Food and Agriculture Organization of the United Nations

EO-Stat

Earth Observation and Artificial Intelligence: a fundamental support to achieve SDG goals and reporting from countries

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Agrifood Economics and Policy Division (ESA), **FAO**

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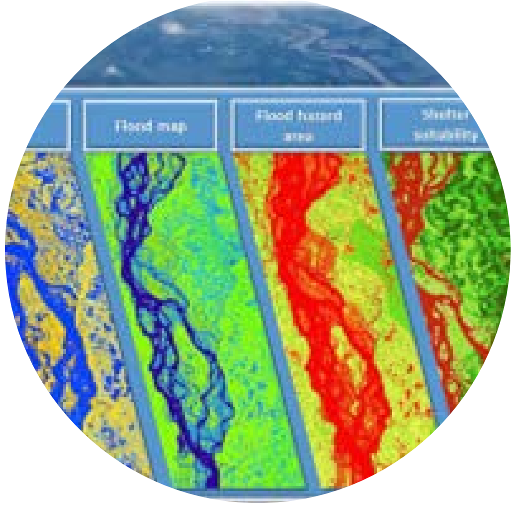
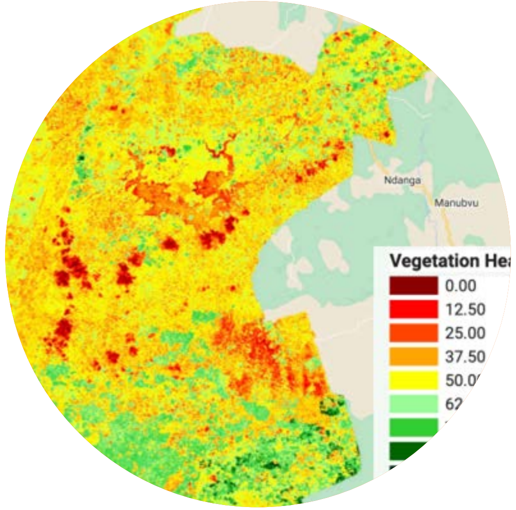
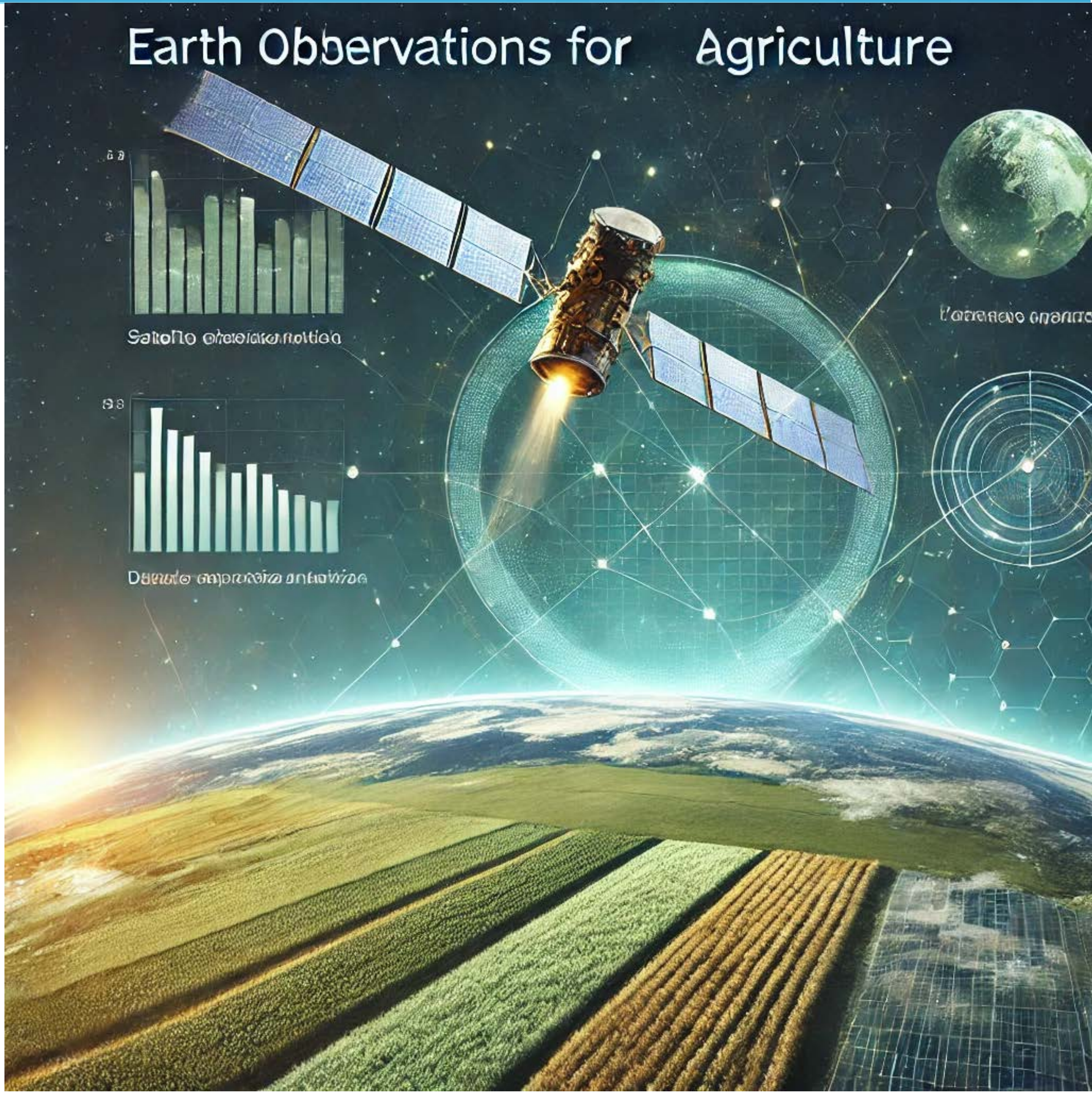




