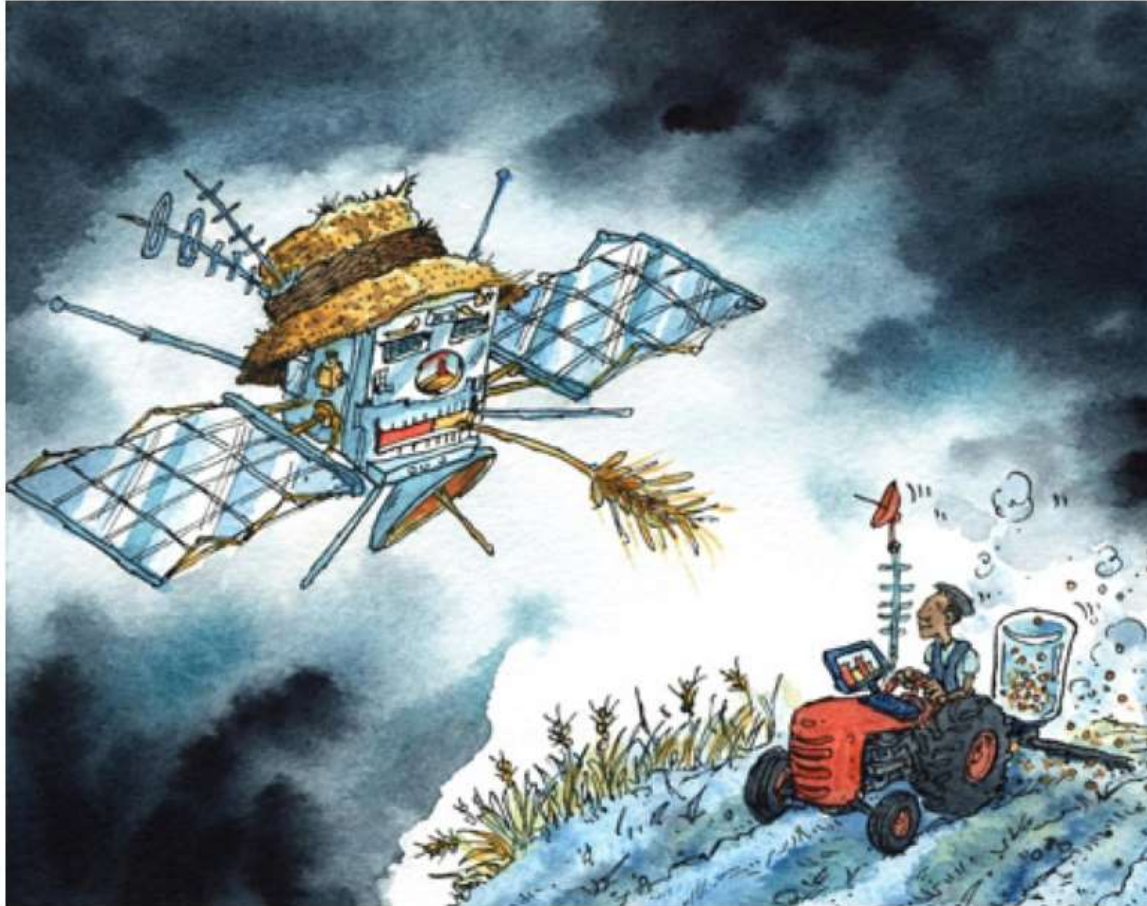


1966-2016
CIMMYT

**New perspectives from satellite data and associated
digital tools smallholder agriculture**

Clare Stirling and Urs Schulthess

DFID, Nov 8, 2016



The Economist, Nov 5, 2009

http://www.economist.com/sciencetechnology/displaystory.cfm?story_id=14793411

Outline

- Remote sensing data
- Remote sensing products
 - Sen2-Agri toolbox
 - Flood monitoring
- Technology targeting
 - Yield gap mapping
 - Potential for sustainable intensification using surface water for irrigation
- Integrated services
 - Crop management recommendations
 - GreenSat
 - PANI (Irrigation scheduling)
- Monitoring of compliance
 - Till vs zero till detection
- Smart phones & Big data
 - Ground cover app

