"Green Cover Index" for National Highways of India

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सत्यमेव जयते

भारतीय राष्ट्रीय राजमार्ग प्राधिकरण
National Highways Authority of India
Ministry of Road Transport & Highways. Government of India

इसरो isro
nrsc

Government of India
National Remote Sensing Centre
Indian Space Research Organisation
ISO 9001:2015

Introduction

National Highway Authority of India 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".

NHAI's mission

- Development, maintenance and management of National Highways
- Manage toll fee collection and regulate traffic on NHs for its proper management
- Advise the Central Government on matters relating to highways
- Assist State Government in the formulation and implementation of schemes for NH development

NHAI's role in Greening of Highways

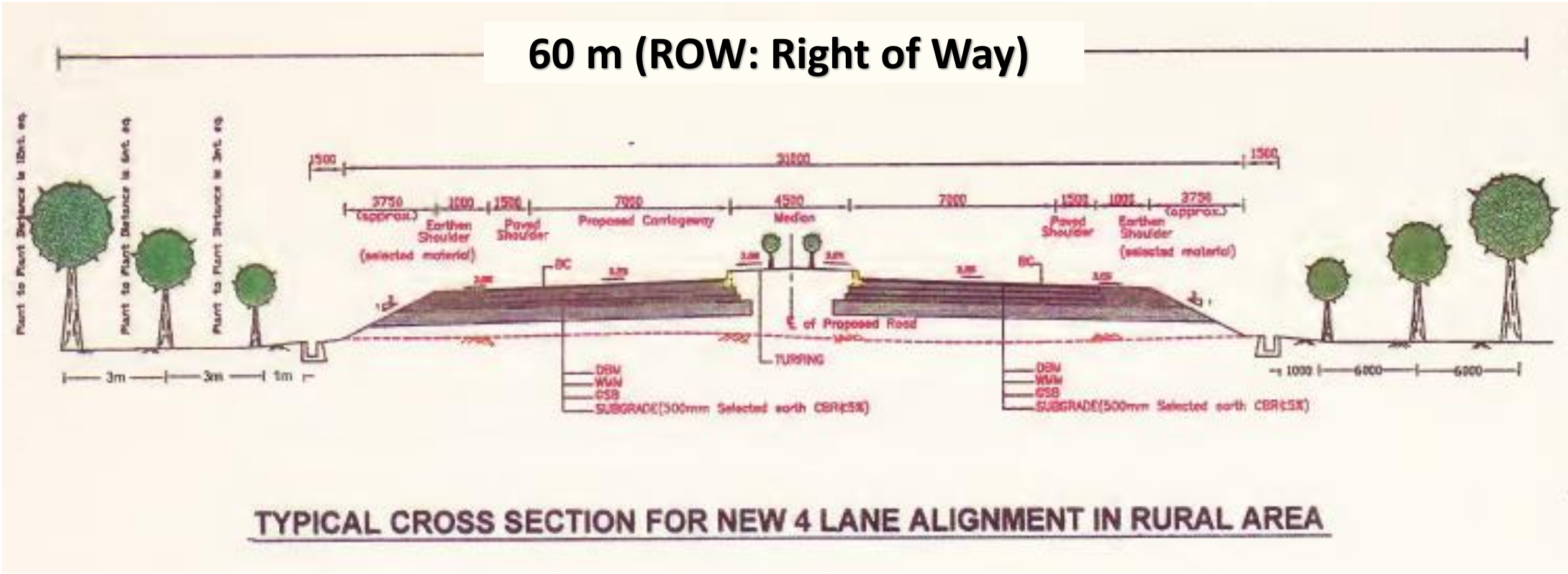
NHAI's mandate also covers objectives of the **Green Highways Policy-2015** by way of:

- Plantation,
- Transplantation,
- Beautification and
- Maintenance activities

to develop green aesthetic corridors along the National Highways by planting ornamental and flowering trees and shrubs on median and along roadside.

Photographs showing Hon'ble Minister RT&H with officials during plantation drives, personnel vising site, plantation workers on site and transplantation activities ongoing on site.

Typical Highway Cross-section



TYPICAL CROSS SECTION FOR NEW 4 LANE ALIGNMENT IN RURAL AREA

NHAI's efforts and its Monitoring

- Since 2015, **~4 Crore plants** have been planted with **52.5 lakh** in this year alone.
- **35000+ km** of National Highways are being maintained and monitored for greening.
- One-time inventory of **2.40 Crore** geo-tagged plants using mobile-based technology.

