur	SawaiMadhopur	8L	NE-4	28.21	25.74	20.52	23.14
N0100103014RJ	RO-Jaipur	Kota	8L	NE-4	26.42	37.66	15.88	27.49
N0400311004RJ	RO-Jaipur	Jodhpur	6L	754K	30.0	25.88	30.40	28.14
N0500302001RJ	RO-Jaipur	Kota	4L	52	48.36	31.05	26.25	28.65
N0200105001RJ	RO-Jaipur	Ajmer	6L	48	90.5	26.40	32.03	29.21
N0100103005RJ	RO-Jaipur	Dausa	8L	NE-4	31.26	32.81	26.49	29.65
N0800404001RJ	RO-Jaipur	Jaipur	2L PS	52 & 58	154.57	27.30	32.63	30.10
N0201802001RJ	RO-Jaipur	Kota	4L	27	27.79	32.97	29.81	31.39
N0200107001RJ	RO-Jaipur	Udaipur	6L	48	93.38	32.37	31.14	31.75
N0400310007RJ	RO-Jaipur	Hanumangarh	6L	754K	30.0	36.08	27.64	31.86
N0503801002RJ	RO-Jaipur	Jaipur	4L	52	51.83	22.59	41.17	31.88
N0200108001RJ	RO-Jaipur	Udaipur	6L	48	24.89	36.95	28.14	32.70
N0400310002RJ	RO-Jaipur	Hanumangarh	6L	754K	29.04	23.82	42.15	33.17
N0801502001RJ	RO-Jaipur	Jodhpur	4L	Jodhpur Ring Road	74.89	30.60	36.49	33.34
N0400310008RJ	RO-Jaipur	Hanumangarh	6L	754K	30.0	38.67	29.40	34.05
N0700701001RJ	RO-Jaipur	Bikaner	2L/4L	911& 911A	216.44	36.00	32.23	34.13
N0300401001RJ	RO-Jaipur	Ajmer	6L	448 & 58	92.19	31.75	36.66	34.20

|								
N0803901002RJ	RO-Jaipur	Ajmer	2L PS	458	127.77	36.05	33.79	34.92
N0400311003RJ	RO-Jaipur	Jodhpur	6L	754K	30.0	28.61	41.34	34.94
N0900701001RJ	RO-Jaipur	Kota	2L PS	148D	213.76	40.34	30.08	35.20
N0802702001RJ	RO-Jaipur	Kota	4L	52	81.63	38.43	32.08	35.25
N0403801001RJ	RO-Jaipur	Dausa	4L	21	109.21	35.75	37.11	36.42
N0200104001RJ	RO-Jaipur	Jaipur	6L	48	90.97	28.74	44.18	36.46
N0900902001RJ	RO-Jaipur	Dausa	4L/2L PS	23 & 148	83.16	45.13	29.97	36.86
N0200106001RJ	RO-Jaipur	Chittorgarh	6L	48	126.78	41.47	32.31	36.97
N0601501001RJ	RO-Jaipur	Udaipur	4L	758	87.06	46.58	28.68	37.64
N0700501001RJ	RO-Jaipur	Bikaner	2L PS	911	162.38	33.74	42.06	37.91
N0300403001RJ	RO-Jaipur	Udaipur	4L	58	79.18	40.54	37.21	38.87
N0200109001RJ	RO-Jaipur	Udaipur	6L	48	113.39	39.81	39.14	39.48
N0400312006RJ	RO-Jaipur	Jodhpur	6L	754K	27.99	33.97	45.42	39.67
N0400310010RJ	RO-Jaipur	Hanumangarh	6L	754K	27.5	42.51	39.35	40.58
N0400311007RJ	RO-Jaipur	Jodhpur	6L	754K	29.7	34.52	46.74	40.62
N0805702001RJ	RO-Jaipur	Jaisalmer	2L PS	25	74.1	41.48	40.08	40.74
N0403701001RJ	RO-Jaipur	Jodhpur	4L	25, 162, 62	244.8	42.87	40.19	41.53
N0802701001RJ	RO-Jaipur	Jaipur	4L	52	149.2	42.92	40.64	41.78
N0100103002RJ	RO-Delhi	Sohna	8L	NE-4	36.9	52.02	31.62	41.83
N0901201002RJ	RO-Gandhinagar	Godhra	2L PS	56	85.34	43.59	40.49	42.04
N0201801005RJ	RO-Jaipur	Udaipur	4L	27	160.57	45.21	39.88	42.54
N0100103004RJ	RO-Jaipur	Dausa	8L	NE-4	31.16	47.88	37.58	42.77
N0901301001RJ	RO-Jaipur	Dausa	2L PS	123	74.97	38.81	47.07	42.94
N0400310009RJ	RO-Jaipur	Hanumangarh	6L	754K	26.80	45.95	41.18	43.09
N0801202003RJ	RO-Jaipur	Jaisalmer	2L PS	11	162.46	45.46	41.48	43.47
N0100103006RJ	RO-Jaipur	Dausa	8L	NE-4	33.05	45.32	41.92	43.54
N0800405001RJ	RO-Jaipur	Jaipur	2L PS	58	119.82	38.90	48.29	43.62
N0201803001RJ	RO-Jaipur	Kota	4L	27	104.29	40.53	46.98	43.76
N0400312004RJ	RO-Jaipur	Jodhpur	6L	754K	23.9	42.08	46.06	44.08
N0801201001RJ	RO-Jaipur	Bikaner	4L/2L PS	11	158.99	45.06	45.04	45.05
N0403803001RJ	RO-Jaipur	Dausa	4L	21	44.52	47.83	44.66	46.27
N0403802001RJ	RO-Jaipur	Dausa	4L	21	57.11	43.03	50.24	46.58
N0802802002RJ	RO-Jaipur	Kota	2L PS	52	62.19	55.16	39.23	47.21
N0400310004RJ	RO-Jaipur	Hanumangarh	6L	754K	35.0	45.25	49.92	47.58
N0901401002RJ	RO-Jaipur	Ajmer	2L PS	148D	69.17	49.69	45.92	47.81
N0400310006RJ	RO-Jaipur	Hanumangarh	6L	754K	25.1	44.82	53.28	49.06
N0805701002RJ	RO-Jaipur	Jodhpur	2L/4L PS	25	85.64	50.15	48.41	49.28
N0700601001RJ	RO-Jaipur	Jaisalmer	4L/2L PS	70	273.55	47.10	51.76	49.41
N0400311006RJ	RO-Jaipur	Jodhpur	6L	754K	28.0	53.13	47.59	49.85
N0901101001RJ	RO-Jaipur	Dausa	2L PS	23	101.03	52.60	47.44	50.01
N0802202002RJ	RO-Jaipur	Jaisalmer	4L/2L PS	68	38.06	53.05	47.62	50.35
N0901501001RJ	RO-Jaipur	Kota	2L PS	552	66.78	52.28	49.93	51.10
N0901601002RJ	RO-Jaipur	Ajmer	2L PS	458	54.78	54.78	51.85	53.32
N0700301001RJ	RO-Jaipur	Jaisalmer	4L/2L PS	925& 925A	197.02	54.67	52.79	53.74
N0201703001RJ	RO-Jaipur	Udaipur	4L	27	118.99	58.63	48.84	53.76
N0400312003RJ	RO-Jaipur	Jodhpur	6L	754K	27.0	48.97	62.03	54.27
N0601501002RJ	RO-Jaipur	Udaipur	2L PS	758	67.72	57.46	51.13	54.30
N0801501001RJ	RO-Jaipur	Jodhpur	4L PS	25	109.85	50.01	58.59	54.33
N0400310005RJ	RO-Jaipur	Hanumangarh	6L	754K	27.0	45.77	63.21	54.49
N0400311002RJ	RO-Jaipur	Jodhpur	6L	754K	28.1	47.81	60.36	54.55
N0900901002RJ	RO-Jaipur	Jaipur	2L PS	148	62.44	60.91	51.93	56.42
N0801503002RJ	RO-Jaipur	Jodhpur	2L/4L PS	125	135.92	54.43	60.38	57.40
N0400312005RJ	RO-Jaipur	Jodhpur	6L	754K	24.99	48.04	67.23	57.70
N0100103003RJ	RO-Delhi	Sohna	8L	NE-4	36.2	58.35	58.75	58.55
N0200103001RJ	RO-Jaipur	Jaipur	6L	148C	53.82	64.19	53.23	58.71
N0400311005RJ	RO-Jaipur	Jodhpur	6L	754K	30.0	55.68	67.57	61.67
N0400312002RJ	RO-Jaipur	Jodhpur	6L	754K	22.15	61.99	78.69	71.73
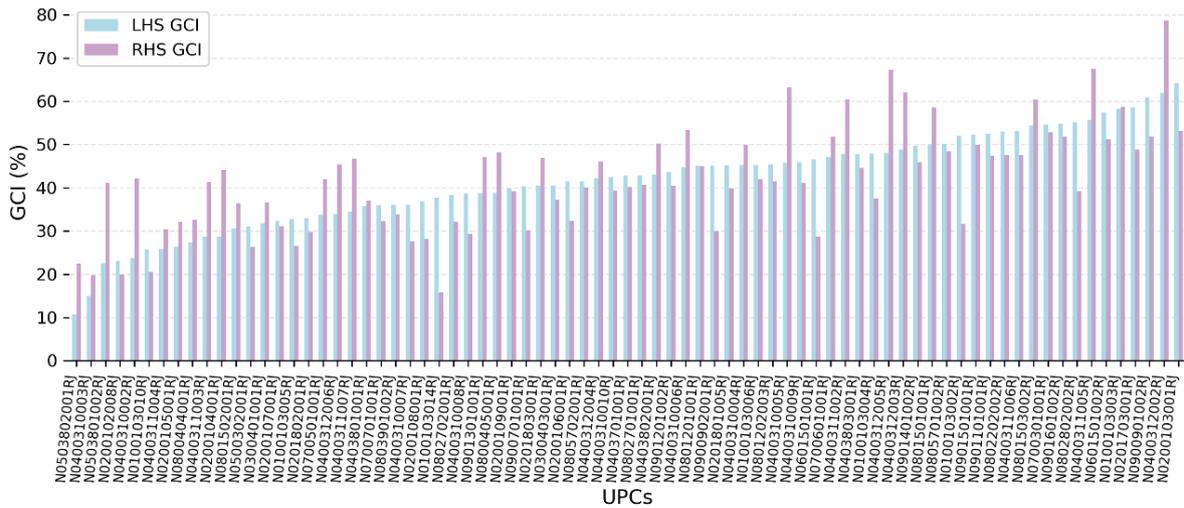
Figure 72 Bar chart depicting UPC wise LHS, RHS GCI values of Rajasthan