Food and Agriculture Organization of the United Nations

Introduction



What can EO and AI do for us?

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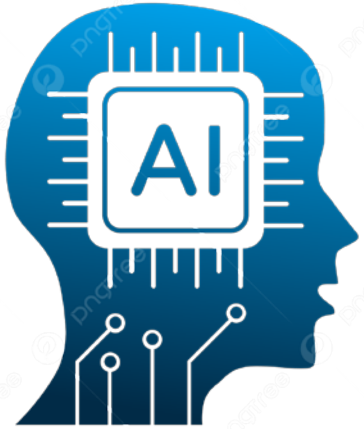
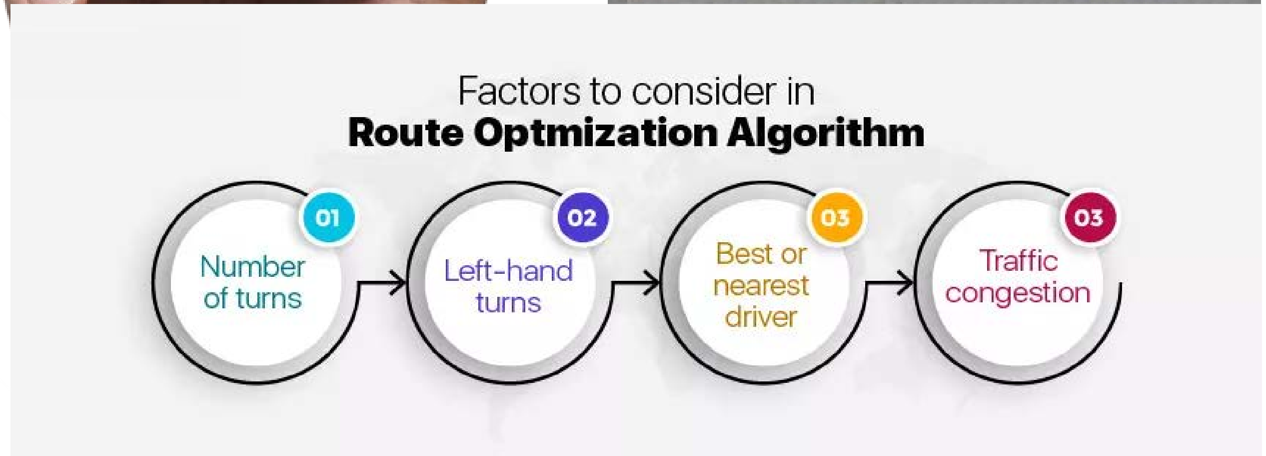
EO and AI jointly can help us measure and monitor key environmental, climatic, and socio-economic variables

Such data when its rapidly transformed into information and responses are automatized, it can be used for efficient decision making, from high level **policy formulation** to the **daily actions** we take.