Current Scenario

- Monitoring is dependent on Field personnel on site to record and digitize status at a fixed interval.
- Digitized reports available through NHAI's Data Lake software

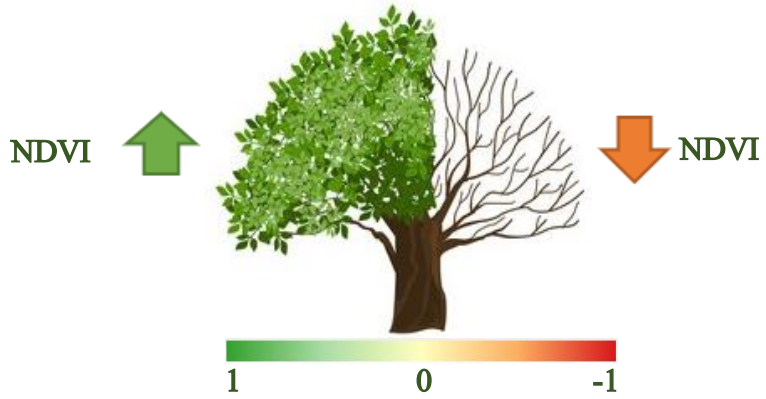
- ✖ Mostly manual paper-based method
- ✖ Labour-intensive
- ✖ Cost ineffective
- ✖ Limited insights
- ✖ Limited scope for Y-on-Y comparison

What is needed

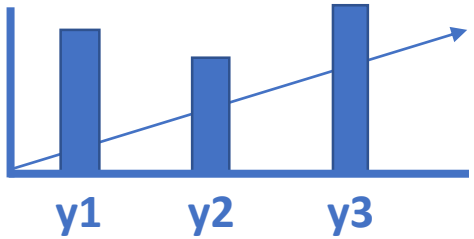
A decision support system that captures the overall status of green cover, allows spatio-temporal analysis, helps identify NH stretches that are devoid of adequate cover and provides insights for better plantation management.

What is GCI?

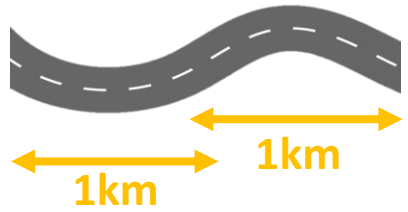
- **Green Cover Index** is a "macro-level metric" derived from satellite data that captures the health and density of plantations through their chlorophyll content based on Normalized Difference Vegetation Index (NDVI).



- **First-ever estimation of green cover on NHs** for monitoring trends and variations annually.



- A pan-India estimation of the presence or absence of green cover at an interval of **every 1 km of NH**.



Green Cover Index

Benefits

- First Pan-India estimation of Green Cover along National Highways
- Monitoring of plantations on Year-on-Year basis during projects' lifecycle
- Aid in decision support for better management of activities pertaining to greening of NHs
- Cost effective G2G approach with assurance of rolling out annual metrics
- Effective contribution towards India's international commitments like NDCs, SDGs, CoP

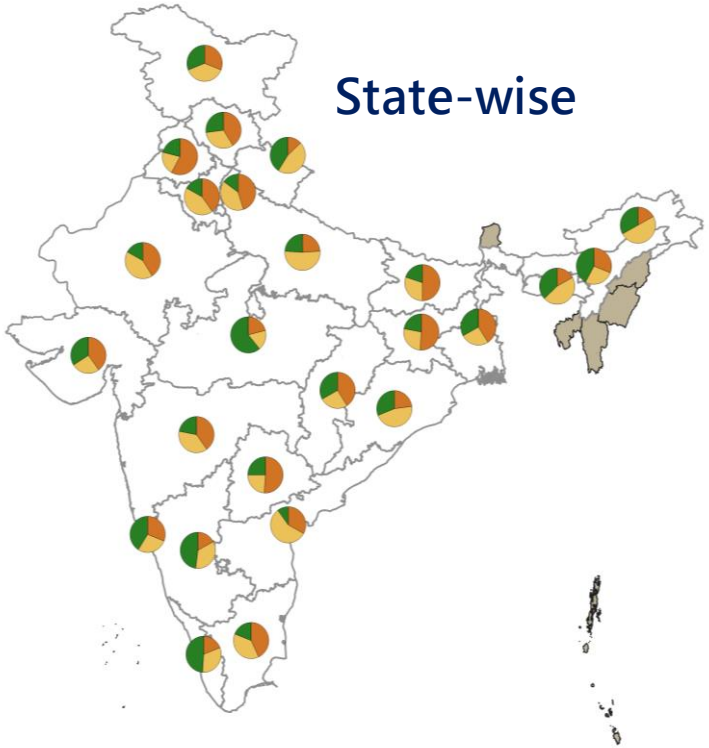
NDCs - Nationally Determined Contributions
SDGs - Sustainable Development Goals
CoP - Conference of the Parties