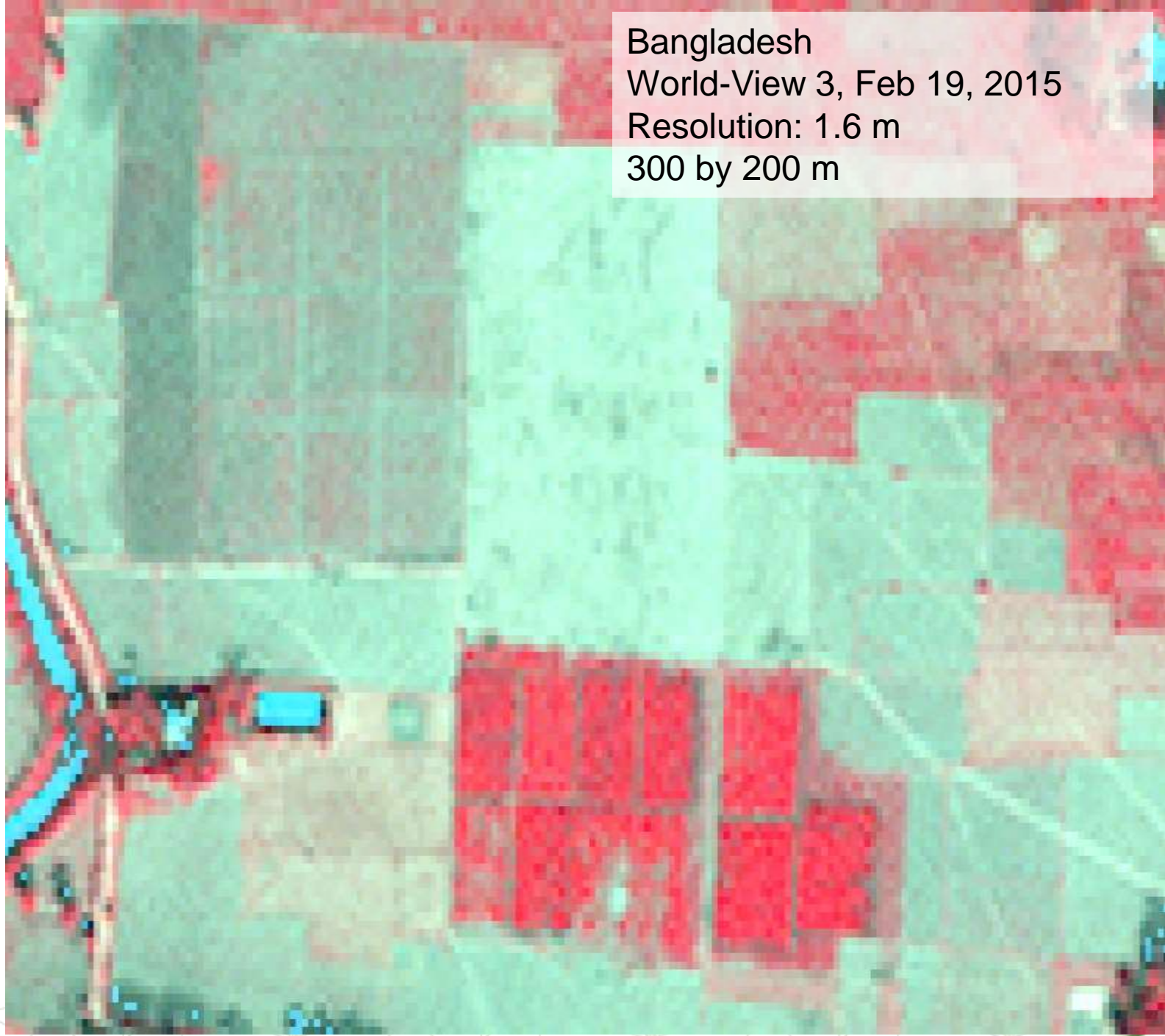


Remote sensing data

- Landsat 8
 - 30 m
- Sentinel 1 (radar)
 - ~ 10 m / ~ 3 day revisit
- Sentinel 2 (optical)
 - 10 m / 5 day revisit starting in mid 2017
- Planet Labs
 - ~ 3 m, 4 bands (RGB and NIR)
 - Daily coverage of all the land surfaces starting in 2017
- WorldView 2/3, soon 4
 - 1.2 m / 2.4 multispectral data
- Many others, such as IRS, SPOT, etc



