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AI for Climate-Smart Smallholder Agriculture: an early warning system

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Problem Statement

80% of the African population is heavily dependent on rain-fed agriculture by smallholder farmers with most farms ranging from 0.5 to 3ha in size.

Farmers are reliant on intuition and years of experience to plant their crops and feed their livestock but this is increasingly not possible as the climate changes.

Support is needed in the form of **access to extension services** and **localized early warnings, access to quality inputs and seeds that are more resilient to climate change**, and other **agronomic best practices for climate adaptation**.

Accurate data on each crop production cycle needed to support data-driven decision-making by **policymakers** and **everyone across agriculture value chains**.

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What does our **Early Warning System** do?

- Monitors smallholder farming activities **in agriculture productive regions** of Kenya
- The EWS monitors the **health of crops, pest infestations, diseases and nutrient deficiencies** early enough and sends alerts to farmers, the local government and other institutions working in the agriculture value chain.
- **Coverage of 14 value chains including maize, beans,** indigenous vegetable varieties.

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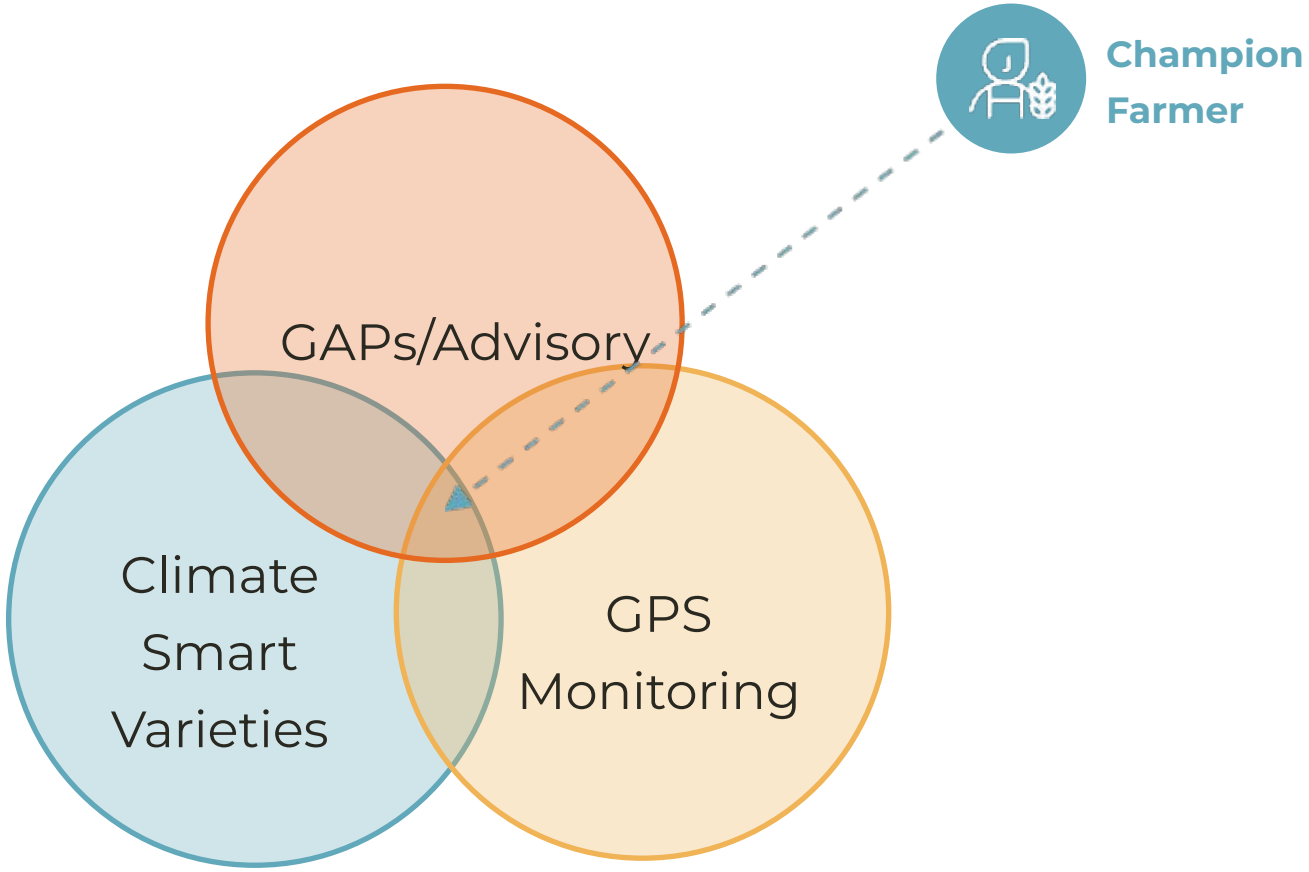
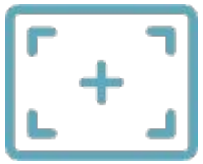
Participatory Data Collection