Mato Grosso – Brazil's agricultural frontier

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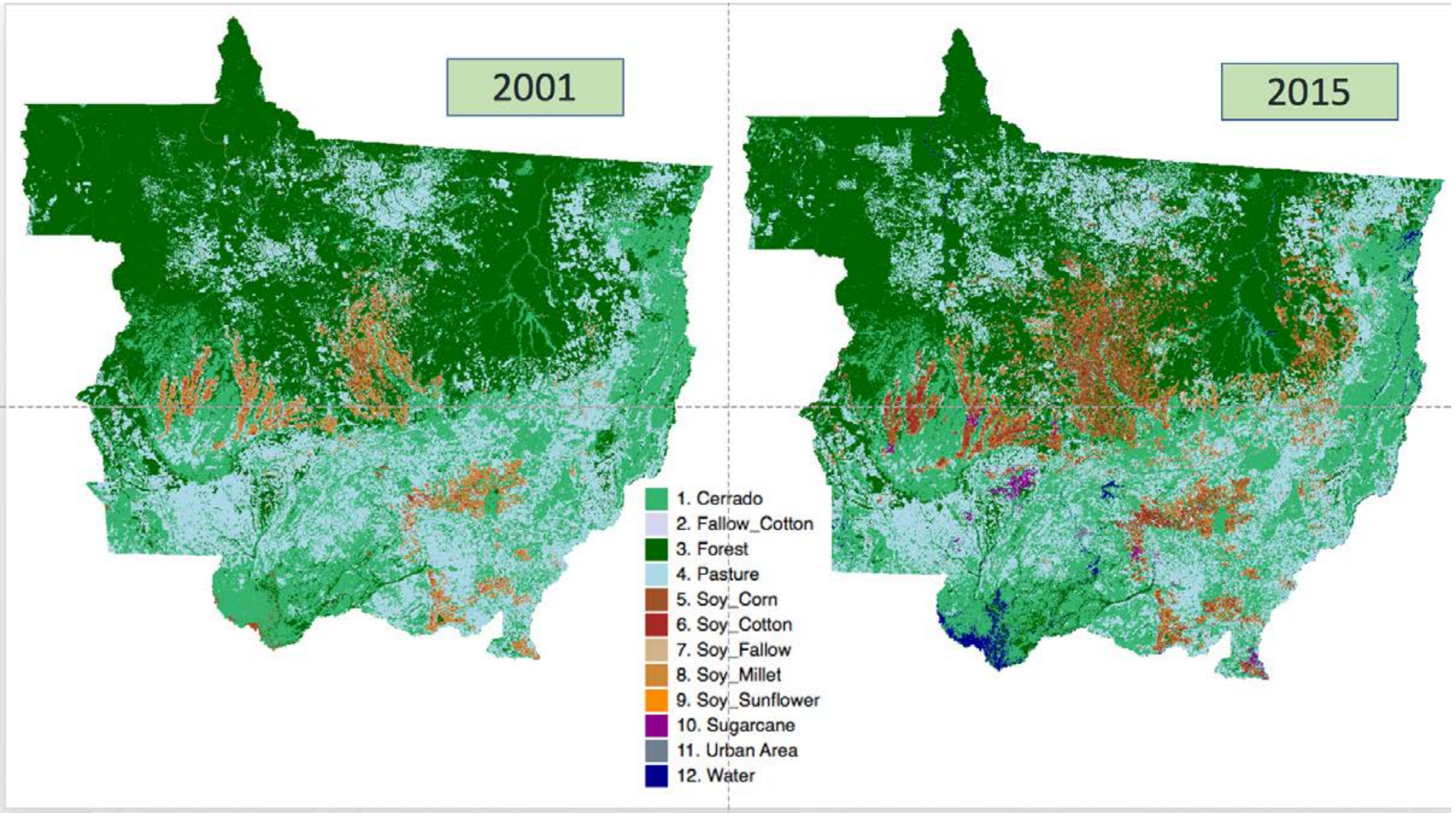