Figure 73 Satellite view of Rajasthan with 77 UPCs overlaid

Table 54 Satellite data details used for GCI analysis of Rajasthan

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-10-08	92	50	C
RS2/L4	2024-10-08	92	51	A
RS2/L4	2024-10-08	92	52	A
RS2/L4	2024-10-08	92	52	C
RS2/L4	2024-10-08	92	51	C

RS2/L4	2024-11-06	93	52	D
RS2/L4	2024-11-06	93	52	B
RS2/L4	2024-11-11	94	51	B
RS2/L4	2024-11-21	96	53	C
RS2/L4	2024-11-21	96	52	A
RS2/L4	2024-11-21	96	52	C
RS2/L4	2024-11-21	96	53	A
RS2/L4	2024-11-21	96	54	A
RS2/L4	2024-11-21	96	55	A
RS2/L4	2024-11-21	96	54	C
RS2/L4	2024-11-26	97	52	C
RS2/L4	2024-11-26	97	53	A
RS2/L4	2024-12-05	94	52	A
RS2/L4	2024-12-10	95	53	A
RS2/L4	2024-12-10	95	53	C
RS2/L4	2024-12-10	95	54	C
RS2/L4	2024-12-10	95	52	C
RS2/L4	2024-12-10	95	54	A
RS2/L4	2024-12-15	96	52	D
RS2/L4	2024-12-15	96	53	B
RS2/L4	2024-12-15	96	54	B
RS2/L4	2024-12-15	96	55	B
RS2A/L4	2024-10-10	90	53	D
RS2A/L4	2024-10-11	95	52	D
RS2A/L4	2024-10-11	95	52	B
RS2A/L4	2024-10-11	95	51	D
RS2A/L4	2024-10-20	92	53	D
RS2A/L4	2024-10-20	92	53	B
RS2A/L4	2024-10-25	93	50	C
RS2A/L4	2024-10-25	93	54	C
RS2A/L4	2024-10-25	93	52	C
RS2A/L4	2024-10-25	93	51	C
RS2A/L4	2024-10-25	93	53	C
RS2A/L4	2024-10-25	93	51	A
RS2A/L4	2024-10-25	93	54	A
RS2A/L4	2024-11-03	90	52	A
RS2A/L4	2024-11-03	90	52	C
RS2A/L4	2024-11-03	90	53	C
RS2A/L4	2024-11-03	90	53	A
RS2A/L4	2024-11-08	91	54	A
RS2A/L4	2024-11-08	91	52	C
RS2A/L4	2024-11-13	92	53	A
RS2A/L4	2024-11-13	92	54	C
RS2A/L4	2024-11-13	92	53	C
RS2A/L4	2024-11-13	92	54	A
RS2A/L4	2024-11-23	94	54	D
RS2A/L4	2024-11-23	94	51	D
RS2A/L4	2024-11-23	94	53	D
RS2A/L4	2024-11-23	94	53	B
RS2A/L4	2024-11-23	94	52	B
RS2A/L4	2024-11-23	94	54	B
RS2A/L4	2024-11-23	94	56	B
RS2A/L4	2024-11-23	94	55	D
RS2A/L4	2024-11-28	95	54	B
RS2A/L4	2024-11-28	95	53	B
RS2A/L4	2024-11-28	95	53	D
RS2A/L4	2024-11-28	95	54	D

RS2A/L4	2024-11-28	95	52	D
RS2A/L4	2024-12-02	91	52	D
RS2A/L4	2024-12-02	91	53	D
RS2A/L4	2024-12-02	91	54	B
RS2A/L4	2024-12-02	91	51	D
RS2A/L4	2024-12-02	91	54	D
RS2A/L4	2024-12-02	91	52	B
RS2A/L4	2024-12-07	92	51	D
RS2A/L4	2024-12-07	92	52	B
RS2A/L4	2024-12-07	92	52	D
RS2A/L4	2024-12-12	93	53	D
RS2A/L4	2024-12-12	93	54	D
RS2A/L4	2024-12-12	93	52	B
RS2A/L4	2024-12-12	93	53	B
RS2A/L4	2024-12-12	93	54	B
RS2A/L4	2024-12-17	94	53	C
RS2A/L4	2024-12-17	94	52	A
RS2A/L4	2024-12-17	94	54	C
RS2A/L4	2024-12-17	94	54	A
RS2A/L4	2024-12-17	94	55	C
RS2A/L4	2024-12-17	94	55	A
RS2A/L4	2024-12-17	94	51	C

Tamil Nadu GCI Analysis:

For the state of Tamil Nadu, 23 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 55.

GCI Results:

Cumulative results of Tamil Nadu: Cumulative GCI of entire State having 23 no. of projects is 42.38 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
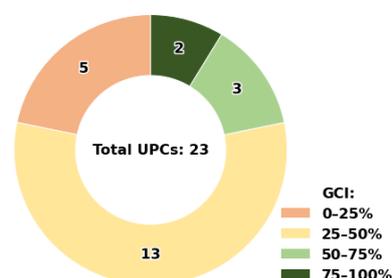

Total UPCs: 23

GCI:
- 0–25%
- 25–50%
- 50–75%
- 75–100%

Table 55 UPC wise statistics for Tamil Nadu

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0200430004TN	RO-Chennai	Chennai	4L PS	16	10.4	9.33	13.23	11.27
N0201304001TN	RO-Chennai	Coimbatore	4L/6L	544	54.91	8.48	22.34	15.41
N0200306001TN	RO-Chennai	Krishnagiri	6L	48	148.54	16.21	16.54	16.37
N0502003001TN	RO-Madurai	Karaikudi	2L/4L	36	55.1	25.29	21.69	23.49
N0402206002TN	RO-Madurai	Trichy	4L	38	124.81	21.70	27.15	24.42
N0201302001TN	RO-Chennai	Salem	4L	47	48.46	25.98	24.11	25.05
N0201102001TN	RO-Chennai	Salem	4L	44	68.35	26.08	30.32	28.22
N0804903002TN	RO-Chennai	Viluppuram	2L	81	31.54	35.53	24.10	29.81
N0201101001TN	RO-Chennai	Salem	4L	44	86.3	33.05	29.05	30.92
N0804202001TN	RO-Madurai	Dindigul	4L PS	83	45.38	31.27	32.00	31.63
N0904401002TN	RO-Madurai	Karaikudi	2L PS	36	77.75	41.13	28.57	34.75
N0201107001TN	RO-Madurai	Madurai	4L	44	53.1	38.28	33.45	35.88
N0402205001TN	RO-Madurai	Trichy	4L	45	38.47	39.38	33.00	36.41
N0602403001TN	RO-Madurai	Dindigul	4L	785	26.11	41.73	45.46	43.62
N0201203006TN	RO-Madurai	Nagarcoil	4L	44	63.36	46.80	46.52	46.66

