Ethiopian Institute of Agricultural Research

CIMMYT
International Maize and Wheat Improvement Center

Digital Agroclimate Advisory is A New Frontier in Transforming Smallholders to Smart Farmers: Experience from EIAR.

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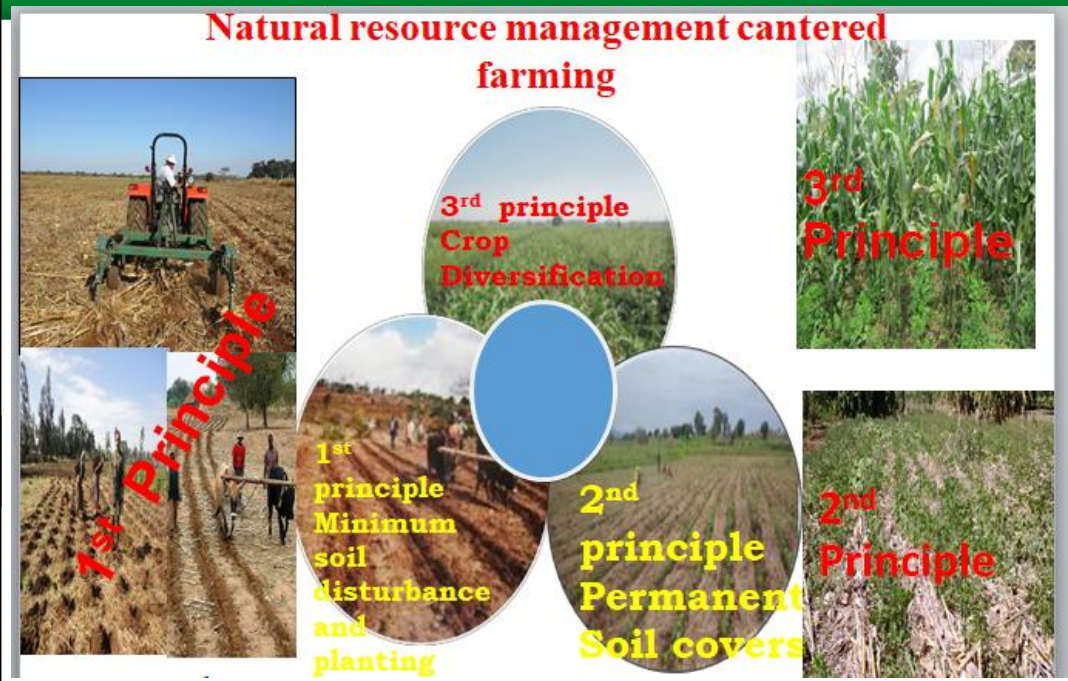
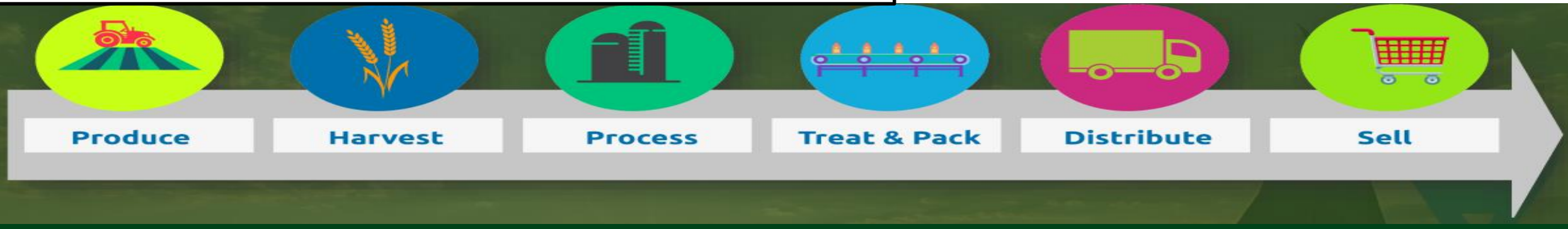
4 November, 2021





Presentation Headlines

- Key message
- Field/farm/level NRM→ climate smart agriculture (CSA)
- Digital agro advisory services within value chain of actors frame
- Response farming according to the season potential performance
  - Experience from EIAR
- Challenges in DCAS Scaling
- Learning Lessons
- Emerging Opportunities

Key message

❖Ethiopian agriculture

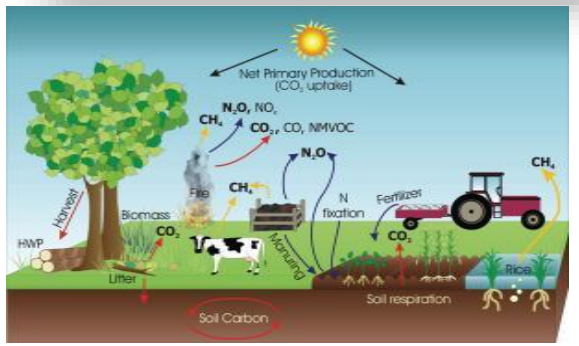
- ✓Frontrunner in terms of growth and game changer in the macro economy; injects the largest share to the GDP
- ✓ technology→ improved cereal seeds and fertilizer
- ✓Currently however, the sector is in the state "from change to challenge"
  - Self exploitative business (ancestors did far less damage to the environment)
  - Farming on steep slopes, ever growing human population & declining per capita land availability, increased soil degradation, due to excessive tillage without integrating SWC responses
  - Conservation ethics→ CBA approach (SLM & PSNP)
    → Limited CSA practices on farmlands/private (No)
  - Crop diseases and insect pest
  - Carbon emission

Smallholders would like to realize… Climate Smart Practices

Increases agricultural productivity to increase income

& food security

Increase adaptive capacity at multiple levels (from farm to nation)