Land change dynamics (2001-2017)

Environmental Benefits
- Deforestation Tracking
- Carbon Stock Assessment
- Biodiversity Conservation

Agricultural and Economic Benefits
- Enhanced Productivity
- Sustainable Land Management
- Market Competitiveness

Policy and Governance Benefits
- Informed Decision-Making
- Compliance and Enforcement
- Community Engagement

Precision farming

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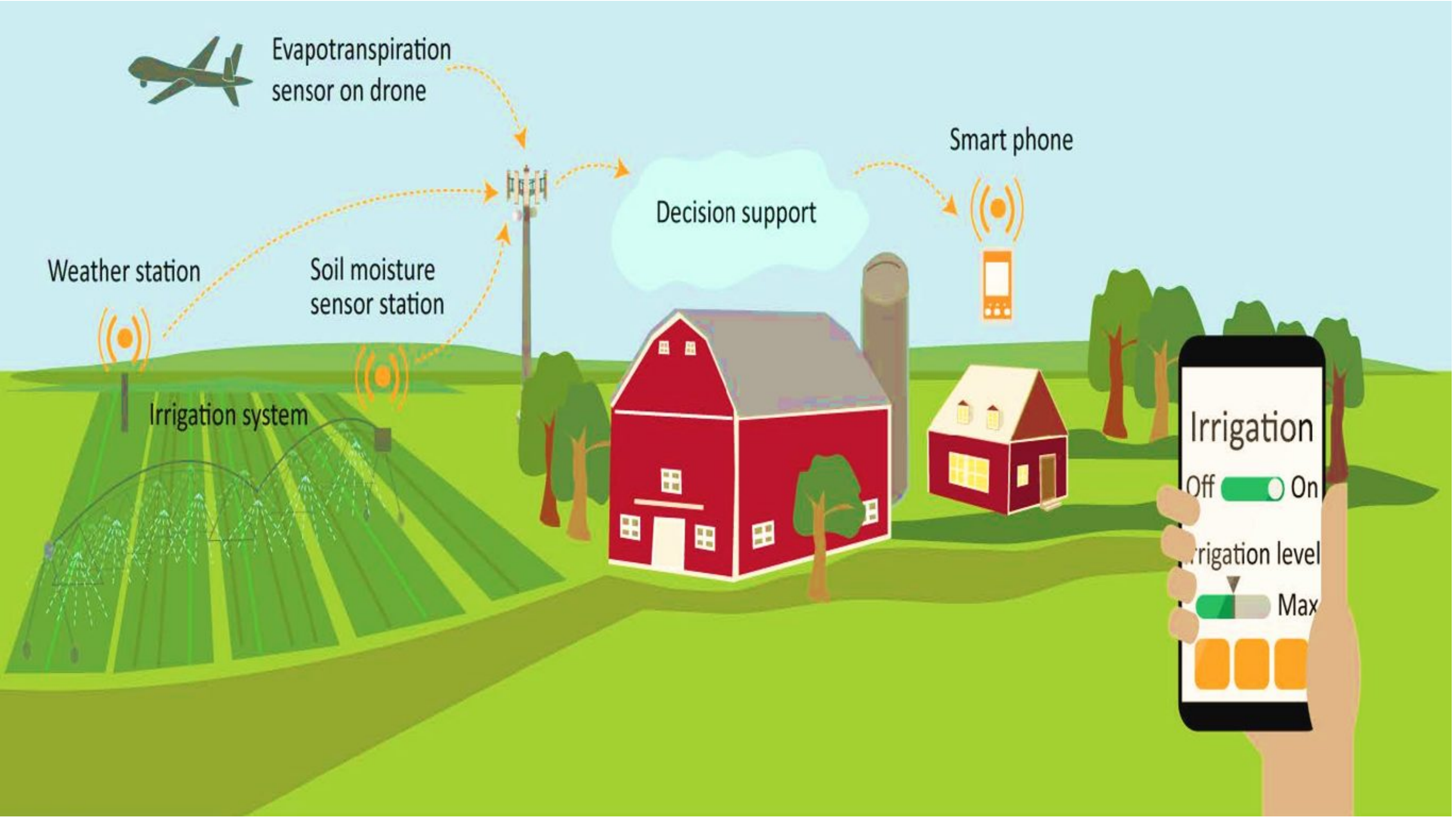