- Citizen Science in Climate Adaptation and Resilience



Our Technology



Smart Phones

Data collection of ground-truth data from farms and mode of delivery of advisory

Inclusion of Indigenous Knowledge

Voice and language data from community

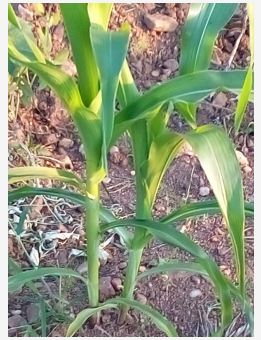
Earth Observations Data

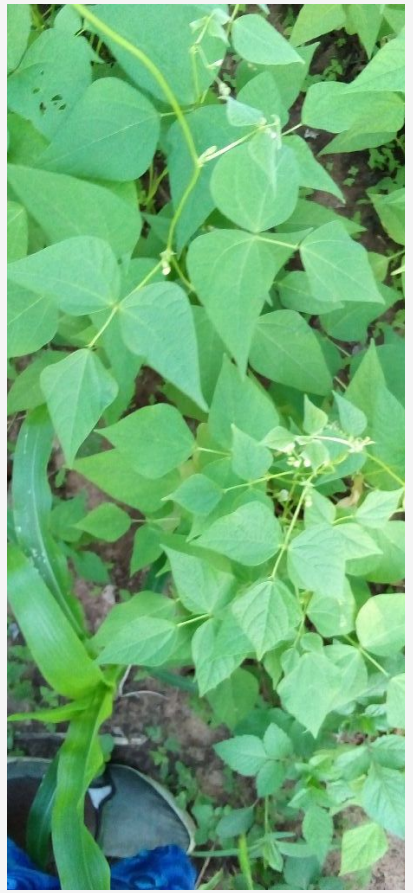
Satellite Imagery and Weather Data

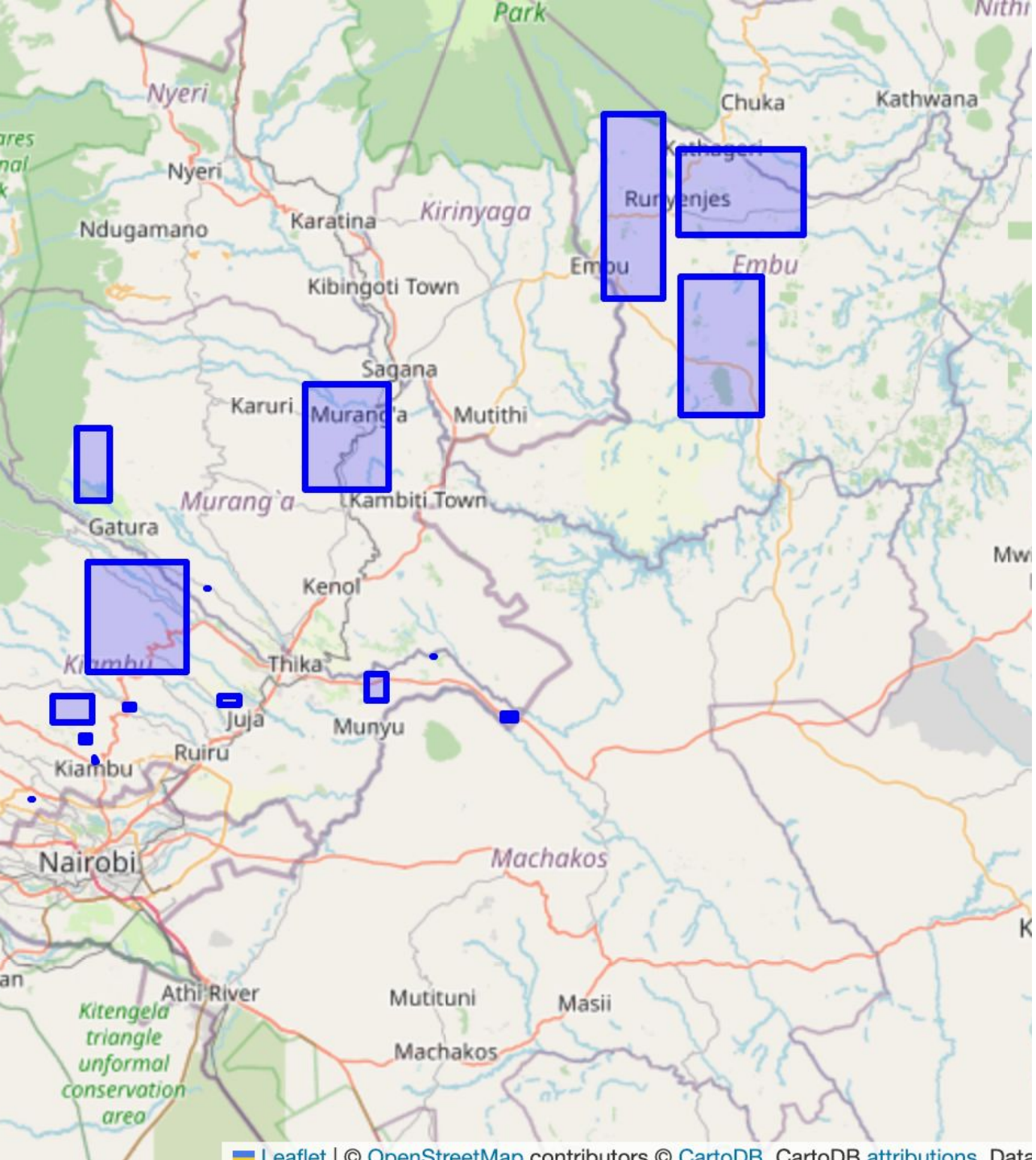
Computer vision and NLP

