AGRICULTURE & IRRIGATION

Theme: Transforming the Future of Indian Agriculture

In Partnership with: Mahalanobis National Crop Forecast Centre (MNCFC), AgHUB & a-idea NAARM and MILLETBANK

18 - 19 October 2023, Hyderabad, India

GEO SMART INDIA 2023

17– 19 OCTOBER 2023

HICC, HYDERABAD, INDIA

Session 2: Technical: Data Analytics & Emerging Technologies

Moderator:

Prof. Siddhartha Khare

Geomatics Engineering

Civil Engineering Dept., IIT Roorkee

& **Founder of Agritech Startup**

Bhoomicam Pvt. Ltd.

Speakers:

- **B V Ramana Kumar,** Chief Executive Officer, RSI
- **B Sivaram Prasad**, Vice President, TriCAD
- **Jigar Gupta**, Product Lead, RagaAI
- **Dr Harish Balduri,** Research Scholar, Osmania University
- **Dr Bharath Setturu,** Post - Doctoral Fellow, EWRG, CES IISc

Key Objectives of this Technical Session: Data Analytics & Emerging Technologies

- ❑ Latest advancements in data analytics and emerging technologies relevant to the agricultural sector
- ❑ Provide real-world examples of how these technologies are being deployed to enhance agricultural practices and improve outcomes
- ❑ Emphasize how data analytics and emerging technologies enable informed decision-making for farmers, agribusinesses, and policymakers.
- ❑ Illustrate how the integration of data-driven approaches contributes to sustainable and efficient agricultural systems, fostering economic growth and food security.
- ❑ Demonstrate to all stakeholders, the larger ecosystem and value of geospatial industry and technology for socio-economic impact

Challenges in Conventional Agriculture

Small Farms

Over 80% of farmers in India are small and marginal, and operate on less than 2 hectares of land. This leads to overuse and exhaustion of the soil .

Non Agricultural Use

Land is being diverted to non-agricultural purposes such as industrial, residential, or infrastructure projects.

Limited Resources

Agriculture in India suffers from lack of technology, finance, and infrastructure, leading to numerous challenges.

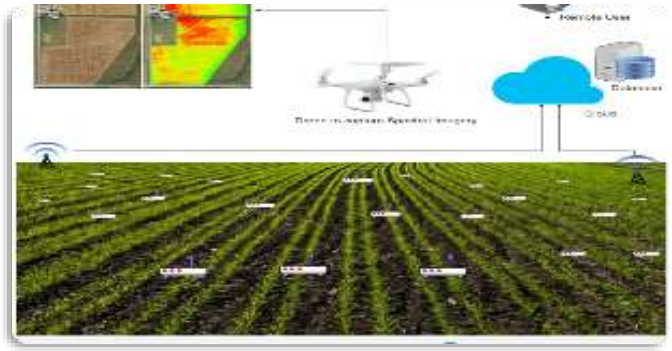
Challenges: Lack of Irrigation Facilities

1. Rain-fed Agriculture: India is still dependent on rainfall for most of its agricultural needs, which is highly erratic, leading to crop damages and low yields.

2. Low Penetration of Irrigation: Nearly 52% of the total agricultural land in India is irrigated. Also, many farmers do not have access to irrigation facilities.

3. Subsidized Electricity: The prevailing policy of free or subsidized power supply to the farmers for irrigation has led to over-exploitation of groundwater resources, thereby affecting the long-term sustainability of agriculture in the country.

Modern Farming Practice Driven by Data and Technology



Data Sensors

Revolutionary data sensors provide accurate, real-time information about weather, soil, and crop health

Drones

Drones are used to monitor crops, analyze crop health, and improve

GPS Mapping

GPS Mapping offers precision planting, crop spraying, and irrigation.

Robots

Robots are being developed to automate tasks like planting and harvesting crops.

How will Data Analytics contribute to Agriculture Industry?

Increased Efficiency ☑

Precision agriculture allows farmers to optimize resources, reduce waste and increase profits.

Improved Sustainability

With less water and fertilizers required, precision farming is an eco-friendly solution for agriculture in India.

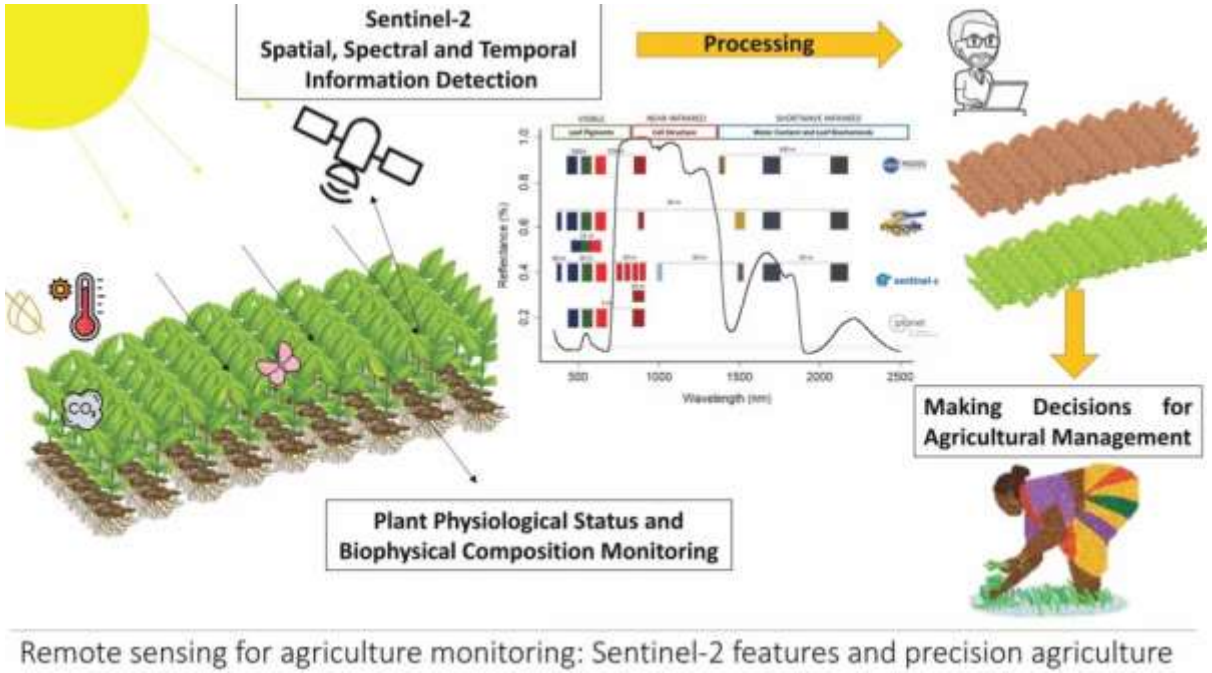
Greater Accuracy

Technology such as **drones and GPS** enable farmers to monitor crops with greater accuracy and make data-driven decisions.

Enhanced Crop Quality

By closely monitoring and adjusting variables, precision agriculture allows farmers **to grow healthier, more nutritious crops**.

Application of Satellites and Drones in Agricultural sector



Remote sensing for agriculture monitoring: Sentinel-2 features and precision agriculture

Crop Monitoring and Mapping

UAVs enable precise monitoring of crop health, growth, and yield estimation, leading to improved resource allocation.

Pest and Disease Detection

UAVs identify pests, diseases, and nutrient deficiencies in crops, allowing for targeted treatments and prevention measures.

Irrigation Management

UAVs provide valuable insights into soil moisture levels and water distribution, helping farmers optimize irrigation efficiency.

Source: https://geopard.tech/blog

Overcoming Agricultural Challenges with Technology

Predicting Crop Yield

Startups are using predictive analysis **on Remote Sensing Data** and **machine learning** to estimate crop yields, and improve re 1 ce allocation.

Farm Management Platforms

Startups are helping farmers access technology and manage their farms more efficiently.

2

Smart Irrigation

Technology like soil moisture sensors and drip irrigation systems are helping farmers optimize water resources.

3

Need of Agritech Advancements in India

Innovation

The ever-changing agricultural industry has to keep up with modern times, and these startups are ensuring the incorporation of new methods of sustainable agriculture to meet the world's food and fiber needs.

1

Increased Production

The population explodes at an alarming rate and the most feasible way to meet food demands is higher productivity.