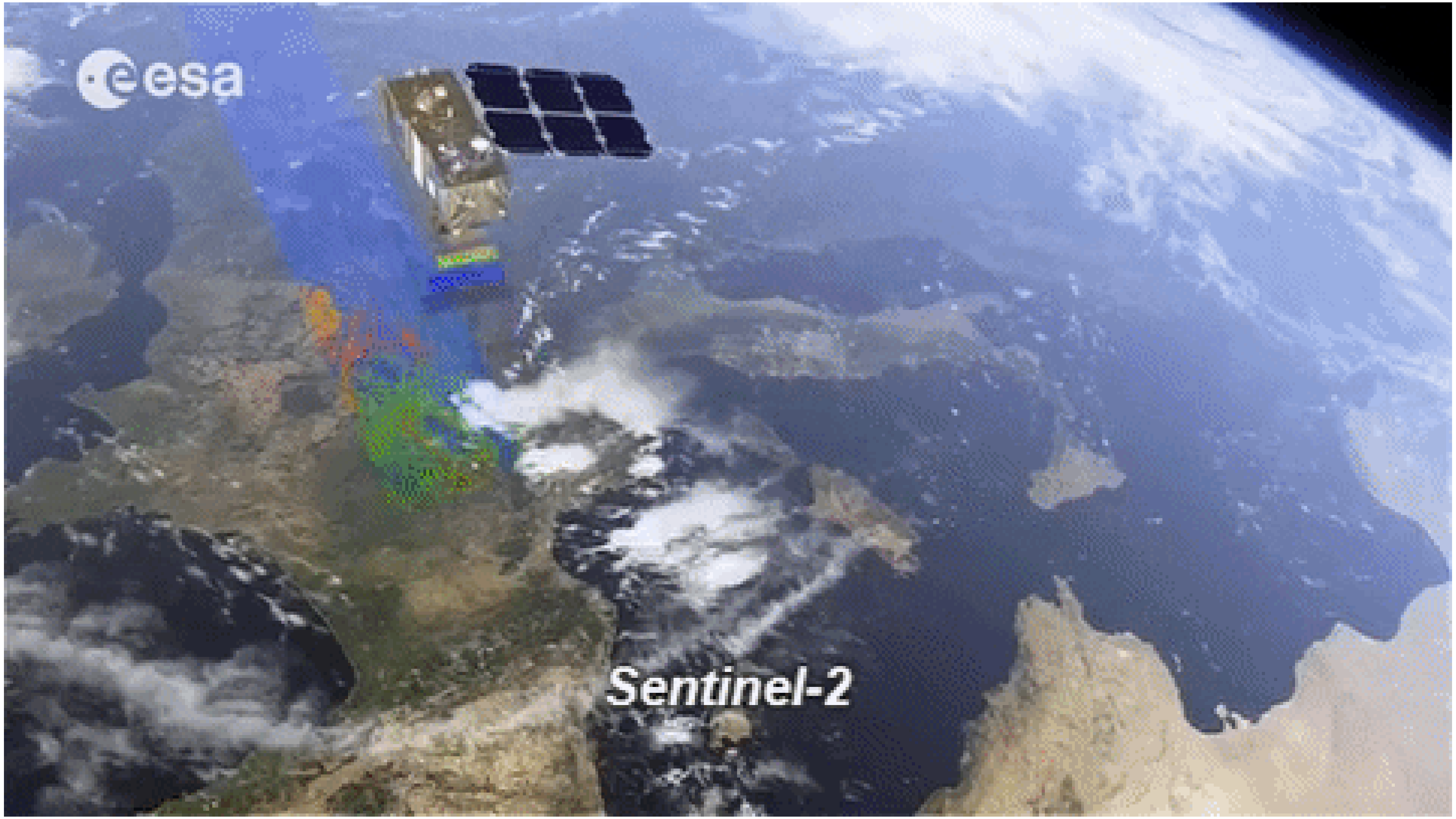


- **Optimize input use**
- **Increase crop yields**
- **Improve resource efficiency**
- **Enhance sustainability**
- **Monitor crop and soil health**
- **Enable data-driven decision-making**
- **Support climate resilience**
- **Facilitate automation and labor optimization**
- **Track and document production.**
- **Increase profitability**

How does EO and AI work together?

