

# AI and satellite-based solutions for agriculture land records

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# About the presenters



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Assistant Professor in Geomatics Engineering,  
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Academic Associate at Habitat, Canada

Founder and Director of **Bhoomicam** Startup

**Expertise:**

- Crop Monitoring
- Biodiversity
- UAV
- Phenology
- PhenoCams
- Artificial Intelligence & Machine Learning



## Prof. S. K. Ghosh

Professor HAG Geomatics Engineering  
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**Expertise:**

- UAV
- Artificial Intelligence & Machine Learning
- Remote Sensing Algorithm Development

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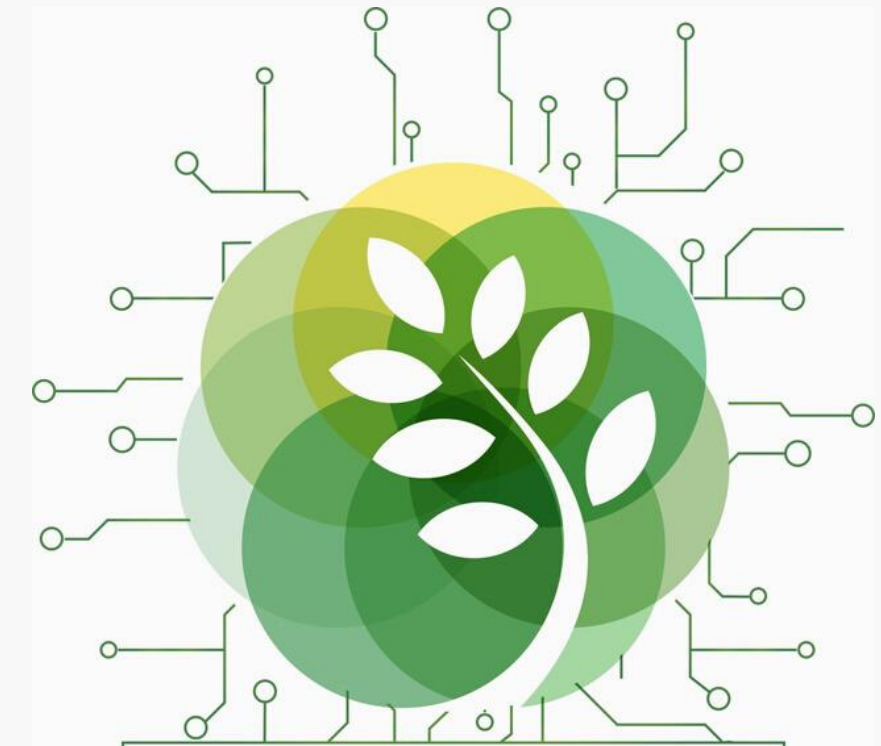


# Introduction

- Agriculture is seeing rapid adoption of Artificial Intelligence (AI) and Machine Learning (ML) both in terms of agricultural products and in-field farming techniques.
- Cognitive computing, is all set to become the most disruptive technology in agriculture services as it can understand, learn, and respond to different situations (based on learning) to increase efficiency.

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# Introduction...

- Providing some of these solutions as a service like chatbot or other conversational platform to all the farmers will help them keep pace with technological advancements as well as apply the same in their daily farming to reap the benefits of this service.

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Image source: <https://www.innominds.com/blog/how-ai-helps-in-precision-agriculture-connected-farm-experience-better-crop-yield>



# Agenda

- Combining AI with satellite and drone data to prepare long term crop monitoring through in-depth field analysis, scanning of fields with satellite derived vegetation indices.
- To prepare digital boundaries of each farm along with their seasonal crop information.

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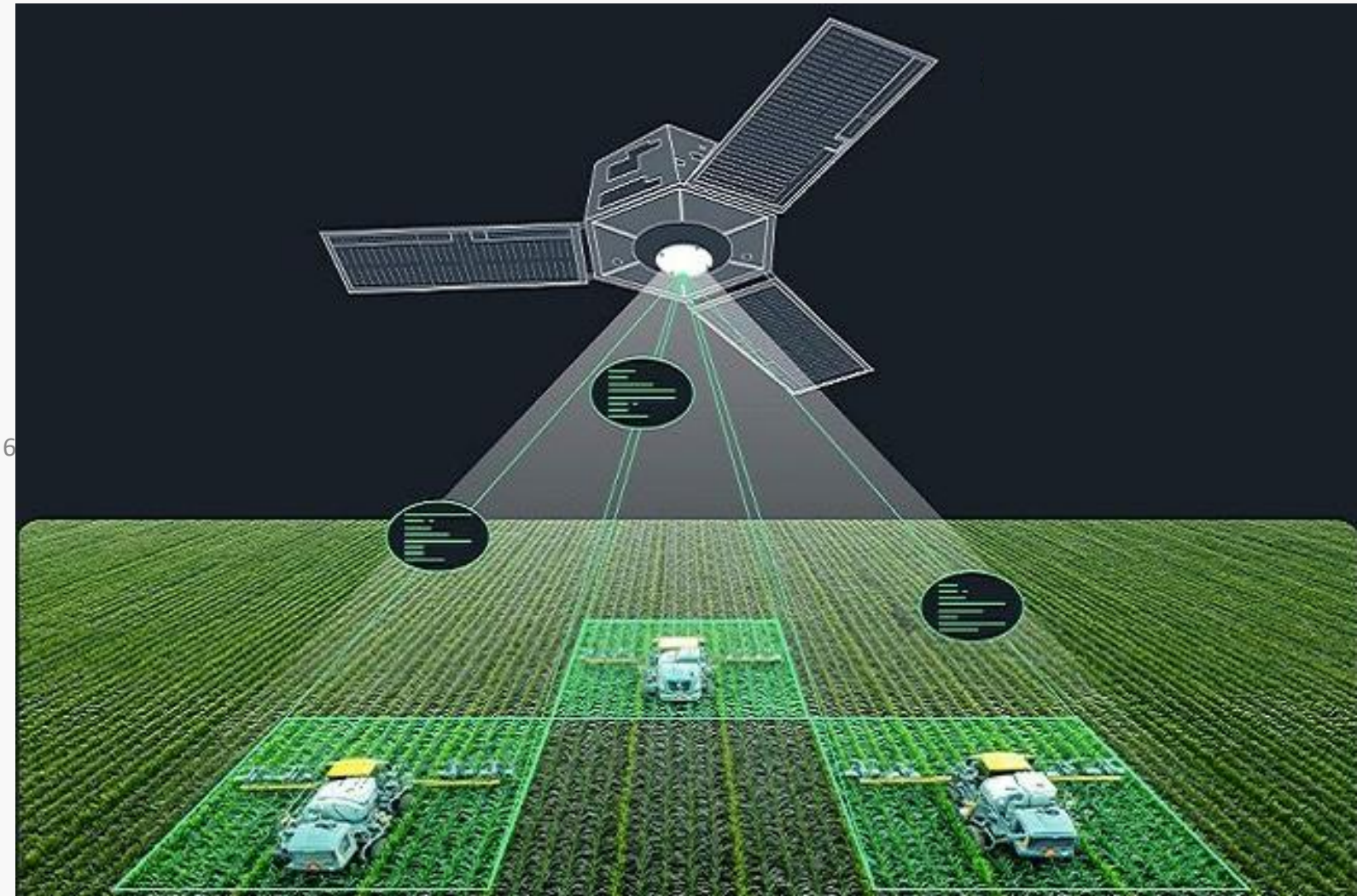


Image source: <https://africaprimenews.com/2022/05/06/interview/farming-in-africa-eos-data-analytics-advocates-use-of-satellite-technologies-interview/>

# Need

- According to UN Food and Agriculture Organization, the population will increase by 2 billion by 2050. However, only 4% additional land will come under cultivation by then.
- **Recent food price hikes** may signal the end of an era of predictable global grain crop plenty due to climate change, population expansion, and dietary changes.
- AI-powered solutions will not only help farmers produce more with **fewer resources**, but they will also **boost crop quality** and assure a speedy market entry time.

# Near Record

## Global food prices stayed near an all-time high

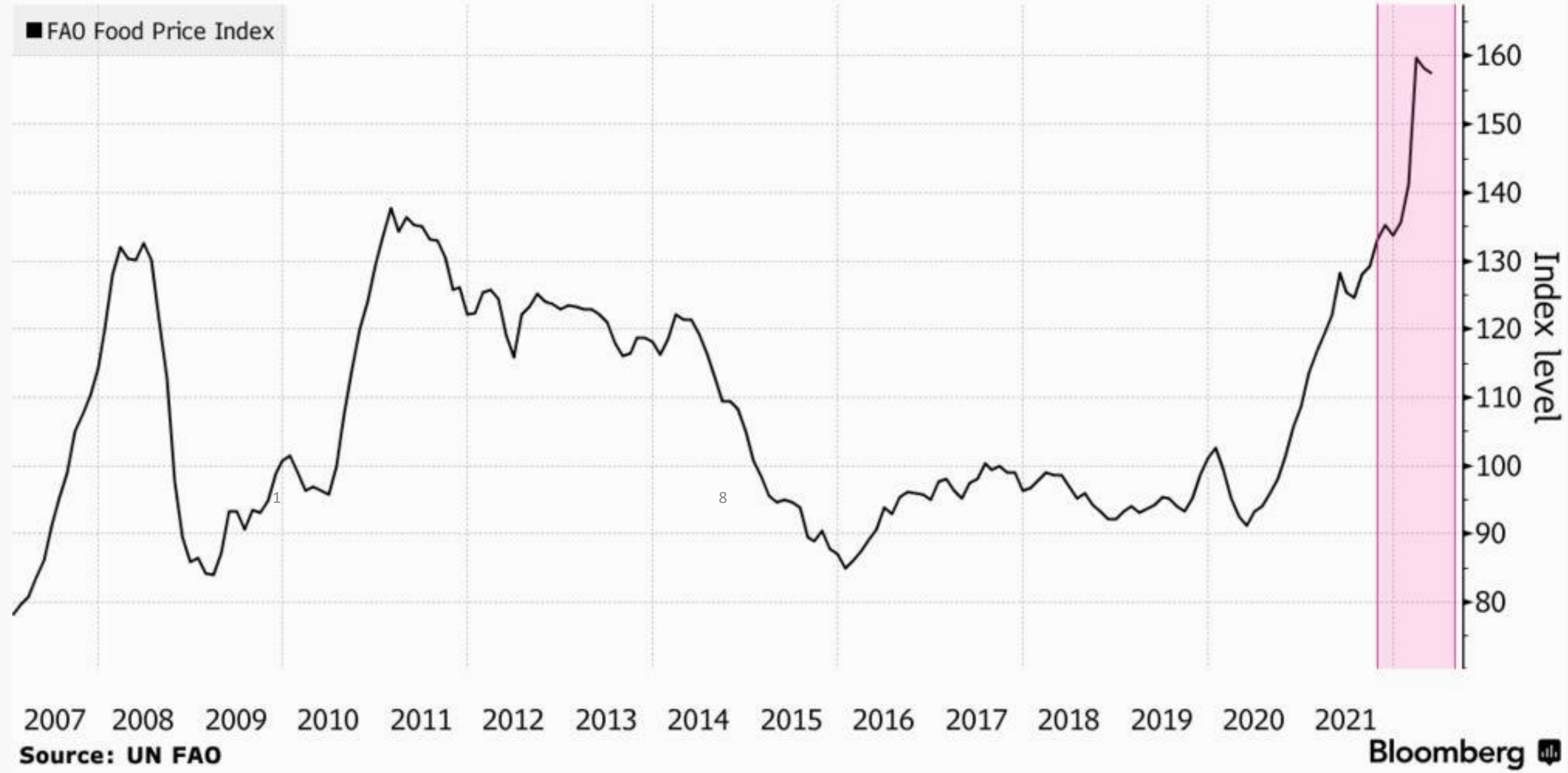


Image Source: <https://www.bloomberg.com/news/articles/2022-06-03/global-food-prices-stay-near-record-as-ukraine-war-upends-trade>



# Importance for Digitization of Land Records

- Decision Making and Planning of ministries and Private sector
- Tracking of Benami Transactions
- Estimate Subsidies
- Land Registration
- Agricultural Credit
- Crop Classification
- Unused Land Information

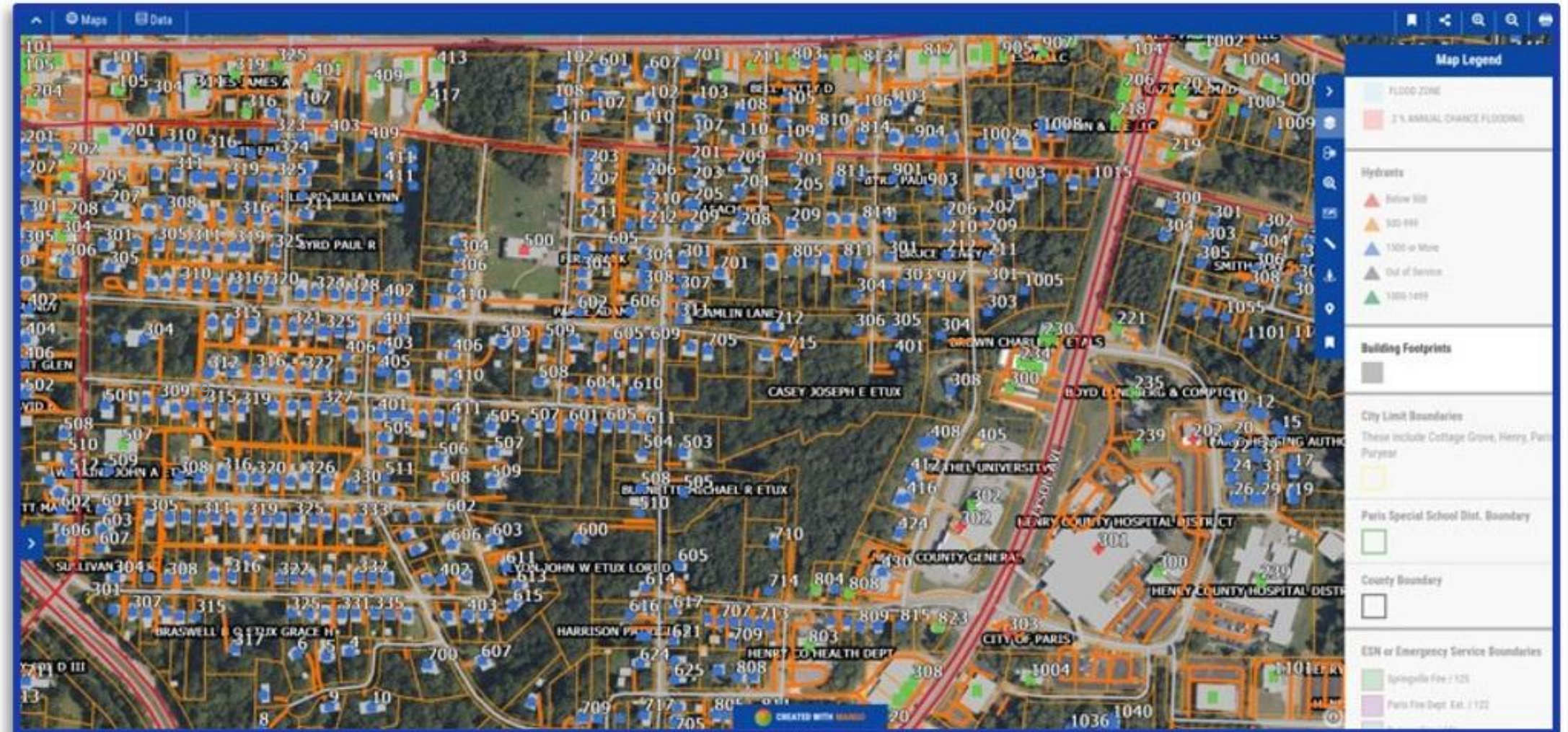


Image Source: <https://mangomap.com/industries/local-government/>

# Government Efforts towards Digitization of Land Records so far

- A good land records system is a necessity for any harmonious and progressive society which will ultimately lead to an improved land governance system.
- Karnataka was the first state in India to computerize land records under the “[Bhoomi Project](#)” followed by Andhra Pradesh and Tamil Nadu in the year 2001.
- The Digital India Land Records Modernization programme ([DILRMP](#)) was launched by Government of India in August 2008. The objective of the programme was [to computerize all land records, digitize maps](#), to streamline and reduce the scope of land and property disputes, thereby improving transparency in the maintenance of land records.