Bangladesh
World-View 3, Feb 19, 2015
Resolution: 1.6 m
300 by 200 m



Bangladesh
RapidEye, Feb 19, 2015
Resolution: 5 m
300 by 200 m



Bangladesh

LandSat 8, Feb 13, 2015

Resolution: 30 m

300 by 200 m



Cattle Grazing in Bangladesh



Cattle in Bangladesh
World-View 3, Mar 18, 2015
Resolution: 1.2 m



Cattle in Bangladesh
World-View 3, Mar 18, 2015
Resolution: 0.3 m

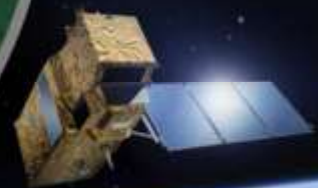


Cattle in Bangladesh
World-View 3, Mar 10, 2015
Resolution: 0.5 m



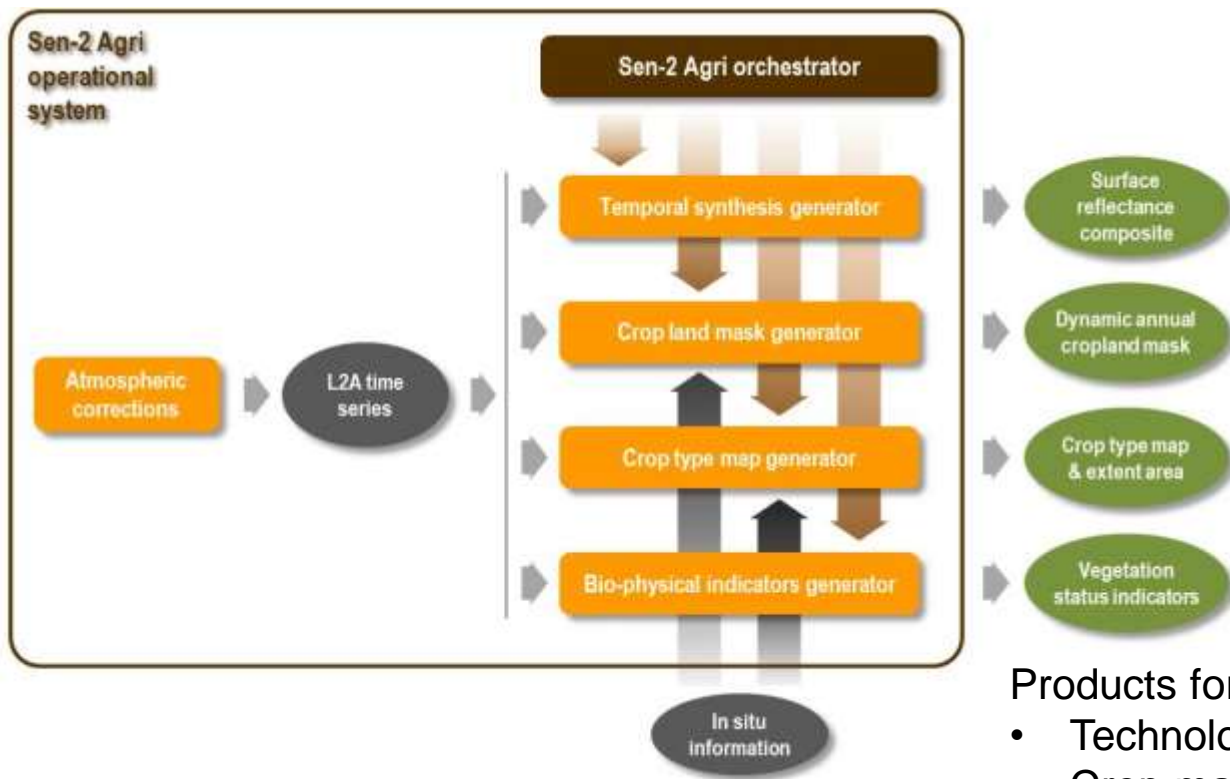
→ SENTINEL-2 FOR AGRICULTURE

Towards the exploitation of Sentinel-2 for local to global operational agriculture monitoring



- Sentinel 2 A&B
- 5 day revisit in 2017
- 10 m resolution

CIMMYT has been selected as a champion user of Sen2-Agri



- Products for:
- Technology targeting
 - Crop management advice
 - Monitoring and Evaluation



Other products

- Weather
- Soil moisture Anomaly (50 km resolution)
 - Data access: <http://www.pecad.fas.usda.gov/>
 - Description: <http://www.pecad.fas.usda.gov/cropexplorer/description.aspx?legendid=355>
- ESA mapping soil moisture: http://www.esa.int/Our_Activities/Observing_the_Earth/SMOS/Mapping_moisture
- GEOGLAM
 - <http://www.cropmonitor.org>