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N0201301001TN	RO-Chennai	Salem	4L	47	55.41	48.57	46.42	47.50
N0201203003TN	RO-Madurai	Madurai	4L	44	52.33	57.25	41.31	49.28
N0201105001TN	RO-Chennai	Salem	4L	44	41.37	52.36	47.07	49.69
N0402204001TN	RO-Madurai	Trichy	4L	38	93.83	52.79	49.71	51.24
N0804202002TN	RO-Madurai	Dindigul	4L	83	51.32	47.84	54.76	51.30
N0201106001TN	RO-Madurai	Dindigul	4L	44	79.47	55.99	41.27	51.36
N0201203004TN	RO-Madurai	Madurai	4L	44	64.23	78.25	75.62	76.94
N0201203005TN	RO-Madurai	Nagarcoil	4L	44	63.5	80.45	78.21	79.33
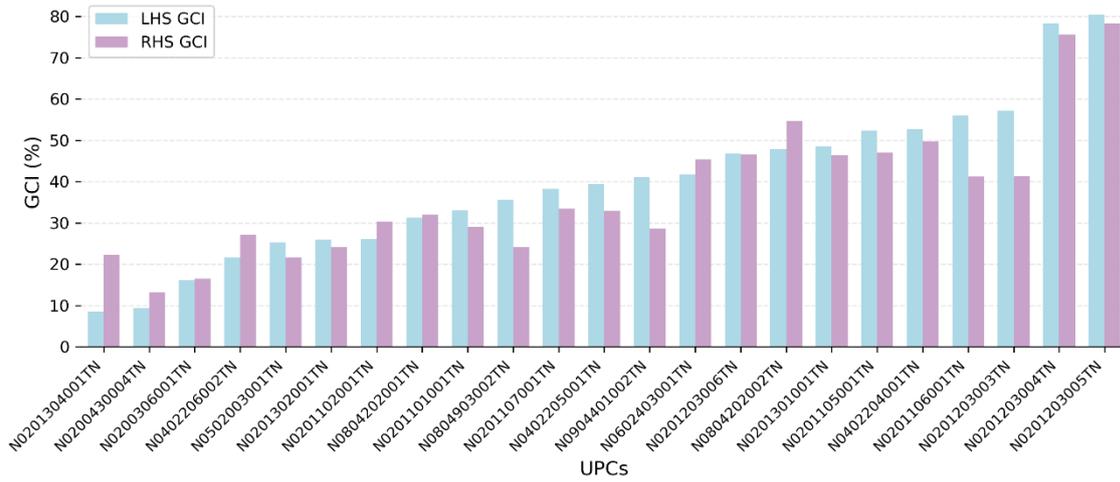
Figure 74 Bar chart depicting UPC wise LHS, RHS GCI values of Tamil Nadu

Figure 75 Satellite view of Tamil Nadu with 23 UPCs overlaid

Table 56 Satellite data details used for GCI analysis of Tamil Nadu

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-07-06	102	66	C
RS2/L4	2024-08-23	102	65	C
RS2/L4	2024-09-11	101	66	D
RS2/L4	2024-09-11	101	66	D
RS2/L4	2024-09-16	102	64	B
RS2/L4	2024-09-16	102	65	D
RS2/L4	2024-10-29	101	64	D
RS2/L4	2024-10-29	101	66	B
RS2A/L4	2024-08-25	100	66	B
RS2A/L4	2024-08-25	100	66	D
RS2A/L4	2024-10-17	101	67	B
RS2A/L4	2024-11-10	101	67	A
RS2A/L4	2024-11-10	101	66	A
RS2A/L4	2024-11-10	101	65	C
RS2A/L4	2024-11-10	101	64	C
RS2A/L4	2024-11-10	101	66	C
RS2A/L4	2024-11-10	101	66	A
RS2A/L4	2024-11-10	101	68	A
RS2A/L4	2024-11-10	101	67	C
RS2A/L4	2024-11-10	101	65	A
RS2A/L4	2024-11-10	101	65	C
RS2A/L4	2024-11-10	101	67	A
RS2A/L4	2024-12-23	100	66	A
RS2A/L4	2024-12-28	101	68	C
Sentinel-2B/MSI (Level-2A)	2024-09-19	19		T43PGN
Sentinel-2B/MSI (Level-2A)	2024-12-18	19		T43PGM

Telangana GCI Analysis:

For the state of Telangana, 18 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 57.

GCI Results:

Cumulative results of Telangana: Cumulative GCI of entire State having 18 no. of projects is 43.57 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
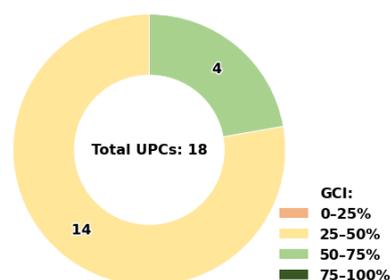

Table 57 UPC wise statistics for Telangana

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0200916001TS	RO-Hyderabad	Kamareddy	4L PS	44	30.95	34.63	19.76	27.51
N0400512001TS	RO-Hyderabad	Gajwel	4L	161	46.83	22.31	33.44	27.88
N0200915001TS	RO-Hyderabad	Kamareddy	4L	44	53.02	37.84	19.55	28.76
N0400513002TS	RO-Hyderabad	Gajwel	4L	161	40.03	35.12	34.52	34.82
N0200914001TS	RO-Hyderabad	Kamareddy	4L	44	54.59	30.54	39.91	35.61
N0501101001TS	RO-Hyderabad	Khammam-II	4L	365BB	58.63	38.94	37.40	38.18
N0400511001TS	RO-Hyderabad	Gajwel	4L	161	49.06	40.77	35.72	38.22
N0200917001TS	RO-Hyderabad	Kamareddy	4L	44	60.29	41.81	35.57	38.69
N0905501001TS	RO-Hyderabad	Hyderabad	2L PS	765	86.08	45.46	33.75	39.60

N0201002001TS	RO-Hyderabad	Mahabubnagar	4L	44	55.72	36.59	45.43	41.01
N0201003001TS	RO-Hyderabad	Mahabubnagar	4L	44	74.41	46.15	38.65	42.41
N0600301001TS	RO-Hyderabad	Warangal	4L	163	35.97	49.61	37.61	43.61
N0800203002TS	RO-Hyderabad	Mancherial	4L	363	52.6	44.80	44.38	44.59
N0200918001TS	RO-Hyderabad	Kamareddy	4L	44	96.98	52.63	38.31	45.47
N0800206003TS	RO-Hyderabad	Warangal	2L	365	32.84	53.45	51.33	52.42
N0201001001TS	RO-Hyderabad	Hyderabad	4L	44	46.33	56.69	48.72	52.70
N0600302001TS	RO-Hyderabad	Warangal	4L	163	99.1	54.27	54.67	54.47
N0905601001TS	RO-Hyderabad	Khammam-I	2L PS	365	48.66	65.73	61.59	63.66
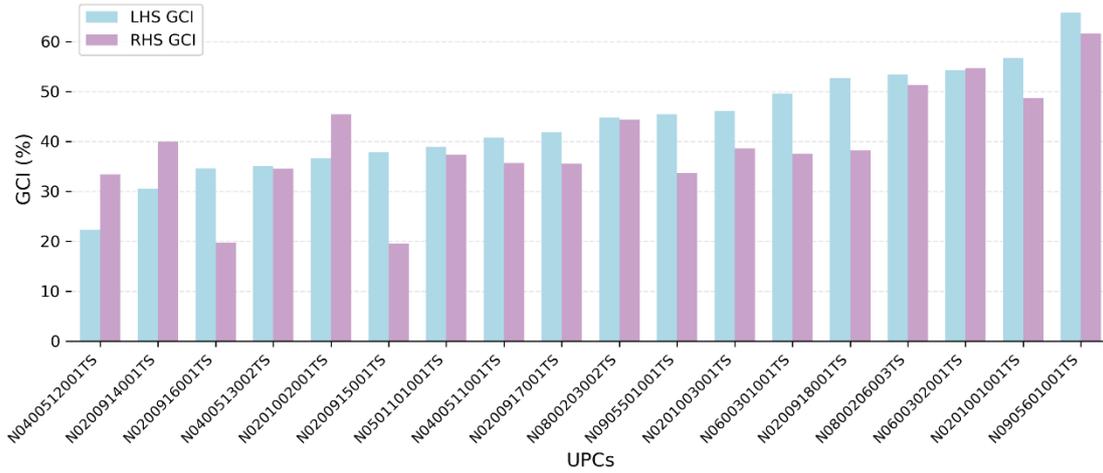
Figure 76 Bar chart depicting UPC wise LHS, RHS GCI values of Telangana
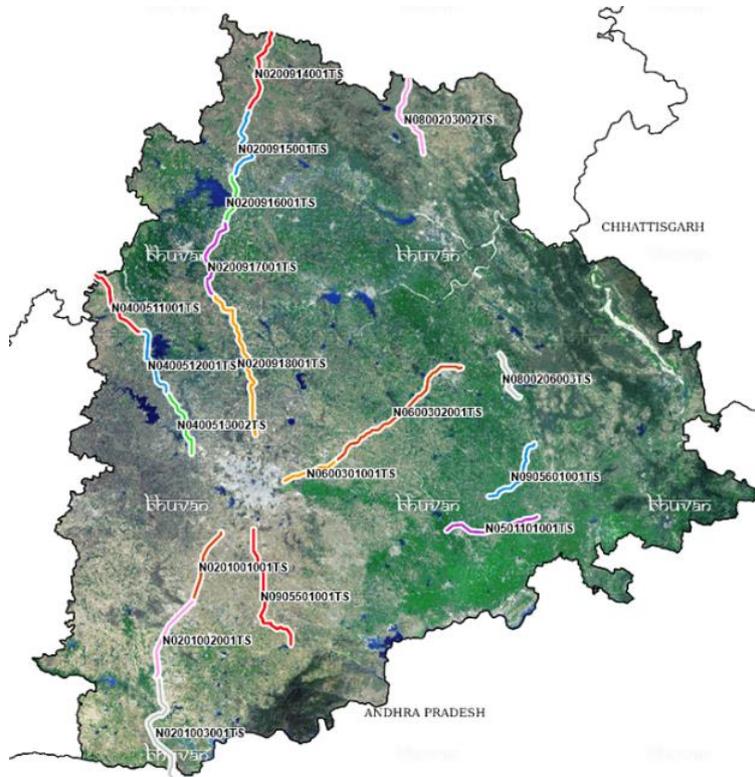
Figure 77 Satellite view of Telangana with 18 UPCs overlaid

Table 58 Satellite data details used for GCI analysis of Telangana

Table 58 Satellite data details used for GCI analysis of Telangana

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-09-30	100	60	D
RS2/L4	2024-10-29	101	60	D
RS2/L4	2024-11-17	100	61	B
RS2/L4	2024-11-22	101	60	A
RS2/L4	2024-11-22	101	060	C
RS2/L4	2024-11-22	101	60	C
RS2/L4	2024-11-22	101	61	A
RS2/L4	2024-12-11	100	059	C
RS2/L4	2024-12-30	99	59	B
RS2A/L4	2024-11-05	100	60	C
RS2A/L4	2024-11-24	99	60	B
RS2A/L4	2024-11-24	99	59	D
RS2A/L4	2024-11-24	99	60	D
RS2A/L4	2024-11-24	99	58	D
RS2A/L4	2024-11-24	99	61	D
RS2A/L4	2024-11-29	100	59	B
RS2A/L4	2024-12-18	99	60	A
RS2A/L4	2024-12-23	100	62	A
RS2A/L4	2024-12-23	100	61	A
RS2A/L4	2024-12-23	100	61	C

Uttar Pradesh GCI Analysis:

For the state of Uttar Pradesh, 46 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 59.