2

3

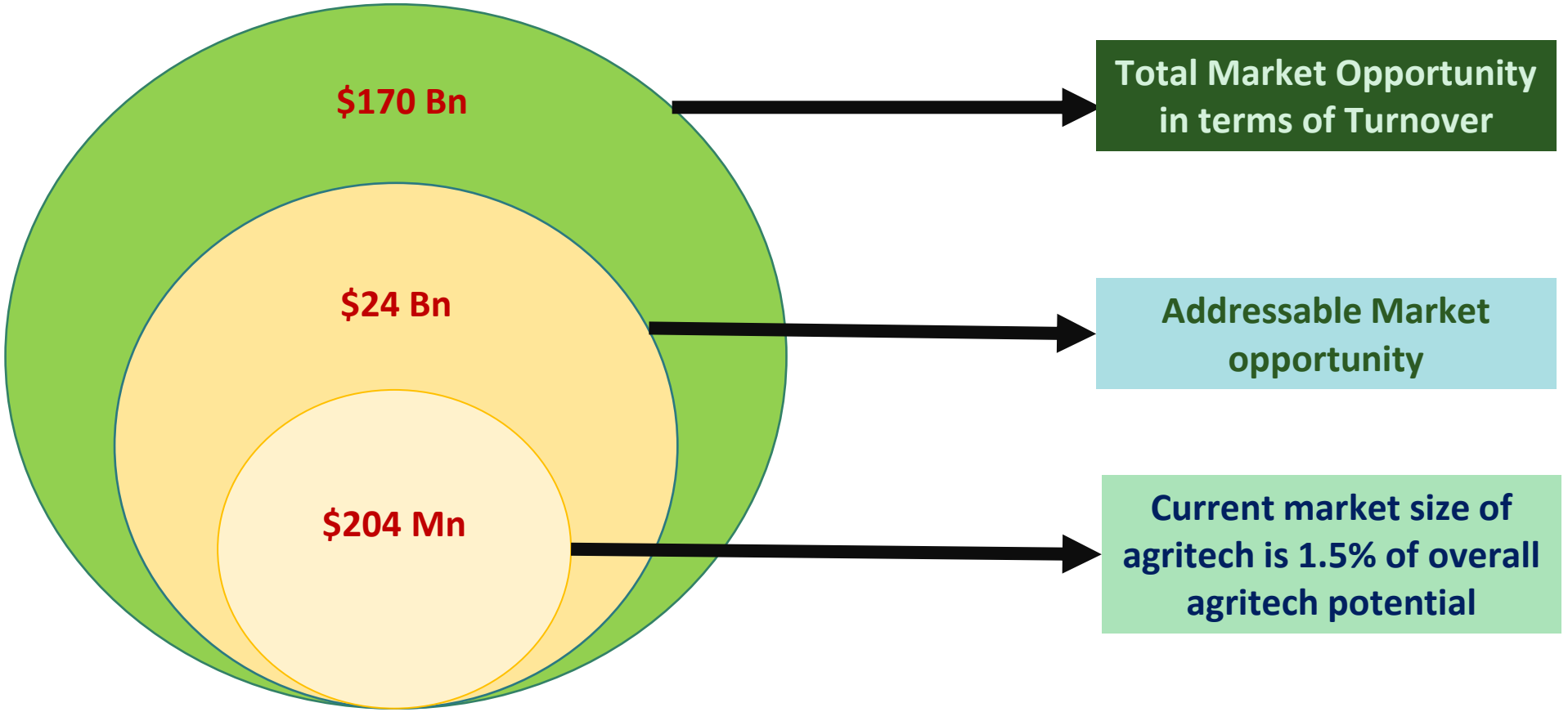
Environmental Sustainability

The introduction of sustainable farming techniques will ensure the agriculture industry does not adversely impact the environment and works towards a better future.

India’s AgriTech Landscape

- An estimated **58%** of India’s population depends on agriculture as the primary livelihood source
- Agriculture contributes ~**17%** to the national **GDP** and employing ~**54%** of the **national workforce**
- The government's vision for the **Indian economy** is to create a **technology-driven** and **knowledge-based** economy

Factors of smart agriculture (Yorghos Voutos)



Source: EY Report, Inc42 Plus 2022

Image Source: https://inc42.com/infocus/farming-3-0-india-mission-agritech/)

BHOOMICAM

Project 1: AI-Based Geo-Enabled Crop Insurance and Farm Equipment Renting Solutions under **BhoomiCam Pvt Ltd.** Startup – Funded by TIH IIT Bhilai and TIDES IIT Roorkee