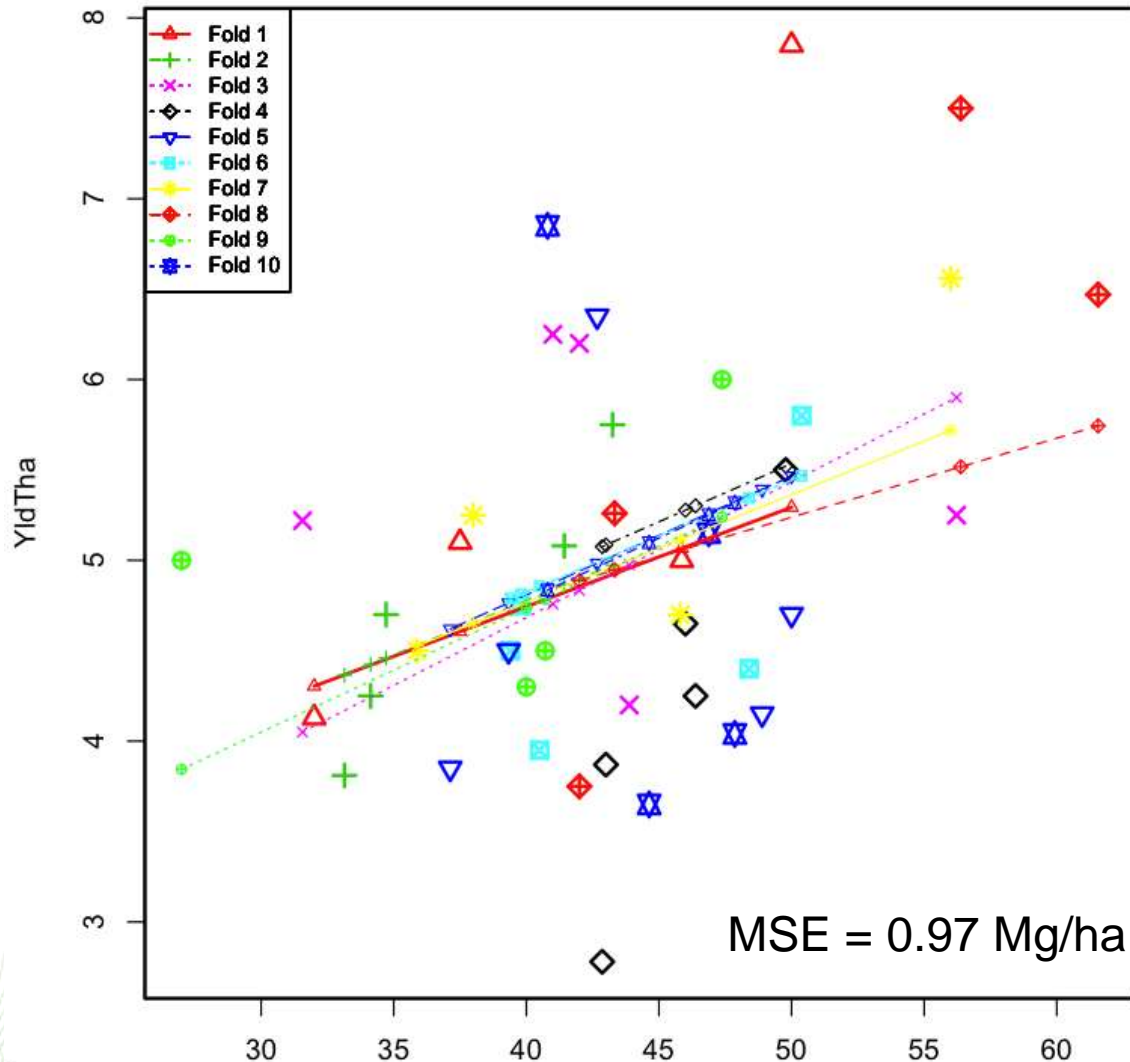
Flood map made from Sentinel-1 image 1 day after cyclone Roanu had hit Bangladesh on May 22, 2016



Yield estimation at the regional scale in Chiapas, Mexico



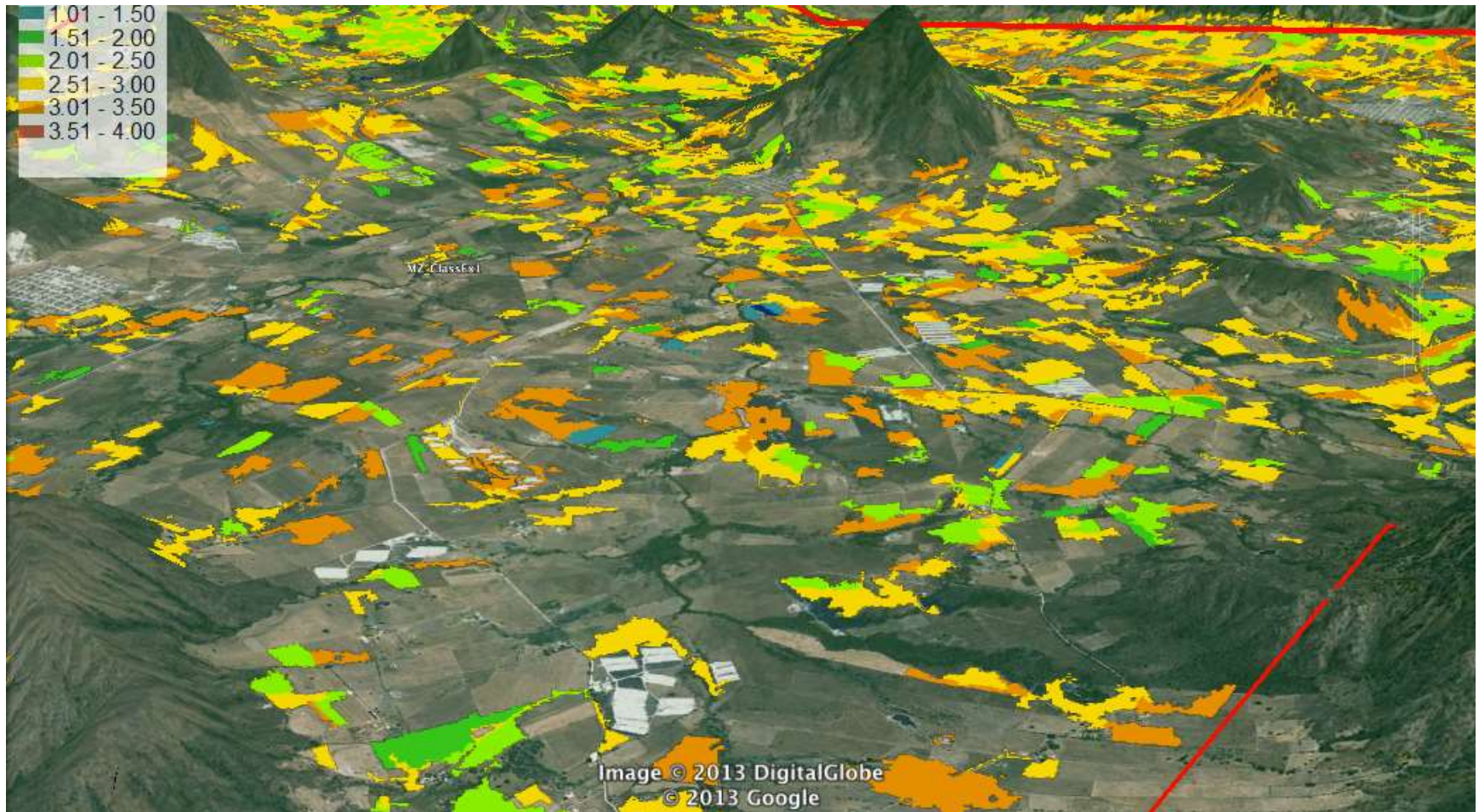
Error estimation of calibrated actual yield with 10-fold-crossvalidation