GCI Results:

Cumulative results of Uttar Pradesh: Cumulative GCI of entire State having 46 no. of projects is 34.5 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
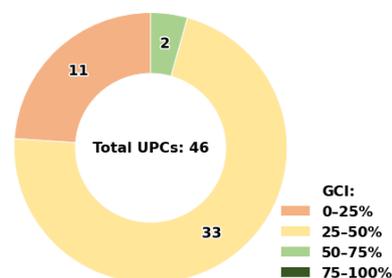
Table 59 UPC wise statistics for Uttar Pradesh

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0202103001UP	RO-UP West	Lucknow	4L	Lucknow Outer Ring Road	32.89	19.06	10.71	14.98
N0802303001UP	RO-UP East	Raebareli	4L	330A	61.01	15.77	18.54	17.14
N0202104002UP	RO-UP West	Lucknow	4L	Lucknow Outer Ring Road	14.51	17.51	17.41	17.46
N0200503001UP	RO-UP West	Agra	6L	19	124.69	22.01	15.14	18.57
N0804002001UP	RO-UP East	Gorakhpur	4L	24	65.71	19.73	19.32	19.53
N0401907001UP	RO-UP East	Varanasi	4L	135	43.59	23.68	16.65	20.15
N0202107002UP	RO-UP East	Gorakhpur	4L	27	31.66	16.45	24.59	20.63
N0804103002UP	RO-UP East	Gorakhpur	2L PS	28	65.82	24.56	16.86	20.67
N0803403013UP	RO-UP East	Azamgarh	2L	31	68.44	24.86	17.10	20.99
N0202102002UP	RO-UP West	Lucknow	4L	Lucknow Outer Ring Road	31.99	27.60	18.53	23.25
N0504501001UP	RO-UP West	Agra	2L	509	77.93	25.46	23.27	24.20
N0402004001UP	RO-UP West	Moradabad	4L	9, 530, 30	121.03	30.57	22.69	26.62
N0802301001UP	RO-UP East	Raebareli	2L PS	335	115.97	30.85	23.24	27.04
N0200504001UP	RO-UP West	Kanpur	6L	19	160.26	30.31	24.69	27.50
N0200510001UP	RO-UP East	Varanasi	4L	135B	15.74	24.41	32.49	28.45

|									
N0804103001UP	RO-UP East	Gorakhpur	2L PS	28		53.20	34.20	25.23	29.72
N04017711001UP	RO-UP West	Kanpur	2L PS	34		123.84	25.81	35.16	30.48
N0202107001UP	RO-UP East	Gorakhpur	4L	24		16.53	39.41	24.89	32.25
N0200505001UP	RO-UP West	Kanpur	6L	19		145.49	38.30	27.90	32.53
N0402104001UP	RO-UP West	Aligarh	4L/6L	34		75.04	35.77	29.48	32.66
N0802003001UP	RO-UP East	Varanasi	4L	731		63.3	31.63	35.56	33.56
N0402006001UP	RO-UP West	Lucknow	4L	30		74.98	41.88	26.37	34.13
N0701304001UP	RO-UP West	Lucknow	2L PS	927		53.84	25.35	43.93	34.63
N0202101010UP	RO-UP West	Lucknow	4L	27		70.62	38.60	31.55	35.08
N0401909001UP	RO-UP East	Varanasi	4L	35		33.97	38.61	32.96	35.81
N0804101001UP	RO-UP East	Raebareli	2L PS	128		148.60	39.66	33.72	36.69
N0202106001UP	RO-UP East	Gorakhpur	4L	27		116.14	36.73	36.82	36.78
N0801801001UP	RO-UP West	Kanpur	4L	31		69.99	43.35	30.57	36.97
N0803403014UP	RO-UP East	Azamgarh	2L	31		45.14	46.51	31.55	39.03
N0200507001UP	RO-UP East	Prayagraj	4L	30		5.48	58.89	26.18	39.45
N0200809001UP	RO-UP West	Jhansi	4L	44		49.96	43.15	36.90	40.01
N0200802001UP	RO-UP West	Agra	4L	44		32.78	38.83	41.43	40.13
N0202104001UP	RO-UP West	Lucknow	4L	Lucknow Outer Ring Road		15.03	47.81	33.80	40.83
N0200509001UP	RO-UP East	Varanasi	4L	135B		16.57	36.73	45.82	41.41
N0402102001UP	RO-UP West	Aligarh	4L/6L	34		52.10	50.04	33.41	42.05
N0805603001UP	RO-Dehradun	Roorkee	4L	344		51.67	39.91	45.14	42.53
N0803501001UP	RO-Delhi	Meerut	4L	34		59.46	49.08	36.06	42.57
N0701303002UP	RO-UP West	Lucknow	2L PS	927		42.31	40.02	45.34	42.67
N0202201001UP	RO-UP East	Gorakhpur	4L	27		80.83	45.52	40.47	43.22
N0701303001UP	RO-UP West	Lucknow	2L PS	927		50.64	44.56	42.94	43.75
N0401908001UP	RO-UP East	Varanasi	4L	35, 135		47.59	47.68	41.23	44.43
N0200506001UP	RO-UP East	Prayagraj (WB)	4L	19		84.22	38.65	50.70	44.67
N0202001001UP	RO-UP West	Jhansi	4L	27		135.93	46.07	48.67	47.36
N0202002001UP	RO-UP West	Kanpur	4L	27		62.23	47.52	48.55	47.97
N0200810001UP	RO-UP West	Jhansi	4L	44		49.01	56.04	53.93	54.99
N0801803001UP	RO-UP East	Prayagraj (WB)	2L/4L	319D & 31		32.18	75.42	72.87	74.14
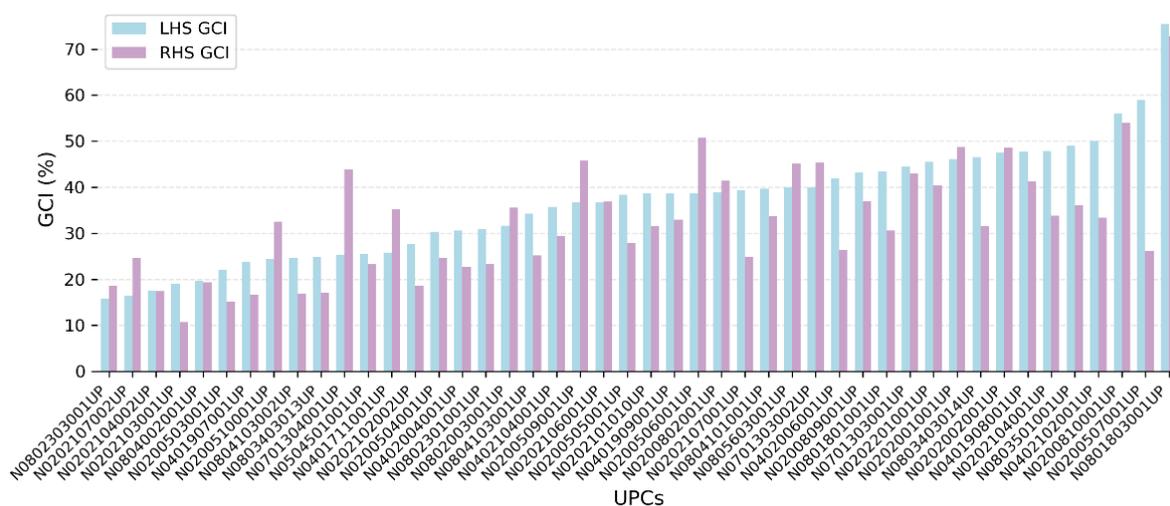
Figure 78 Bar chart depicting UPC wise LHS, RHS GCI values of Uttar Pradesh