# Government Efforts towards Digitization of Land Records so far

## SVAMITVA scheme

Survey of Villages And Mapping with Improved Technology in Village Areas

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Image source: <https://vikaspedia.in/social-welfare/rural-poverty-alleviation-1/svमितva-scheme>



# Implications

## Kisan credit card:

- Kisan credit card scheme is an important effort of the banking sector for promoting agricultural credit and for achieving financial inclusion.

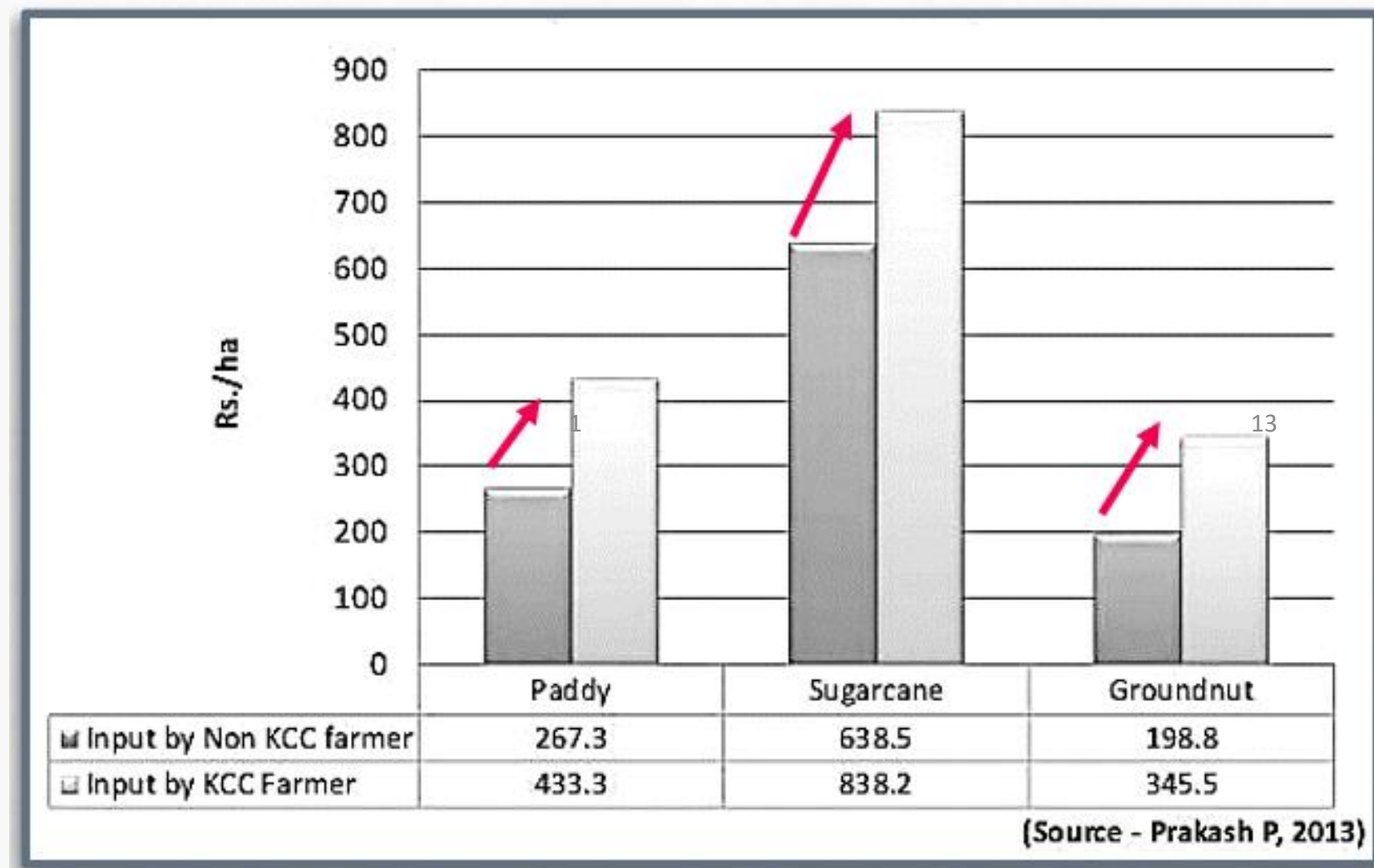


Image Source: <https://pmyojanaportal.com/kisan-credit-card-scheme/>

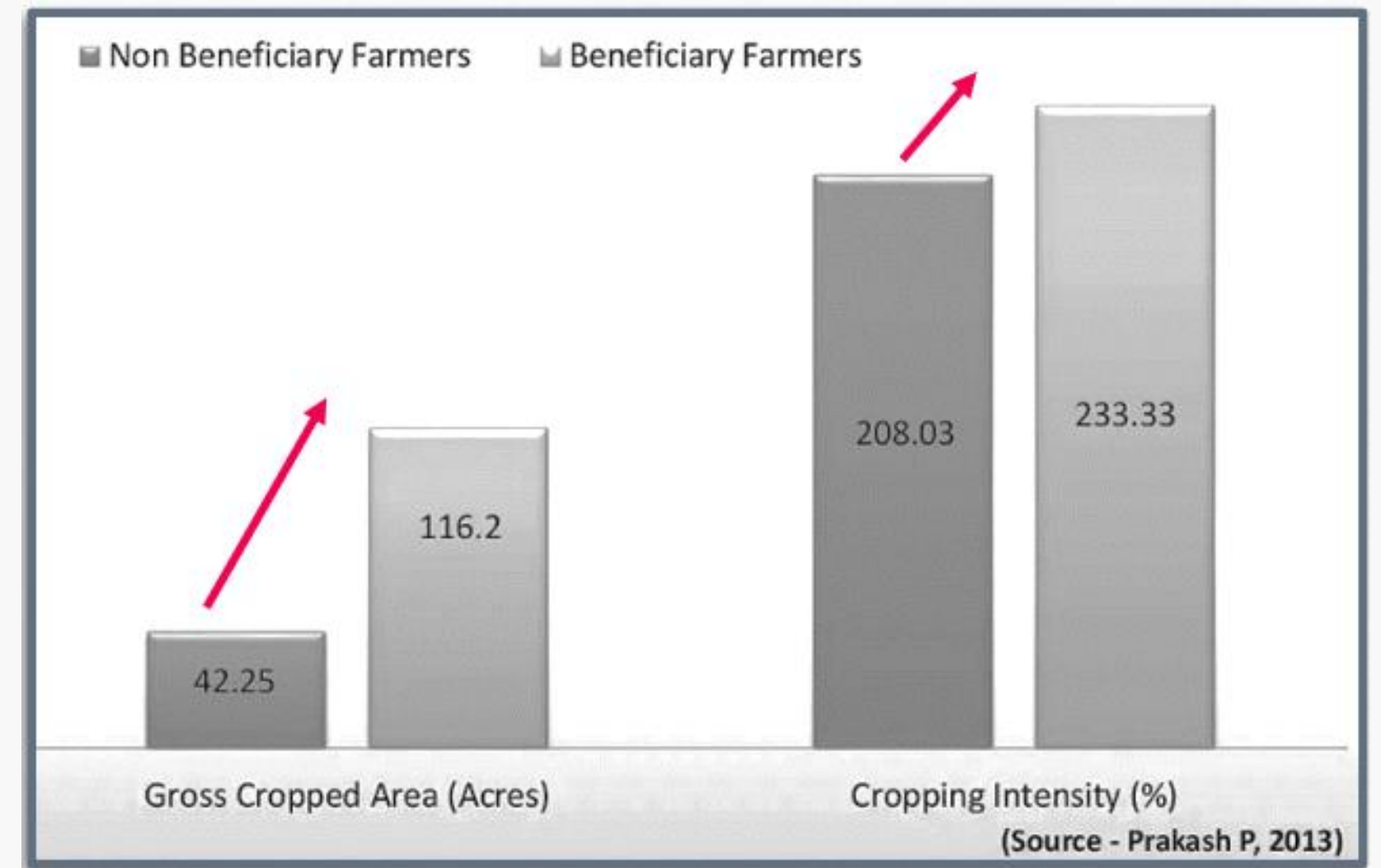
# Implications

## Kisan credit card:

Diagrammatic representation of Input use by beneficiary and non-beneficiary farmers



Diagrammatic representation of Input use by beneficiary and non-beneficiary farmers



*Study conducted in Ashta Block of Sehore District of Madhya Pradesh*

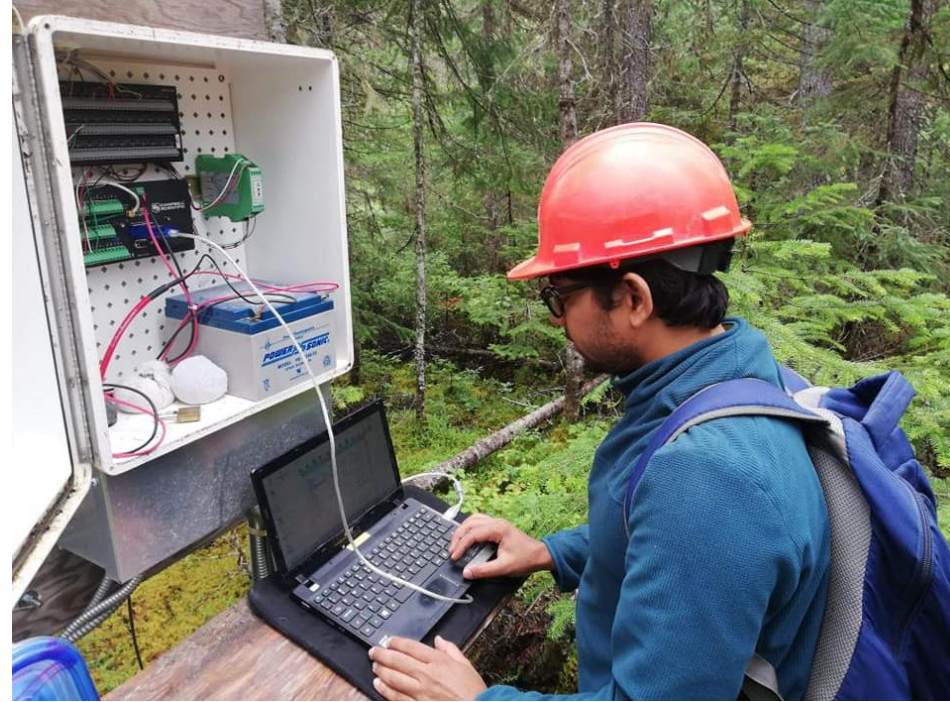
# Implications

## Crop Insurance

The impact of various natural or manmade calamities that cause destruction can be studied and mapped using geographic information technology and assist in insurance GIS.