Analyze images generated from satellites and phones to detect crop health; Language dataset for advisory generation

Examples of photos taken by farmers







As at March, 2024

Project in Numbers

- **150** champion farmers
- **~3000 farms** in 21 agro-ecological zones
- **65% of farmers** practice intercropping
- Most farmers **above the age of 35** and **~60% women**
- **200,000** images of crop and fields
- **~500 sqkm** of crop monitored

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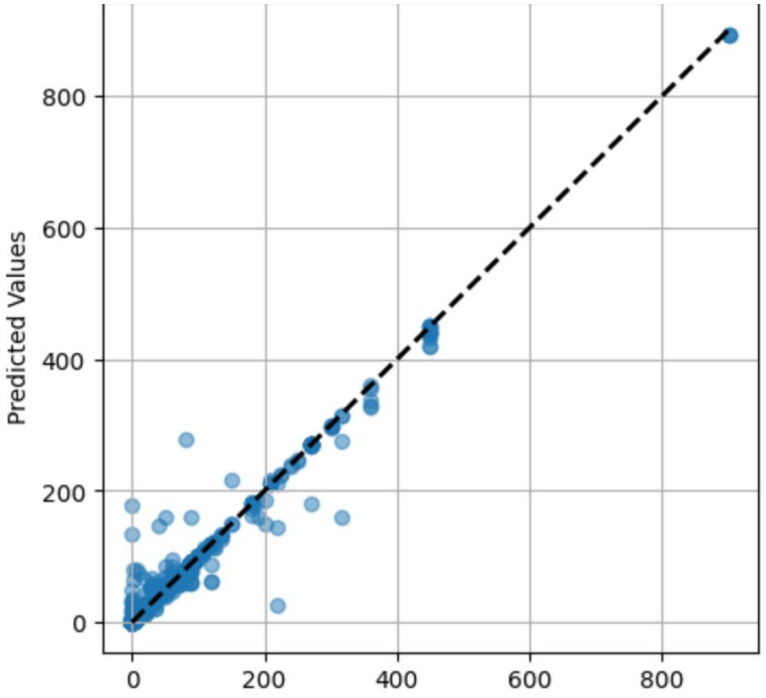
AI Models Available