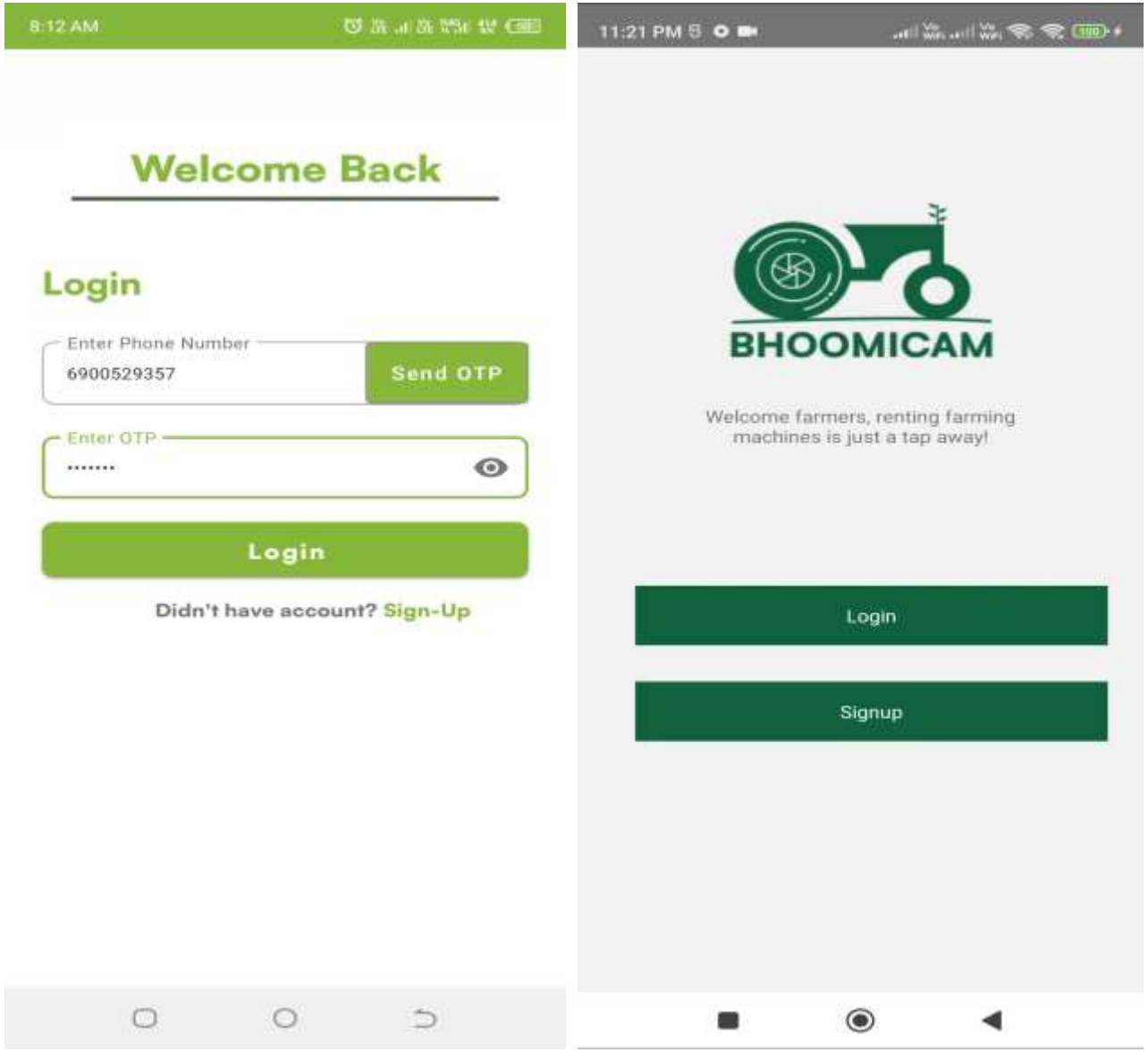
www.bhoomicam.com

Issues in Traditional Farming Practices

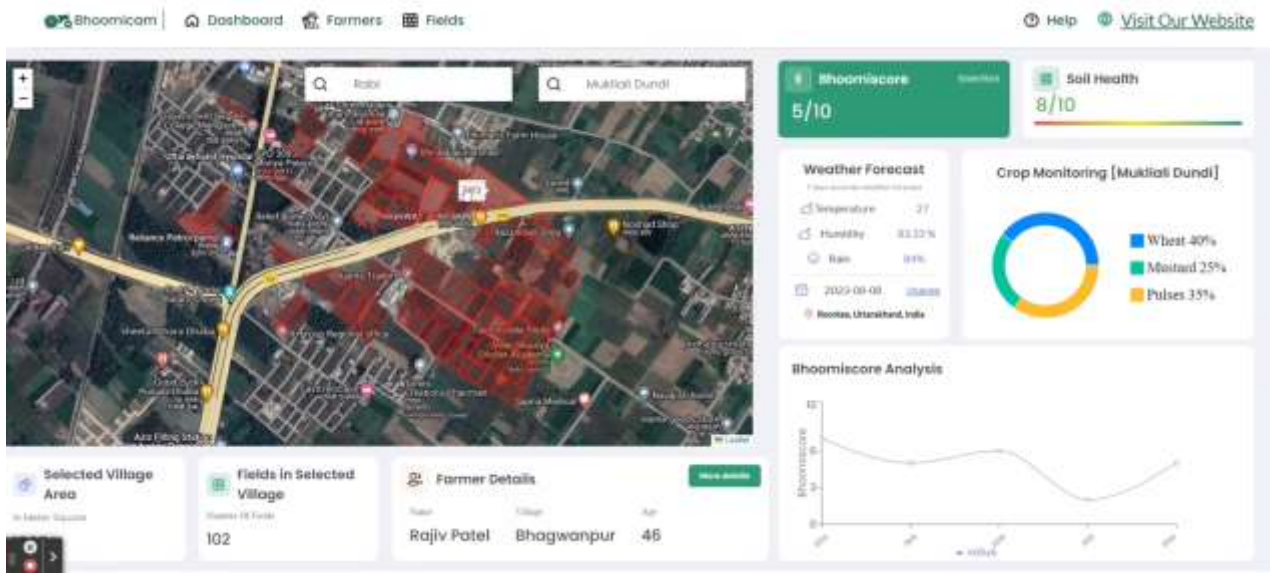
- Overuse of pesticides/fertilizers etc **->** Uneven spray of fertilizers, Health risks to farmers during manual use of pesticides, Inefficient utilization of time, money and labor, extra usage of water **-> affects agricultural productivity**
- Lack of financial means to purchase agriculture machineries/instruments for cultivation **–> affect agricultural productivity**

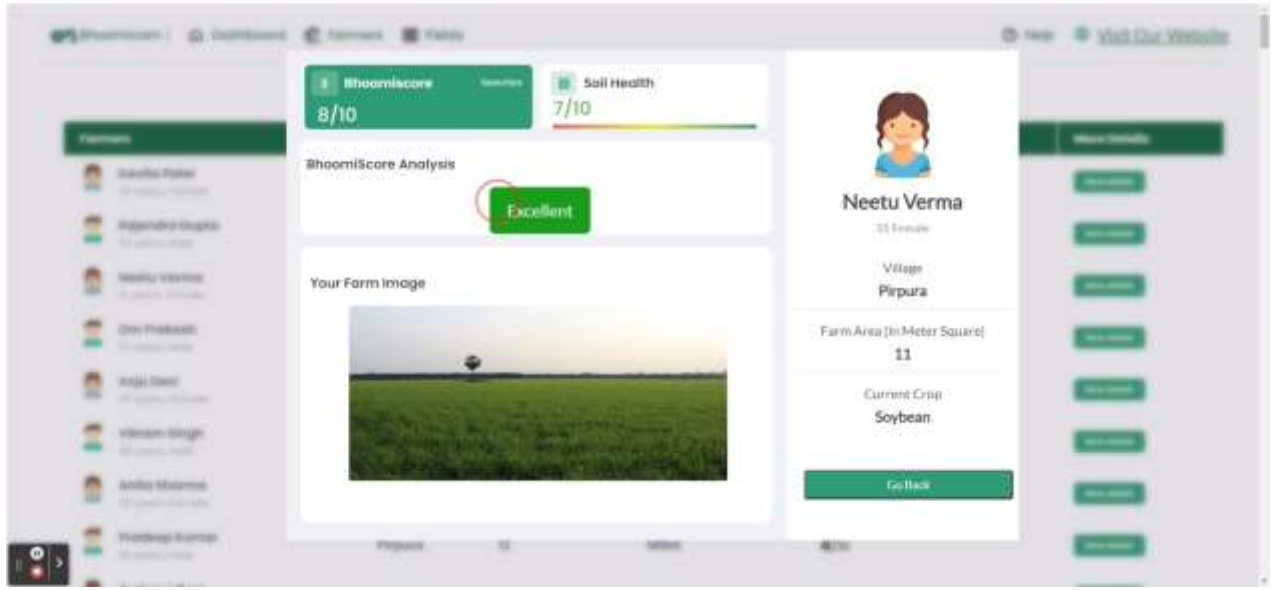
Current Issues in Farmer Bank Relationship

- Diversion of agricultural loans to other activities
- Inability of loan agencies to verify loan use post disbursement
- Inability of crop insurance providers to segregate genuine claims from False claims
- Agencies must visit the farm to verify crop status, **no real-time application available** to monitor crop status



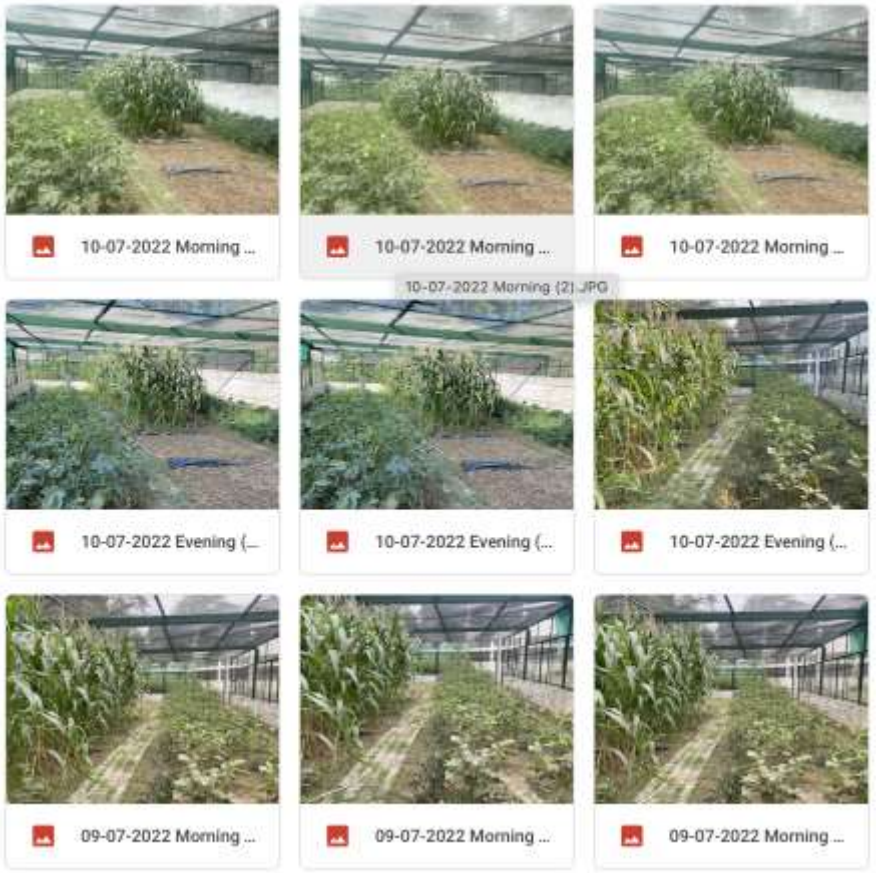
Our Products: Field Data Collection and Renting Applications

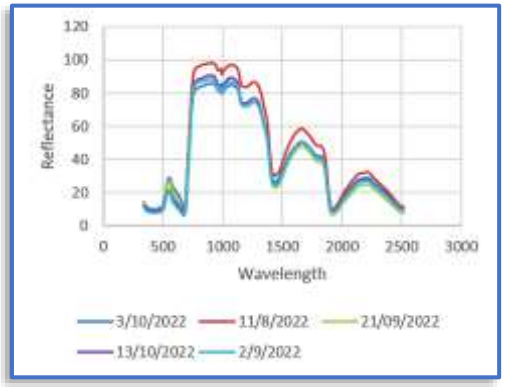




Dashboard of web-tool showing all the important features related agriculture field

Project 2: Artificial Intelligence based solutions for crop monitoring – Funded by Faculty Initiation Grant, IIT Roorkee





Experimental Farm at IIT Roorkee

Experimental Farm at IIT Roorkee

27-July-2022 → 06-Nov-2022

Rice Crop (Kharif Season)

- Daily time-lapse images using phone-based camera and weekly spectroradiometer readings.