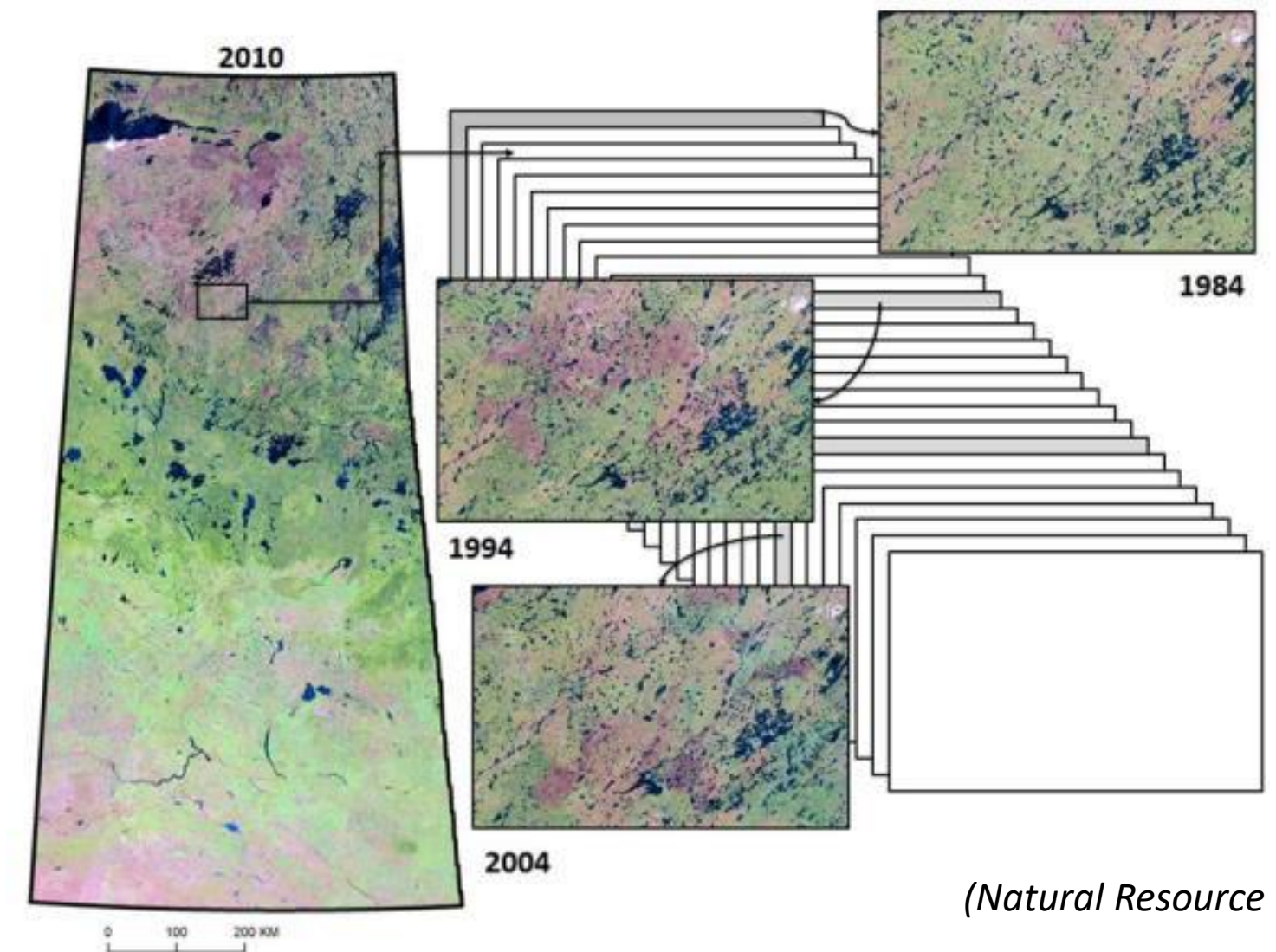
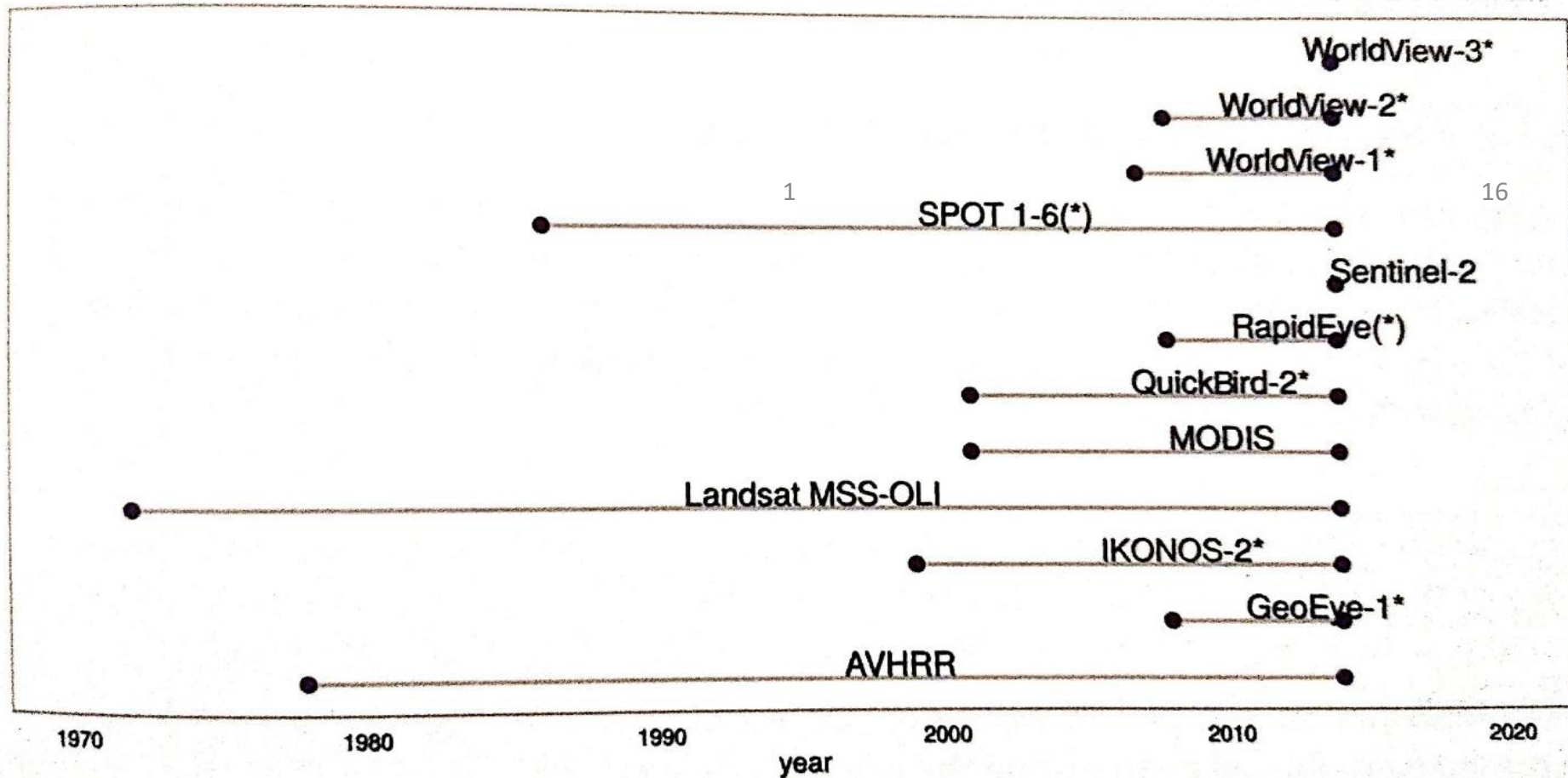
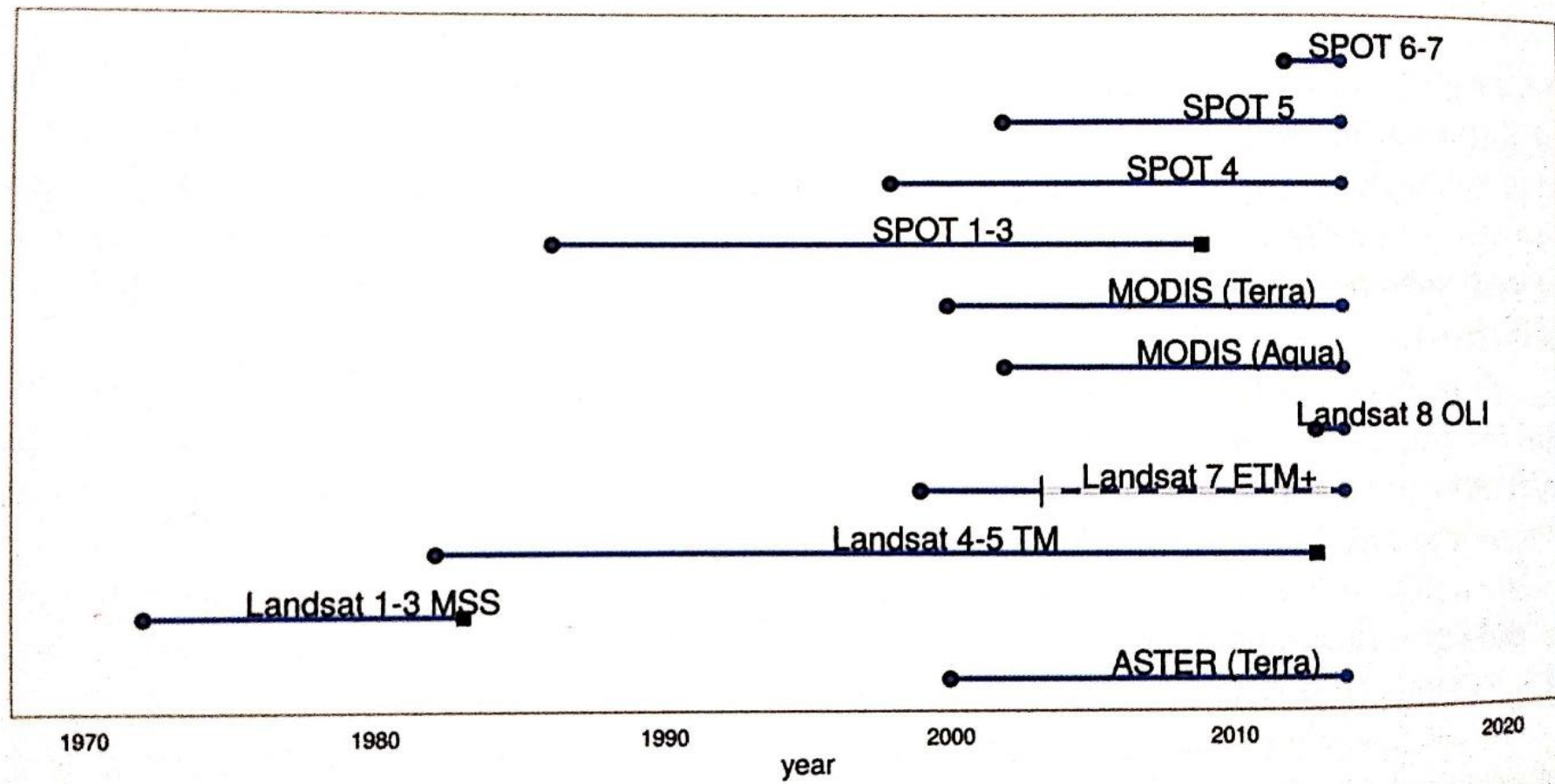
# Examples of Modern Farming Tools



# Spatio-temporal dynamics

- Our ability to identify changes over time has improved because:

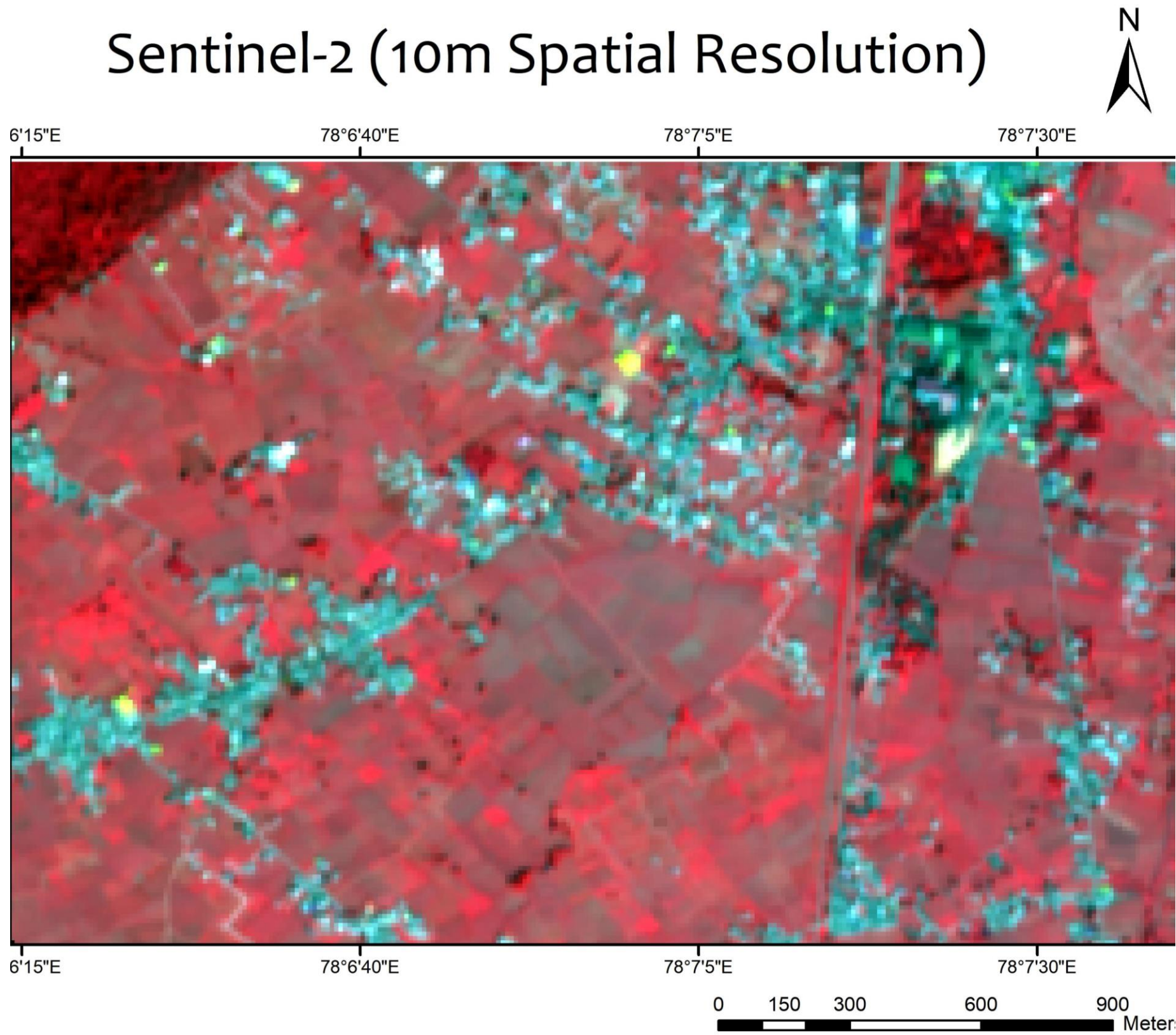
- The availability of long term data sets
  - Landsat (30+ years)
  - MODIS (19 years)
- Improved computing power
- Improved processing methods



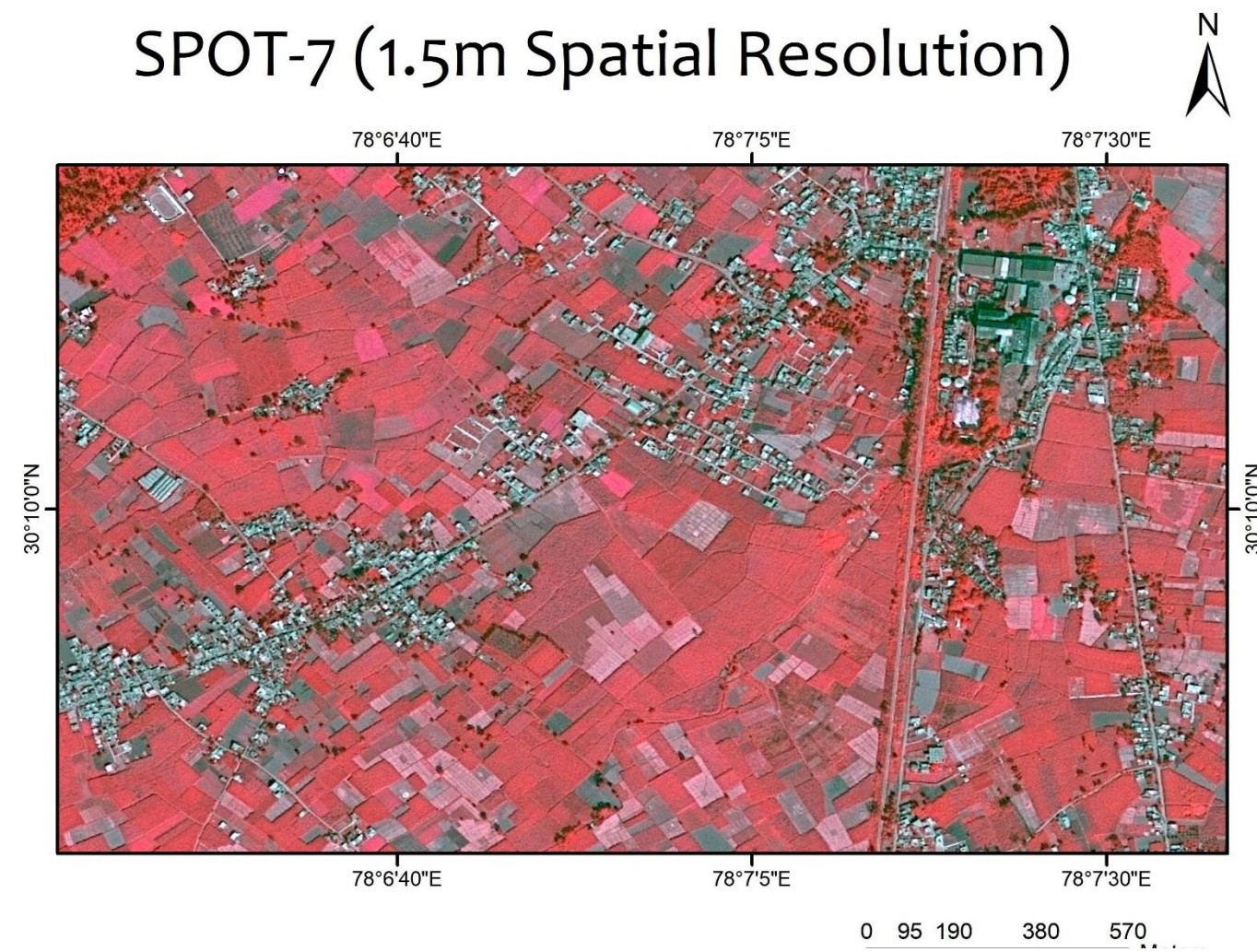
(Natural Resource Canada)