Rationale

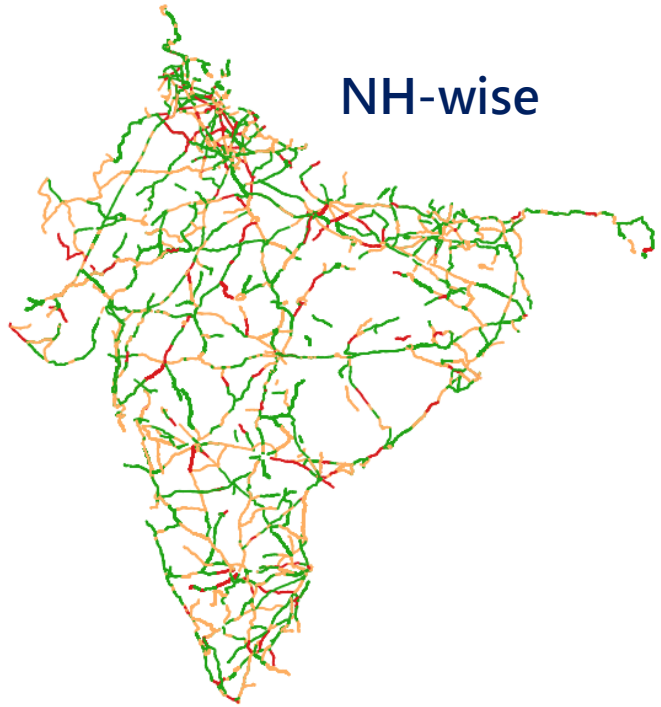
Based on the condition of green cover maintained along NHs, a disaggregated index can be built that would help in categorization and ranking:

- State-wise
- NH-wise
- RO-wise
- Project / Package-wise etc.

Data for illustrative purpose only

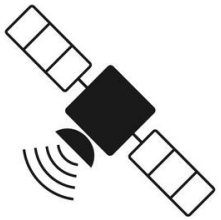


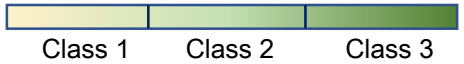
Map for illustrative purpose only



Map for illustrative purpose only

Methodology





Step I	Step II	Step III	Step IV
NDVI values ranging from -1 to 1	Classification of NDVI values	Region-specific weights	Normalized Green Cover Index

Final Deliverable: **% value of Green Cover w.r.t. the area available for plantation** would be calculated at a granularity of 1km for all NHs that may further be categorized into:

Say, 0 – 50% - **Poor Green Cover**

50 – 80% - **Moderate Green Cover**

80 – 100% - **Dense Green Cover**

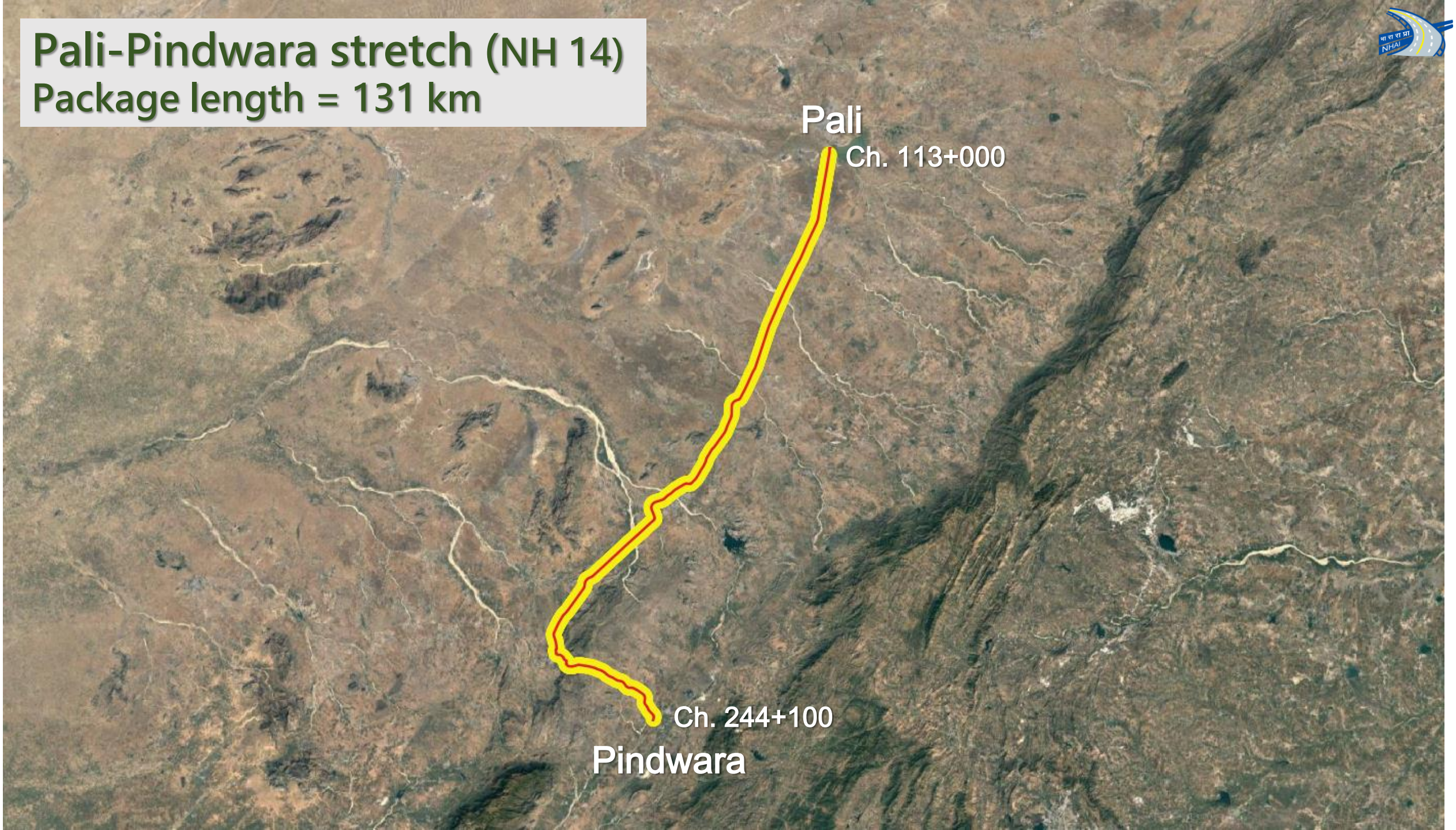
Pilot Study Results

Pali-Pindwara stretch (NH 14)
RO-Jaipur | PIU-Jodhpur | Site Visit: 16 May 2023

Amritsar-Pathankot stretch (NH 54)
RO-Chandigarh (PB) | PIU-Amritsar | Site Visit: 06 Jun 2023

Chandikhole-Paradip stretch (NH 53)
RO-Bhubaneshwar | PIU-Chandikhole | Site Visit: 08 Nov 2023