30-Apr-2023 → Contd..

Maize Crop (Zaid Season)

- Sowed Maize in all 11 plots

Wheat Crop (Rabi Season)

- Daily time-lapse images using phone-based camera and 3D point cloud readings using TLS (Terrestrial Laser Scanner).

10-Dec-2022 → 07-Apr-2023

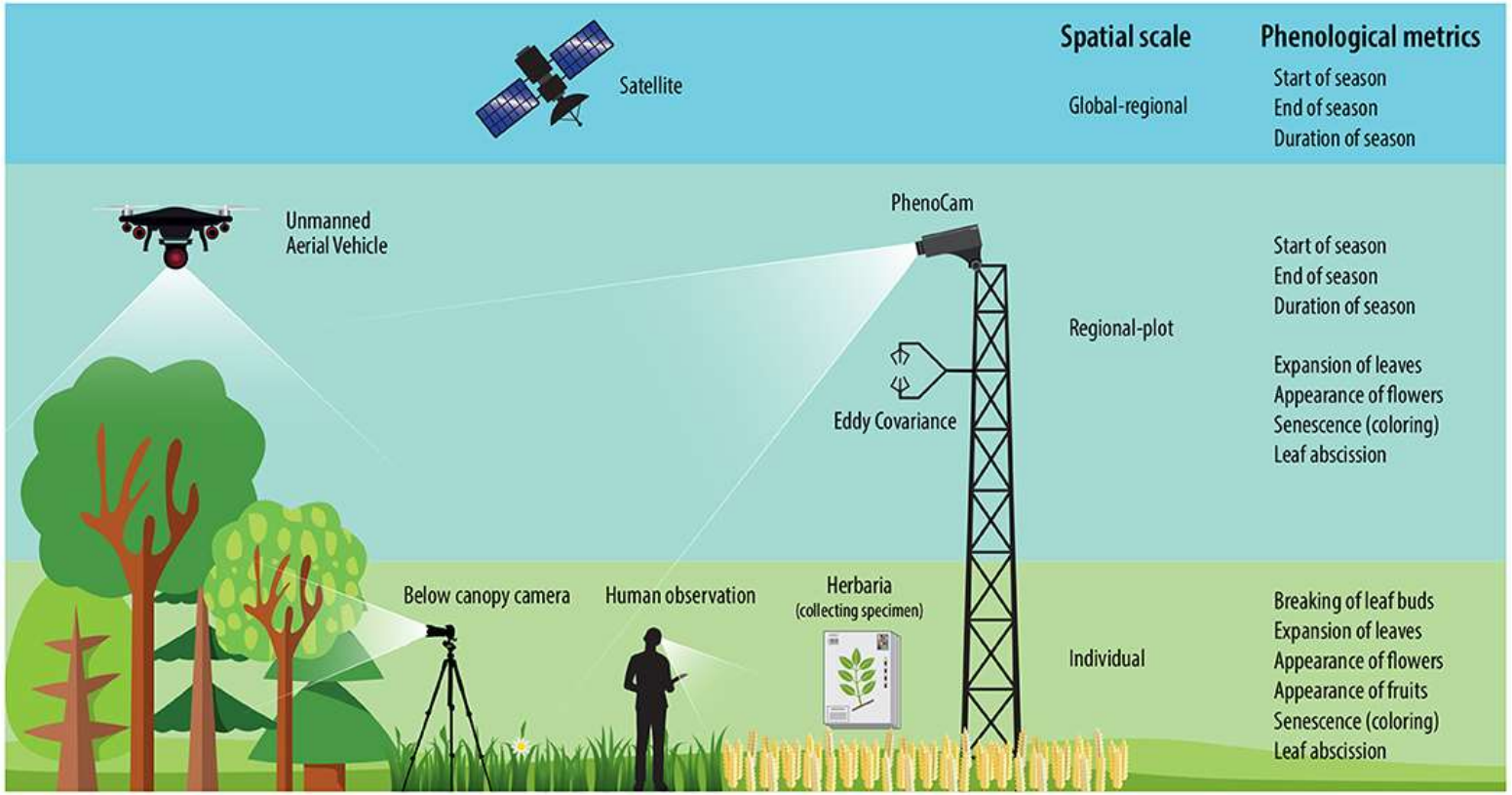
Data Acquisition:

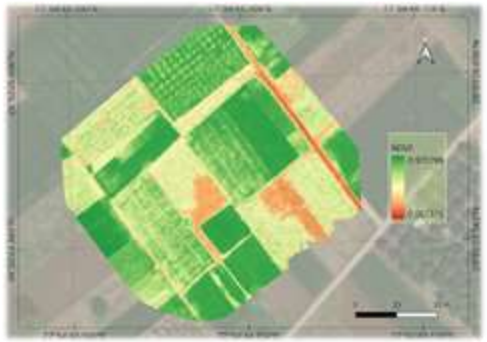
Sample Collection Time	Between 11:00 AM – 12:30 PM
Frequency	Daily Image, Weekly Spectroradiometer and Monthly TLS
No. of Plots	14 for Rice (10 Wheat Plots) & (11 Maize Plots)

Instrument:

Full Plot View

Project 3: Artificial intelligence (AI)-powered android platform for monitoring crop health using satellite, UAV, and **PhenoCam** data – Funded by AI4CIPS IIT Kharagpur





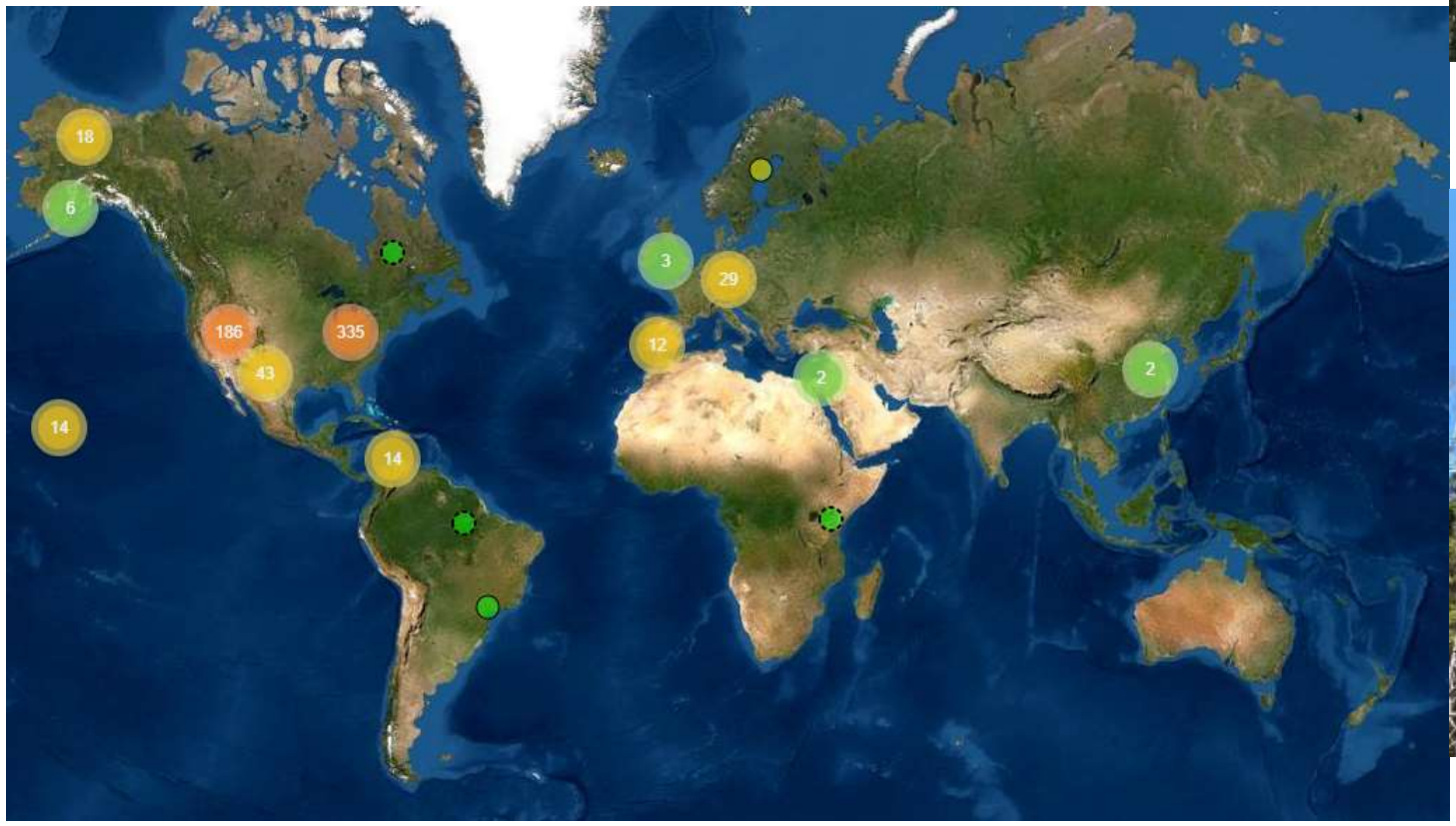
Near Remote Sensing Platforms

- For the first time in India, permanent plots will be outfitted with the PhenoCam network for agricultural monitoring.
- Establishment of a standard and open-source methodology for climate-based crop growth management at high temporal resolution.
- A network of stations for long-term crop monitoring. This study will be used as a baseline to give farmers with site-specific suggestions for India's irrigated and rainfed regions.