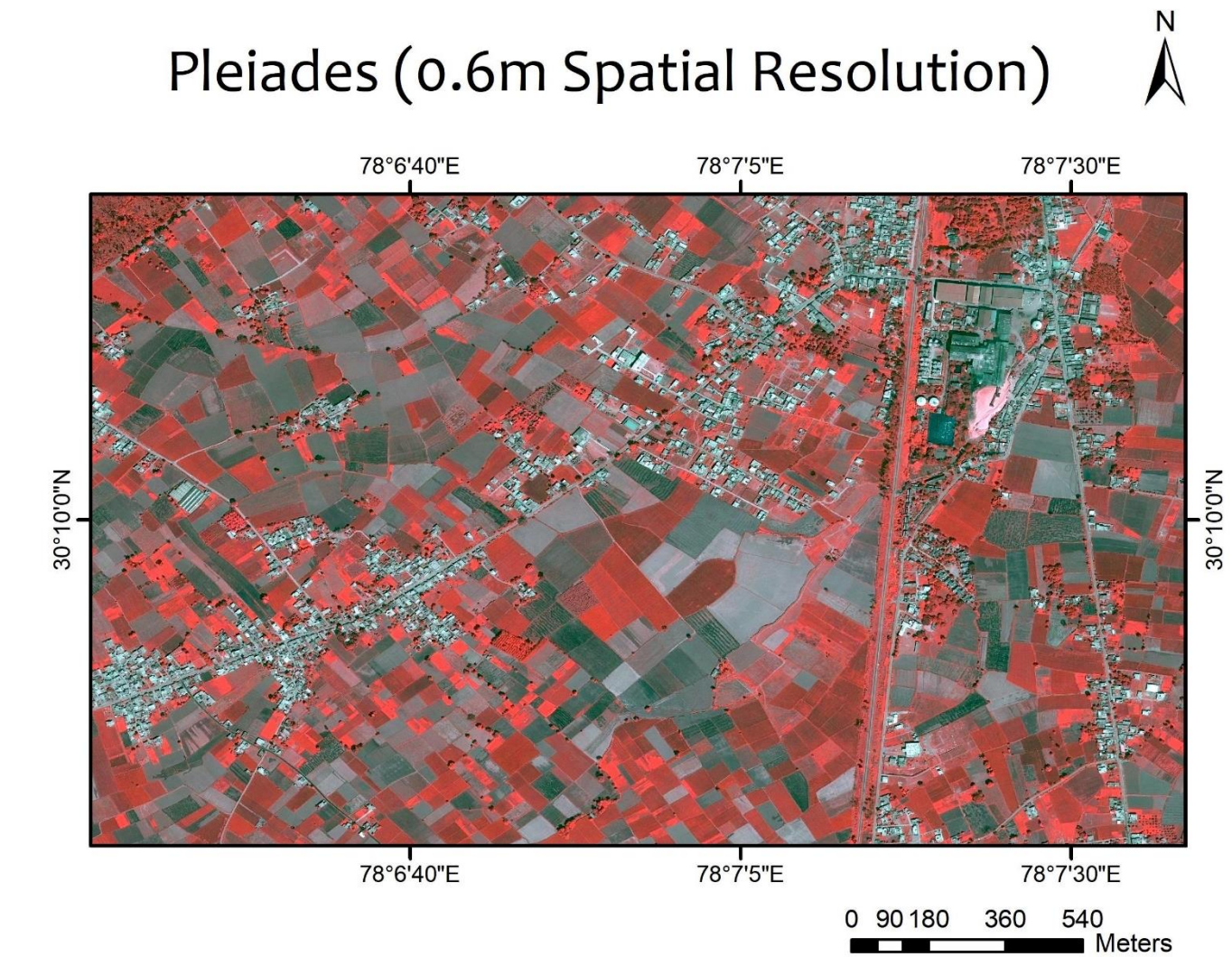
# Sentinel-2 (10m Spatial Resolution)



# SPOT-7 (1.5m Spatial Resolution)



# Pleiades (0.6m Spatial Resolution)









# Multispectral UAV Data application in crop management

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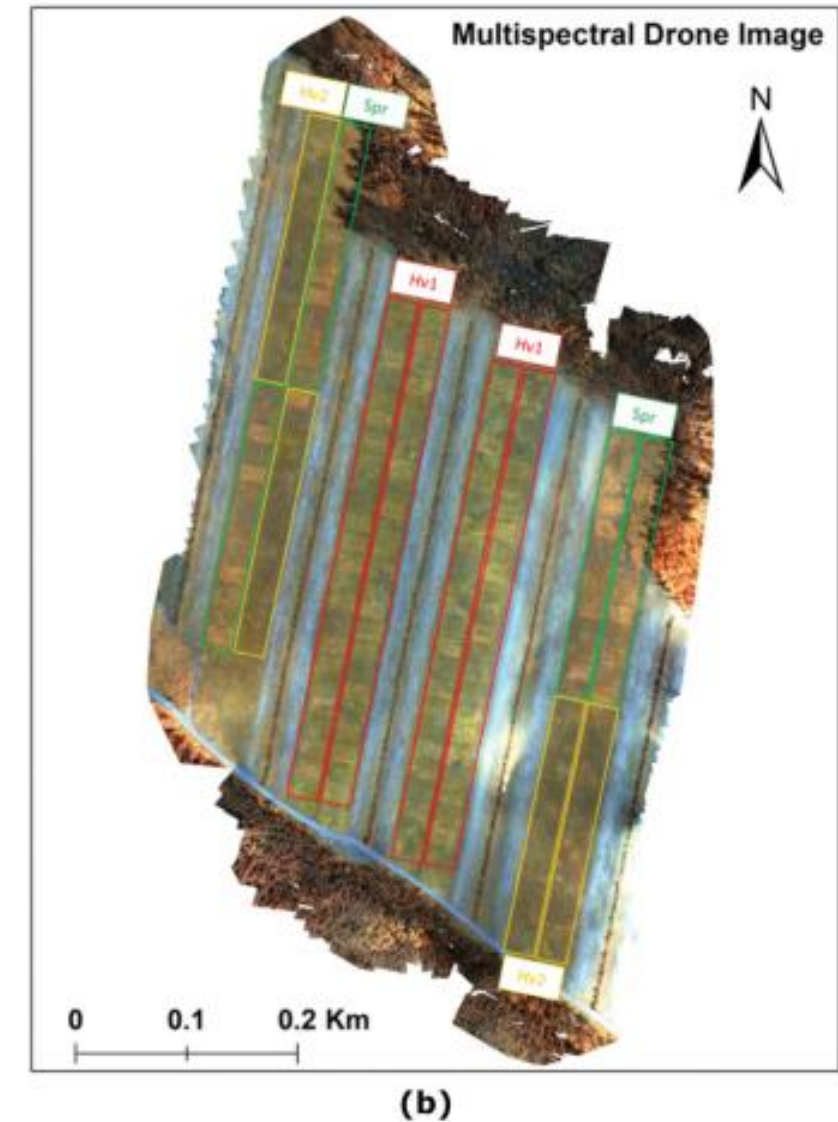
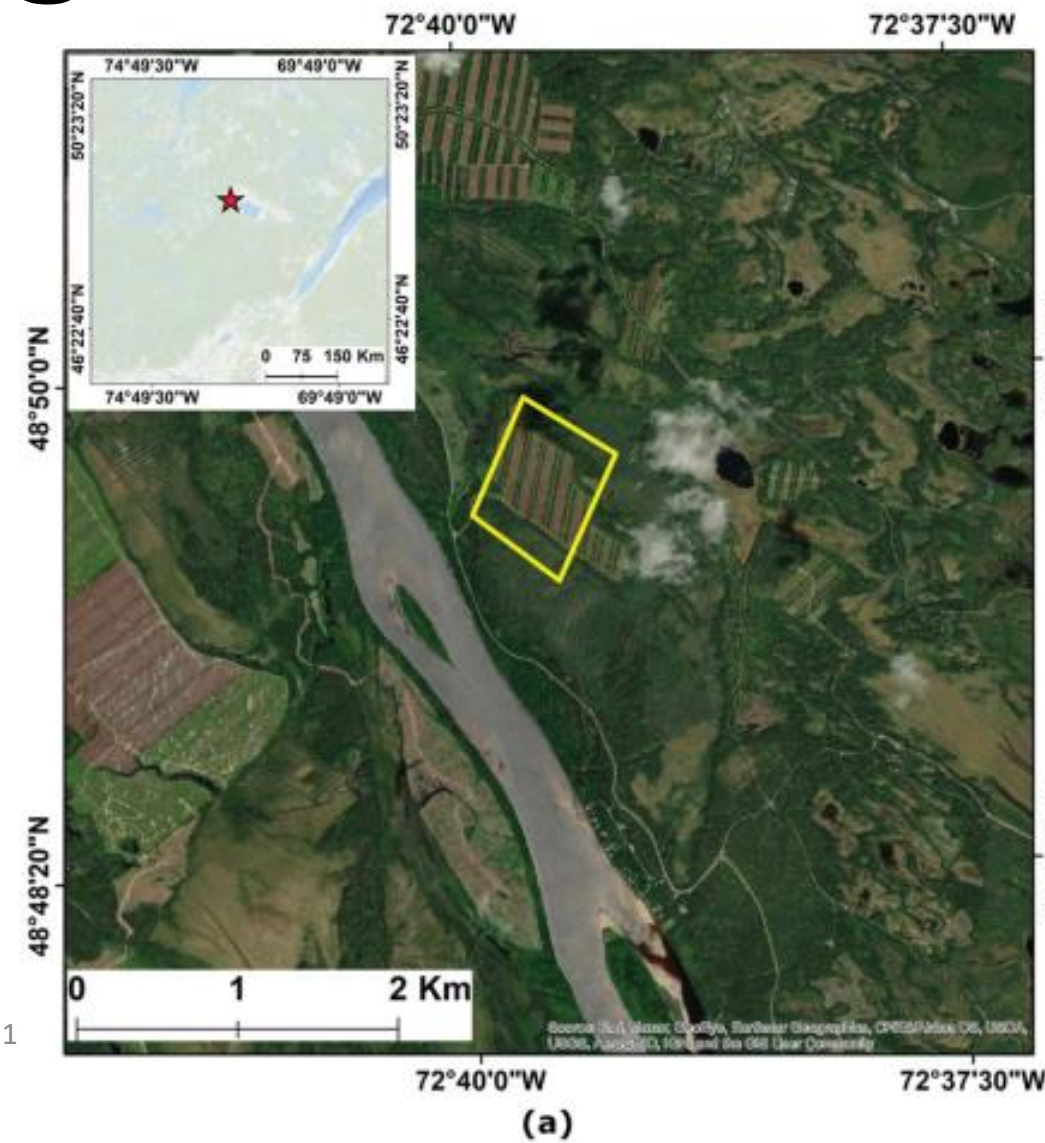
We investigated the **sensitivity** of Normalized difference vegetation index (**NDVI**) and normalized difference red-edge index (**NDRE**) to **management practices in lowbush blueberry fields**.

2

Stem density (number of stems.  $m^2$ ) and length (cm) as well as proportion of contaminated leaves per stem were measured in three  $0.25 m^2$  square quadrats ( $50*50 cm$ ) in each of the 192 experimental units (sprout, H1, and H2 plots). Measurements were taken between the last week of July and the first week of August during blueberry lignification.

3

**Fertilization increased** both NDVI and NDRE compared to the **control plots** for the 3 cropping phases, reflecting the **enhancement of aboveground biomass** production by the fertilizers.



(c)

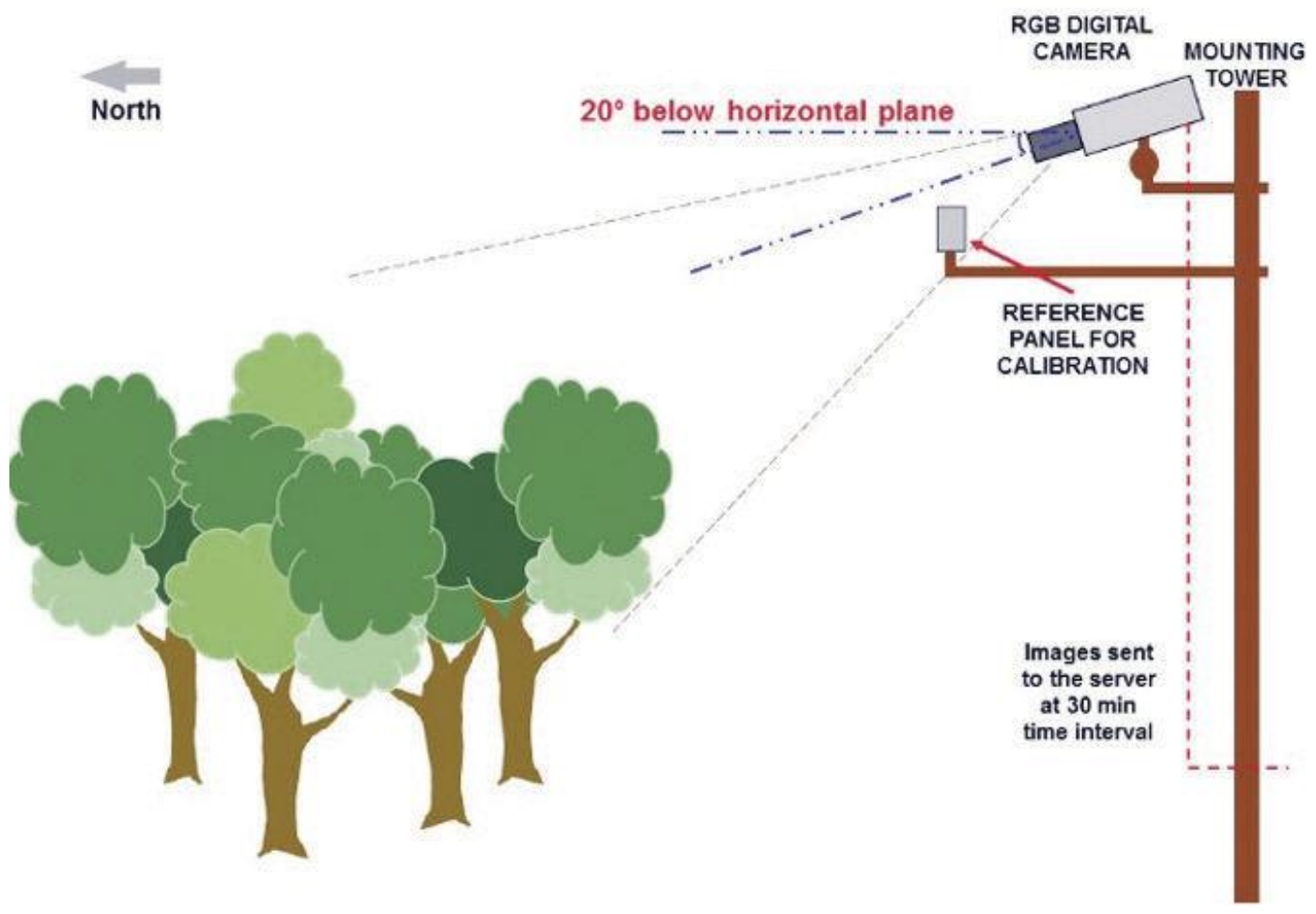


(d)



(e)





# Phenocam Networks

- PhenoCam network was established in 2008 in forested ecosystems of the 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).