Figure 79 Satellite view of Uttar Pradesh with 46 UPCs overlaid

Table 60 Satellite data details used for GCI analysis of Uttar Pradesh

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-10-05	101	53	C
RS2/L4	2024-10-19	99	53	A
RS2/L4	2024-10-29	101	53	B
RS2/L4	2024-10-29	101	52	D
RS2/L4	2024-11-12	99	53	B
RS2/L4	2024-11-21	96	50	A
RS2/L4	2024-11-22	101	53	A
RS2/L4	2024-11-26	97	52	A
RS2/L4	2024-11-26	97	52	C
RS2/L4	2024-11-27	102	54	C
RS2/L4	2024-11-27	102	53	A
RS2/L4	2024-11-27	102	53	C
RS2/L4	2024-11-27	102	52	C
RS2/L4	2024-12-01	98	51	C
RS2/L4	2024-12-01	98	52	C
RS2/L4	2024-12-11	100	53	C
RS2/L4	2024-12-11	100	54	A
RS2/L4	2024-12-11	100	53	A
RS2/L4	2024-12-11	100	52	C
RS2/L4	2024-12-15	96	51	B
RS2/L4	2024-12-15	96	51	D
RS2/L4	2024-12-21	102	53	B
RS2/L4	2024-12-21	102	53	D
RS2/L4	2024-12-26	103	53	D
RS2A/L4	2024-10-17	101	54	B

RS2A/L4	2024-10-17	101	53	D
RS2A/L4	2024-10-22	102	54	B
RS2A/L4	2024-10-22	102	52	D
RS2A/L4	2024-10-26	98	53	D
RS2A/L4	2024-10-26	98	53	B
RS2A/L4	2024-10-26	98	54	D
RS2A/L4	2024-10-26	98	54	B
RS2A/L4	2024-10-31	99	53	C
RS2A/L4	2024-11-10	101	54	A
RS2A/L4	2024-11-10	101	53	C
RS2A/L4	2024-11-15	102	54	A
RS2A/L4	2024-11-19	98	54	A
RS2A/L4	2024-11-19	98	54	C
RS2A/L4	2024-11-20	103	53	A
RS2A/L4	2024-11-20	103	54	A
RS2A/L4	2024-11-24	99	54	B
RS2A/L4	2024-11-24	99	53	D
RS2A/L4	2024-11-29	100	51	D
RS2A/L4	2024-11-29	100	53	D
RS2A/L4	2024-11-29	100	52	B
RS2A/L4	2024-11-29	100	52	D
RS2A/L4	2024-11-29	100	53	B
RS2A/L4	2024-12-08	97	51	B
RS2A/L4	2024-12-08	97	52	D
RS2A/L4	2024-12-08	97	52	B
RS2A/L4	2024-12-13	98	51	D
RS2A/L4	2024-12-13	98	52	D
RS2A/L4	2024-12-18	99	53	C

Uttarakhand GCI Analysis:

For the state of Uttarakhand, 07 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 61.

GCI Results:

Cumulative results of Uttarakhand: Cumulative GCI of entire State having 07 no. of projects is 39.78 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
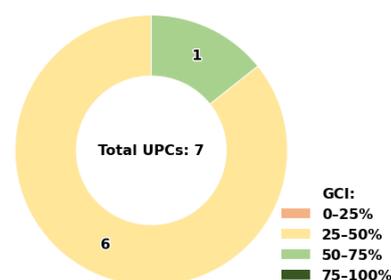
Table 61 UPC wise statistics for Uttarakhand

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0803504010UK	RO-Dehradun	Roorkee	4L	34 & 334	39.20	23.81	29.24	26.62
N0806501001UK	RO-Dehradun	Rudrapur	4L	9	43.51	27.46	35.82	31.59
N0805604001UK	RO-Dehradun	Roorkee	4L	307 & 344	53.09	36.39	36.84	36.61
N0803504011UK	RO-Dehradun	Roorkee	4L	334	37.48	41.51	39.98	40.67
N0806502001UK	RO-Dehradun	Rudrapur	4L	109	49.81	45.60	38.75	42.17
N0804401003UK	RO-Dehradun	Rudrapur	2L PS	9	44.31	49.14	48.33	48.73
N0803202001UK	RO-Dehradun	Najibabad	4L	734	100.60	49.66	51.47	50.48
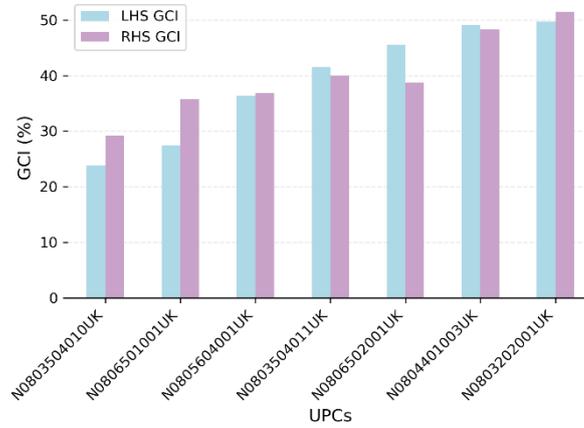
Figure 80 Bar chart depicting UPC wise LHS, RHS GCI values of Uttarakhand

Figure 81 Satellite view of Uttarakhand with 7 UPCs overlaid

Table 62 Satellite data details used for GCI analysis of Uttarakhand

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-11-21	96	50	A
RS2/L4	2024-11-26	97	50	C

RS2/L4	2024-12-15	96	50	B
RS2/L4	2024-12-15	96	50	D
RS2A/L4	2024-10-31	99	51	A
RS2A/L4	2024-11-19	98	51	A
RS2A/L4	2024-12-08	97	51	B
RS2A/L4	2024-12-08	97	50	D
RS2A/L4	2024-12-13	98	51	B

West Bengal GCI Analysis:

For the state of West Bengal, 9 UPCs projects have been estimated in the current cycle of assessment. List of projects with project details are placed in Table 63.

GCI Results:

Cumulative results of Uttar Pradesh: Cumulative GCI of entire State having 09 no. of projects is 41.32 considering Avenue Plantations. This value is derived on the basis of GCI estimated for individual projects as detailed below:
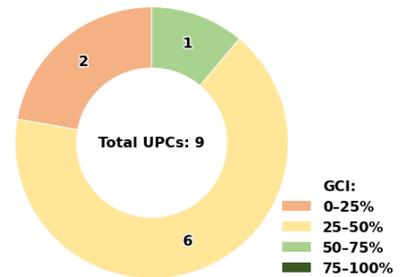
Table 63 UPC wise statistics for West Bengal

UPC	Regional Office	PIU	Lane	NH	Length (km)	LHS GCI	RHS GCI	Avenue GCI
N0202502001WB	RO-Kolkata	Jalpaiguri	4L	27	10.27	15.36	23.68	19.52
N0200518001WB	RO-Kolkata	Durgapur	4L	19	67.75	22.60	19.39	21.09
N0202601001WB	RO-Kolkata	Jalpaiguri	4L	27	26.6	20.50	29.94	25.22
N0908901001WB	RO-Kolkata	Kolkata	4L	12	6.09	20.90	33.70	26.85
N0200519001WB	RO-Kolkata	Kolkata	4L	19	64.99	28.24	28.71	28.48
N0200401001WB	RO-Kolkata	Kolkata	6L	16	111.19	36.43	39.99	38.23
N0200520001WB	RO-Kolkata	Kolkata	6L	19	7.44	32.08	48.14	38.65
N0400126001WB	RO-Kolkata	Kharagpur	4L	49	55.65	47.71	37.12	42.41
N0200402001WB	RO-Kolkata	Kharagpur	4L	16	119.49	73.66	69.56	71.62
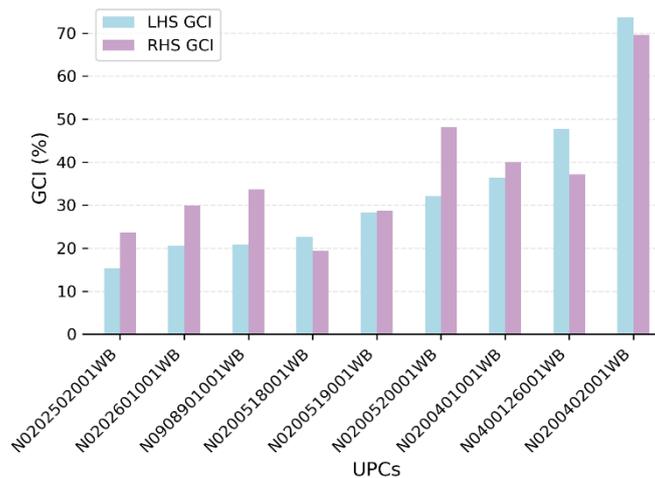
Figure 82 Bar chart depicting UPC wise LHS, RHS GCI values of West Bengal
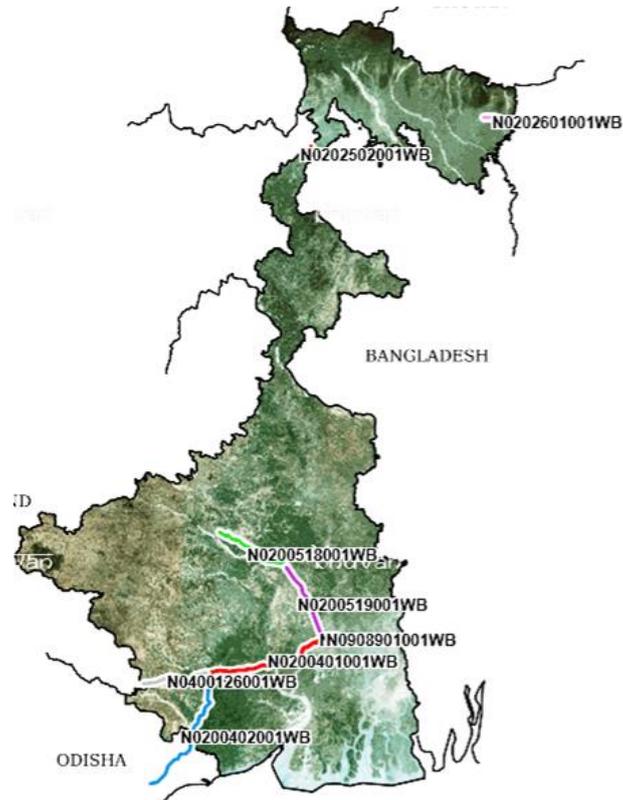
Figure 83 Satellite view of West Bengal with 9 UPCs overlaid