Katal et al., (2022) Frontiers in Plant Science

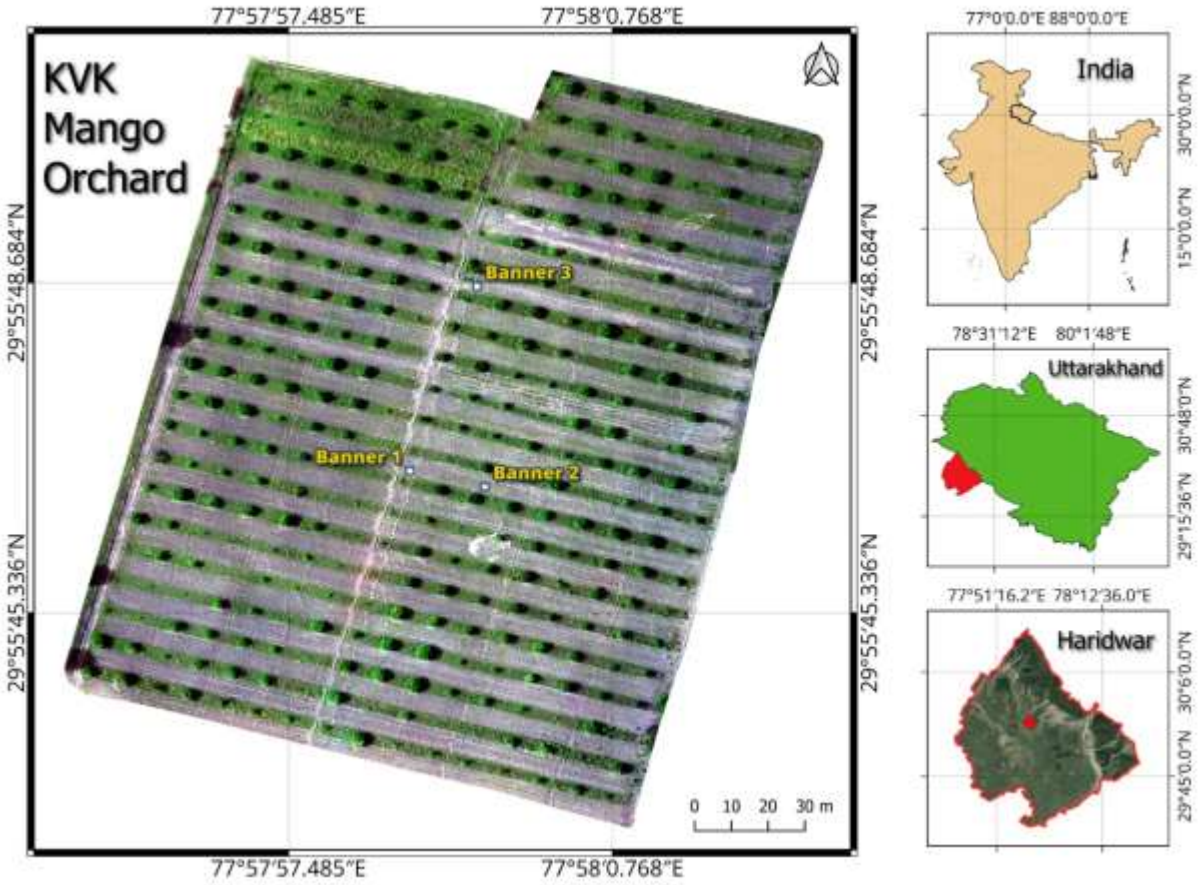
Need of PhenoCam Network

- PhenoCam network was established in 2008 at Northeastern United States and adjacent Canada.
- Long-term phenological observatory.
- Images are being uploaded to the PhenoCam server at least once daily (and in some cases as frequently as every 15 min).



Khare et al., (2021) and Zhang et al., (2020)

Drone based Mapping



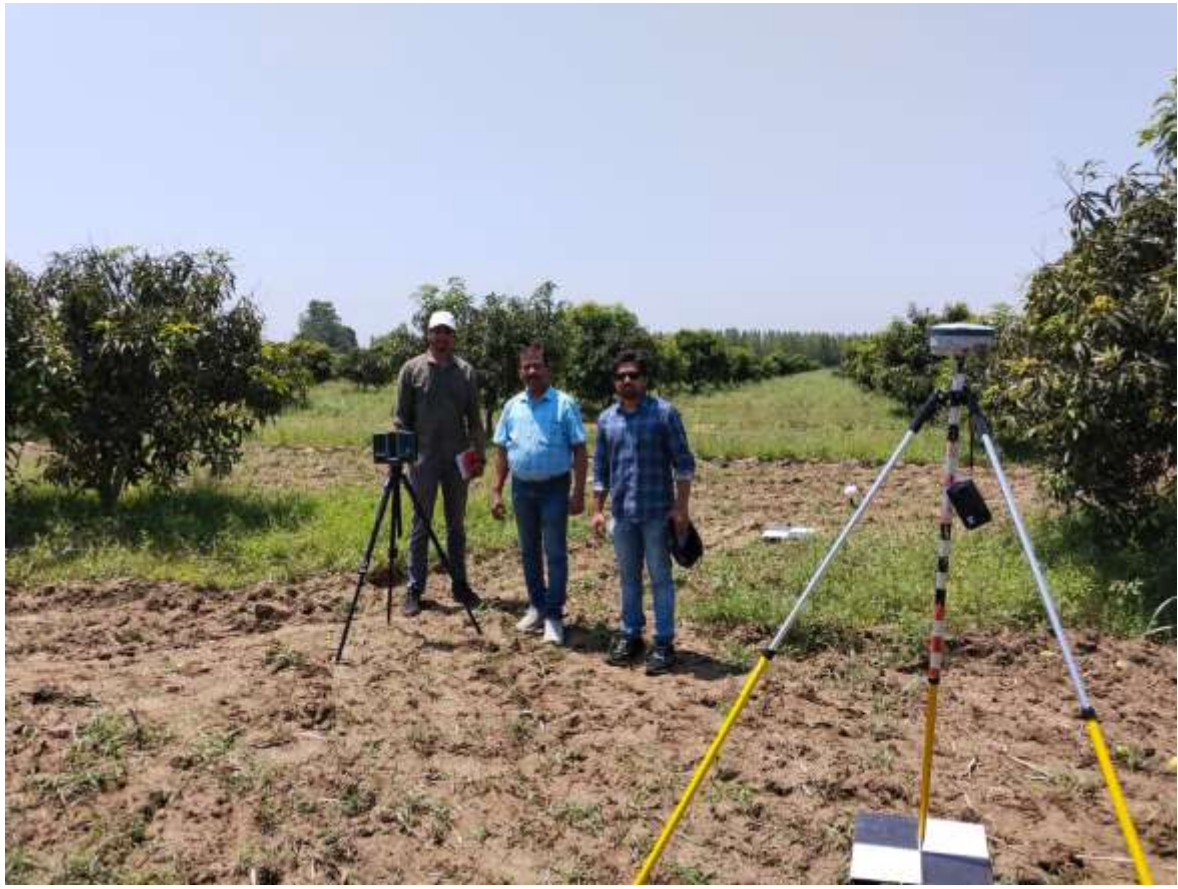
Drone Image Mosaic of Mango orchards

The KVK is situated at Dhanauri in Tehsil Roorkee by the side of the Upper Ganga Canal.

The center specializes in seed production of cereals, pulses and sugarcane.