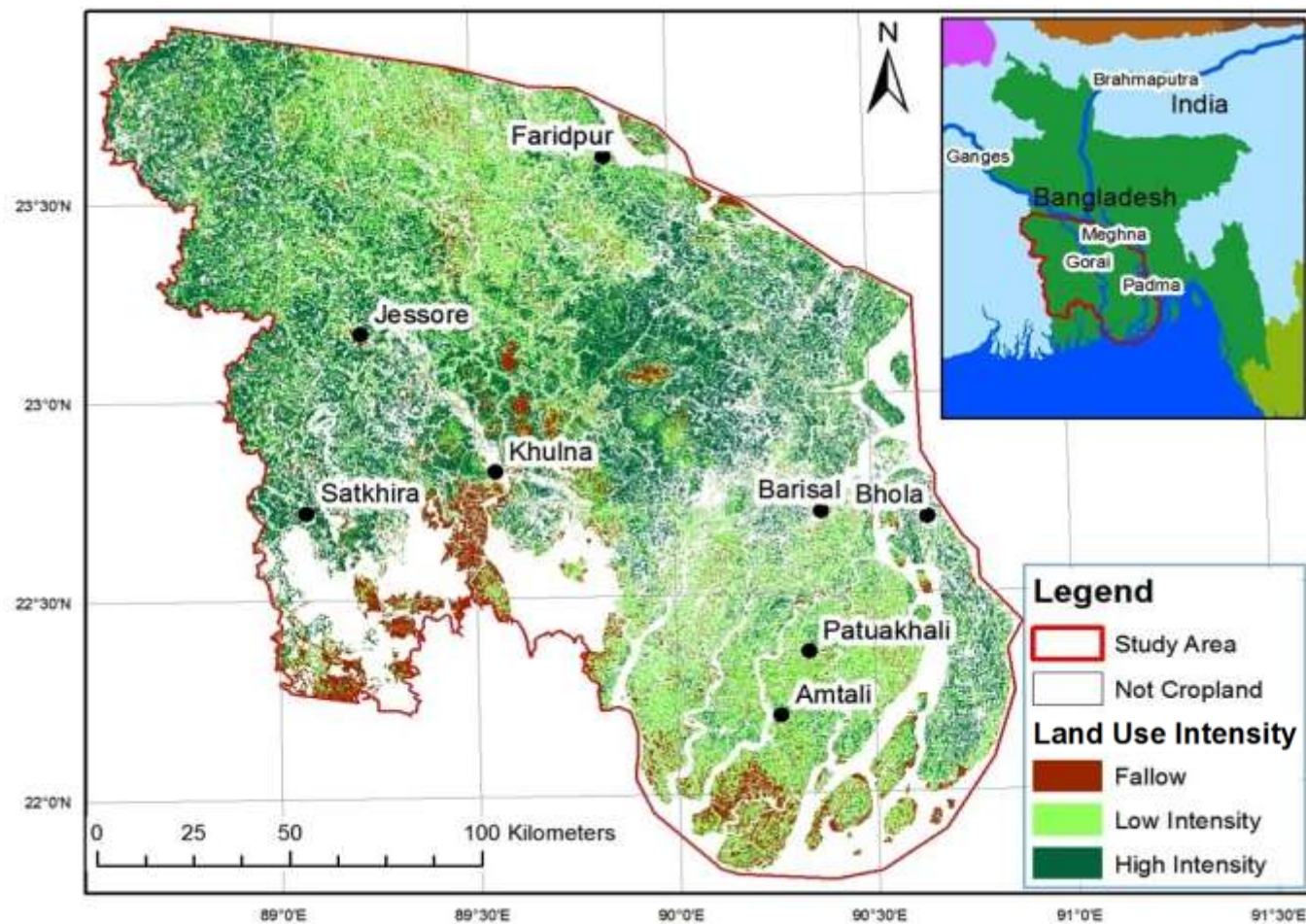
Yield data:
Average yield of
45 farmer's
fields

Ground cover:
Derived from
satellite image
acquired around
tasseling on
Sept 7, 2012