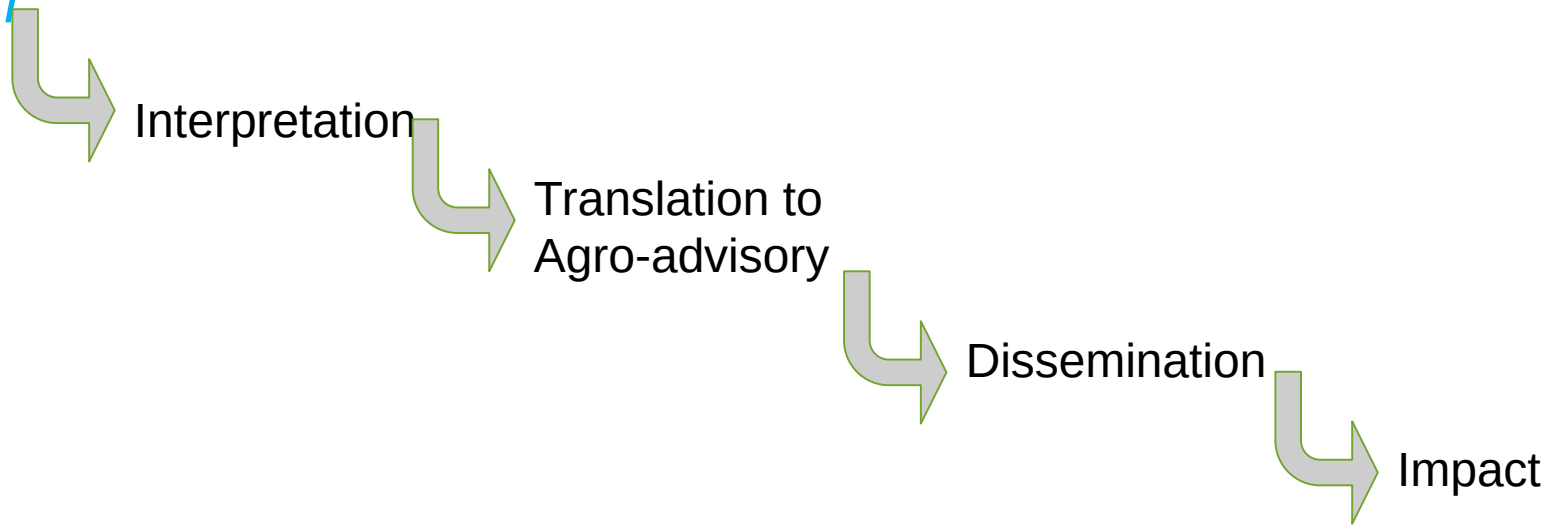


Decrease greenhouse gas (GHG) emissions

Leveraging CSA with digital/innovative agro climate advisory service

- CSA+ Climate Service (CS)= CS practices → Agro-advisory service (the first added value to CSA)
- Receiving an increasing attention to support and enhance farmers decision-making in the face of climate risks (rainfall timing, amount, duration).
- *Seasonal and in-season climate forecast*

Co-production



- Co-designing, co-production of seasonal and in-season climate forecast (rainfall, heat, frost)
- Translation of forecast into local context, with the net effect that, smallholders incentivized to invest on improved technologies i.e seed, feed, fertilizers and farm mechanization etc

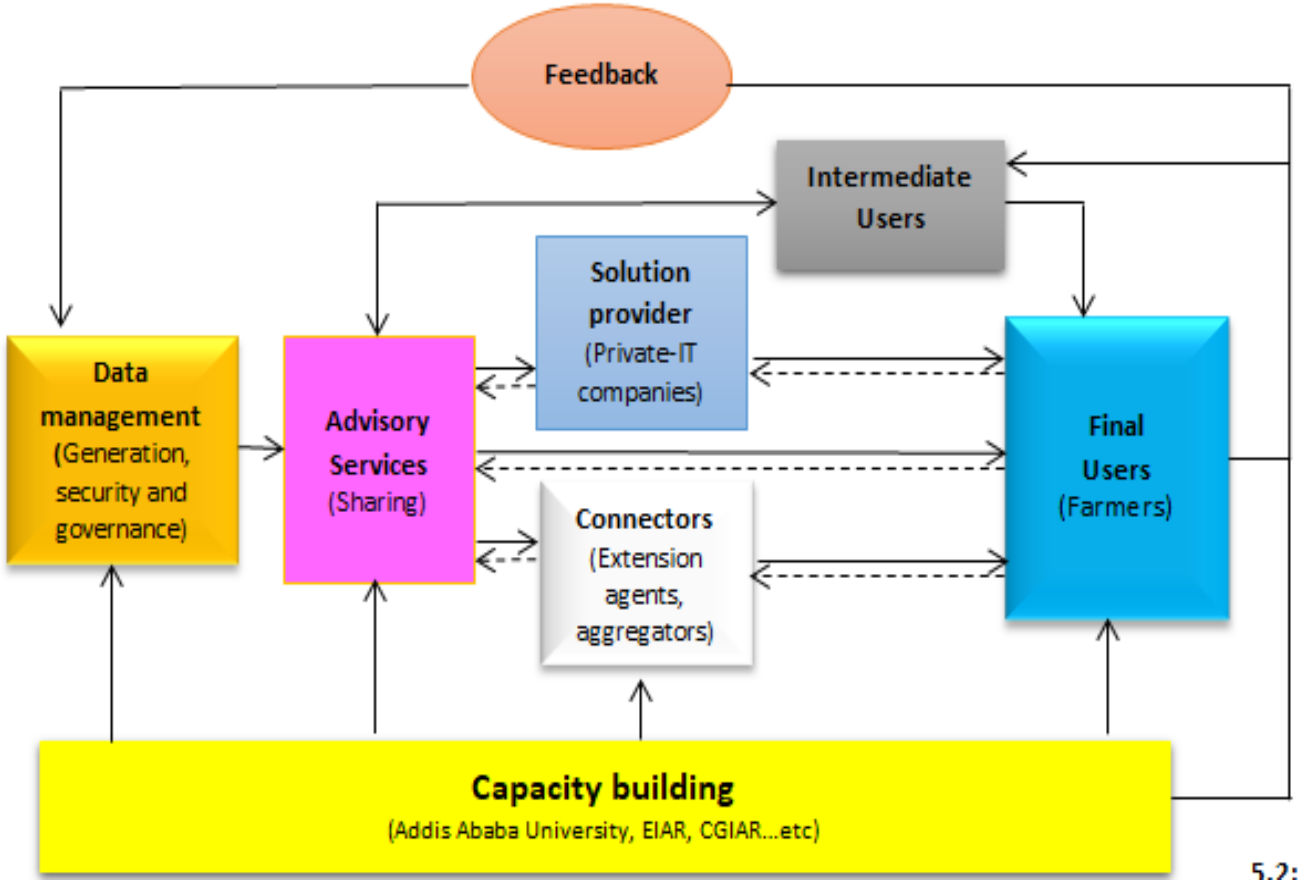
Innovative approach: Value chain of actors consortium framework in agroadvisory service extension

- **Strategic direction**

- Employing D,A., UAV, satellites,

- Incentive-tailored innovative instruments; including the digital Agro-climate advisory services (DCAS)

  - Supply side→ left most, input/enablers
  - Intermediary:
    insurance, financers, private actors
  - Demand side→ right most
    Producers,
    aggregators→
    unions, cooperatives
    farmers federations
    Processors
    Sellers→ whole, retail, exporters



Digital l agro-climate advisory service flow across value chain

Five key climate challenges to supply and demand sides

	Supply side	Demand side
1	Co-desining, co-production and Co-implementation with respect to service bundling an one stop technology shopping	Communication tools, affordability, language and illiteracy (access)
2	Innovative CS to be piloted , and scaling , what already proven to be scaled using appropriate business model	Voice in the co-design and co-implementation of CS (legitimacy)
3	Addressing barriers to CS extension to the smallholders	Poor & vulnerable communities marginalized to access & use CS (equity)
4	Context specificity of CS contents (how much will it rain/deterministic values	Farmers don't need climate forecast information per se (bundling)
5	Timely access to services, largely to the remote lying smallholders and pastoralists	Willingness to pay for the bundied , (affordability)

Status of Digital Agro-climate Advisory Services (DCAS) in Ethiopia

- **CSA+CS+Digital service 9the second value added to CSA**
- **DCAS have not attracted attention**
  - ✓ **hanging around the clever name 'climate smart agriculture'**

    Little inractice on the ground, except too much attendance to the ceremonials workshops, training, conferences etc