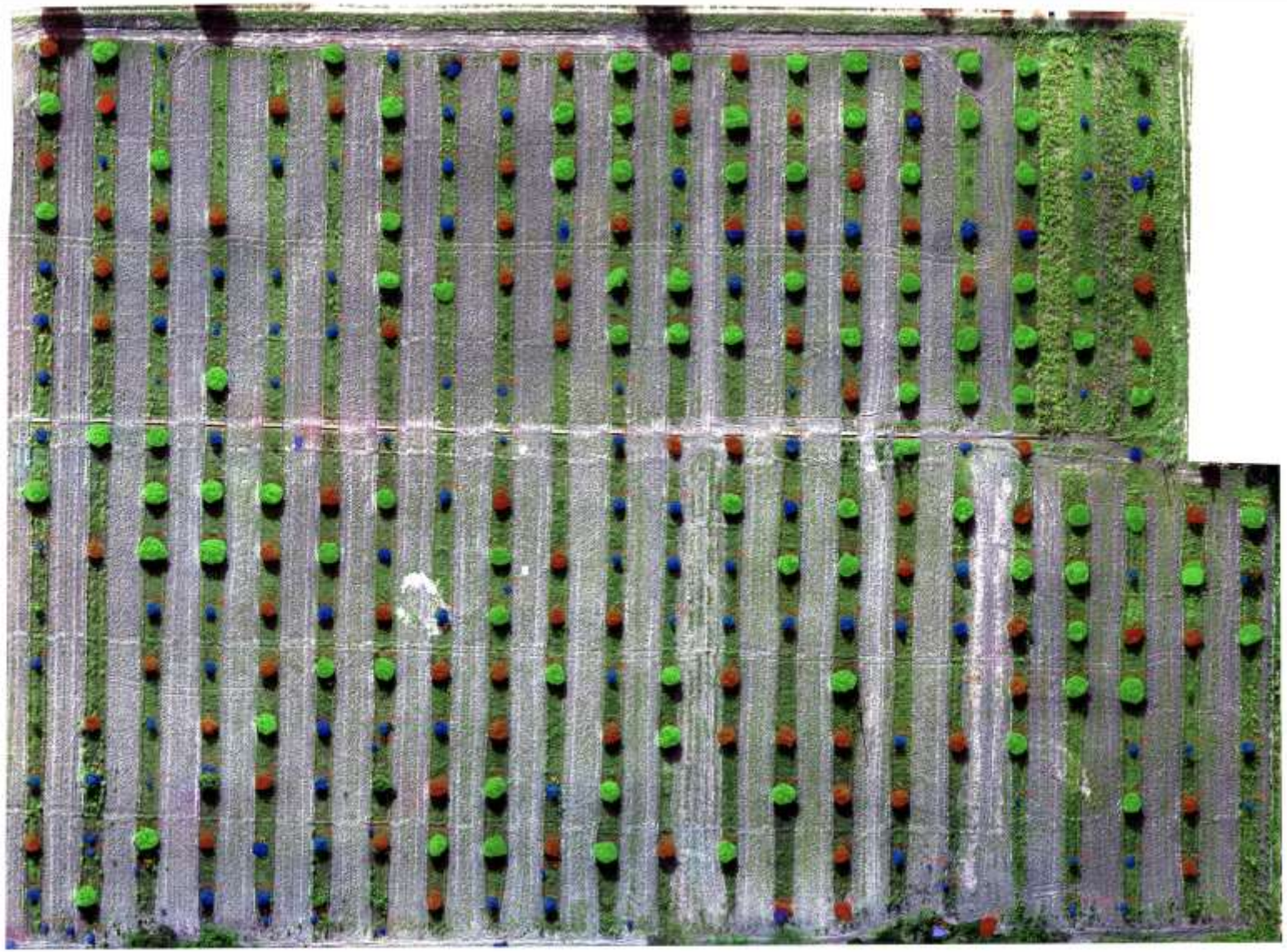
LiDAR based Mapping

- Accurate tree counting and creating digital twin in agroforestry applications
- Our research explores a novel approach to detect structural parameters of trees using terrestrial LiDAR data



Drone Image Mosaic of Mango orchards

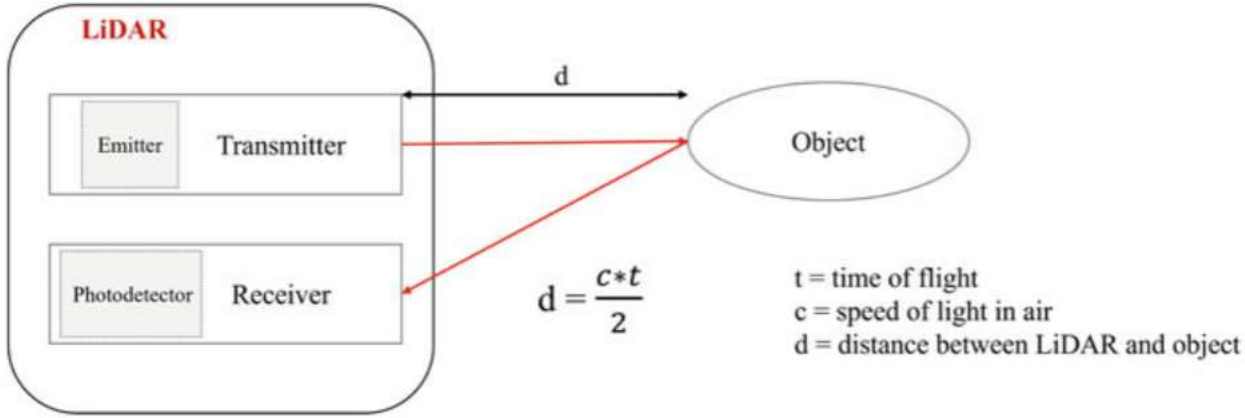
Canopy Area Measurement



This figure shows the tree canopy detection output.
Different colors represent the size of Tree canopy.

Blue < $5m^2$
8 m^2 >Red > $5m^2$
Green > 8 m^2

Application of Terrestrial LiDAR in Agriculture

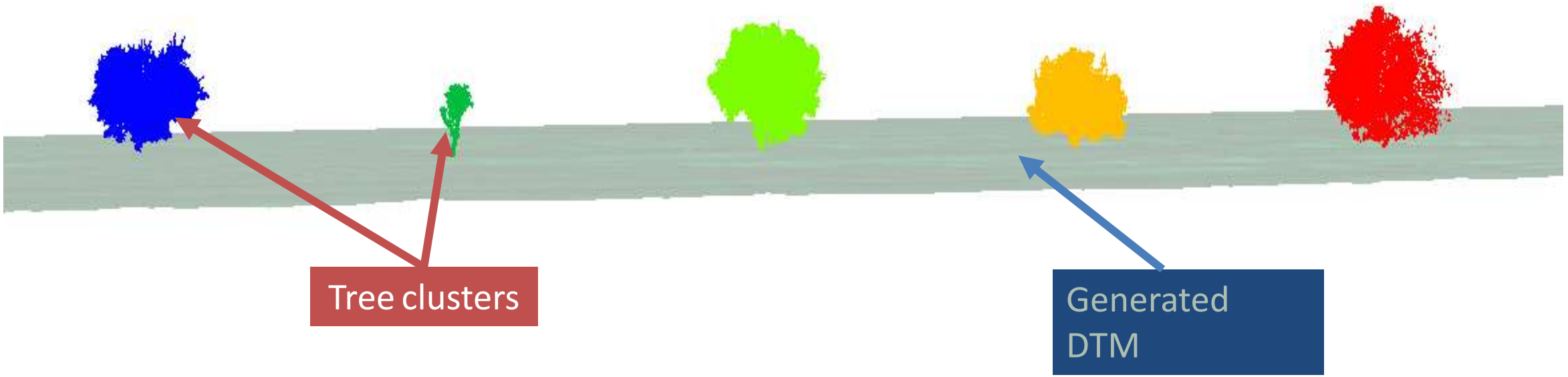


Point Cloud Formation

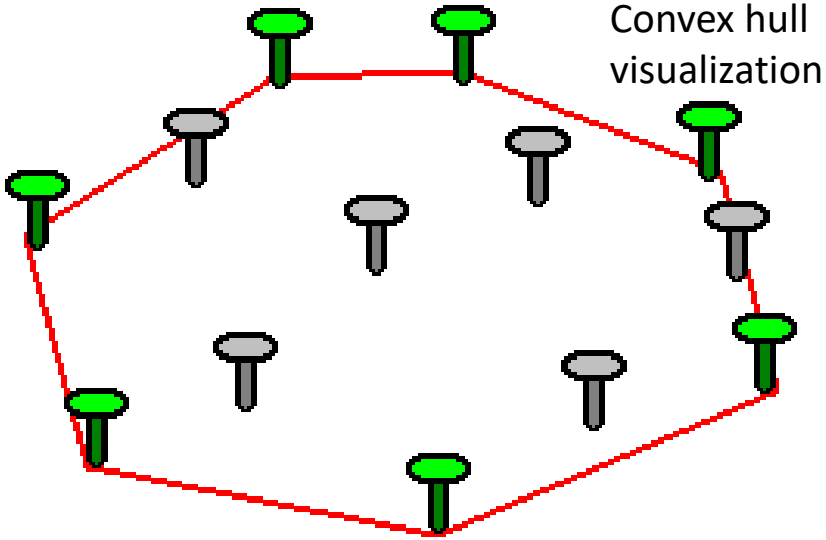
- The formation of 3D point clouds is very different to that of 2D images. Forming a 2D image is an optical phenomenon.
- In contrast, 3D point clouds are commonly acquired using LiDAR sensors. It is closely related to its more familiar counterparts, RADAR and SONAR.
- The distance and direction information is recorded to produce a point in 3D space. Several thousands of these beams are emitted at the same time, which gives rise to many points.