# AI in Agricultural Land Parcel Segmentation

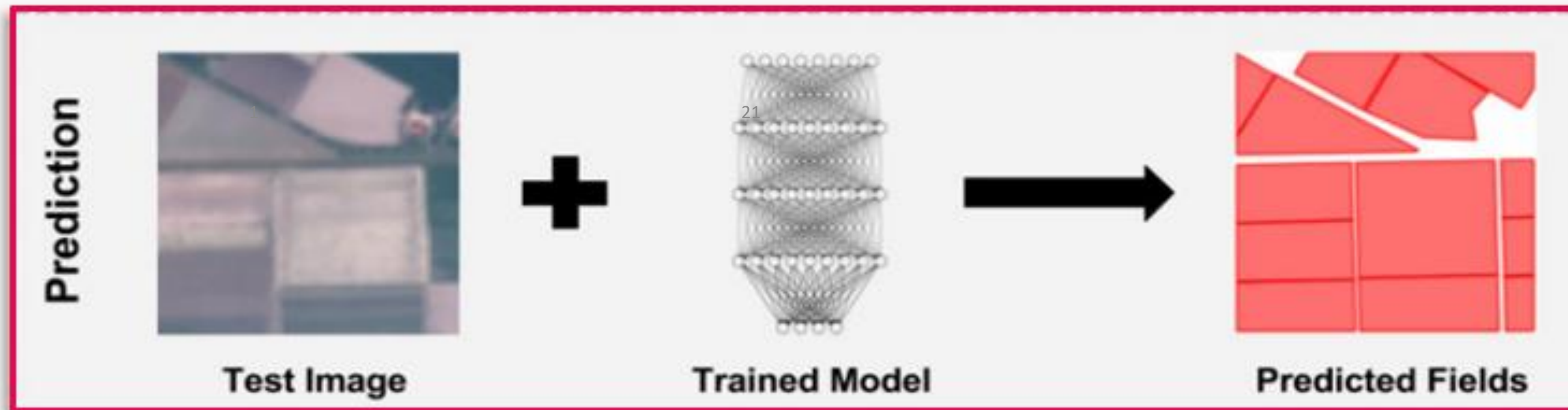


Image Source: Rieke, C. 2017. Deep Learning for Instance Segmentation of Agricultural Fields.



# Agricultural Land Parcels Segmentation

- Reproducible automatization of Agricultural field parcels.
- An ideal automatic method would be able to deliver satisfying speed and accuracy for large areas with variable environmental settings.

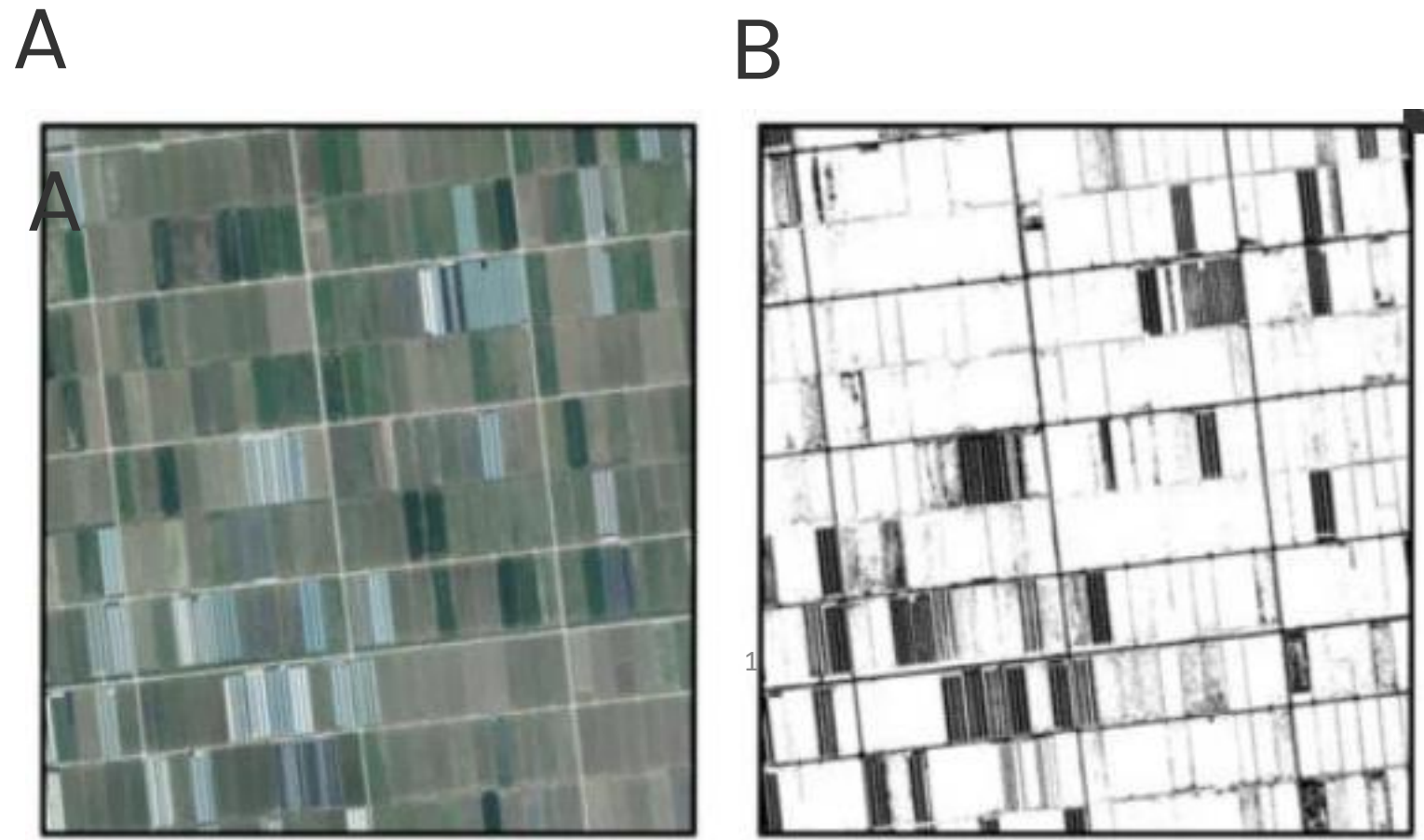


Image Source: <https://www.mdpi.com/2072-4292/11/18/2082>

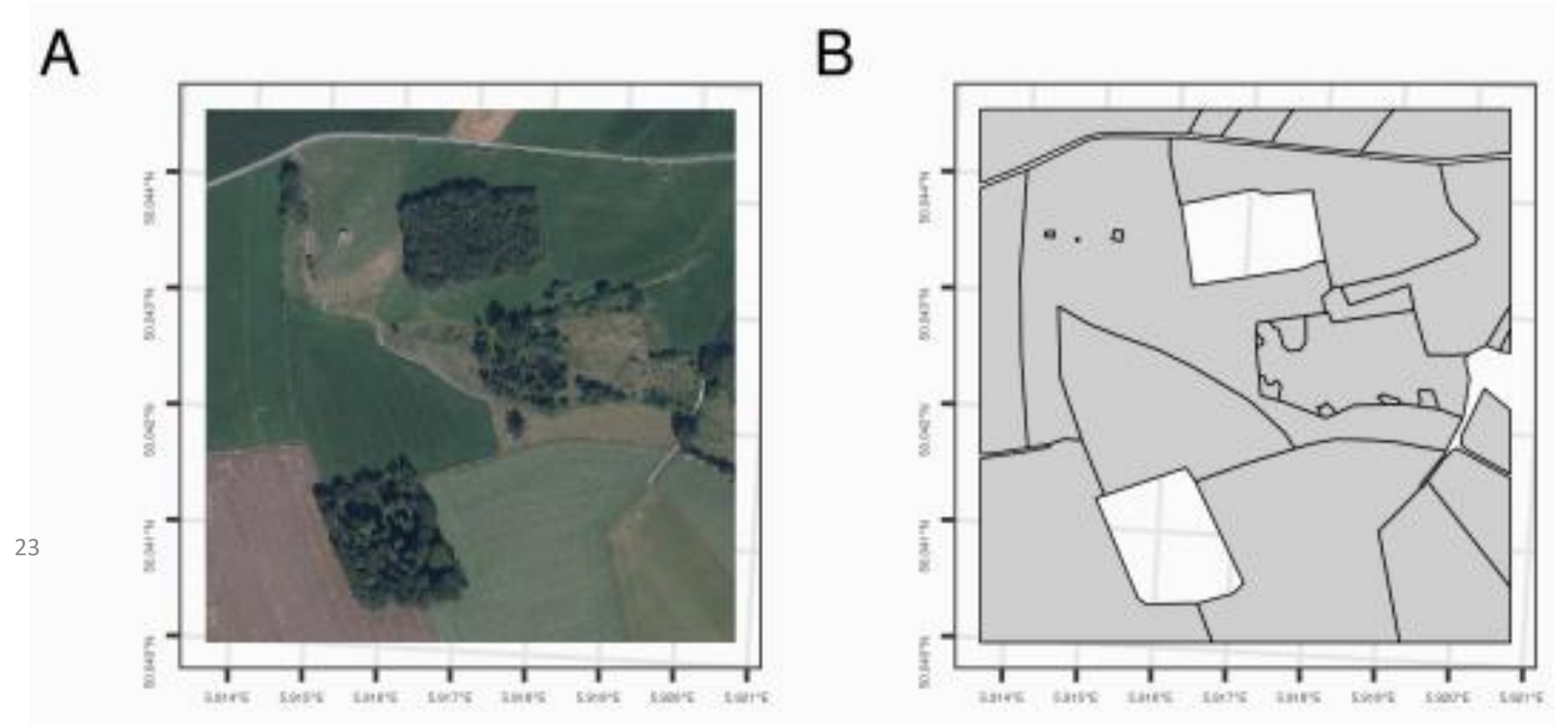


# Agricultural Land Parcels Segmentation..

Most of the fields in India are very irregular compared to developed countries.