- ☑ lack of policy direction
- ☑ prioritize the easiest-to-achieve activities (poor investment)
- ☑ no targeted extension services, aiming at DA practices

- Limited registered farmers and pastoralists practicing DA so far, except may be few once-off projects fueled by donors. **Examples include;**

  - ☑ the weather surveillance advisory solutions a Where's **CLIMARK** for pastoralists in northern Kenya and southern Ethiopia

  - ☑ 8028 of the ATA in Ethiopia, much can be learnt from Kenya

CSA+CS+DCAS …

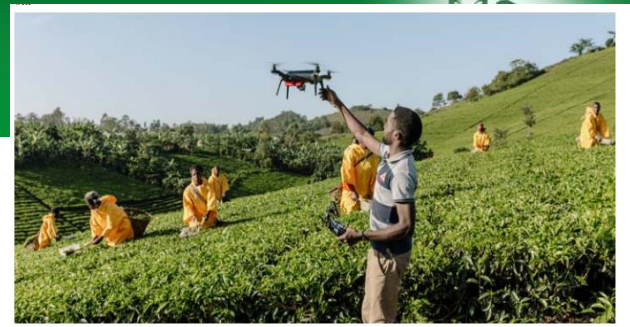
- Key elements of Digital Agriculture Practices indicate the African perspective plan (CTA, 2018)
  - → CAADP, AU Agenda 2063

✓ digital agricultural revolution' will be the newest frontier and shift to ensure agriculture meets the needs of the population into the future

✓ products & services that utilize digital technologies, or digitally-enabled data analytics to transform practices across the agricultural value chain: Including
  - Digital agro-climate advisory services, aiming at impact
  - market linkage/connecting smallholder farmers to high-quality farm inputs
  - including mechanization (Hello Tractor!) services down the line to off-take markets (product prices),

✓ Enabling digitalization of agriculture information for the key role players (policy gaps)

"Capturing the late comer advantage"

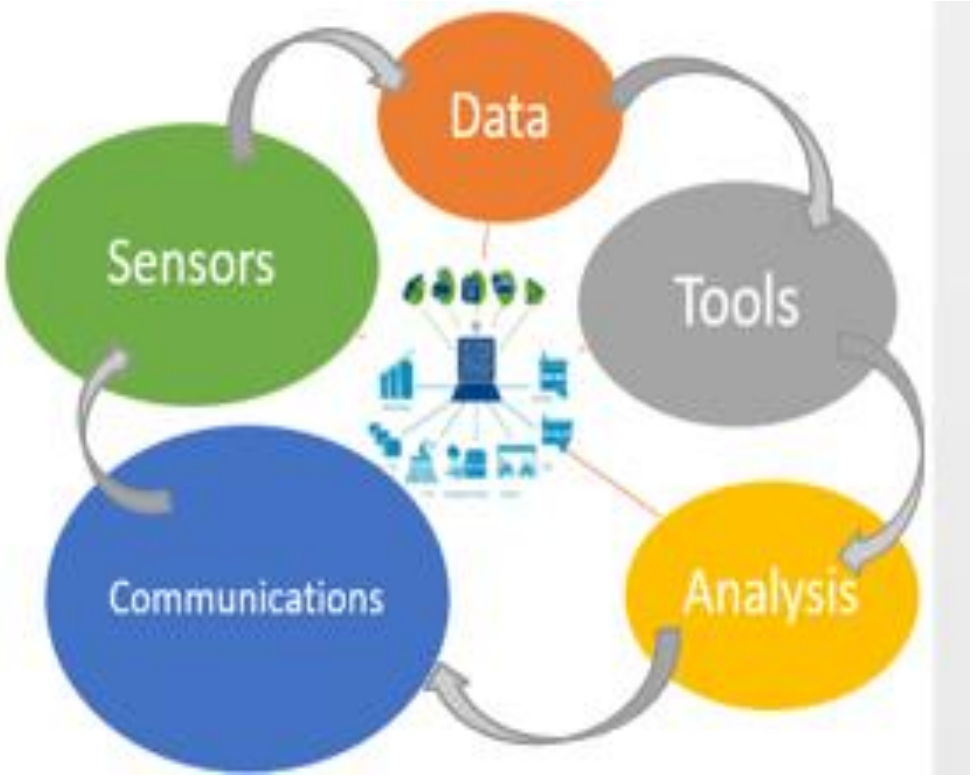


DCAS: High on the Ethiopian government 10 (2021-2030) years perspective plan

❖**Transformative:** A vibrant agriculture, modern & sustainable business that creates value for smallholders, to produce affordable, nutritious & healthy food for all (CTA, 2018).

❖**A practice driven by** digits, aiming at an integrated agriculture-system, processing & automation of decisions using digitalization

- ✓ the lifeblood of innovation, thus deriving significant shifts from the business as usual **'traditional' way of doing things**
- ✓ In research, it enables moving from a manually collected climate data per se to real-time insights and predictive capabilities



Four compelling reasons for integrated CSA+CS+DCAS in Ethiopia

- Enhancing the current levels of production over the next decades to meet growing demand and achieve food and nutrition security.

- Ubiquity of mobile phones→ ?? % of smallholder farmers access smartphones (?)

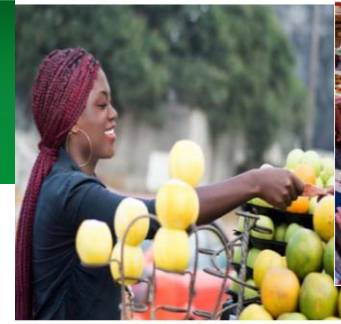
✓Despite data is scanty, the reach of digital solutions will continue to grow and may cover 10% as much of the Ethiopian smallholders within a short term

- Stretched objective→ all about money, not productivity per se

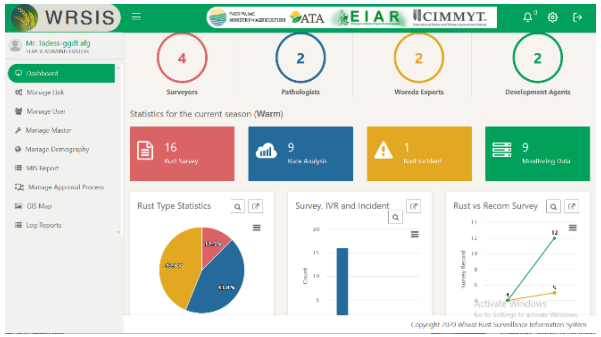
- Most of the population in GHA and Southern Africa youngster, reluctant to work with backward system, rural exodus and looking for a different world

- Smallholding, but smart farming::

- Producing more food with less land, limited water and fewer resource hence, making farming profitable