Pali-Pindwara stretch (NH 14)
Package length = 131 km



ROW

ROW

161200

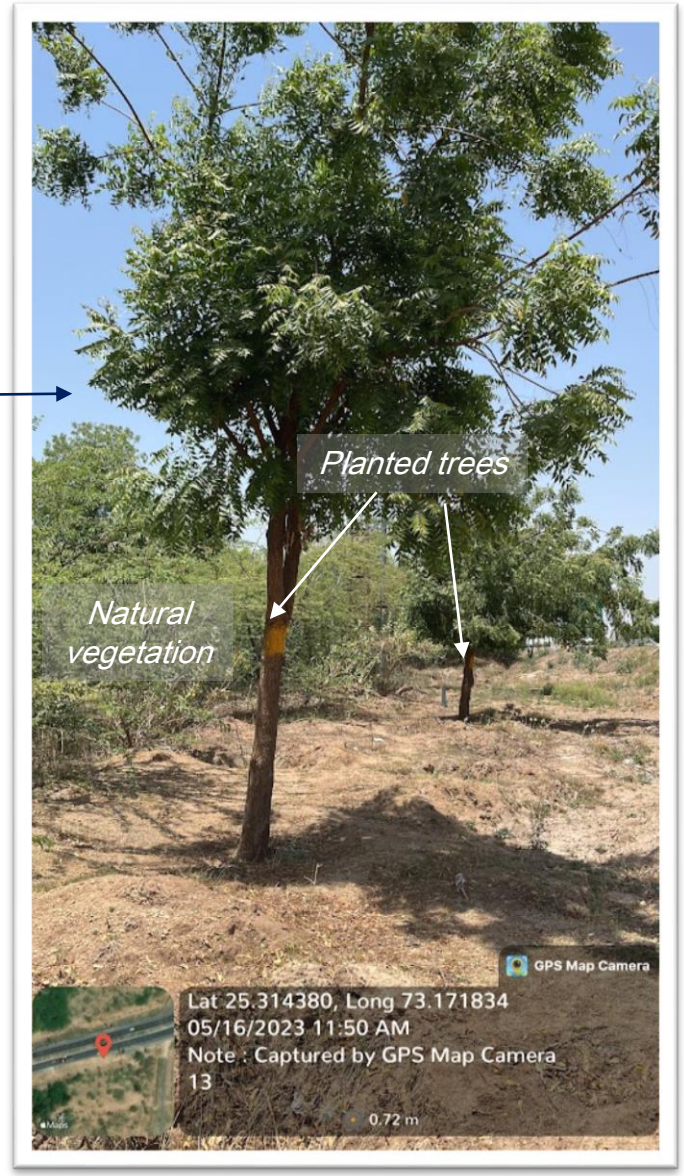
161300

Chainage :
161+200 to 161+300

Findings:
Green Cover Index / NDVI values corresponds with LHS plantations observed within the ROW