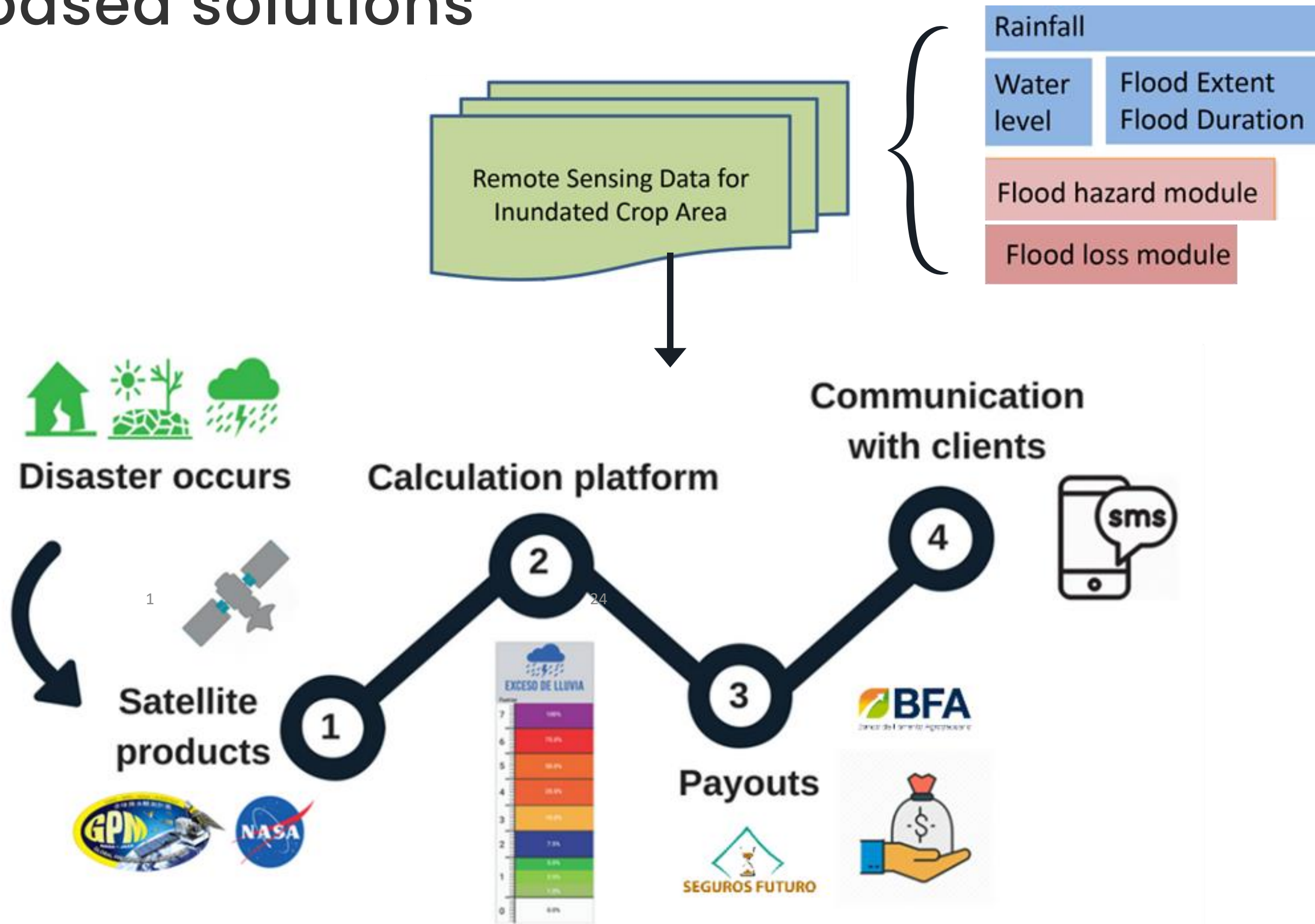
Fields in developed countries



Fields in India



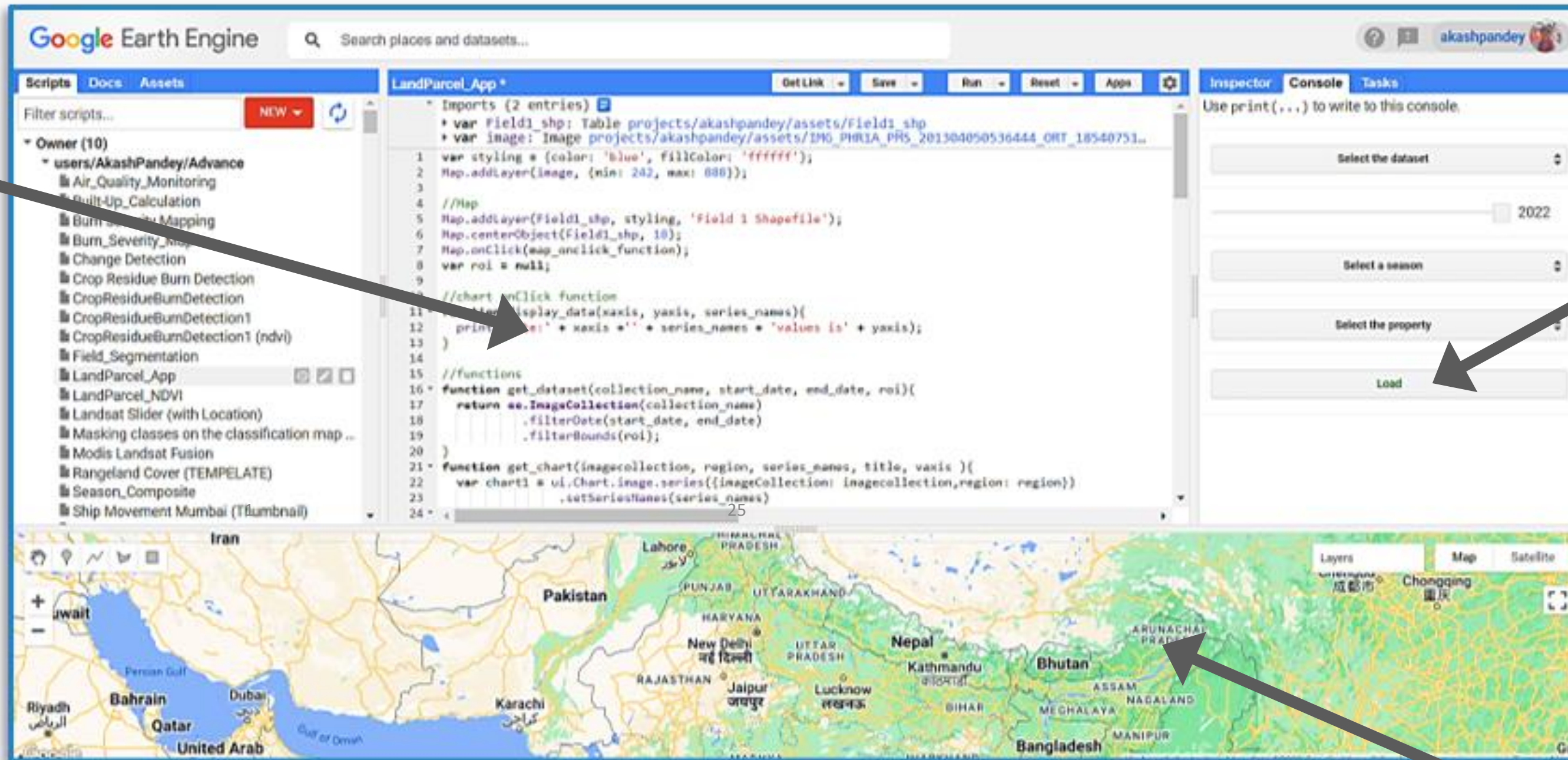
# Tech-based solutions





# GEE Code Interface for Seasonal Crop Information

**Code Editor**



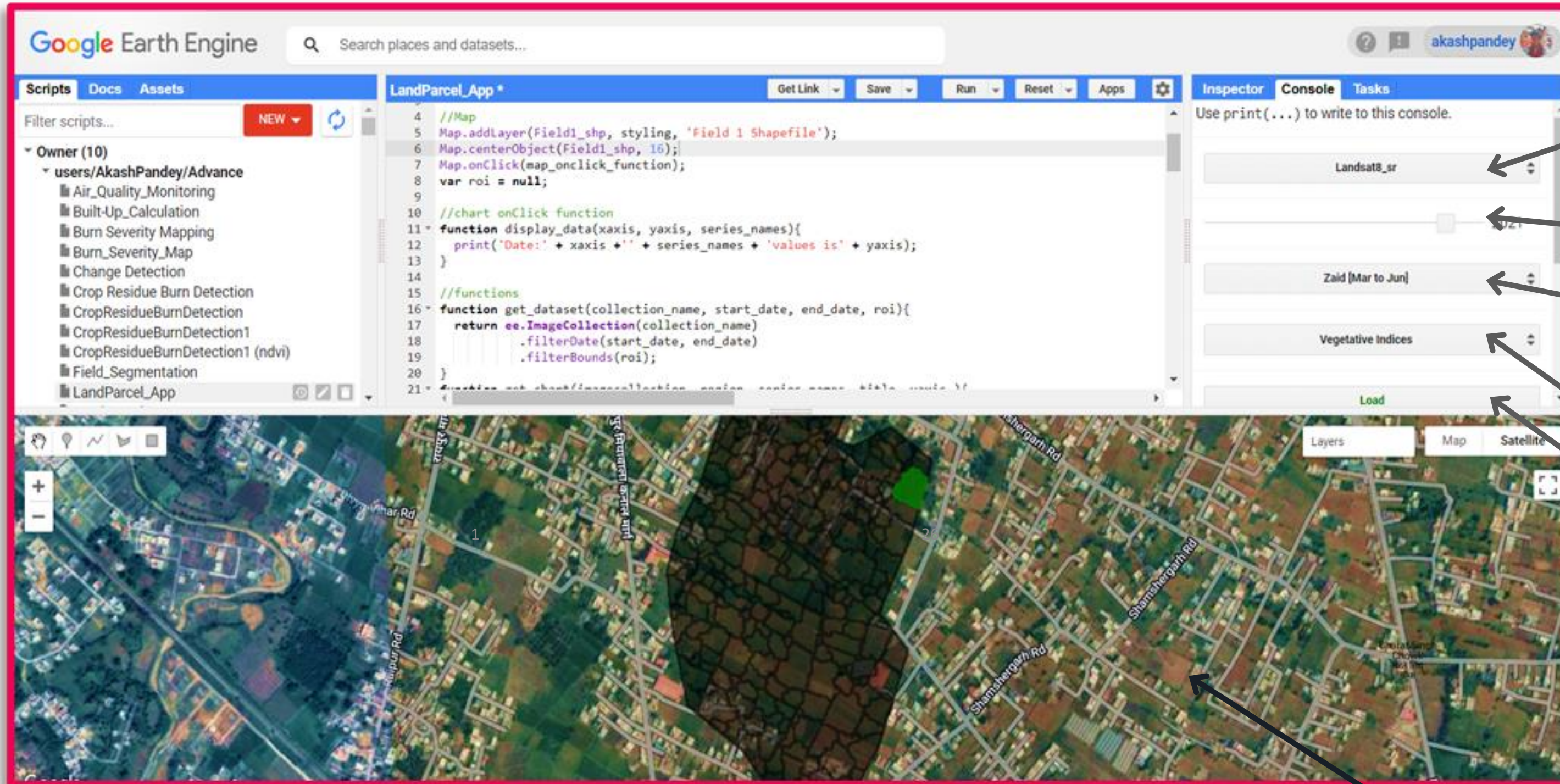
**Result Console**

Google Earth Engine (GEE)'s Code Editor Interface

**Map**



# Web-Application for Seasonal Crop Information

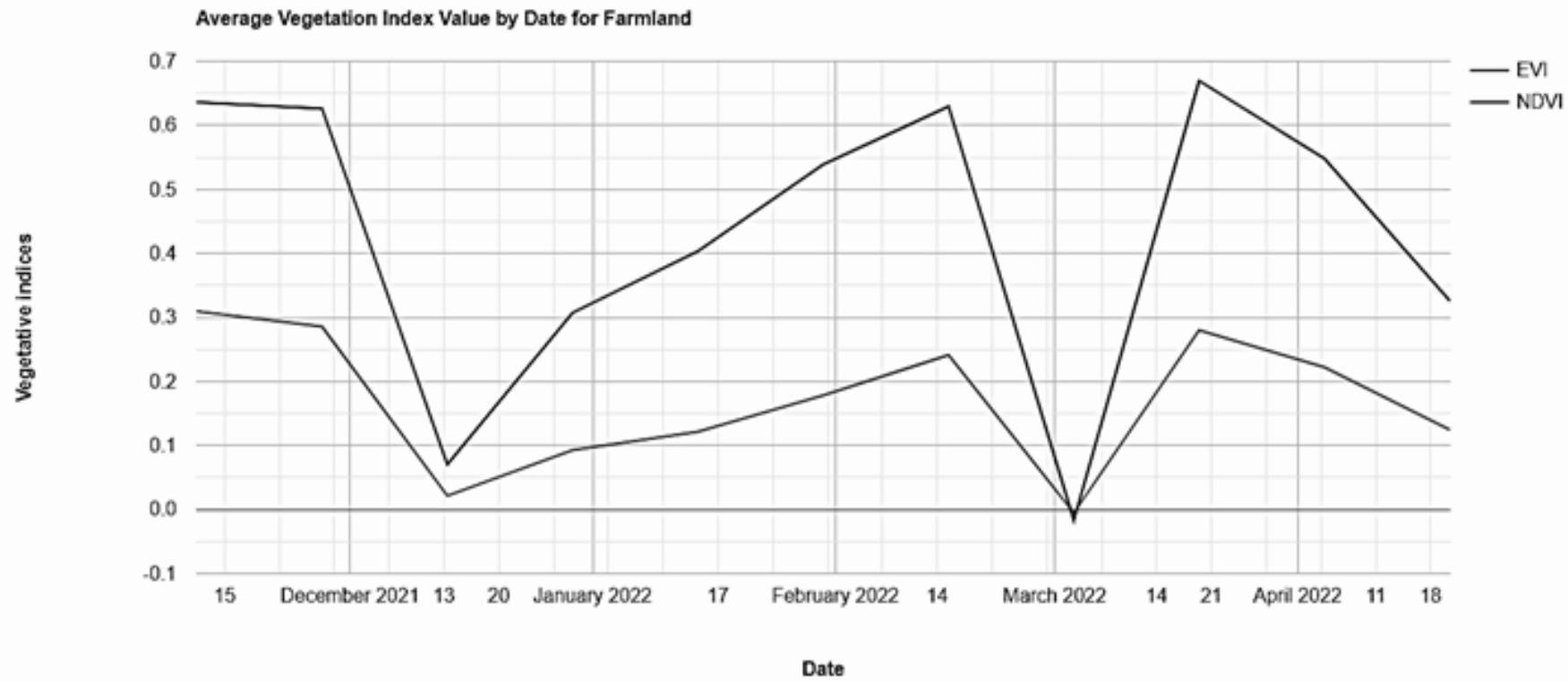


2. Select the Satellite  
(Landsat 8 or Sentinel-2)
3. Select Year (2013-2022)
4. Select Season  
(Rabi/Kharif/Zaid)
5. Indices (NDVI / EVI)
6. Load

Google Earth Engine (GEE)'s Code Editor Interface

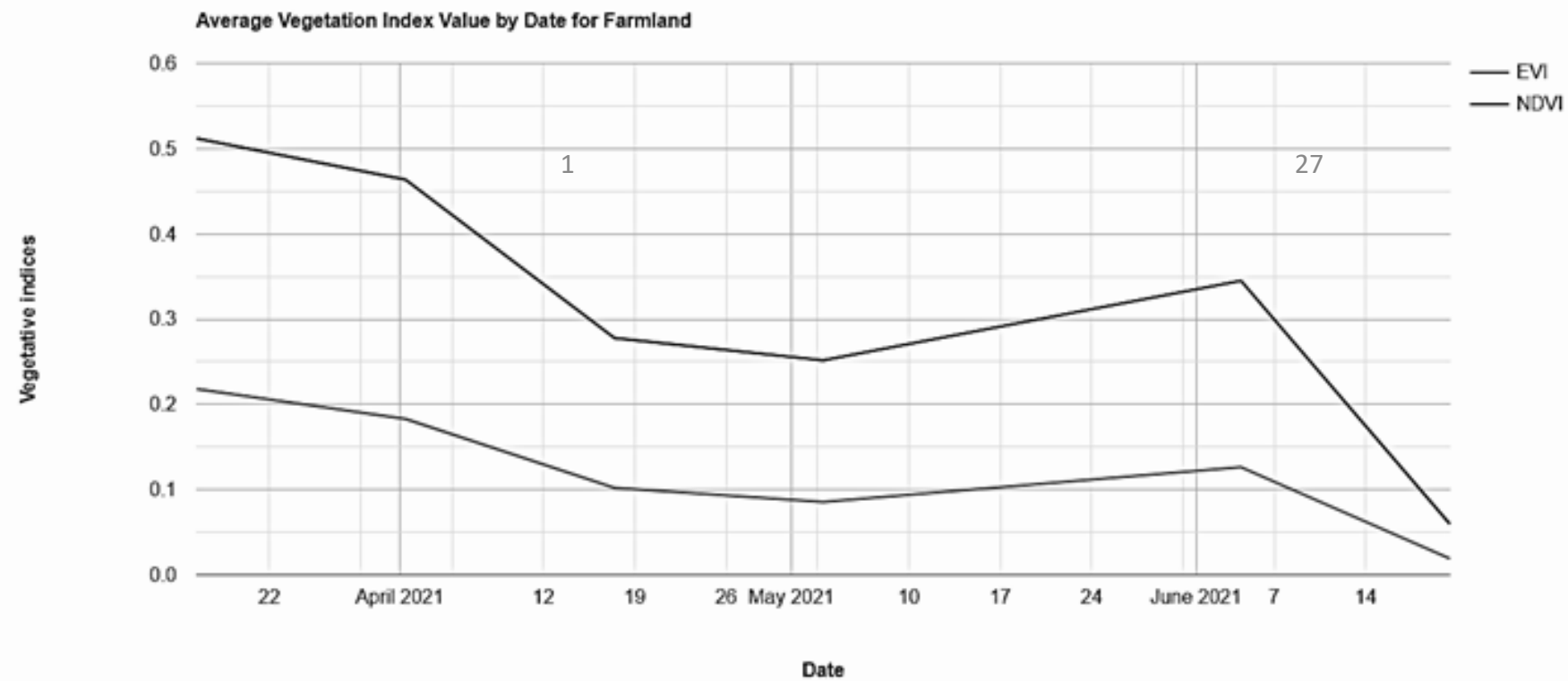
1. Select the field boundary





← **Rabi (Nov-Apr)**

**Seasonal NDVI & EVI  
Time-series of Selected Field**



← **Zaid (Mar-Jun)**



# Bhoomicam

- Helps farmers to monitor their fields efficiently by providing :



Bhoomicam provides

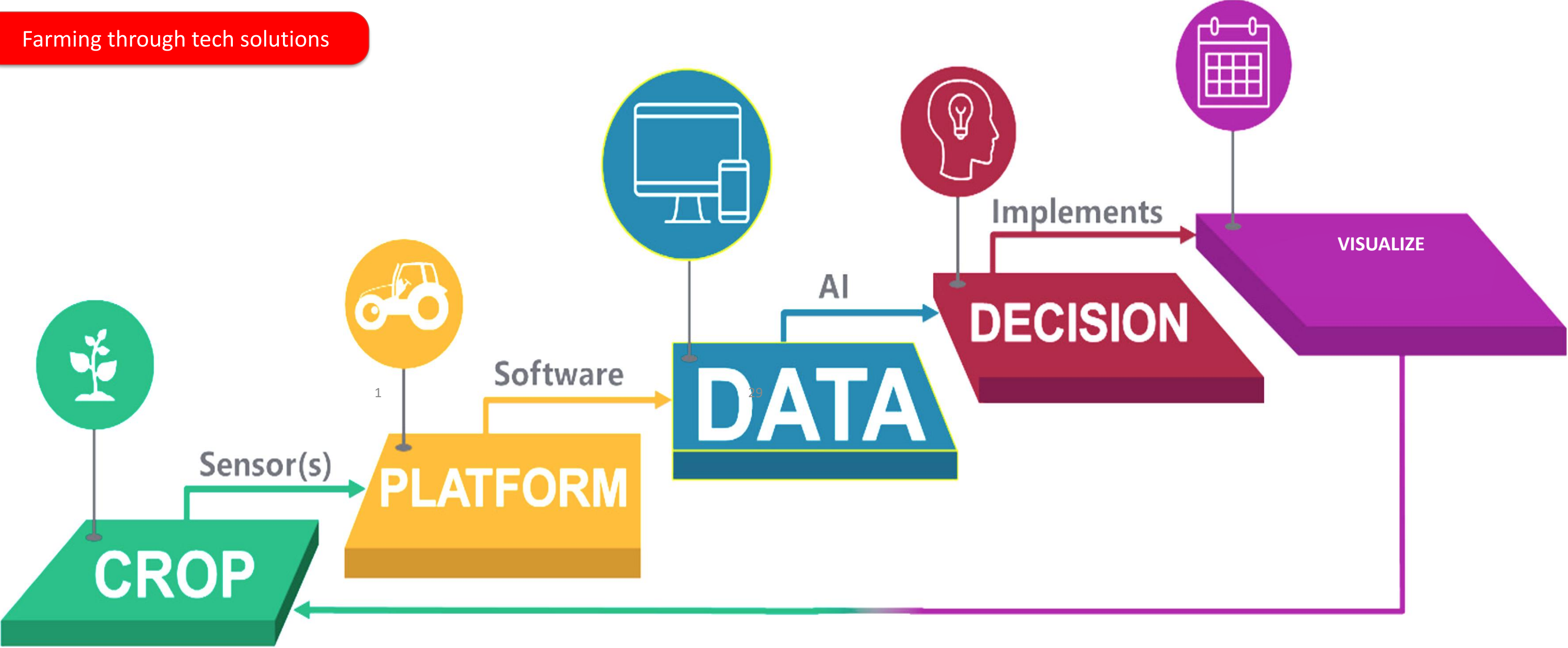
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- Growth/Yield estimation
- Watering condition
- Fertilizer details
- Disease identification
- Crop specific solutions
- Field Monitoring