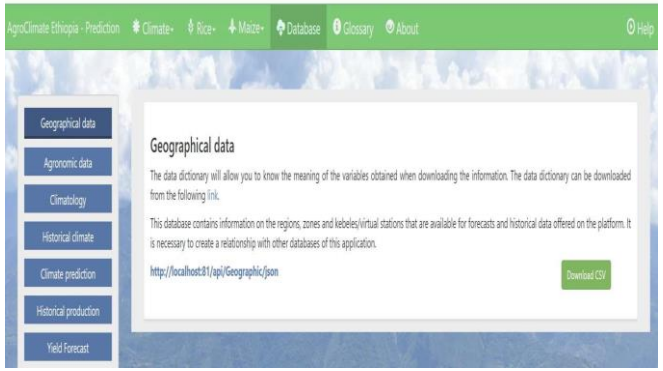
Digital-Agriculture Platforms



Wheat Rust Survillance Information System 197.156.117.171

Sensors, Remote Sensing, GIS, mobile Applications (survey Data)

Soil and Agronomy Data Portal

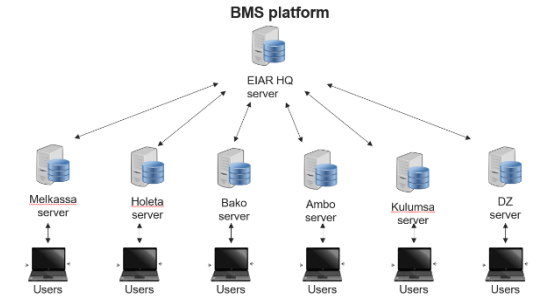


EDACaP -Agro – Weather Tool

- http://ethioagroclimate.org

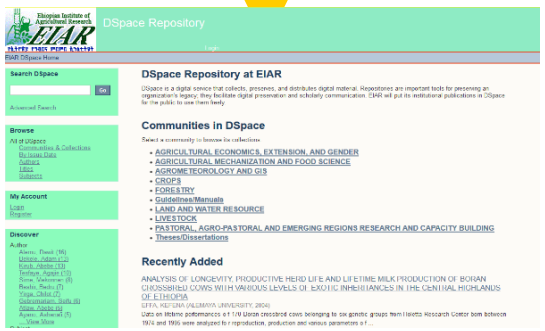
EIAR DATA & INF. MGNT. PLATFORMS

Modernizing Breeding program in *EIAR* *(MERCI project funded by Bill and milinda gates foundation)* Sharing data through a plant breeding database



The project aim is to **implement a plant breeding database** which links data types and provides tools for plant breeding operations.

Breeding Management System (BMS)



Publications Repository- DSPACE

Demonstrated experiences in DCAS practices: The use of UAVs in EIAR

- As the future of agriculture is towards smart farming, integration of technologies such as UAS-based data is becoming crucial.

- UAS role in agriculture are becoming important systems to collect data for precision farming to improve sustainability, efficiency and productivity of the agricultural practices.

- UAS help precision agriculture through helping variable rate mapping, and guide targeted farm management activities.

- As the DA journey, EIAR made quick attempts towards reaching a geo-tagged large numbers of farmers organized under Large Scale Demonstration (LSD) since 2020 cropping season

CTA, supported Drone Piloting and Data analysis/visualization training

CTA

Ethiopian ATA
Agricultural Transformation Agency
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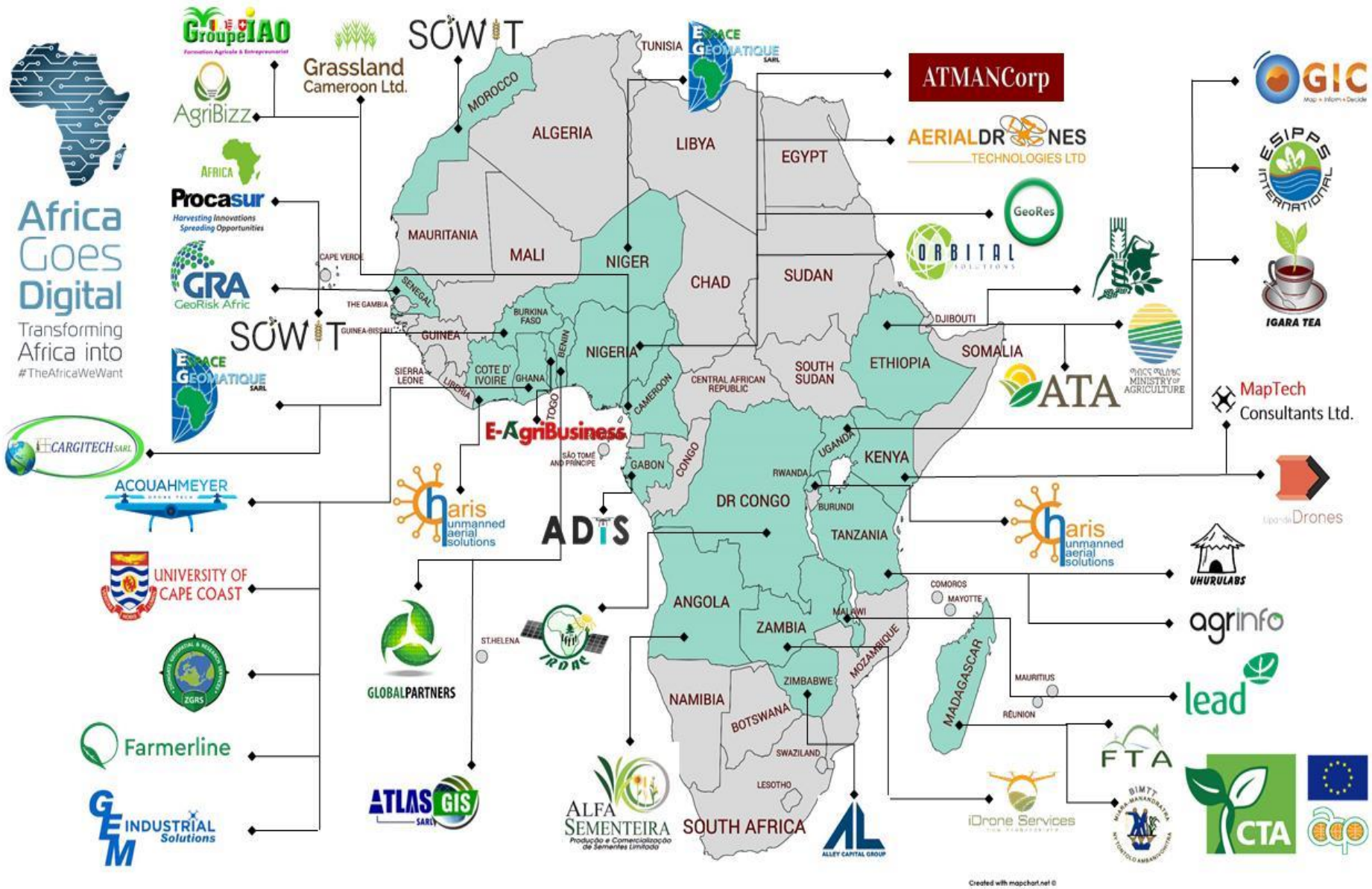
MINISTRY OF AGRICULTUR