Yield gap mapping in Chiapas, MX



Example of land use intensity, *rabi* 2013–14



PANI

Smartphone app for irrigation scheduling developed in Bangladesh & Mexico¹⁾



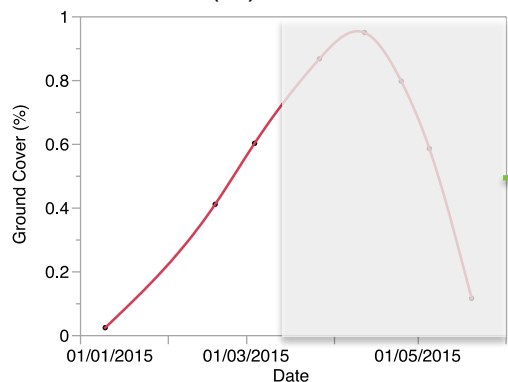
- Daily Weather
- Tmax
 - Tmin
 - Solar radiation
 - Precipitation

Generic soil water balance model

Evapotranspiration
Soil water balance

Forecasted irrigation need on a weekly basis (yes/no) sent by SMS

Ground Cover (%) from remote sensing



Water table depth



Irrigation recommended in next 7 days

¹⁾ Also works anywhere in between those 2 countries



GreenSat: generates N recommendations for maize at V7-V8 and V10-V12

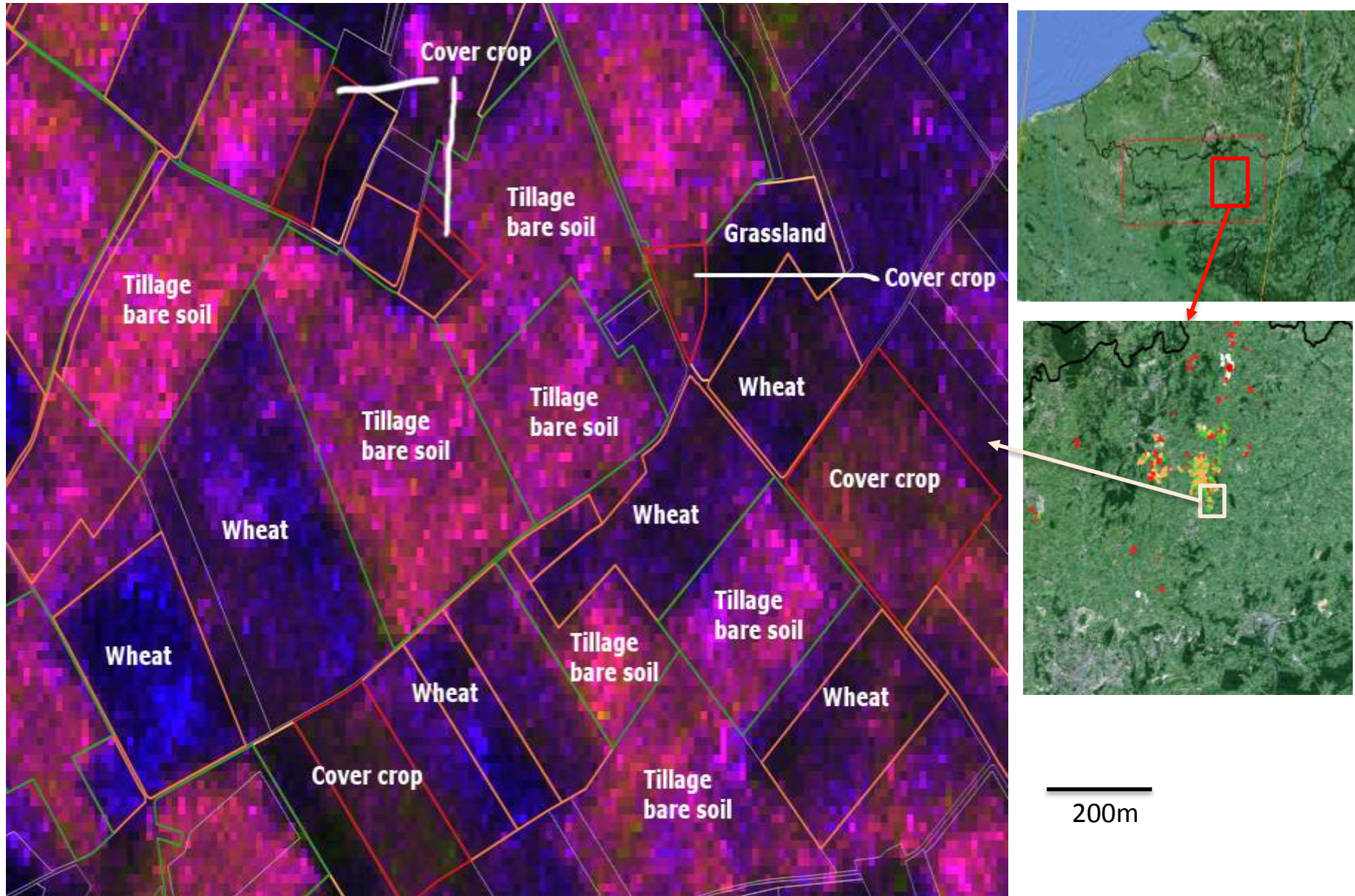
The screenshot displays the GreenSat web application interface. At the top, the URL is www.cmgs.gob.mx:89/GreenSat/. The page features the MasAgro logo and logos for CIMMYT, SAGARPA, and SIAP. The main content area is divided into several sections:

- Histogram**: A section for viewing data histograms.
- Leyenda**: A legend for the satellite imagery.
- Calculadora de Nitrógeno**: A nitrogen calculator tool with the following settings:
 - Región: Valle del Yaqui
 - Cultivo: Maíz V10-V12
 - Rendimiento Máx: (kg/ha): 12000
 - Fecha de siembra: 11-15-2015
 - Fecha, medidas: 01-14-2016
 - Franja Rica con N: 0.615
 - Práctica del Agricultor: [Empty field]
 - NUE anticipado: 0.35
- Medir NDVI**: Options for Automático and Mapa de N.
- Buscar parcela por coordenadas geográficas**: A search button.

The background is a satellite map of a field with a red dashed line indicating a selected area. A scale bar at the bottom left shows 200m. The bottom right corner of the map area contains the text: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and MasAgro.

<http://www.cmgs.gob.mx:89/GreenSat/>

Mapping result seems promising but rely on high knowledge on farming systems



Source: G. Chomé, UCL

A Smart Tricorder



Tricorder can

- sense
- analyze
- record

Smart phones

- Sensors
 - GPS
 - Temperature
 - Hyperspectral sensors
- Analyze
- Record / Store data
- Provide recommendations
- Financial transactions

Source: <www.dailymail.co.uk/sciencetech>

Estimation of percent ground cover with a smart phone

Canopeo: www.canopeoapp.com



Definition of ground cover: Fraction of ground covered by green vegetation when seen from above.