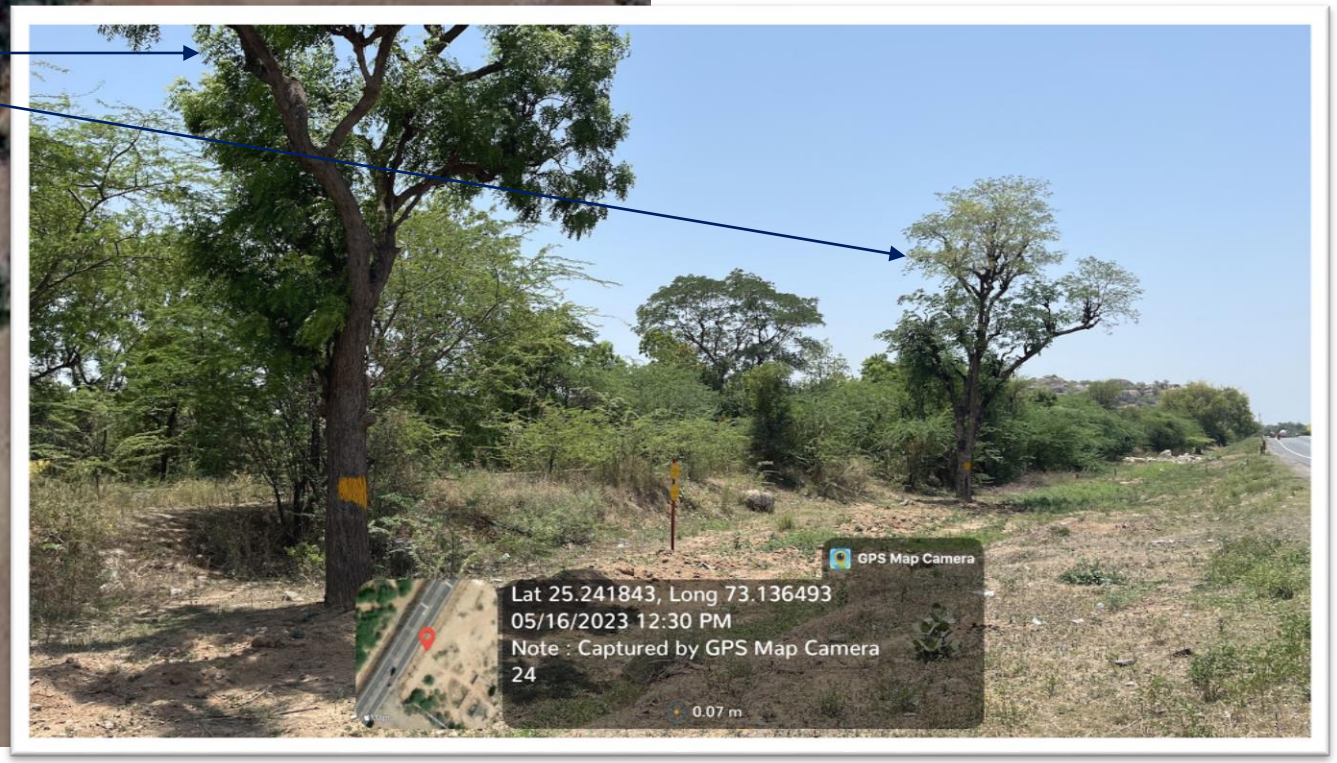
Dense/healthy plantation

Scanty/poor plantation



Chainage :
170+300 to 170+400

Findings:
Green Cover Index / NDVI values corresponds with LHS plantations observed within the ROW