TLS Walkthrough of Mango Orchard at KVK, Haridwar

Original Point Cloud Segment (RGB)



Tree Parameter Extraction

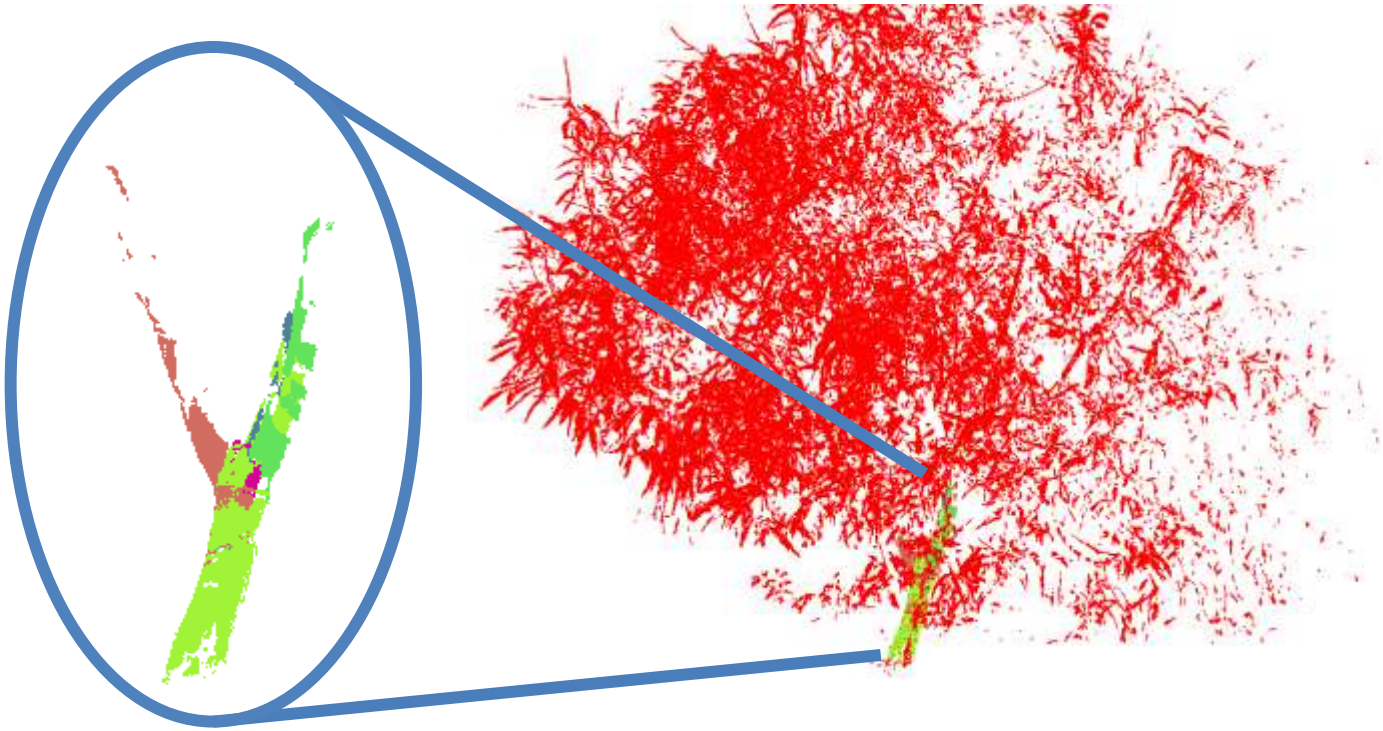


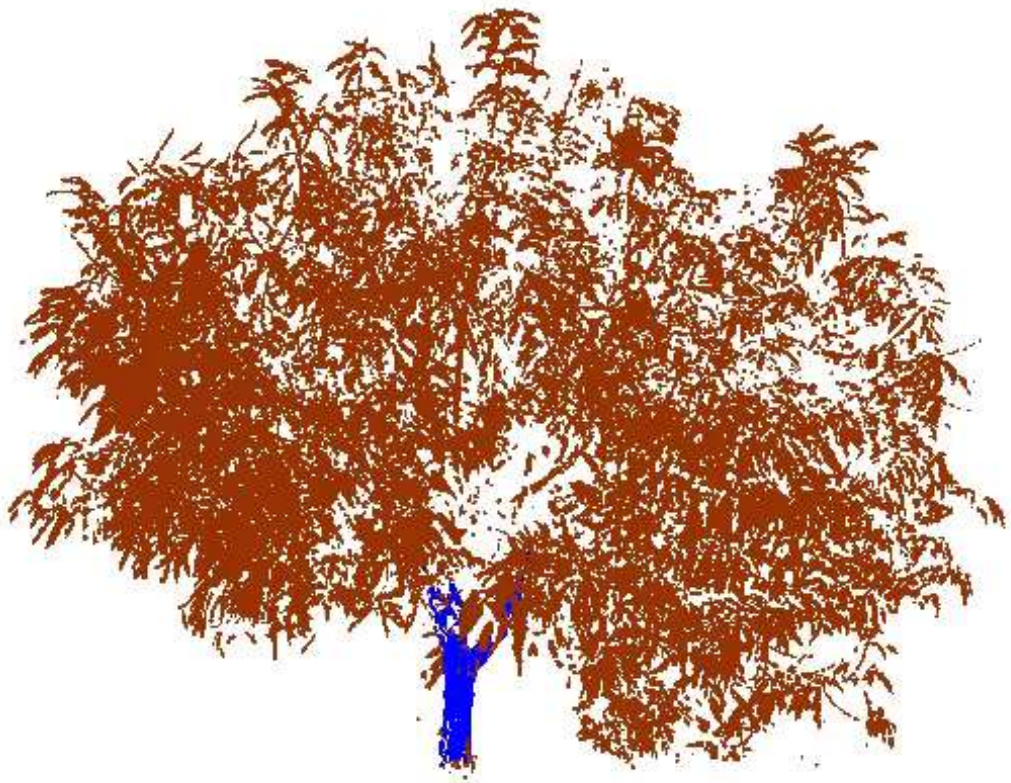
1. Canopy area was calculated using convex hull algorithm by determining the projected area of (x, y) coordinates of all the points belonging to each tree cluster.

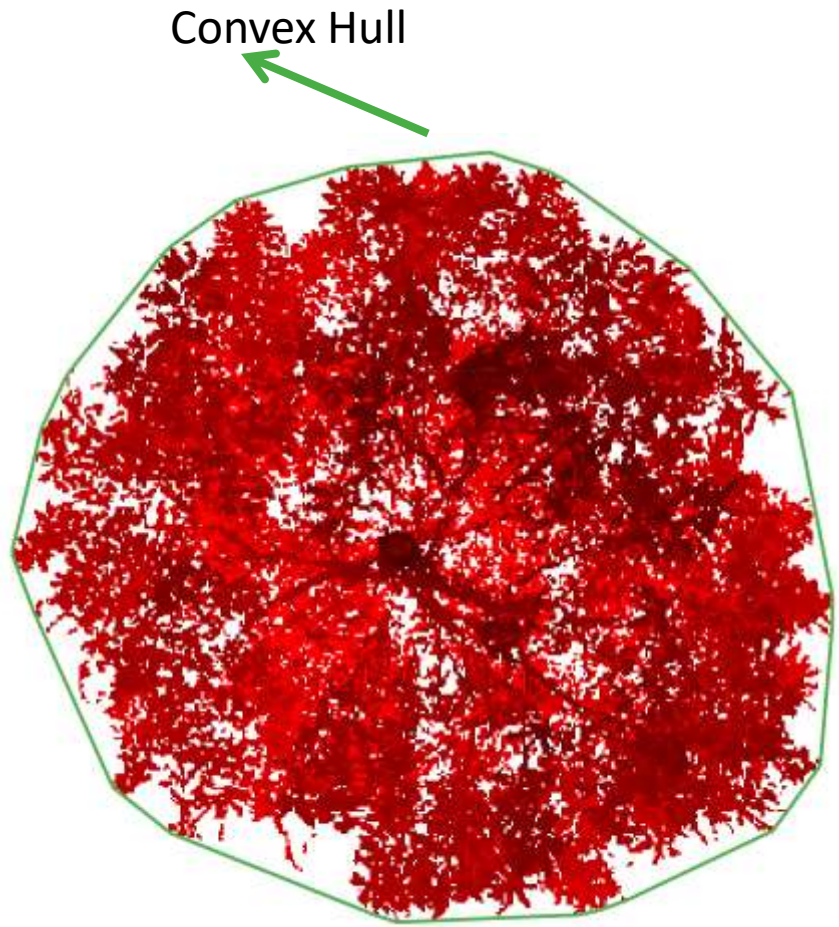
2. Tree heights were obtained after determining highest points in each tree clusters