$$\text{Ground cover} = 1 - \exp(-k \cdot \text{LAI})$$

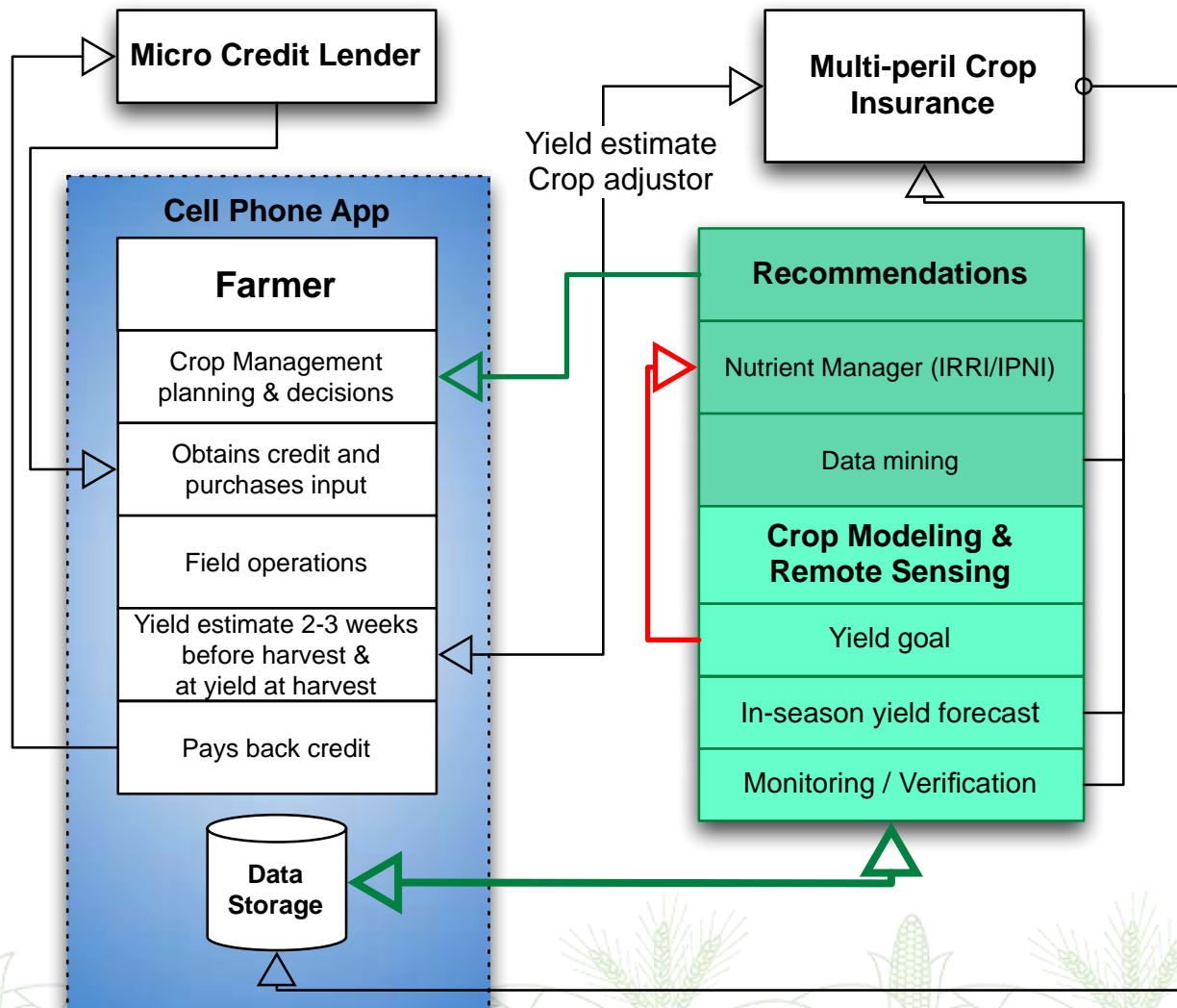
Where

k = light extinction coefficient

LAI = Leaf area index



Learning from the best: an integrated approach to optimize crop production



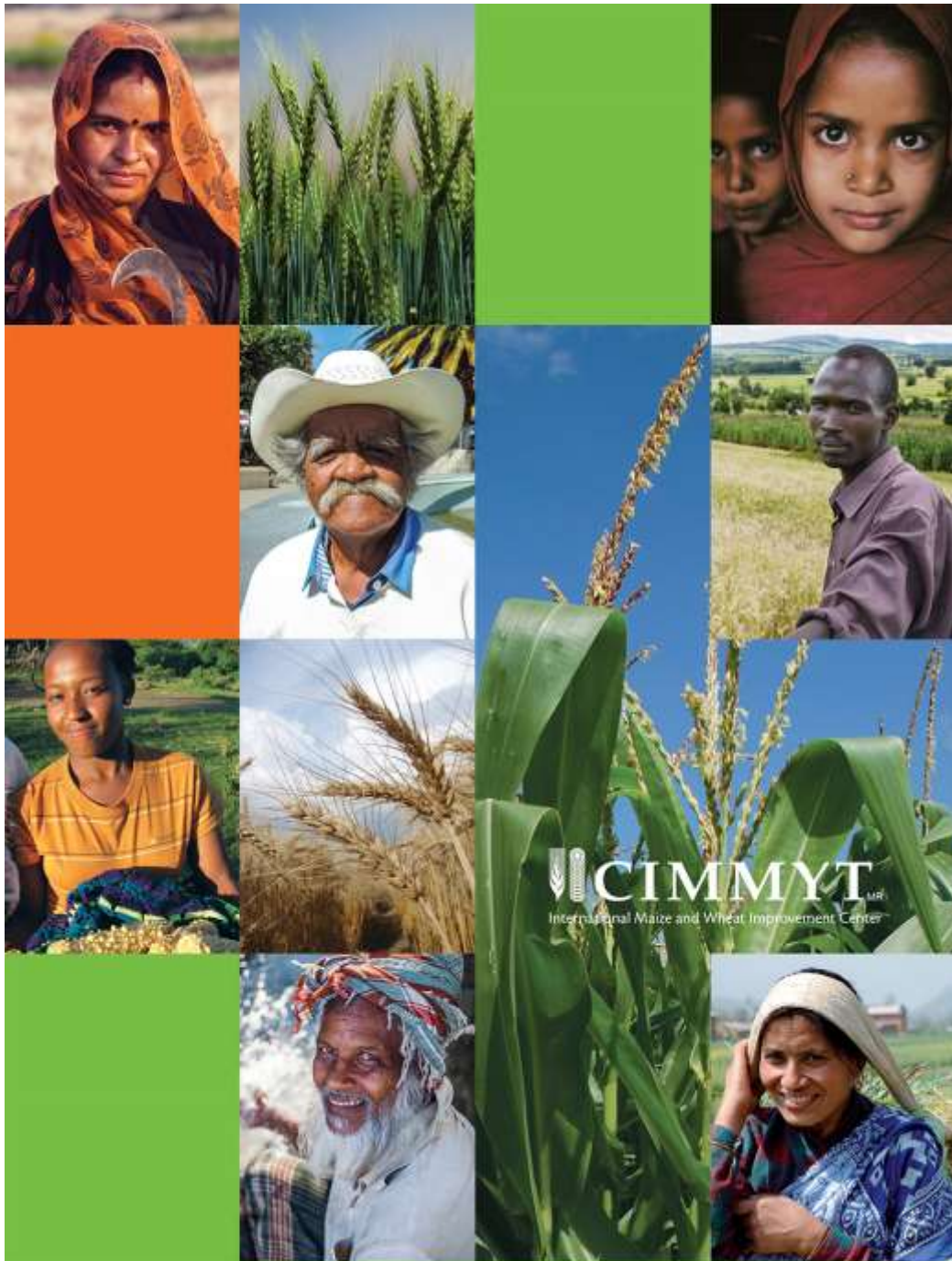
Conclusions

Finally, remote sensing can live up to its promises:

- ✓ Data
- ✓ Processing
- ✓ Delivery

Remote sensing works better with ground truth data





**Thank you
for your
interest!**

u.schulthess@cgiar.org