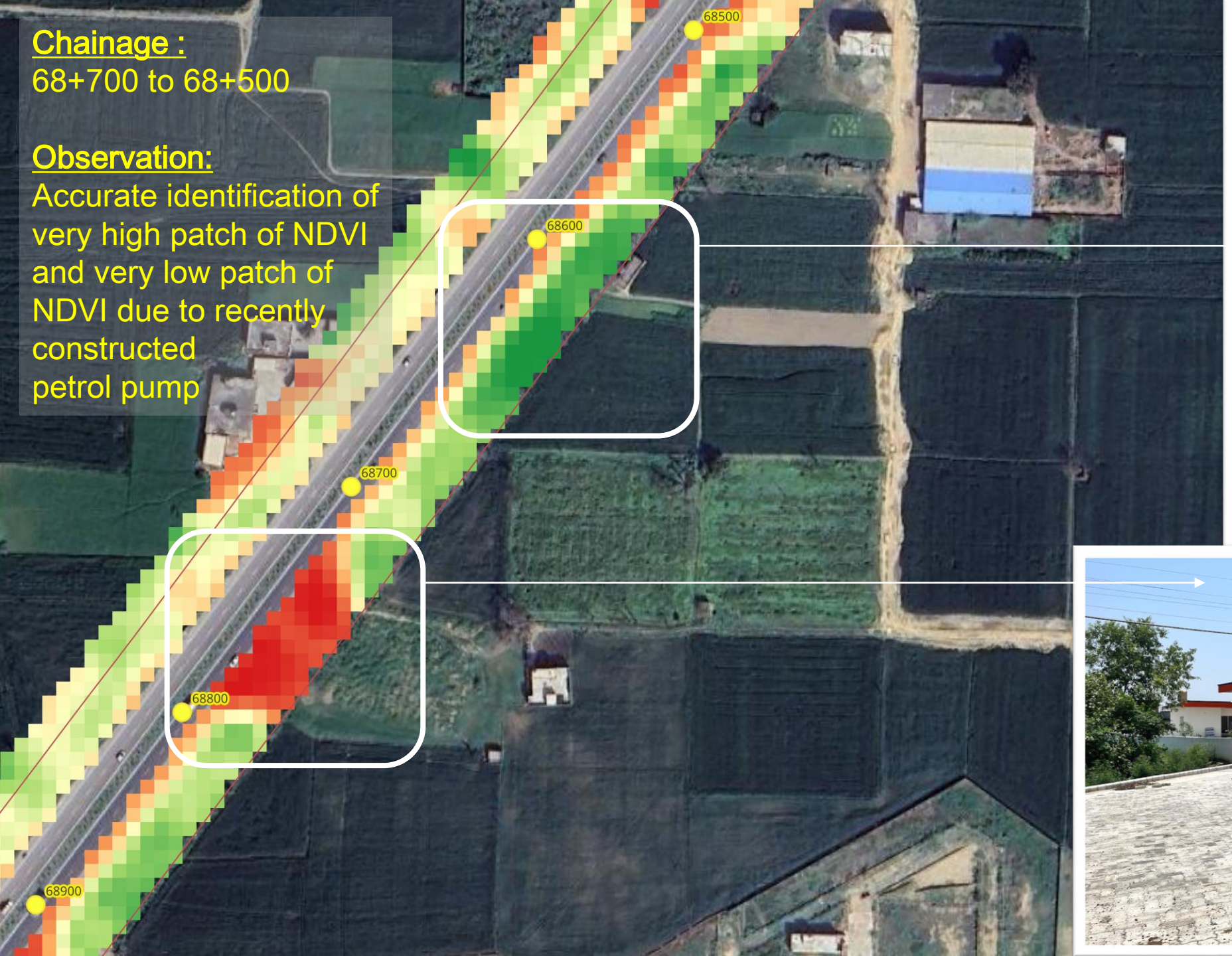
157400
157500
157600
157700
ROW
ROW
Dense / healthy plantation
Scanty / poor plantation
Chainage :
157+500
Findings:
Low Green Cover Index / NDVI values match with long term absence of green cover due to structure