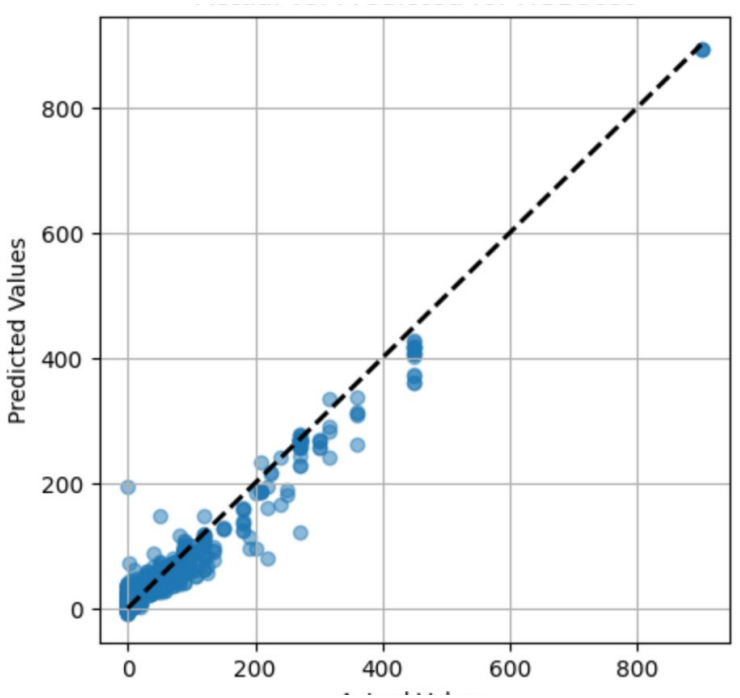
- Disease, pest and nutrient deficiency detection
- Area under cultivation/field boundary detection
- Crop identification
- Yield prediction and crop stress index