# Our Tech-Architecture

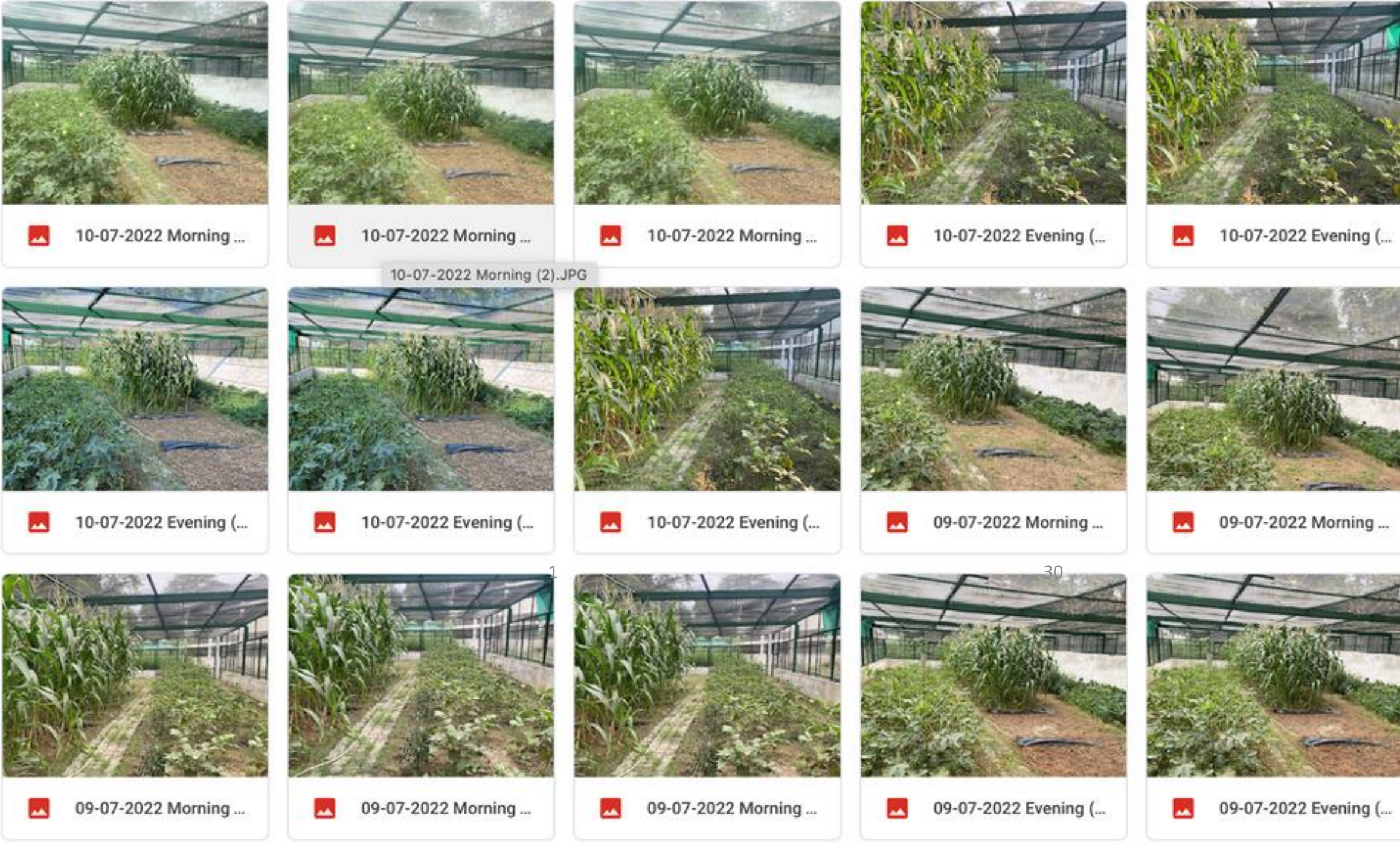
Farming through tech solutions



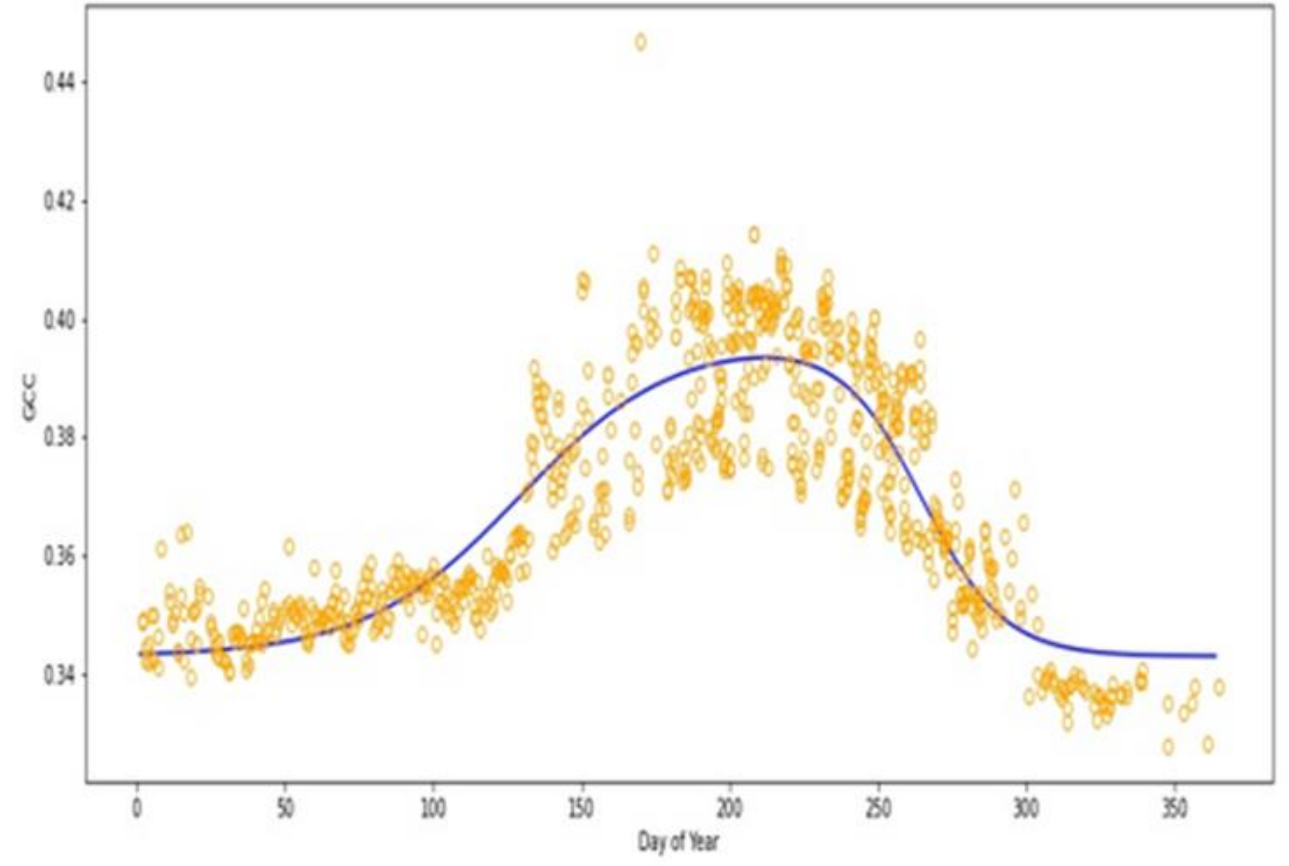
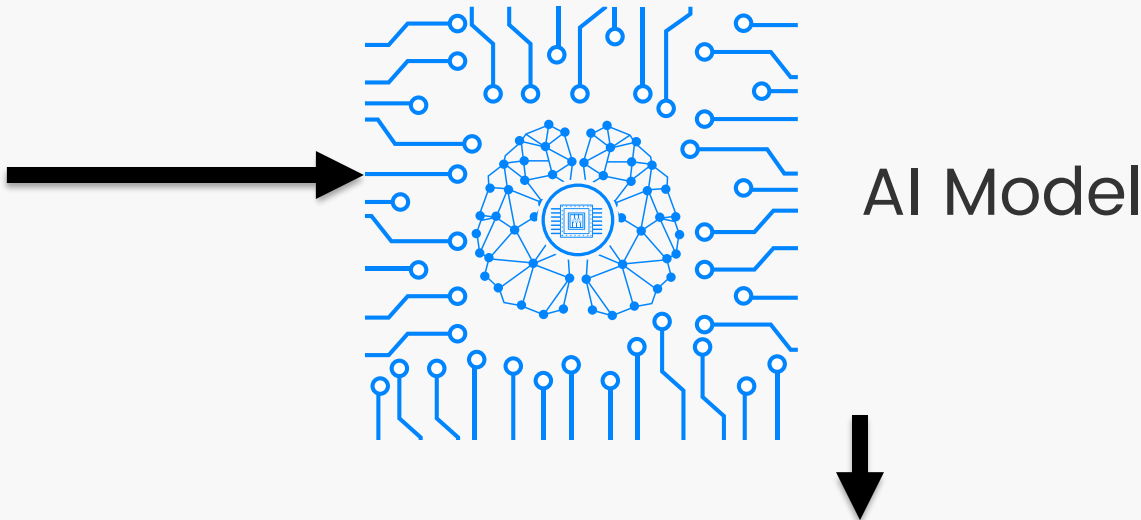


# Bhoomicam

We have prepared an AI model which processes the image of the field and shows the information about the crop.