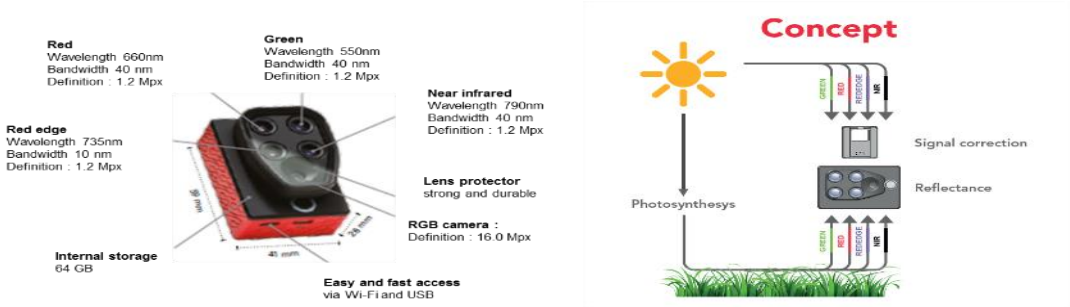
Fig: Africa Goes Digital: Transforming Africa into The AfricaWeWant (Source: CTA, 2018)

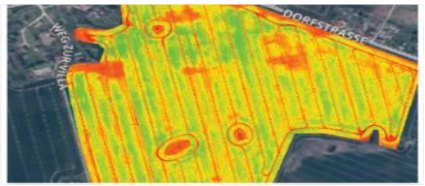


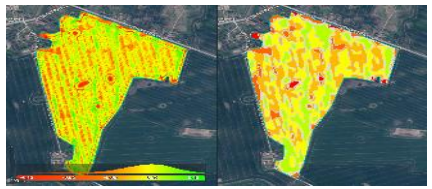
Demonstrable experience in a promising UAV based DCAS research:

Parrot Bluegrass – Onboard sensors

CAPTURE CROP DATA FROM THE SKY WITH MULTIPURPOSE ADVANCED SENSORS





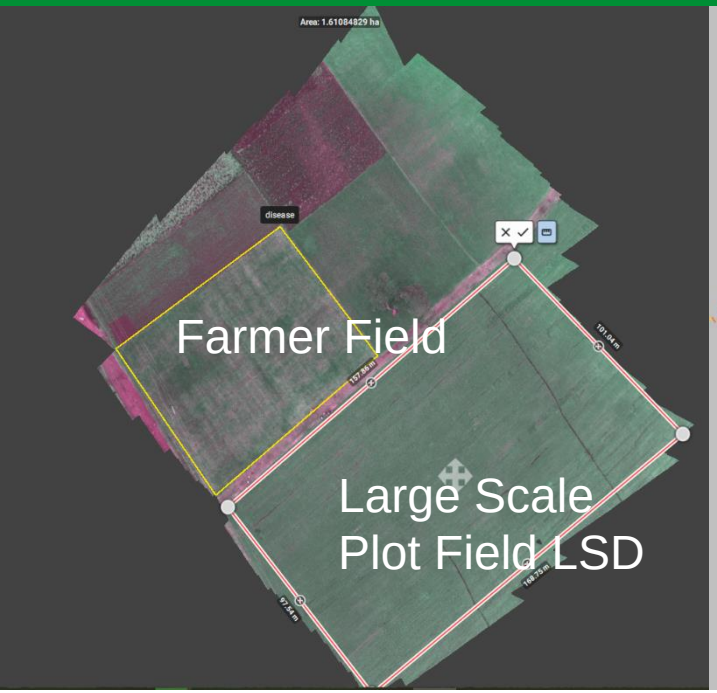


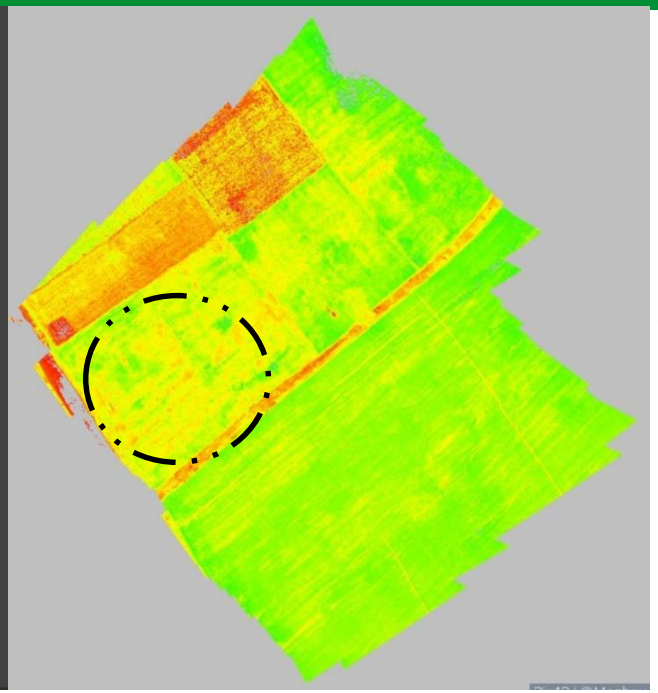
Front Camera:

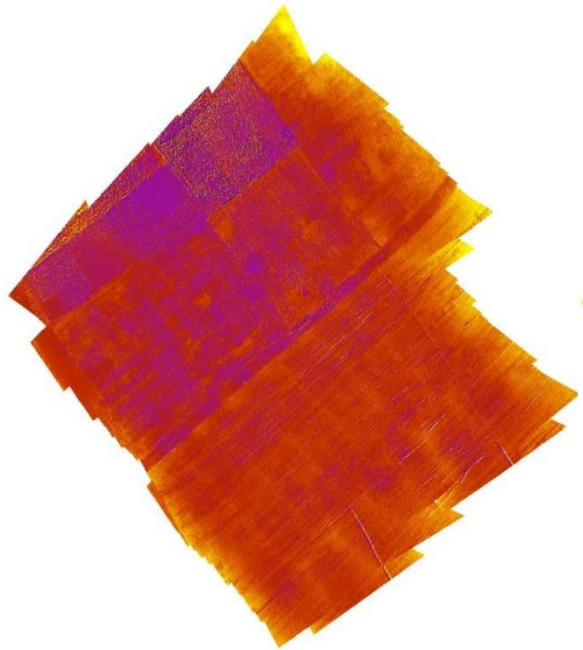
- **Video - Full HD 1080p**
- **Photo - 14Mpx**

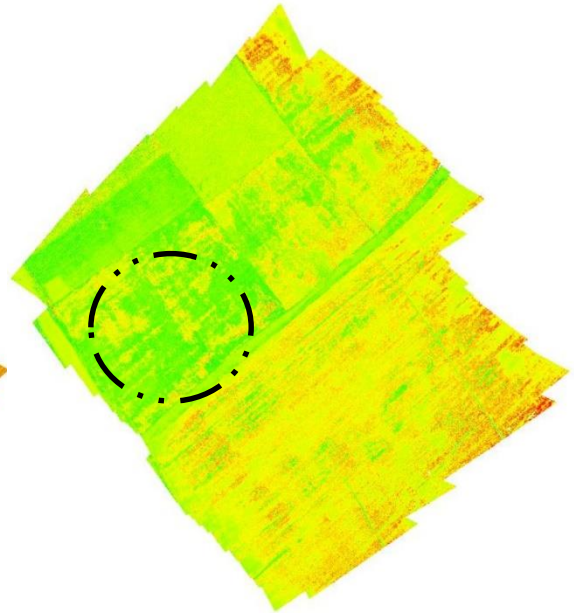
- Industry-leading multispectral Parrot Sequoia sensor for highly accurate crop mapping:
  - 4 multispectral mono-bands (1.2 MP, global shutter):
    - Red (Wavelength: 660 nm / Bandwidth: 40 nm)
    - Green (Wavelength: 550 nm / Bandwidth: 40 nm)
    - Red Edge (Wavelength: 735 nm / Bandwidth: 10 nm)
    - Near Infrared (Wavelength: 790 nm / Bandwidth: 40 nm)
- Front 14 MP RGB camera for fast, effective live scouting of problem areas (including the capture of photos and 1080p - Full HD - quality video)

