AI and satellite-based solutions for agriculture land records
About the presenters

Prof. Siddhartha Khare
Assistant Professor in Geomatics Engineering, Civil Engg. Dept., IIT Roorkee
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 (Civil Engg. Dept) at IIT Roorkee*

Expertise:
- UAV
- Artificial Intelligence & Machine Learning
- Remote Sensing Algorithm Development
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.
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.

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.

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

Source: UN FAO

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 Improvised Technology in Village Areas

Image source: https://vikaspedia.in/social-welfare/rural-poverty-alleviation-1/svamitva-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

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.

Image Source: https://www.slideshare.net/southasia-ifpri/ifprirole-of-remote-sensing-technology-in-pmfbymanoj-yadav
Examples of Modern Farming Tools
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

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

Stem density (number of stems. m²) and length (cm) as well as proportion of contaminated leaves per stem were measured in three 0.25 m² 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.

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.

Marty and Khare et al., (2022)
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).

Source: https://phenocam.sr.unh.edu/webcam/network/map/
AI in Agricultural Land Parcel Segmentation

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.
Tech-based solutions

Remote Sensing Data for Inundated Crop Area

Disaster occurs

Calculation platform

Communication with clients

Satellite products

Payouts

Rainfall
Water level
Flood Extent
Flood Duration
Flood hazard module
Flood loss module

Image Source: https://gpm.nasa.gov/sites/default/files/2021-10
GEE Code Interface for Seasonal Crop Information

Google Earth Engine (GEE)’s Code Editor Interface

- Code Editor
- Result Console
- Map
Web-Application for Seasonal Crop Information

1. Select the field boundary
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
Rabi (Nov-Apr)

Seasonal NDVI & EVI

Time-series of Selected Field

Zaid (Mar-Jun)
Bhoomicam

• Helps farmers to monitor their fields efficiently by providing:

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

Farming through tech solutions

1. CROP → PLATFORM
2. Sensor(s) → Software → DATA
3. DATA → AI → DECISION
4. DECISION → Implements → VISUALIZE
We have prepared an AI model which processes the image of the field and shows the information about the crop.

Output shows us Crop Condition
Bhoomicam

https://ommanimesh2.github.io/Clone-new/
Bhomicam

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

<table>
<thead>
<tr>
<th>Offering and Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather forecasting</td>
</tr>
<tr>
<td>Crop planning</td>
</tr>
<tr>
<td>Crop backup planning</td>
</tr>
<tr>
<td>Time to harvest</td>
</tr>
<tr>
<td>Finance tracking / Agro-Economics</td>
</tr>
<tr>
<td>Irrigation</td>
</tr>
<tr>
<td>Pre-harvest planning</td>
</tr>
<tr>
<td>Disease Insect</td>
</tr>
<tr>
<td>Fertigation</td>
</tr>
</tbody>
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current status and go to market plan

Current Status

- Designs ready for the mobile/web application
- Buying hardware components and developing the remote sensing and UAV based data
- Reaching out to the Stakeholder and hiring the team

Go to market approach

- Nov 2022
  - Customer Awareness
- Jan 2023
  - Test the product within the already identified unknown market
- May 2023
  - Roll out the basic Plan with 100 Customers
- Sep 2023
  - Roll out the Standard offering to customers

Social and Print Media Marketing
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  
(B.Tech 4th year)  
Android Developer

Omm Animesh Mishra  
(Btech 2nd year)  
Web Developer

Priyanshu Mehra  
(Btech 2nd year)  
Web Developer

Prakhar Khatri  
(Btech 2nd year)  
Web Developer

Priyanshu Gupta  
(Btech 2nd year)  
Designer

Raushan Raj  
(Btech 2nd year)  
Designer
Thank you!