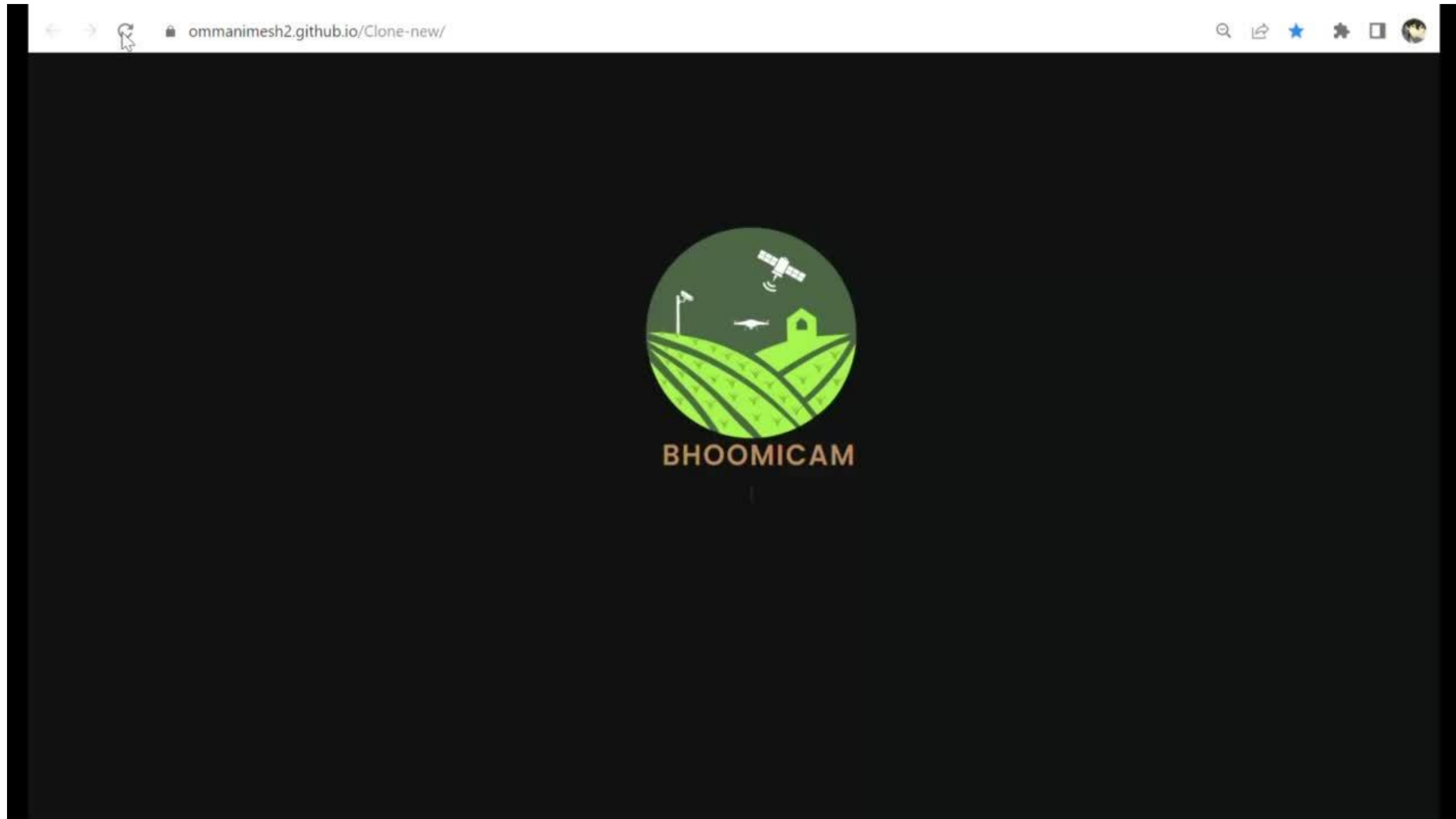
Input



Output shows us Crop Condition



# Bhoomicam

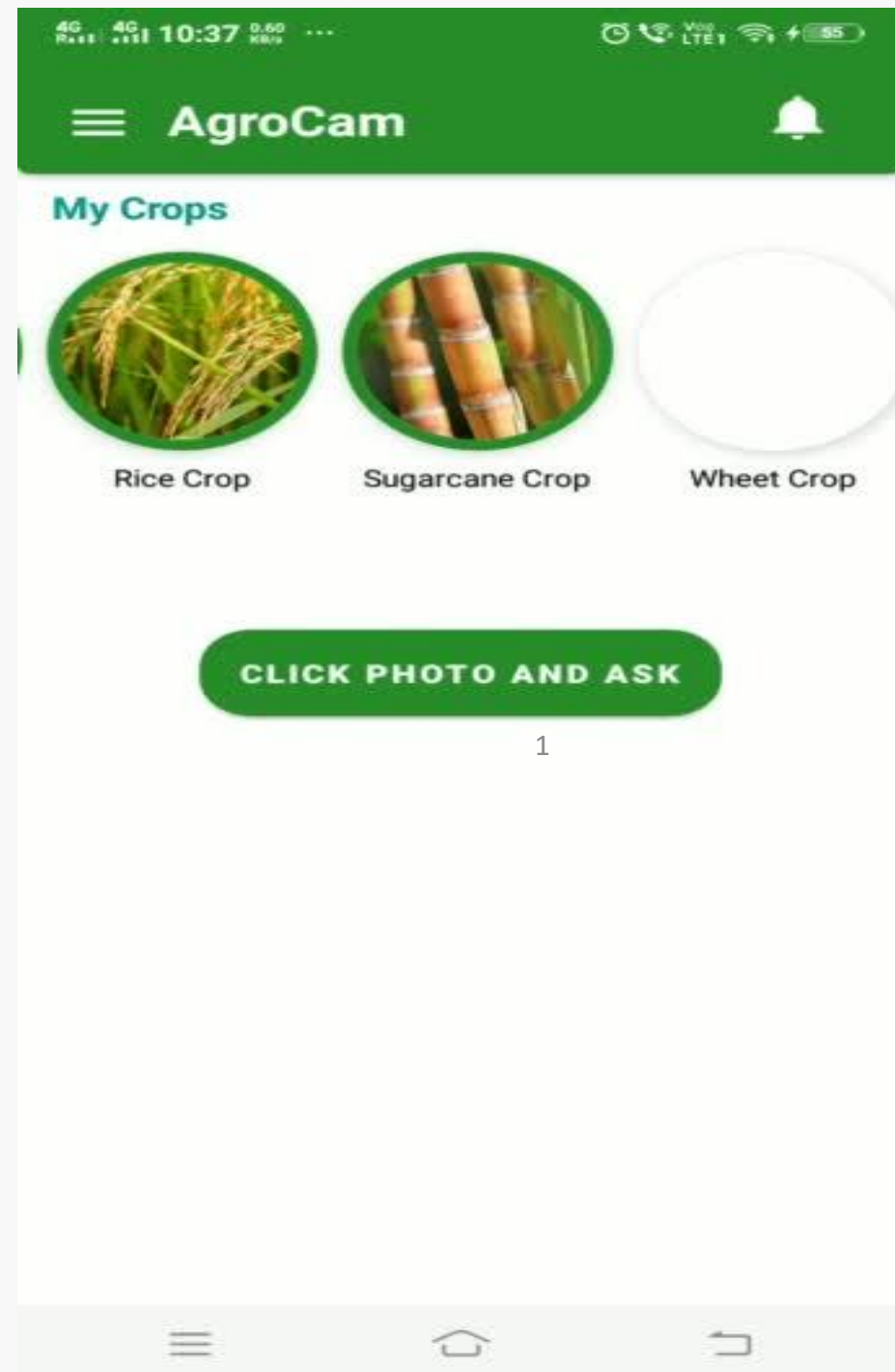


<https://ommanimesh2.github.io/Clone-new/>



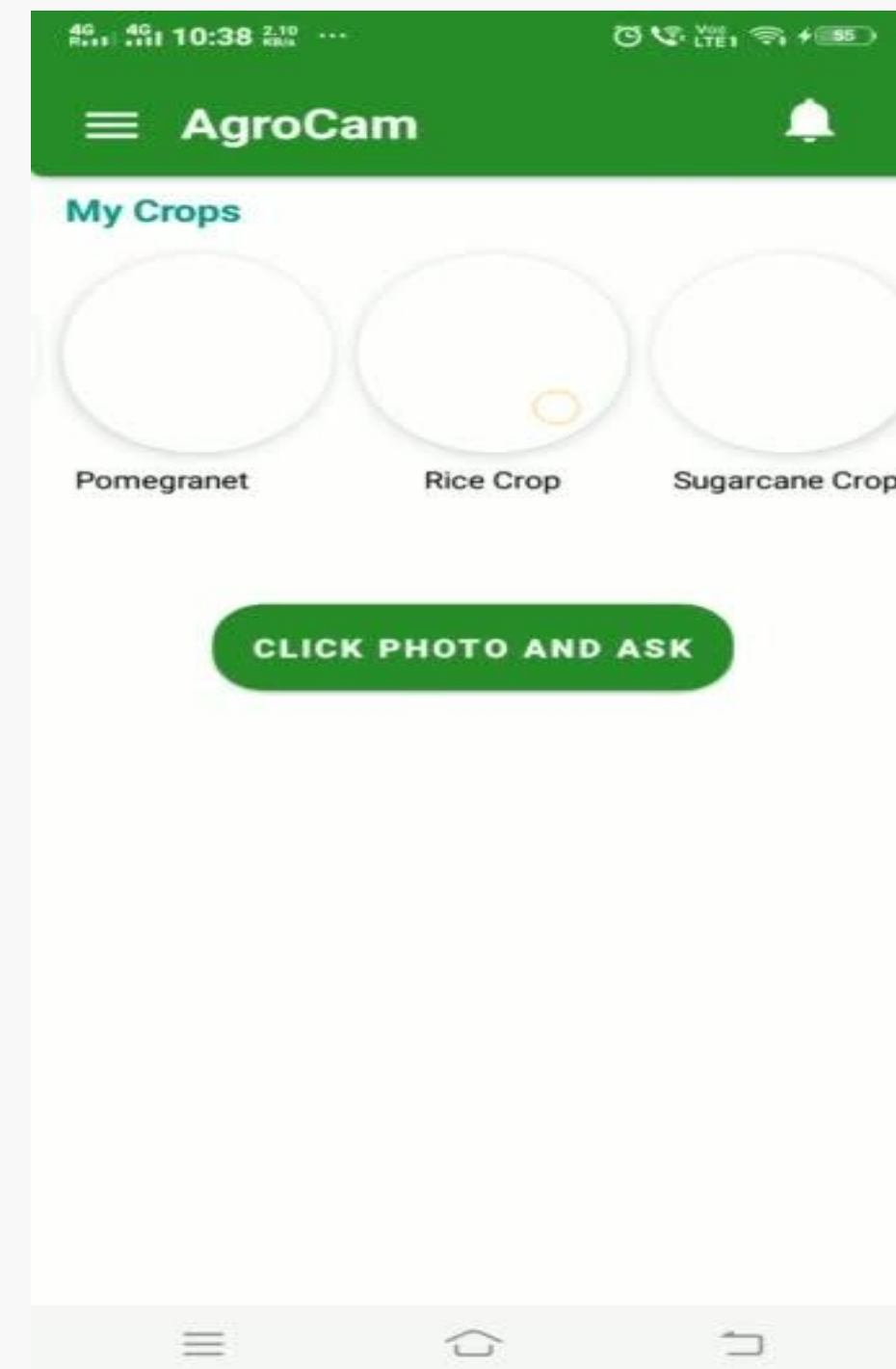
# Bhoomicam

Currently, We are designing an application with an AI model for monitoring fields.



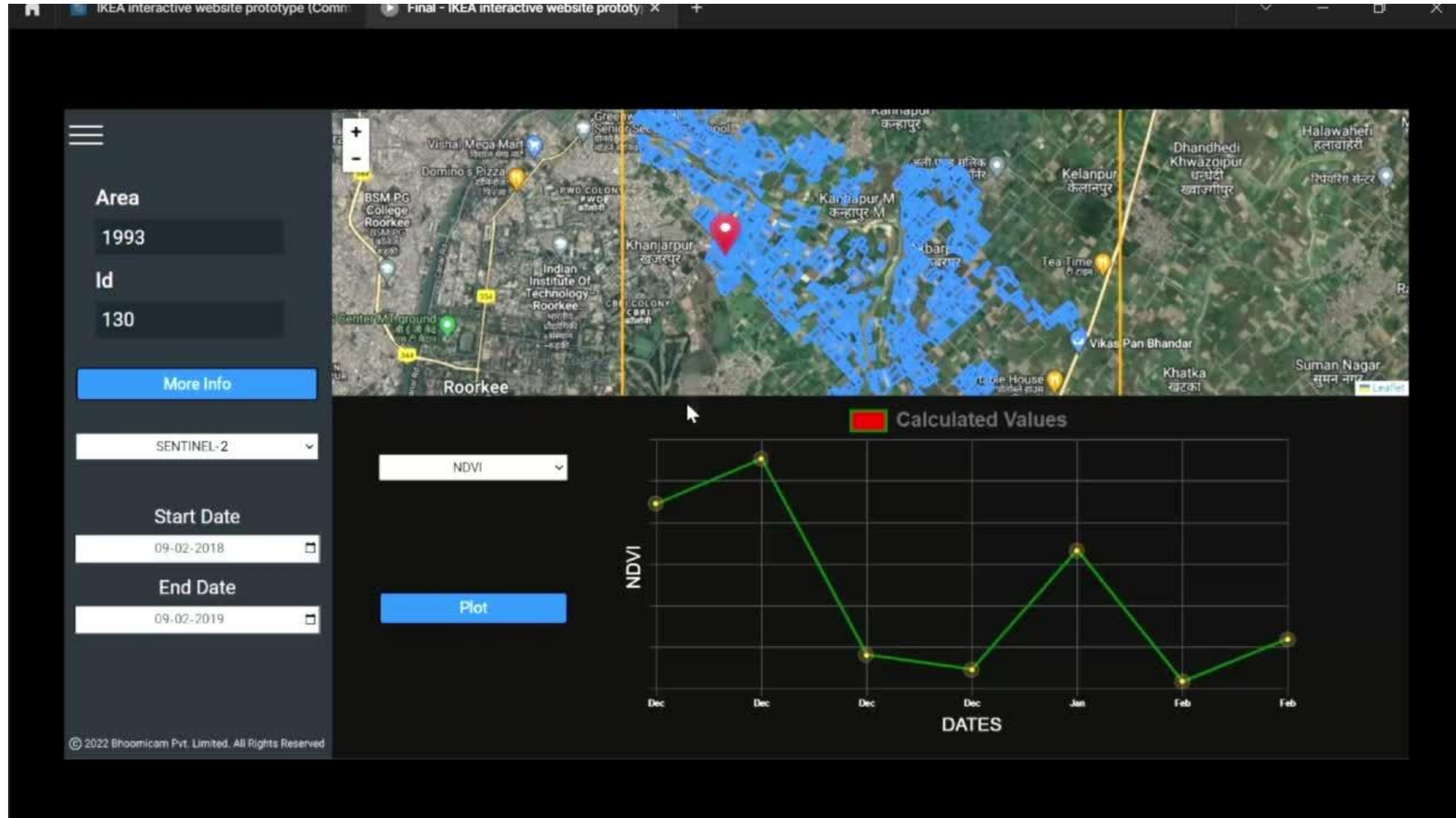
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# Future goals





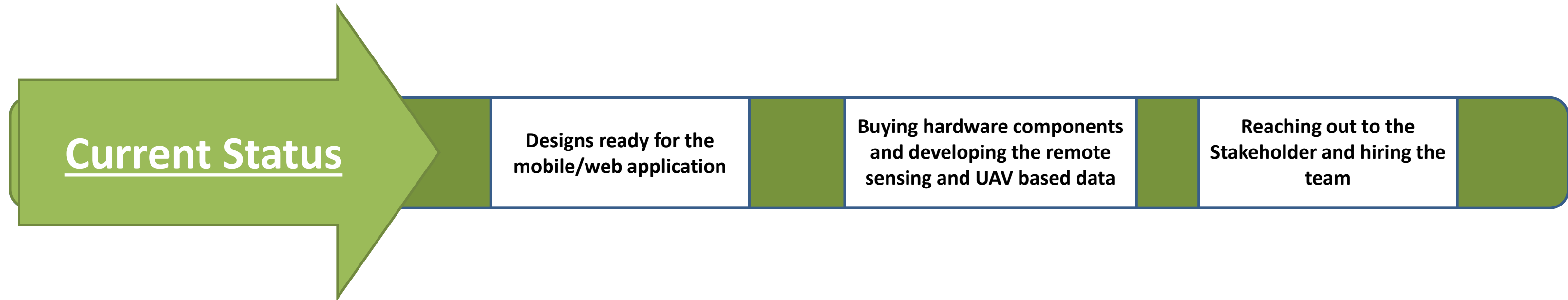
# Looking ahead

- These are the first steps leading to farm level digital base.
- Drone based identification disease infested areas and their remedial actions to be shared with farmers
- Affordable solutions to the stakeholders.
- Correlation between type of seed used-fertilization provided vs yield to give optimal advice for adaptation of seed for the future at village level
- Correlating the hydrometeorological data to understand the impacts of climatic changes on crop yields.
- Productivity oriented crop insurance

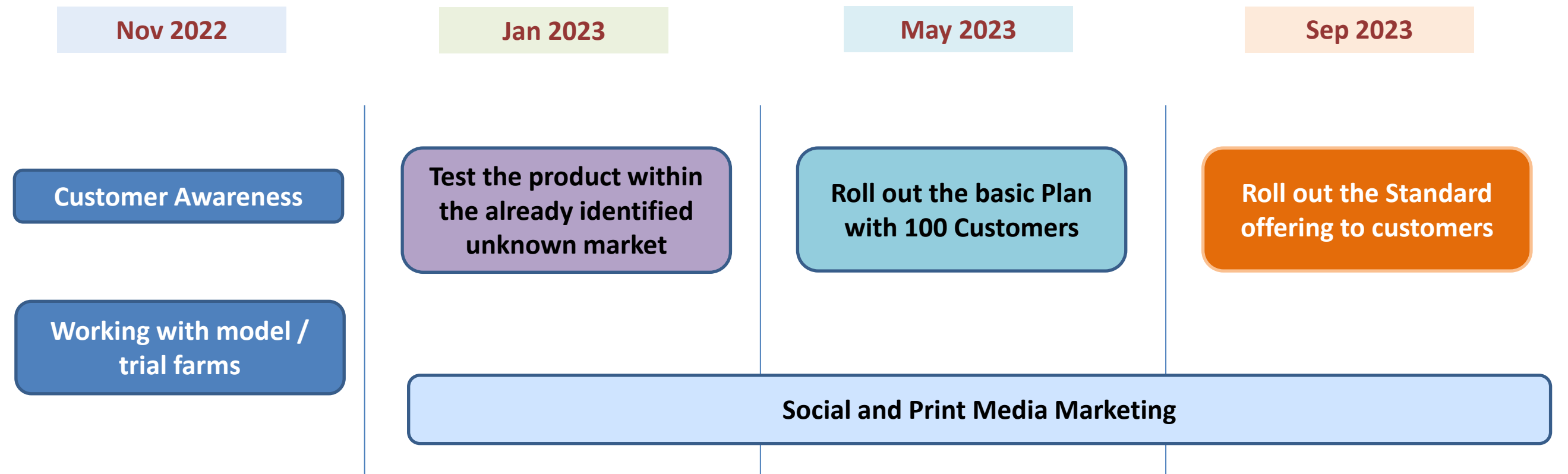
<b>Offering and Services</b>
<b>Weather forecasting</b>
<b>Crop planning</b>
<b>Crop backup planning</b>
<b>Time to harvest</b>
<b>Finance tracking / Agro-Economics</b>
<b>Irrigation</b>
<b>Pre-harvest planning</b>
<b>Disease Insect</b>
<b>Fertigation</b>



# current status and go to market plan



## Go to market approach





# Our Team



Prof. Siddhartha Khare  
Founder & Director



Prof. Sanjay Kumar Ghosh  
Advisory Board Member



Tushar Bharadwaj (JRF)  
CEO



Akash Pandey(Phd)  
AI Expert



Akash Kumar Beniwal  
(B.tech 4th year)  
AI Expert



Yatendra Singh Hinunia  
(B.tech 4th year)  
Android Developer



Nitish Kumar Boro  
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Android Developer



Omm Animesh Mishra  
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Web Developer



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Designer



Raushan Raj  
(Btech 2nd year)  
Designer



# Thank you!