3. Stem Diameter were calculated by first identifying stem candidates using RANSAC shape fitting.

4. Diameter was then calculated by fitting a circle around the stem just before the stem division as the height of trees were smaller, i.e. less than standard DBH.

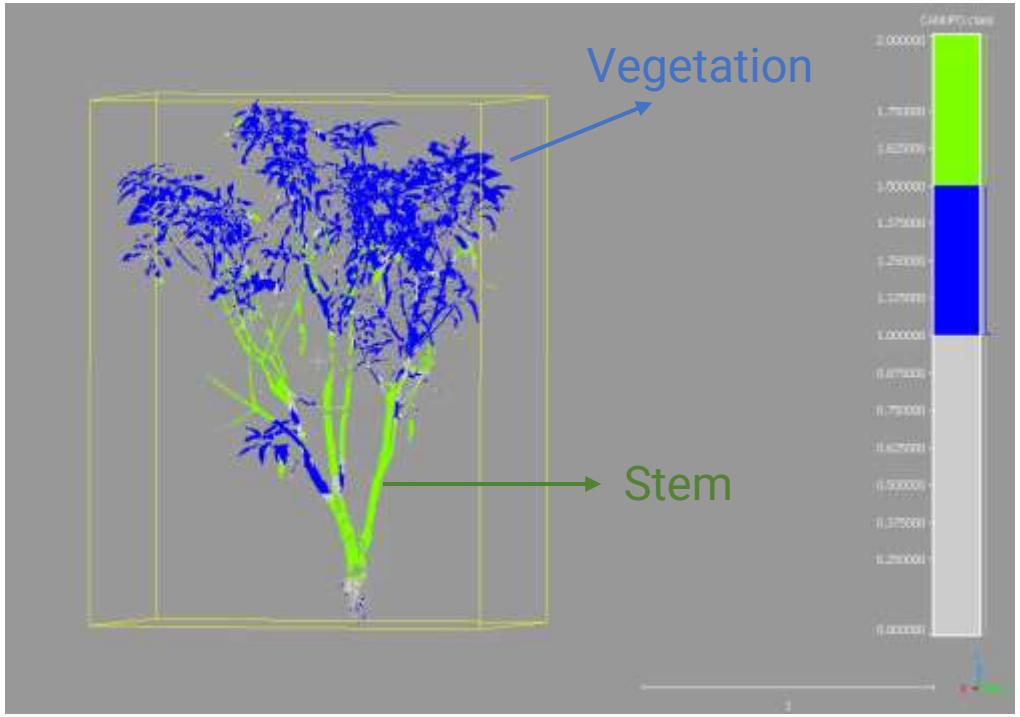





Convex Hull

Processed 3D point cloud of single segmented Tree

Cloud Compare → Model Training using CANUPO → **Multiscale Dimensionality Classification**



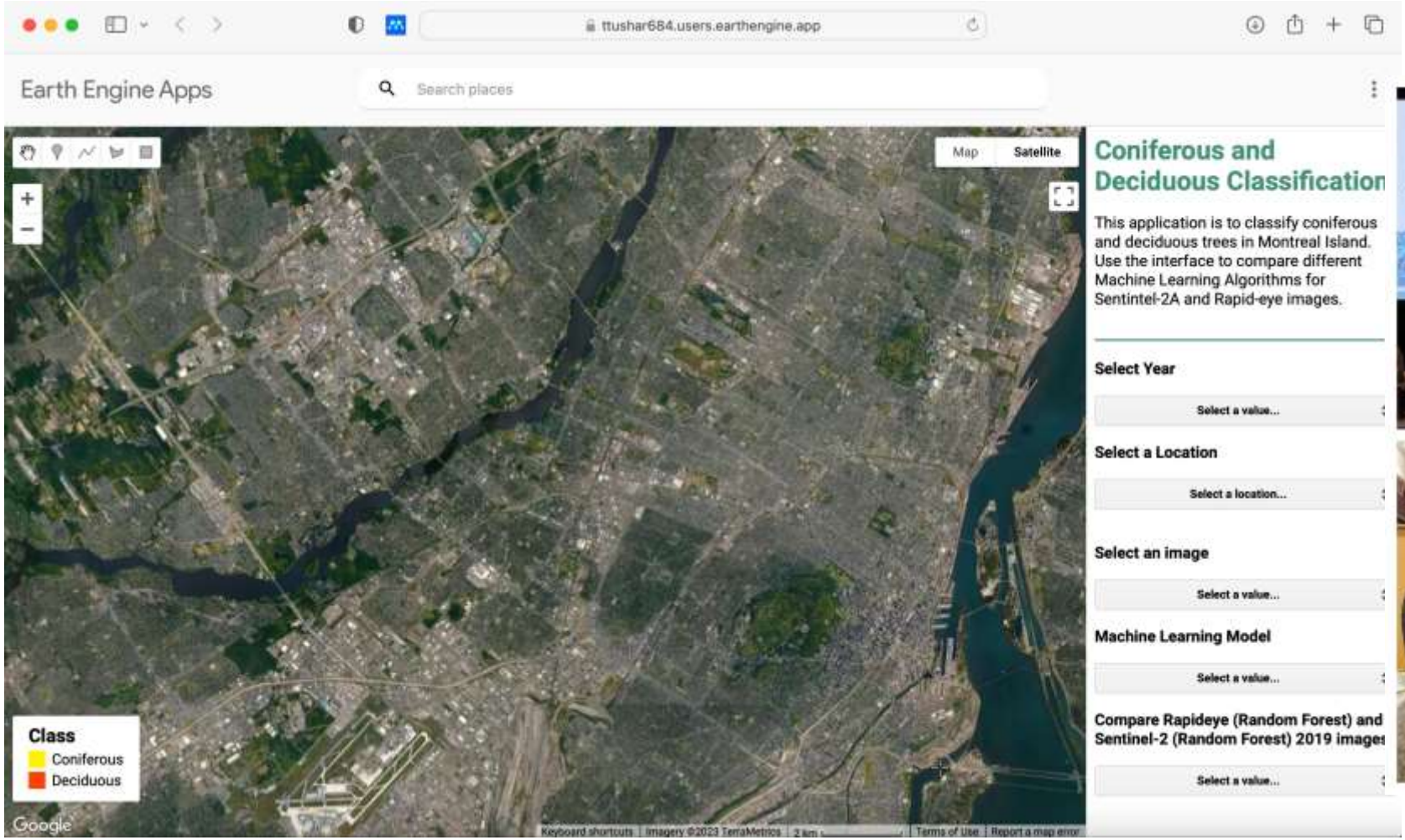



LiDAR for Crop Growth

Date of capture		Avg. Height
18-05-2023	Emergence Stage (DoS 18)	0.4 Meters
01-06-2023	Tassling & Silking Stage (DoS 31)	1.3 Meters
15-06-2023	Milk & Dough Stage (DoS 45)	1.7 Meters
24-07-2023	Maturity Stage (DoS 84)	2.2 Meters

DoS = Date of Sowing

Project 4: Artificial Intelligence and Remote Sensing at the Service of Nature Solutions: from Urban Trees to Landscapes – Funded by Habitat Nature Based Solution Company, Montreal, Canada



GEOBON Conference at Montreal, Canada 9 to 13 October 2023

PleineTerre Group Inc. and Department of Bioresource and Engineering at McGill University

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Thank You

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