Wheat fields – Dawa-Bursa (Arsi Zone), individual farmer Vs. Large scale Demonstration plots









Orthomisiac

NDVI index

Correlated to the plant **health** and biomass quantity of the crop

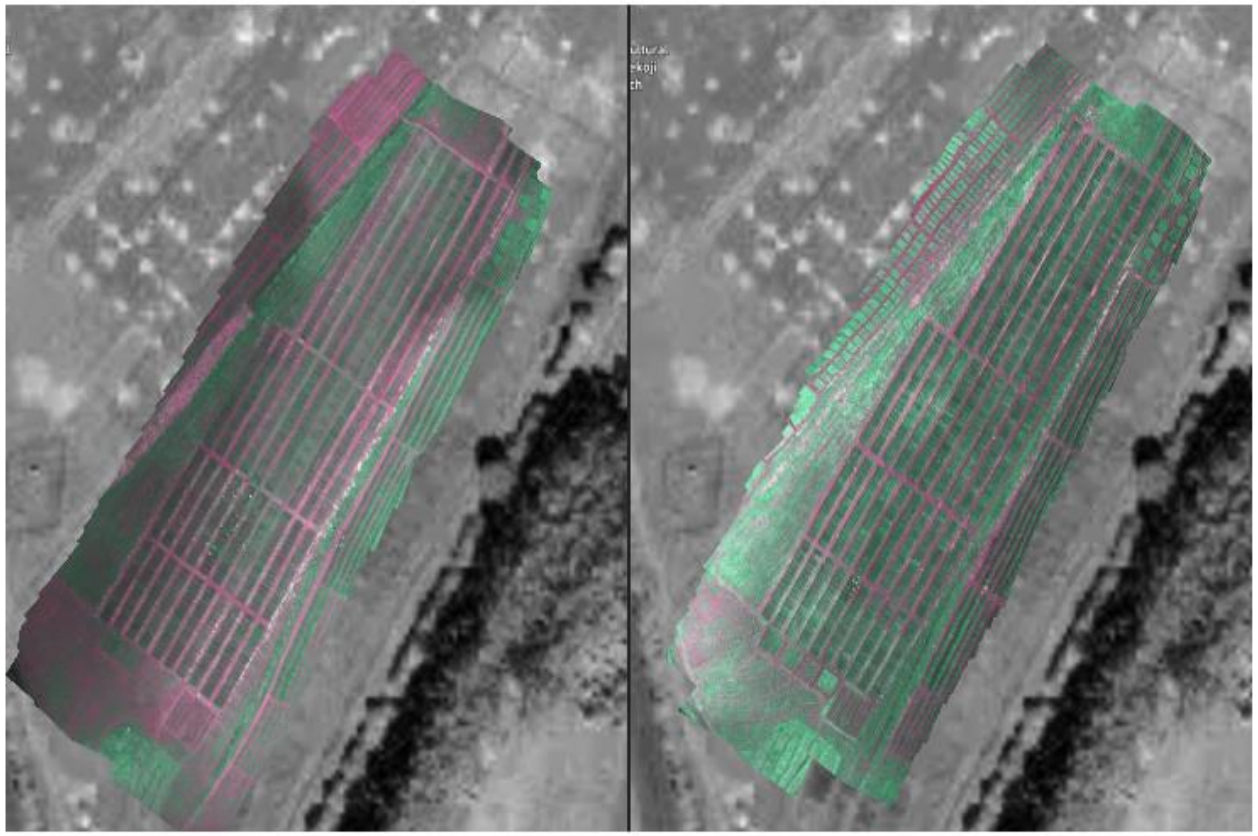
NDRE Index

Linked to the growing state of the crop.

SIP2 index

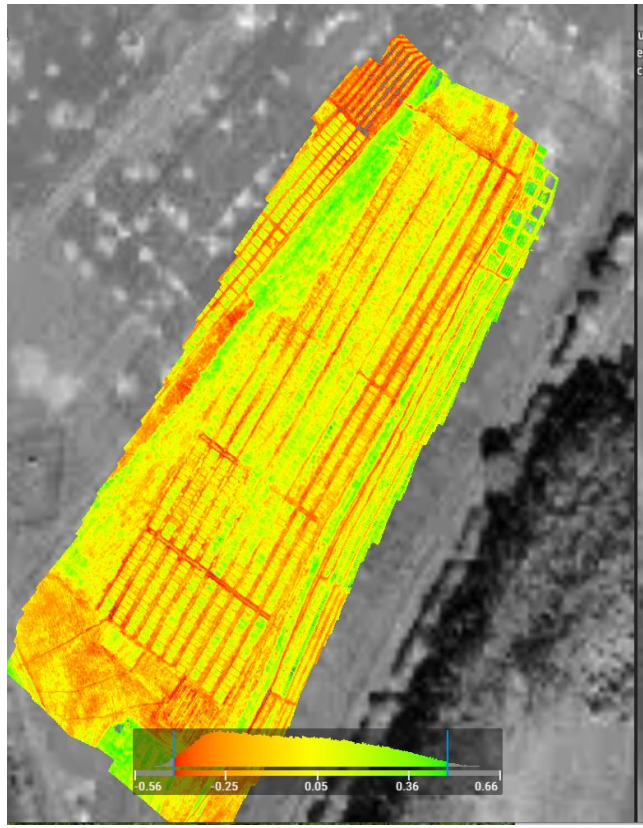
Results: As seen in the above figures, the values of NDVI and SIP2 were significant difference between the individual farmer filed and farmers under large scale demonstration plot (LSD) after application herbicide ‘’ ‘’.

