Spatial information is revolutionizing agriculture in high-income countries but not in low-income countries. Here, important adoption barriers exist: *heterogeneity*.

**STARS: coordinated effort to**

- learn,
- identify opportunities, constraints & risks,
- test hypotheses

*around potential exploitation of high-resolution RS technology in production systems and livelihoods of smallholders.*
Project facts

- Five partners: ITC, University of Maryland, ICRISAT, CIMMYT, CSIRO
- 26 months = 1 or 2 crop seasons per region
- Supported by DigitalGlobe & RapidEye data & knowledge contracts
- Started June 1, 2014 will run to July 31, 2016
- Various subgrants/-contracts: Uni Sokoine, ESIPPS, ...
- Links with other initiatives:
  - Cereal Systems for South Asia (CSISA),
  - Drylands Systems CGIAR Research Program,
  - VitalSigns,
  - African Soil Information Service,
  - International Potato Center (CIP),
  - National Food Security Department Tanzania
Objectives

• Better understand why RS has *not* been taken up for SHA, and *which investments* are required to unlock potential.

• *Demand-driven* experimental *use cases* where currently poor information is the norm, and where *RS-based workflows can help* improve.

• *Match private sector* partners (satellite data/spatial analysis) *with public sector* actors and public good objectives.
Main hypotheses

We think we can

• *monitor crop growth* within the small farms of sub-Saharan Africa and Southern Asia, *using time-series remote sensing*.

If achievable, *this will*

• allow *improved outlooks for crop yields* throughout the season, *informing policy-makers*, and
• ensure more effective evidence-based advisory services at the farm scale, *informing farmers and agro-business*. 
Three facets

- **Technology**: information products that inform & transform agricultural processes
- **Stakeholder**: sustainable models of realization
- **Business**: ground-based, airborne, and spaceborne monitoring throughout the crop season
Challenges

Heterogeneity in
- Crops and crop varieties
- Crop systems
- Soils and nutrient content
- Climatic conditions
- Farm field practices and consistency
  - Farm field boundaries
  - Tillage and planting system
  - Rain-fed vs irrigated fields
  - Use of fertilizers
  - Use of mechanization
High dimensionality of problem space
Compared to high-income ag

- Smallholder farming in Africa/Asia is a *data-poor* context; there are many facets of the production systems that we do not know.
- Tanzania 2008 maize bumper crop
- Much ground truthing required
- Build an infoconomy with the farmer as active partner?
Where we work

Stakeholder approaches:
bottom-up
top-down
mid-level
STARS Data collection

Satellite data

DigitalGlobe
• Biweekly, WorldView-2 & -3
  8-spectral band, 2m resolution

RapidEye/Blackbridge
• Biweekly, 5-spectral band, 5m resolution

Challenges
• Cloud cover
• Off-nadir angle
• Pre-processing
• Analytical processing
• (Licenses)

WorldView-2 image of the Mali study site, growing season May-November 2014
STARS Data collection

UAV data

eBee
- GR+NIR 12 Mp Canon camera, 3.5cm resolution (5cm vertical)
- GRRe+NIR 4-band 1.2Mp multiSPEC camera, 10cm resolution

Geo X-8000 Octocopter
- Tetracam miniMCA 5/6-band 1.3Mp, 10cm resolution
- RGB Sony NEX-7 24 MP, 2cm resolution
- OPTRIS PI 400 thermal camera, 1.1 Mp, 15 cm resolution

Challenges
- Hw robustness, stitching, calibration

eBee multiSPEC and GR+NIR example images
Public good outcomes

• Landscaping study — CSIRO & partners
  Aim to understand
  – the decision-making environment for key stakeholders
  – the pathways for agricultural development that are likely to emerge
  – the nature of the infrastructure systems needed for delivering the right information to the right stakeholders at the right time.

• Crop Spectrotemporal Signature Library
  – Spectral info for crops followed over time
  – Accompanying farm field data

• Image analysis algorithm repository
  – Data ingestion workflows
  – Analytical workflows
Soil conditions

Dry soil

Wet soil
Species determination

Spectral reflectance values of select leaves

% Reflectance

Wavelength (nm)

Pine  Juniper  Dead leaf
Crop Spectrotemporal Signature Library

UAV/Formosat-2 crop spectral profile,
MSc thesis Caroline Gevaert (EOS/ITC)
Lund University, 2014
UNIVERSITY OF TWENTE.

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