Crop identification model outputs

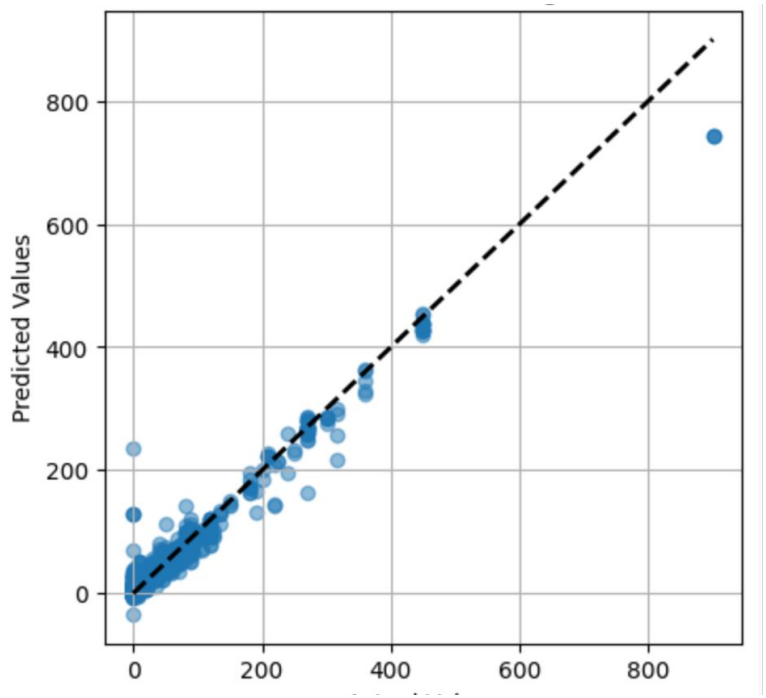
Yield Model Performance



Random Forest

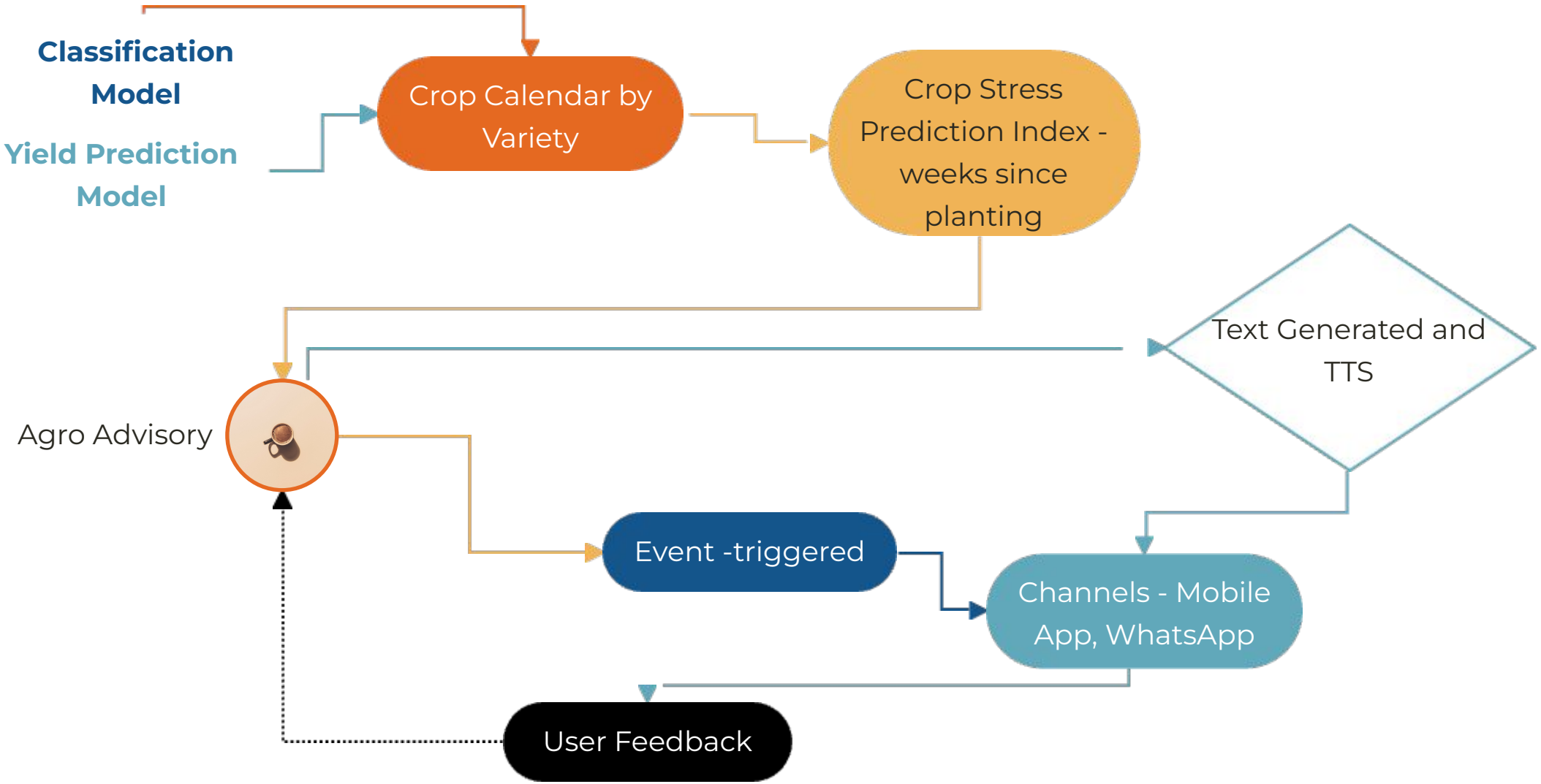


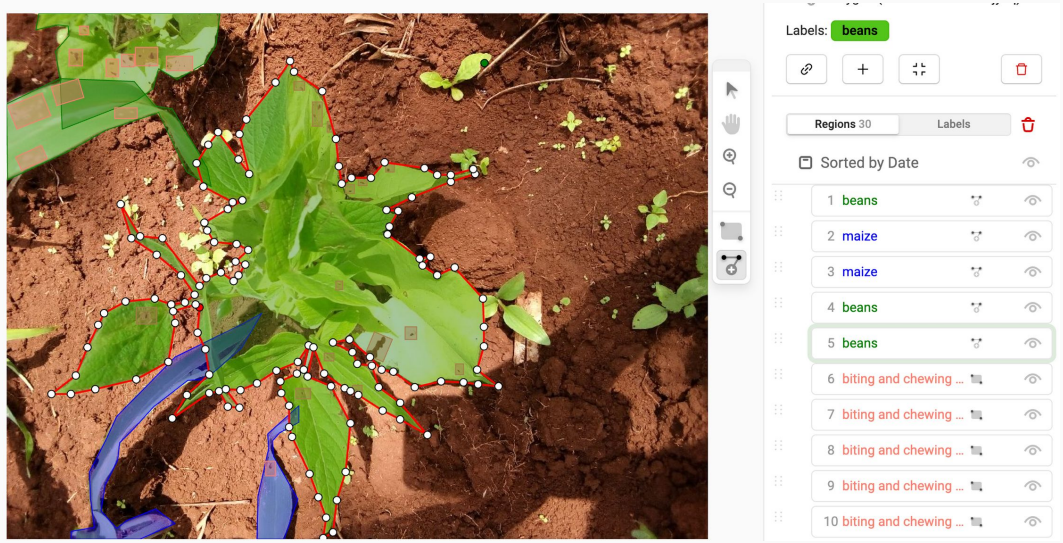
XGBoost

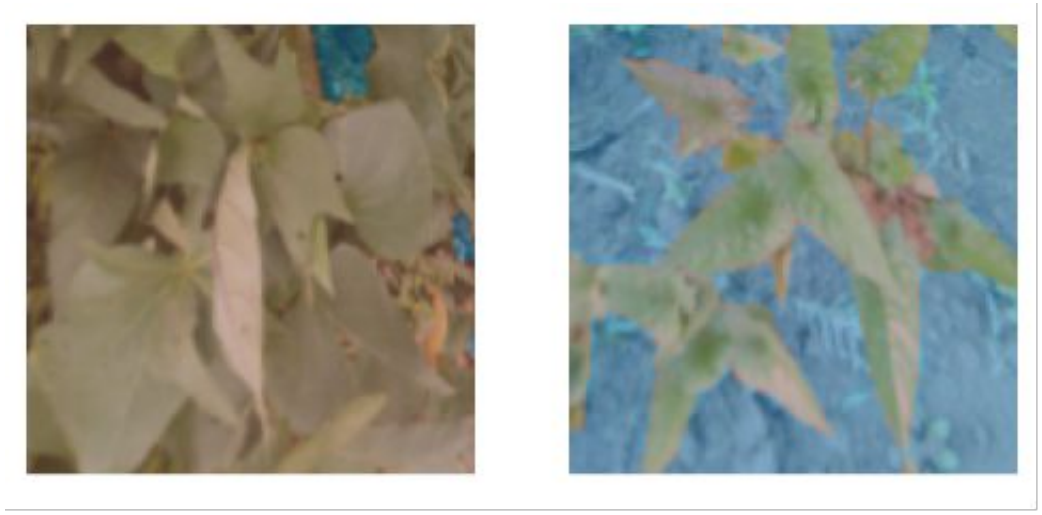


Light GBM

From Model to Advisory







Sustainable practices in **AI-development**

- **Dataset Efficiency** - Carefully annotated datasets in initial training reduces training datasets and model parameters required for transfer-learning as we move from one value chain to the next.
- **Open-sourcing datasets** - Adoption of FAIR principles in dataset creation ensures production of sustainable training datasets
- **Efficient model training** -use of efficient neural net architectures and re-use of models reduces compute requirements

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Collaboration opportunities

Support for agro-forestry monitoring

Expand monitoring to include intercropping with trees and agroforestry practices.

Deploy in 15 counties in Kenya and across EA

Extend coverage to agriculture-productive agroecological zones and entry in TZ and UG

Deploy AI on multi-modal platforms

Include Generative AI capabilities in Swahili, Kikuyu and Kiembu

Lessons Learned

Local / Community Designed AI more sustainable in resource-scarce contexts

- Use of **champion farmers and Farmer Field schools** enable us to build trust as we onboard farmers to EWS while at the same time offering practical GAPs training and sustained engagement with agronomists.
- User-centred approaches in technology design to support **behavioural changes** - adoption of climate resilience strategies
- Use of **local languages and indigenous knowledge** - AI should be opportunities to enable communities derive value from their own resources and therefore beneficial and not extractive.

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Thank **you**.

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