Wheat breeding nursery: Bekoji sub Station (Arsi Zone)

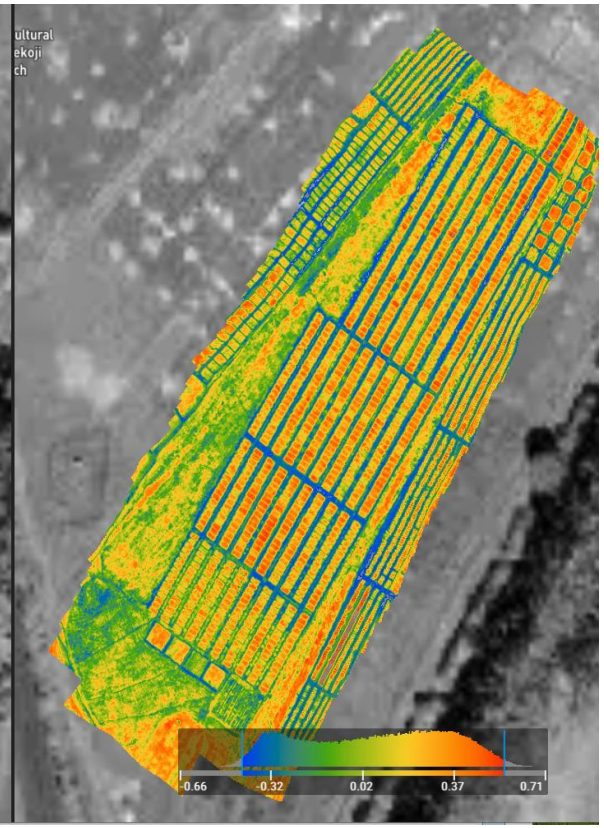


Aug 2020

Sep 2020



NDVI index

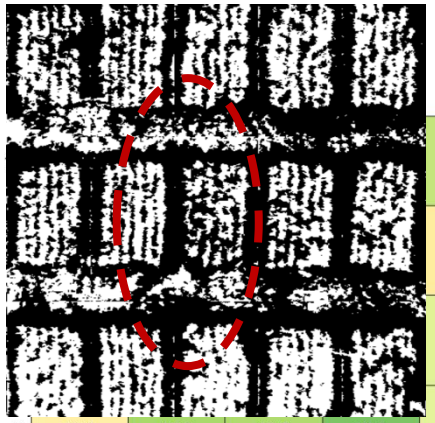


NDVI index

Results: The values of NDVI shows the health changes across time and breeders can visualize and monitor the status.

Post flight processing: plot level metrics

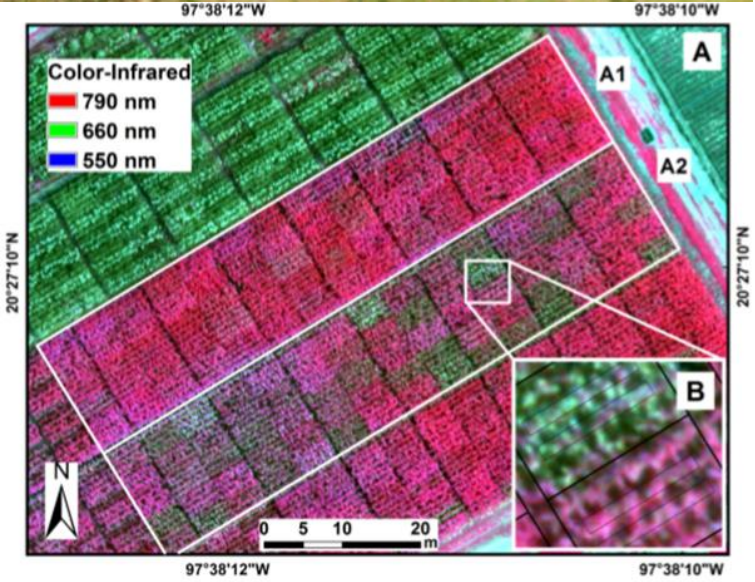
Vegetation cover color map



Results: A map that shows Plot level metrics- **vegetation cover** and plots with low vegetation cover indicates the missing plant or susceptible varieties affected by disease other stress.

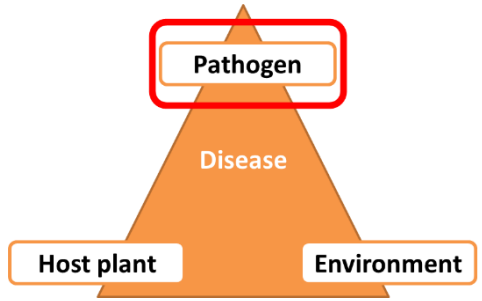
Breeders can see their breeding fields digitally being in office at plot level.

Our big picture is to develop a remote sensing solution for wheat rust detection at regional / national scale.



- Very few literature on remote sensing + rusts
  → start from scratch
  → but, building on existing UAV work on TSC (Maize)

- Started in 2020 with RS work on stem and yellow rust in Ethiopia

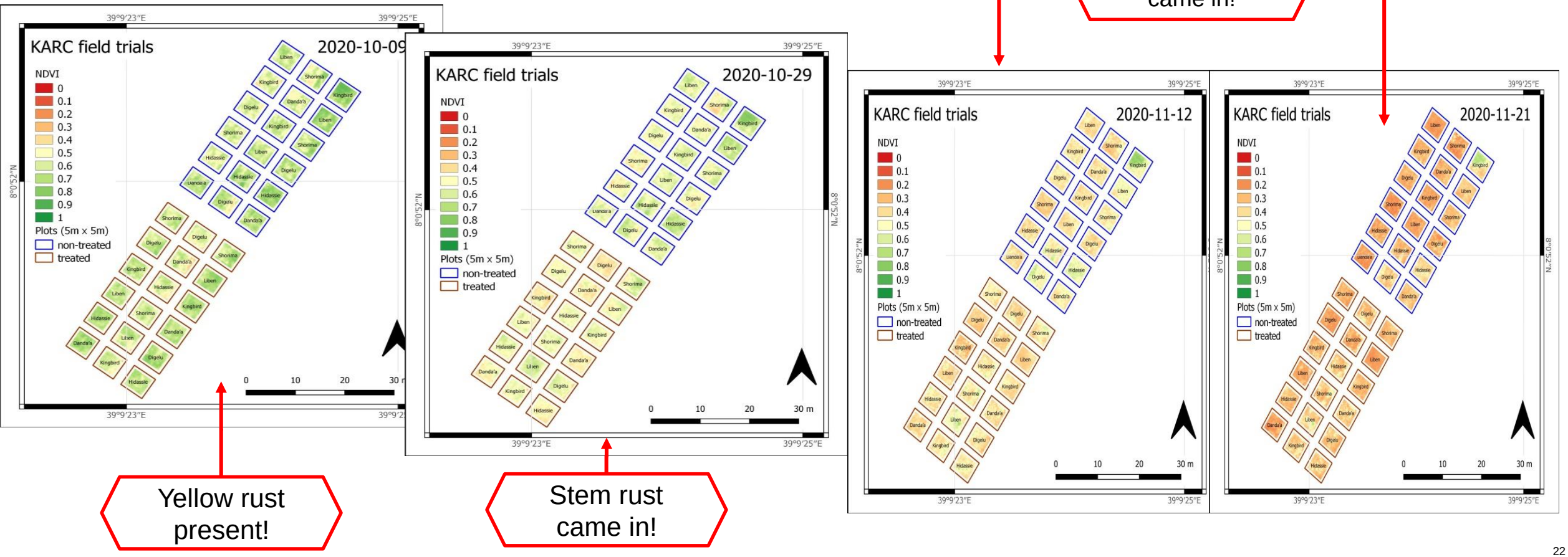


(Loladze et al. 2019)