Table 64 Satellite data details used for GCI analysis of West Bengal

Satellite/Sensor	Date of Pass	Path	Row	Sub-Scene
RS2/L4	2024-10-11	107	056	C
RS2/L4	2024-10-11	107	057	A
RS2/L4	2024-11-04	107	56	D
RS2/L4	2024-11-28	107	53	A
RS2A/L4	2024-11-16	107	56	C
RS2A/L4	2024-11-21	108	53	B
RS2A/L4	2024-12-15	108	56	C
RS2A/L4	2024-12-15	108	56	A
Sentinel-2B/MSI (Level-2A)	2024-12-29	33		T45QWF

Annexure 3: Field Validation of GCI using survey Photographs

Field photographs have been collected using mobile application developed by NRSC across 1km segments identified for each UPC by NHAI's Field Surveyors. In each segment, observations at 4-5 locations were collected either on LHS or RHS. Surveyors were required to capture minimum two photographs at each location along with attributes. These photographs were then validated within a given AOI patch generated for 15 m x 15 m of area.

Note: 'Matched' and 'Not Matched' status of Ground Truth Validation indicates whether site photographs have matched with the GCI values at the same location.

Table 65 Field photographs validated with neighbourhood GCI (15mx15m) segment

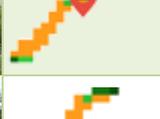| SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
1	Andhra Pradesh	N0402703001AP	201+400	13.1986, 78.7103	LHS	3			Matched
2	Andhra Pradesh	N0201004001AP	434+100	14.0074, 77.6210	RHS	8			Matched
3	Andhra Pradesh	N0200429002AP	91+000	13.7774, 79.9605	LHS	8			Matched
4	Andhra Pradesh	N0200415001AP	673+300	17.9545, 83.4172	LHS	3			Matched
5	Andhra Pradesh	N0200415001AP	647+900	18.1149, 83.5751	RHS	8			Matched
6	Andhra Pradesh	N0200413002AP	570+200	18.4942, 84.1295	RHS	9			Matched
7	Andhra Pradesh	N0200413002AP	507+200	18.8724, 84.5221	RHS	5			Matched
8	Andhra Pradesh	N0200418003AP	761+500	17.6065, 82.8769	LHS	5			Matched
9	Andhra Pradesh	N0200418003AP	812+200	17.3559, 82.5299	RHS	5			Matched
10	Andhra Pradesh	N0200423002AP	3+900	16.6236, 80.9800	RHS	7			Matched
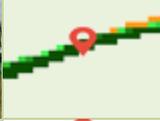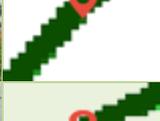
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
11	Assam	N0202605004AS	1007+000	26.4356, 90.9681	RHS	8			Matched
12	Assam	N0202605004AS	1006+800	26.4374, 90.9676	RHS	8			Matched
13	Assam	N0202605004AS	992+000	26.4814, 90.8850	LHS	8			Matched
14	Assam	N0202605004AS	991+600	26.4784, 90.8824	LHS	8			Matched
15	Assam	N0202605004AS	1011+600	26.4161, 91.0009	RHS	8			Matched
16	Assam	N0202605004AS	1012+200	26.4188, 91.0060	RHS	8			Matched
17	Assam	N0202605004AS	994+600	26.4897, 90.9043	RHS	8			Matched
18	Assam	N0202605004AS	995+000	26.4924, 90.9071	RHS	8			Matched
19	Assam	N0202701003AS	146+500	26.1533, 91.6767	RHS	7			Matched
20	Assam	N0202701003AS	146+300	26.1550, 91.6763	RHS	7			Matched
21	Bihar	N0202301002BR	495+900	26.2577, 85.1858	LHS	9			Not Matched
22	Bihar	N0202301002BR	490+900	26.2821, 85.1462	LHS	9			Matched
23	Bihar	N0202301002BR	491+100	26.2805, 85.1474	LHS	9			Matched
24	Bihar	N0202301002BR	485+700	26.3240, 85.1237	RHS	8			Matched
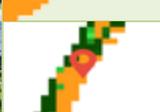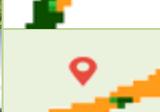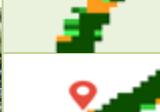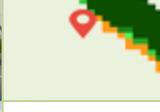
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
25	Bihar	N0202301002BR	489+100	26.2963, 85.1379	RHS	9			Matched
26	Bihar	N0202301002BR	488+700	26.2996, 85.1363	RHS	9			Matched
27	Bihar	N0802501003BR	101+500	25.0056, 85.5274	RHS	6			Matched
28	Bihar	N0802501003BR	101+100	25.0020, 85.5275	RHS	6			Matched
29	Bihar	N0907701001BR	5+600	25.3808, 86.4937	LHS	4			Matched
30	Bihar	N0907701001BR	5+200	25.3784, 86.4965	LHS	4			Matched
31	Chhattisgarh	N0400121001CG	223+200	21.1875, 82.0633	RHS	2			Matched
32	Chhattisgarh	N0400121001CG	184+200	21.2222, 82.4090	RHS	4			Matched
33	Chhattisgarh	N0400117001CG	344+600	21.0949, 81.0039	RHS	5			Matched
34	Chhattisgarh	N0400117001CG	382+600	21.0715, 80.6504	RHS	5			Not Matched
35	Chhattisgarh	N0400117001CG	391+600	21.0880, 80.5683	RHS	7			Not Matched
36	Chhattisgarh	N0400118001CG	325+700	21.1585, 81.2083	LHS	7			Matched
37	Chhattisgarh	N0400118001CG	312+700	21.2147, 81.2879	RHS	5			Matched
38	Chhattisgarh	N0400118001CG	314+700	21.2126, 81.2688	RHS	7			Matched
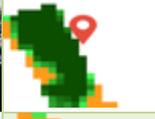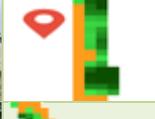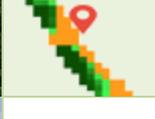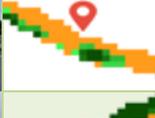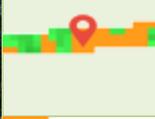
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
39	Chhattisgarh	N0400119001CG	262+300	21.2330, 81.7314	RHS	5			Matched
40	Chhattisgarh	N0400119001CG	275+300	21.2215, 81.6181	RHS	3			Matched
41	Delhi	N0200119005DL	4+300	28.8075, 77.0393	RHS	10			Matched
42	Delhi	N0200119005DL	13+300	28.8838, 77.0179	RHS	8			Matched
43	Delhi	N0100703001DL	49+900	28.7198, 77.7228	RHS	10			Matched
44	Delhi	N0100703001DL	42+100	28.7060, 77.6447	RHS	7			Matched
45	Delhi	N0100701001DL	6+000	28.6241, 77.3083	RHS	4			Matched
46	Delhi	N0100701001DL	0+200	28.5990, 77.2576	LHS	8			Matched
47	Delhi	N0100702001DL	13+600	28.6326, 77.3845	RHS	5			Matched
48	Delhi	N0100702001DL	22+600	28.6460, 77.4666	LHS	0			Matched
49	Delhi	N0100704001DL	28+200	28.6811, 77.5057	RHS	7			Not Matched
50	Delhi	N0100704001DL	48+800	28.8185, 77.6429	LHS	8			Matched
51	Gujarat	N0100106001GJ	364+300	22.3522, 73.0912	LHS	8			Matched
52	Gujarat	N0100108001GJ	313+300	21.9227, 72.9734	RHS	5			Matched

SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
53	Gujarat	N0201704001GJ	623+700	24.3772, 72.5949	LHS	10			Matched
54	Gujarat	N0400603001GJ	77+500	22.9368, 73.3176	LHS	5			Matched
55	Gujarat	N0800909001GJ	13+200	21.6621, 72.1439	LHS	8			Matched
56	Gujarat	N0100105005GJ	796+600	22.6863, 73.4855	LHS	6			Matched
57	Gujarat	N0200113002GJ	1051+800	22.1494, 73.1854	LHS	3			Matched
58	Gujarat	N0200116003GJ	335+300	20.6146, 72.9611	RHS	6			Matched
59	Gujarat	N0201401002GJ	89+300	21.7545, 70.3928	LHS	2			Matched
60	Gujarat	N0400604001GJ	177+148	22.8393, 74.1157	LHS	8			Matched
61	Gujarat	N0100109001GJ	287+500	21.6971, 72.9266	LHS	8			Matched
62	Gujarat	N0100107001GJ	347+300	22.2042, 73.1027	RHS	9			Matched
63	Haryana	N0805801001HR	16+400	28.9414, 77.0493	RHS	5			Matched
64	Haryana	N0805801001HR	24+400	28.9290, 76.9691	LHS	9			Matched
65	Haryana	N0805801001HR	24+300	28.9289, 76.9704	LHS	9			Not Matched
66	Haryana	N0805801001HR	24+200	28.9289, 76.9712	LHS	9			Matched
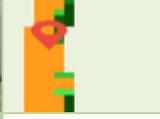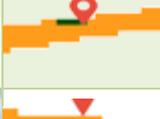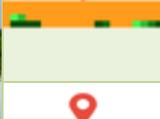
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
67	Haryana	N0805801001HR	24+100	28.9288, 76.9722	LHS	9			Not Matched
68	Haryana	N0805801001HR	24+500	28.9292, 76.9681	LHS	9			Matched
69	Haryana	N0805801001HR	16+500	28.9413, 77.0486	RHS	5			Not Matched
70	Haryana	N0805801001HR	16+200	28.9417, 77.0513	RHS	5			Matched
71	Haryana	N0805801001HR	16+100	28.9420, 77.0525	RHS	5			Not Matched
72	Haryana	N0805801001HR	16+300	28.9416, 77.0504	RHS	5			Matched
73	Himachal Pradesh	N0802106001HP	264+090	31.9656, 77.1187	LHS	8			Not Matched
74	Himachal Pradesh	N0802106001HP	264+110	31.9657, 77.1188	LHS	8			Not Matched
75	Himachal Pradesh	N0802106001HP	264+130	31.9659, 77.1189	LHS	8			Matched
76	Himachal Pradesh	N0802106001HP	264+070	31.9656, 77.1187	LHS	8			Matched
77	Himachal Pradesh	N0802106001HP	264+150	31.9660, 77.1190	LHS	8			Matched
78	Jharkhand	N0200516001JH	360+700	23.9636, 86.0606	RHS	2			Matched
79	Jharkhand	N0200516001JH	361+100	23.9614, 86.0638	RHS	2			Matched
80	Jharkhand	N0200516001JH	360+500	23.9647, 86.0590	RHS	2			Matched
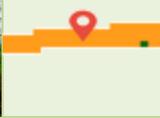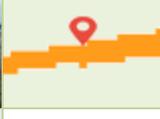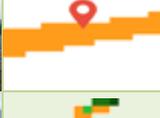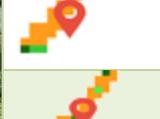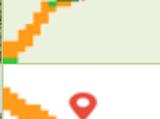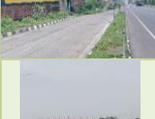
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
81	Jharkhand	N0200516001JH	360+900	23.9625, 86.0623	RHS	2			Matched
82	Jharkhand	N0500404002JH	0+100	23.4434, 85.4342	LHS	3			Matched
83	Jharkhand	N0500404002JH	0+200	23.4425, 85.4357	LHS	3			Matched
84	Jharkhand	N0500404002JH	0+300	23.4404, 85.4390	LHS	3			Not Matched
85	Jharkhand	N0802505001JH	4+100	24.2691, 85.4091	LHS	4			Matched
86	Jharkhand	N0802505001JH	41+100	24.2677, 85.4083	LHS	4			Not Matched
87	Jharkhand	N0802505001JH	4+400	24.2626, 85.4058	LHS	4			Matched
88	Jharkhand	N0802505001JH	4+200	24.2645, 85.4065	LHS	4			Matched
89	Jharkhand	N0802505001JH	41+300	24.2659, 85.4073	LHS	4			Matched
90	Karnataka	N0201005001KA	477+300	13.6894, 77.7849	RHS	9			Matched
91	Karnataka	N0201005001KA	477+100	13.6911, 77.7849	RHS	9			Matched
92	Karnataka	N0201005001KA	473+100	13.7275, 77.7862	LHS	8			Matched
93	Karnataka	N0201005001KA	473+300	13.7256, 77.7861	LHS	8			Matched
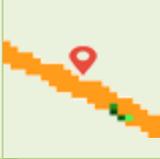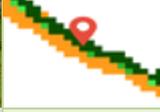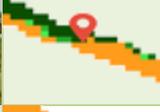
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
94	Karnataka	N0200216001KA	253+100	14.4241, 75.9754	LHS	0			Matched
95	Karnataka	N0200216001KA	253+300	14.4252, 75.9739	LHS	0			Matched
96	Karnataka	N0200216001KA	250+000	14.4065, 75.9967	RHS	0			Matched
97	Karnataka	N0200216001KA	249+900	14.4059, 75.9982	RHS	0			Matched
98	Karnataka	N0402507001KA	296+300	14.8651, 76.7779	LHS	6			Matched
99	Karnataka	N0402507001KA	296+100	14.8669, 76.7779	LHS	6			Matched
100	Karnataka	N0400203001KA	305+890	13.4436, 74.7353	LHS	7			Matched
101	Karnataka	N0400203001KA	305+290	13.4445, 74.7297	LHS	7			Matched
102	Kerala	N0400220002KL	548+300	8.5644, 76.8756	RHS	2			Matched
103	Kerala	N0400220002KL	548+100	8.5661, 76.8747	RHS	2			Matched
104	Kerala	N0400220002KL	548+500	8.5627, 76.8759	RHS	2			Matched
105	Kerala	N0400220002KL	548+900	8.5593, 76.8761	RHS	2			Matched
106	Kerala	N0400220002KL	549+500	8.5538, 76.8769	LHS	1			Matched
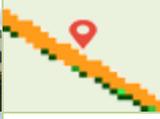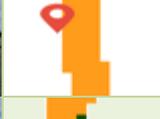
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
107	Kerala	N0400220002KL	547+800	8.5685, 76.8733	RHS	6			Matched
108	Kerala	N0400221001KL	38+000	8.3488, 77.1073	LHS	8			Matched
109	Kerala	N0400221001KL	38+600	8.3469, 77.1124	LHS	8			Matched
110	Kerala	N0400221001KL	38+400	8.3476, 77.1108	LHS	8			Matched
111	Kerala	N0400221001KL	38+200	8.3481, 77.1090	LHS	8			Matched
112	Madhya Pradesh	N0100104005MP	562+120	23.7977, 75.2668	LHS	2			Matched
113	Madhya Pradesh	N0100104008MP	634+520	23.2891, 74.8478	LHS	1			Matched
114	Madhya Pradesh	N0100104007MP	617+420	23.3967, 74.9585	LHS	0			Matched
115	Madhya Pradesh	N0100104002MP	457+320	24.5759, 75.8373	LHS	1			Matched
116	Madhya Pradesh	N0100104010MP	695+420	23.0038, 74.3564	LHS	2			Matched
117	Madhya Pradesh	N0100104009MP	657+220	23.1463, 74.6900	LHS	0			Matched
118	Madhya Pradesh	N0100104006MP	573+720	23.7104, 75.2066	LHS	1			Matched
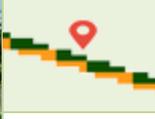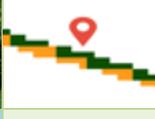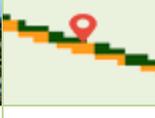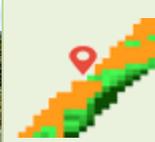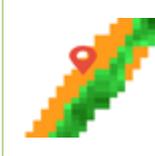
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
119	Madhya Pradesh	N0100104004MP	521+420	24.0982, 75.4913	LHS	1			Matched
120	Madhya Pradesh	N0100104003MP	486+620	24.3549, 75.6862	RHS	4			Matched
121	Madhya Pradesh	N0400409001MP	1208+800	22.4275, 75.6127	LHS	7			Matched
122	Maharashtra	N0200821001MH	1992+600	21.5344, 79.3425	RHS	6			Not Matched
123	Maharashtra	N0400417002MH	406+811	20.0408, 73.8705	RHS	8			Matched
124	Maharashtra	N0402305001MH	341+200	20.0266, 75.1561	LHS	4			Matched
125	Maharashtra	N0400508001MH	162+300	19.5386, 77.4091	LHS	6			Matched
126	Maharashtra	N0200906001MH	62+800	20.6183, 78.9297	RHS	9			Matched
127	Maharashtra	N0400412001MH	222+200	21.2103, 74.8313	LHS	8			Matched
128	Maharashtra	N0301005001MH	33+000	21.1446, 78.8812	RHS	8			Matched
129	Maharashtra	N0401401001MH	47+300	18.1951, 76.4412	RHS	7			Matched
130	Maharashtra	N0200911001MH	162+300	19.9134, 78.5385	LHS	9			Matched
131	Maharashtra	N0400102001MH	470+300	19.6846, 73.5111	RHS	10			Matched

SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
132	Maharashtra	N0401406001MH	369+900	20.1420, 77.9590	RHS	8			Matched
133	Maharashtra	N0402304001MH	311+400	19.8470, 75.2657	LHS	5			Matched
134	Odisha	N0400128001OR	278+100	21.9952, 86.1393	LHS	9			Matched
135	Odisha	N0400122001OR	18+300	21.4196, 83.8809	LHS	9			Matched
136	Odisha	N0400122001OR	26+900	21.3884, 83.8072	RHS	8			Matched
137	Odisha	N09060001003OR	0+000	20.3087, 85.8726	RHS	8			Matched
138	Odisha	N09060001003OR	6+200	20.2545, 85.8641	RHS	7			Matched
139	Odisha	N09060001003OR	26+200	20.0948, 85.8406	LHS	8			Matched
140	Odisha	N0806601001OR	236+000	22.2350, 84.7792	LHS	3			Matched
141	Odisha	N0806601001OR	232+200	22.2600, 84.7833	RHS	9			Matched
142	Odisha	N0806601001OR	220+000	22.3538, 84.7462	LHS	7			Matched
143	Odisha	N0806601001OR	222+800	22.3295, 84.7525	LHS	8			Not Matched
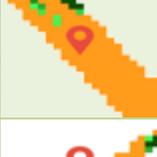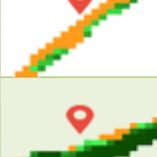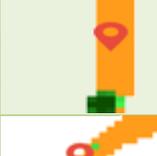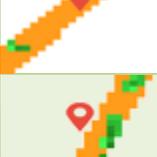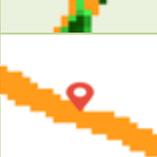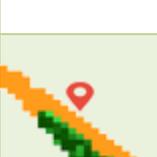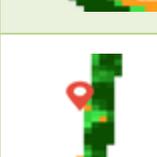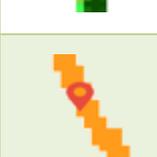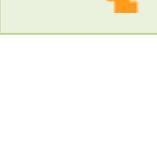
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
144	Odisha	N0905902001OR	230+900	21.9918, 85.1067	RHS	3			Matched
145	Odisha	N0905902001OR	214+300	21.9449, 85.2174	LHS	5			Matched
146	Punjab	N0400304001PB	274+400	30.3389, 74.9456	RHS	9			Matched
147	Punjab	N0400302003PB	162+100	31.1700, 74.9297	RHS	8			Matched
148	Punjab	N0400302003PB	153+900	31.2330, 74.9528	LHS	7			Matched
149	Punjab	N0400302003PB	158+100	31.1953, 74.9549	RHS	7			Matched
150	Punjab	N0400302003PB	150+900	31.2595, 74.9477	RHS	8			Matched
151	Punjab	N0100401007PB	169+100	30.1060, 76.0570	LHS	6			Matched
152	Punjab	N0100401007PB	171+600	30.1272, 76.0478	RHS	2			Matched
153	Punjab	N0100401007PB	186+700	30.2544, 75.9921	LHS	5			Matched
154	Punjab	N0200704001PB	22+700	31.5157, 75.6357	RHS	7			Matched
155	Punjab	N0200704001PB	32+700	31.6054, 75.6415	LHS	7			Matched
156	Rajasthan	N0100103005RJ	207+300	26.6944, 76.3391	LHS	1			Not Matched
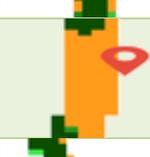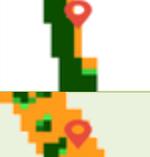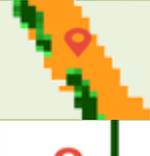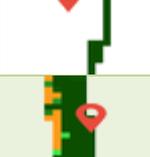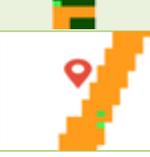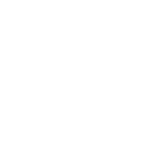
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
157	Rajasthan	N0100103002RJ	115+000	27.3762, 76.7984	RHS	2			Matched
158	Rajasthan	N0100103003RJ	132+000	27.2265, 76.7617	RHS	9			Matched
159	Rajasthan	N0201703001RJ	706+000	24.6861, 73.0997	RHS	8			Matched
160	Rajasthan	N0200104001RJ	316+800	26.7525, 75.3298	RHS	5			Matched
161	Rajasthan	N0100103006RJ	218+500	26.6091, 76.2791	LHS	2			Matched
162	Rajasthan	N0901201002RJ	217+000	23.2015, 74.2146	RHS	6			Matched
163	Rajasthan	N0400310006RJ	128+200	28.7307, 73.9561	RHS	4			Matched
164	Rajasthan	N0100103004RJ	172+100	26.9643, 76.5026	LHS	5			Matched
165	Rajasthan	N0801501001RJ	93+200	26.2665, 73.2779	RHS	0			Not Matched
166	Tamil Nadu	N0200306001TN	49+200	12.6550, 78.6018	RHS	6			Matched
167	Tamil Nadu	N0201105001TN	279+800	11.0714, 78.0080	RHS	6			Matched
168	Tamil Nadu	N0201105001TN	270+700	11.1440, 78.0221	RHS	0			Not Matched
169	Tamil Nadu	N0402204001TN	284+300	11.1125, 78.8302	RHS	8			Matched
170	Tamil Nadu	N0502003001TN	40+500	10.4449, 78.9036	LHS	8			Matched
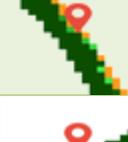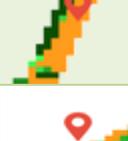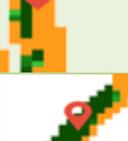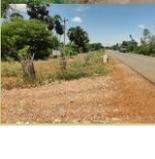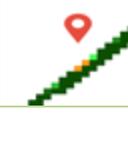
SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
171	Tamil Nadu	N0201107001TN	416+600	10.0283, 78.0147	RHS	10			Not Matched
172	Tamil Nadu	N0201107001TN	419+800	10.0011, 78.0229	LHS	10			Matched
173	Tamil Nadu	N0201203006TN	235+150	8.1375, 77.5655	LHS	8			Matched
174	Tamil Nadu	N0201203006TN	233+350	8.1490, 77.5753	LHS	10			Matched
175	Tamil Nadu	N0201203006TN	209+950	8.3466, 77.5920	RHS	10			Matched
176	Telangana	N0201001001TS	42+300	17.0962, 78.2464	LHS	7			Matched
177	Telangana	N0201002001TS	98+600	16.6632, 78.0174	LHS	7			Matched
178	Telangana	N0400511001TS	111+000	18.3565, 77.6926	LHS	9			Matched
179	Telangana	N0400512001TS	45+200	17.9334, 77.9859	RHS	7			Matched
180	Telangana	N0400513002TS	22+200	17.7626, 78.0881	RHS	10			Matched
181	Telangana	N0501101001TS	44+300	17.1992, 79.9330	RHS	6			Matched
182	Telangana	N0600301001TS	23+690	17.4501, 78.6944	LHS	3			Matched
183	Telangana	N0201003001TS	154+300	16.2040, 77.9830	LHS	4			Matched
184	Telangana	N0600302001TS	111+400	17.8413, 79.3595	LHS	7			Matched

SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
185	Telangana	N0800206003TS	183+400	18.0828, 79.8656	RHS	0			Matched
186	Uttar Pradesh	N0200809001UP	1299+900	25.2254, 78.4773	LHS	7			Matched
187	Uttar Pradesh	N0200809001UP	1275+500	25.4059, 78.4873	RHS	8			Matched
188	Uttar Pradesh	N0200809001UP	1295+900	25.2560, 78.4979	LHS	8			Matched
189	Uttar Pradesh	N0801801001UP	16+100	26.4193, 80.5684	LHS	3			Matched
190	Uttar Pradesh	N0200504001UP	237+100	26.3725, 79.9407	LHS	2			Matched
191	Uttar Pradesh	N0200506001UP	701+230	25.4495, 82.1223	LHS	10			Matched
192	Uttar Pradesh	N0200506001UP	705+830	25.4130, 82.1327	RHS	6			Matched
193	Uttar Pradesh	N0200506001UP	649+830	25.5761, 81.6829	RHS	5			Matched
194	Uttar Pradesh	N0202107002UP	1962+800	26.7040, 83.3629	LHS	9			Matched
195	Uttar Pradesh	N0202107002UP	1967+600	26.7022, 83.4102	RHS	7			Matched
196	Uttarakhand	N0805604001UK	10+300	30.0924, 77.8093	RHS	2			Matched
197	Uttarakhand	N0803504011UK	52+400	29.6690, 77.8390	RHS	7			Matched

SNo	State	UPC	Chainage	Lat, Lon	Side	Green Cover Rating	Photograph	GCI chip	Ground Truth Validation
198	Uttarakhand	N0803504011UK	66+400	29.5654, 77.7621	LHS	5			Matched
199	Uttarakhand	N0803504011UK	57+600	29.6321, 77.8103	RHS	7			Matched
200	Uttarakhand	N0806501001UK	22+100	28.8644, 79.1966	RHS	4			Matched
201	Uttarakhand	N0806501001UK	6+100	28.8017, 79.0600	RHS	5			Matched
202	Uttarakhand	N0806501001UK	41+300	28.9450, 79.3606	LHS	1			Matched
203	Uttarakhand	N0806501001UK	24+100	28.8715, 79.2157	LHS	4			Matched
204	Uttarakhand	N0806501001UK	10+500	28.8273, 79.0869	LHS	5			Matched
205	Uttarakhand	N0804401003UK	19+100	28.9400, 79.8789	RHS	4			Matched
206	West Bengal	N0200518001WB	585+200	23.1924, 88.0164	RHS	7			Not Matched
207	West Bengal	N0200518001WB	586+000	23.1887, 88.0224	RHS	7			Matched
208	West Bengal	N0200518001WB	585+400	23.1919, 88.0182	RHS	7			Matched
209	West Bengal	N0200518001WB	585+600	23.1913, 88.0201	RHS	7			Matched
210	West Bengal	N0200518001WB	585+800	23.1901, 88.0215	RHS	7			Matched

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