Amritsar-Pathankot stretch (NH 54)

Package Length = 101 km

Chainage :
68+700 to 68+500

Observation:
Accurate identification of very high patch of NDVI and very low patch of NDVI due to recently constructed petrol pump



Chainage :
76+200 to 76+000

Observation:
The reason for low NDVI values along the NH could be attributable to the on-going widening activities.

Chandikhole-Paradip stretch (NH 53)
Package Length = 76 km
Chandikhol
Ch. 0+000
Ch. 76+588
Paradip

LHS

3.7

ROW

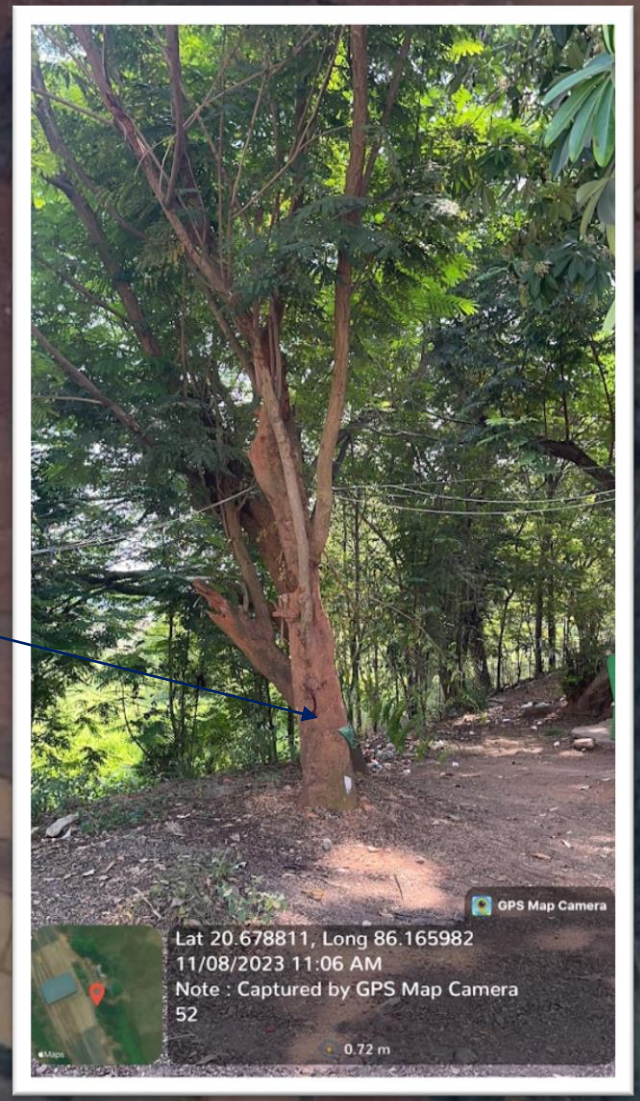
Toll Plaza

3.8

ROW

3.9

4



Chainage :
03+800 to 03+900

Observation:
Good correlation with ground condition

LHS

13.3 13.4 13.5 13.6 13.7 13.8 13.9 14 14.1 14.2 14.3 14.4 14.5 14.6 14.7 R_O49 14.8 14.9 15 15.1 15.2 15.3 15.4 15.5

Chainage :
13+800 to 14+100

Observation:
Good correlation with ground condition

MEDIAN

6.7

6.8

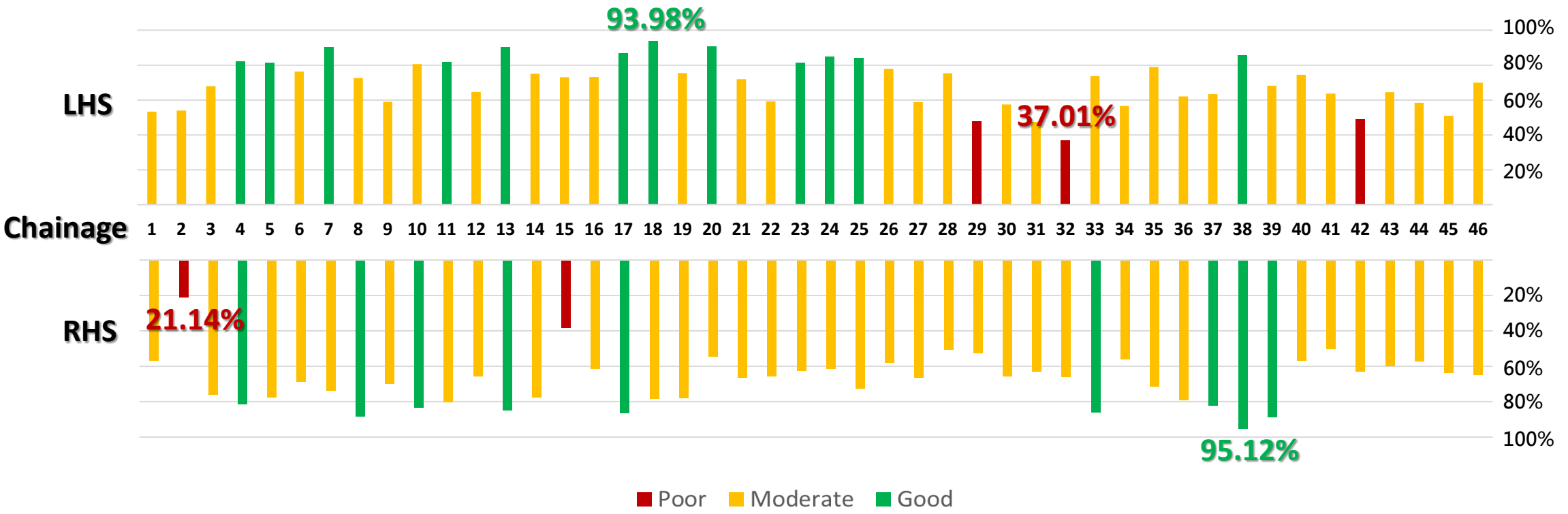
6.9

7

Chainage :
06+700 to 06+800

Observation:
Large trees in median were captured well in the data

Green Cover Statistics for every 1 km



Green Cover Index = 69.5% for 46 km of Chandikhole-Paradip

Challenges vs Benefits

- Typical ROW of 45 to 60 m leave only a few meters available for plantations;
- With a spatial resolution of ~5 m of LISS IV MX data, a very narrow segment of the imagery can be used for analysis;
- Commission/omission errors would be unavoidable;
- Errors in vectors of the highway design could lead to miscalculations;
- Exact geometric matching of scenes from one pass to the next would be a must for temporal analysis of the same location.

- Fastest and most cost effective method of deriving macro-level green cover estimates;
- High granularity of 1 km would allow NHAI to fine tune its interventions and take focused measures to improve green cover;
- Year-on-Year growth / temporal analysis of National Highways green cover;
- Other than count, GCI would present a first ever quantification of efforts made by NHAI;
- Would serve as a basis to support ranking and promote healthy competition amongst NHAI's Field Offices to maintain their stretches better.

MoU between NHAI and NRSC

MoU signed between NHAI and NRSC on 03 Jan 2024 to develop the Green Cover Index for National Highways of India in the gracious presence of Hon'ble Union Minister

NHAI and NRSC Teams Meeting at NRSC, Shadnagar to discuss roadmap and way forward

Thank you