CIMMYT International Maize and Wheat Improvement Center
UCLouvain
EIAR

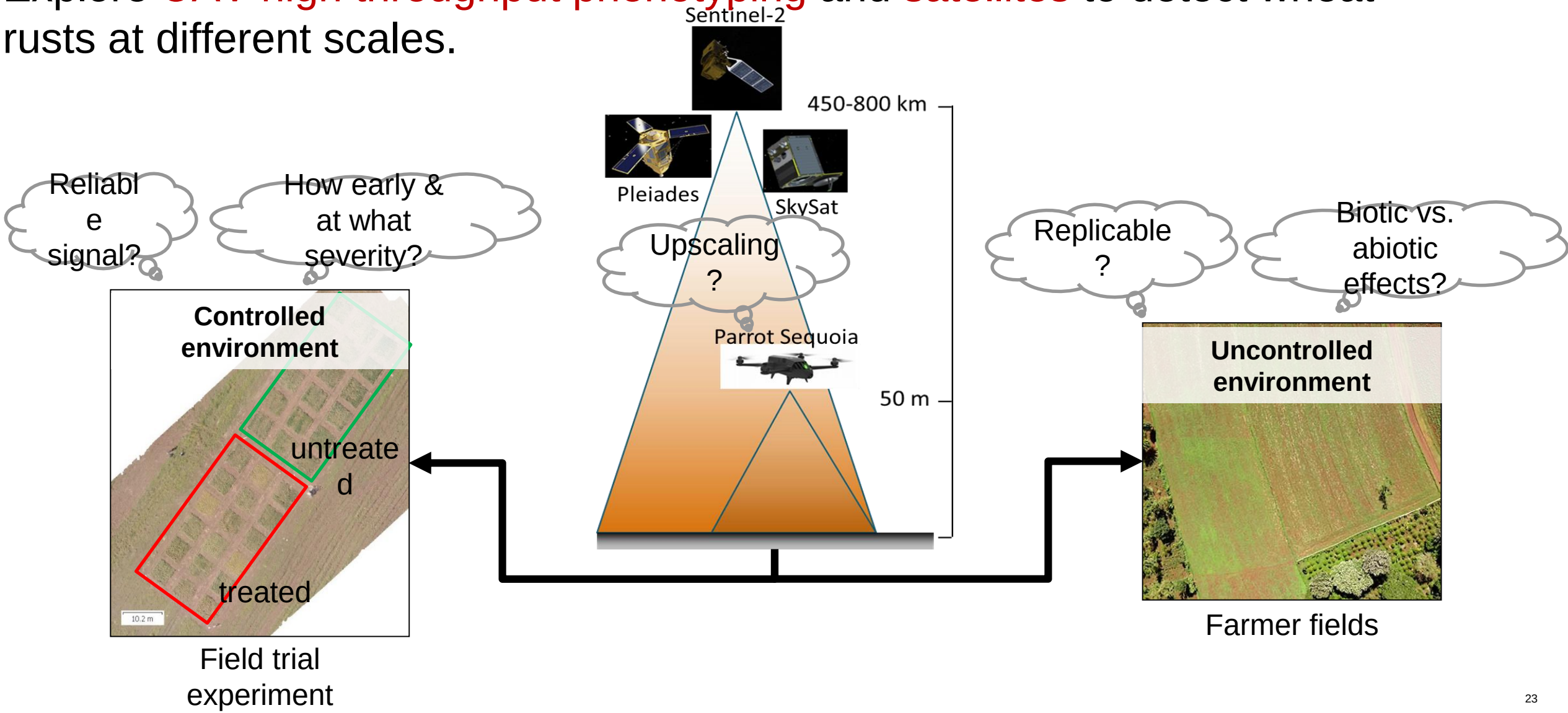
Multispectral UAV Applications

Multispectral UAV RS can reveal crop health changes related to biotic and abiotic stress over the season. Problem: mixed stress signal



Multispectral UAV and Satellites

Explore UAV high throughput phenotyping and satellites to detect wheat rusts at different scales.



Processes in DCAS based solutions toward greater interactivity and adaptation

Planning and policy stage White collars)

Seasonal and 10-days climate forecast

Expert analysis

Decision support tools

Farm advisories generated

Server

Optional

Rado TV

Discussions and farmer selection

Identify scaling domains (soil, climate, socioeconomics)

Inventory of Scalable technologies

Feedback (Blue collars)

DA

Farmers

Dissemination stage

Capture → Process/ Analyze → Interpret & Share → Agronomic Advisory

Critical Challenges to DCAS with respect to building a consortium of Partners (CP)

- Lack of consistent standards in the validation and dissemination to the last mile
- Supply driven service is the major features of existing initiatives (passive participation from the demand side)
- Co-development of the services in a way accommodating different value chain actors (supply, intermediary, demand sides) in a disaggregated ways
- Lack of workable business model and limited public-private partnership (coordination)
- Current monitoring, evaluation, learning (MEL) and evidence generation strategies are not adequate to shape future of DCAS.
- There is a lack of digital readiness among the farmers, pastoralist and development agents needing DCAS most,
- Limed enabling environment for innovative DCAS to establish viable private-public partnerships (PPP).

Challenges…

- ❖ Limited focus on field/farm scale natural resource management based production system
- ❖ Resource pooling and investing in the missing DA middleware infrastructure capacity building
  - enabling software and analytics tools (e.g., SAS, R, Python),
  - hardware that captures data into agriculture data systems
    e.g. drones, weather stations, soil-pest-crop diagnostics equipment/field sensors relevant for smallholder farmers and farms (low cost, without compromising data quality).
- ❖ Establishing strong consortium with key advisory solution providers worldwide and regionally
- ❖ Partnering with local hardware service providers (eg; Tractor Service providers)
- ❖ Limited flight permission
- ❖ Enhance-revolutionize ICT role for agriculture innovations
  ICTs revolutionize how people access information, do business & receive various services
- ❖ Agricultural research to lead at least the first wave of innovation or start up development projects and proliferate scientific evidences on the benefits of DA practices (FR&TC)
- ❖ Capacitating human and physical infrastructure at every level of the DA ecosystem.
- ➢ Training research-farmers- policy makers in order to proliferate literacy and greater digital skill across the agricultural value chain (input supply to exporters (each of them uses the same information for different decision making)

Learning Lessons

- Both research and development communities face significant literacy and digital literacy constraints that is required for successful implementation of DA practices

- We also learnt that most of the funding for agricultural research have been on non DCAS projects, while far fewer investments for DCAS centered projects.

- Globally, independently validated impact studies indicates the average yield improvements across all data points of roughly 20% for advisory services from the business as usual way of doing things

Emerging opportunities

- The current substantial advances in climate and agricultural sciences and technologies have generated a great deal of interest for digital innovation

- Driven by wireless technologies and liberalization of telecommunication markets, the rapid adoption of mobile phones by the broader smallholder farming communities
- There is a much **broader range of digital technologies** that innovators can draw on beyond basic information collection and communication tools

  (e.g., satellites, drones, portable diagnostic technologies and sensors linked to the internet of things).

- Money is hovering in the air, as international communities are interested in DCAS

- Time is right and ripe to confront climate change and that, international donors are demonstrating great interest.

The late comer advantage establishing community of small but smart farmer

"To live with change, optimize change, then there need to be principles that do not change" (Stephen R.C)

"The illiterates of the 21st century are not those who cannot read and write, but those who cannot learn unlearn and relearn" (Dcounte)