Sentinel-2

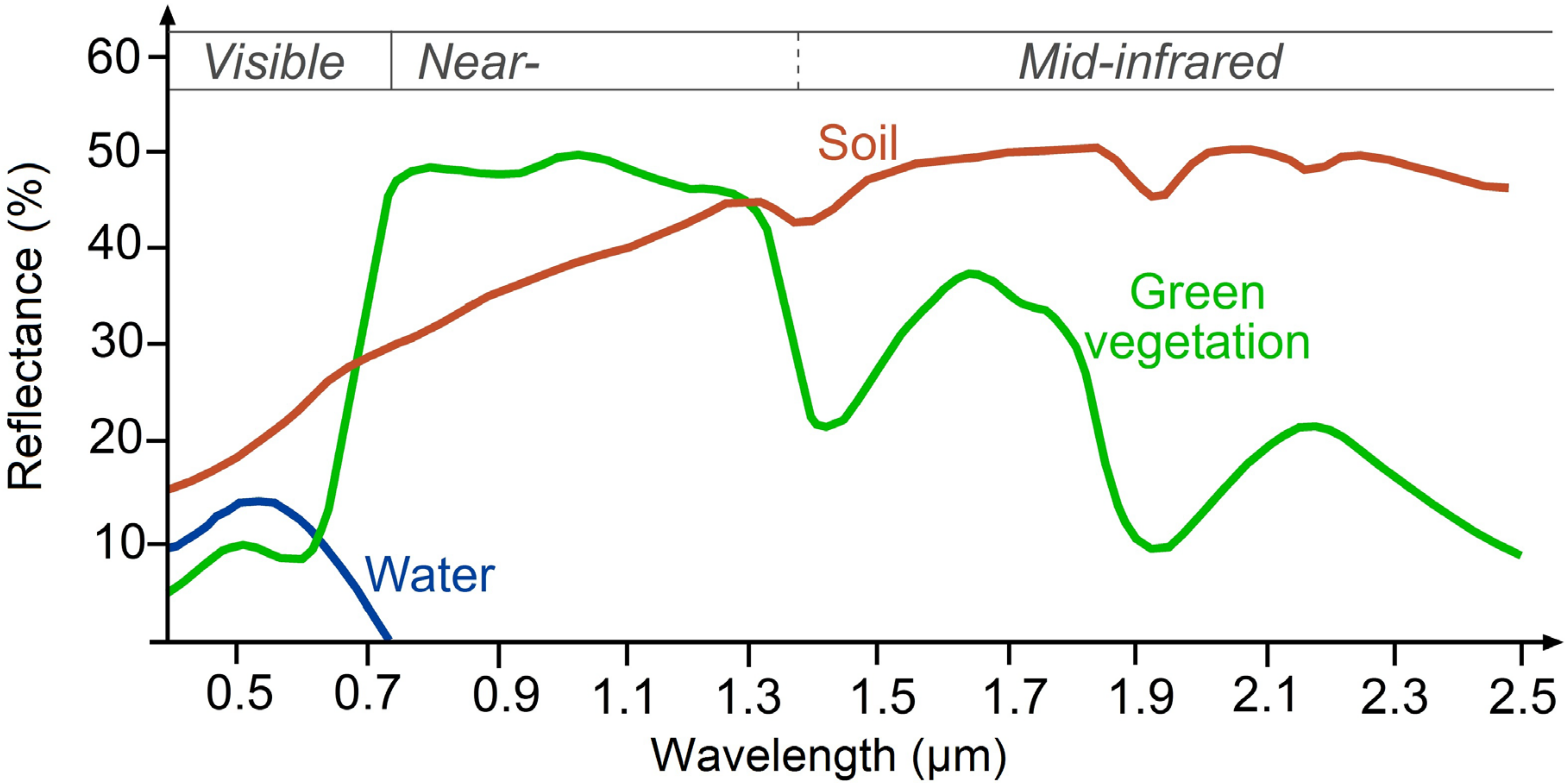


Credits: European Space Agency

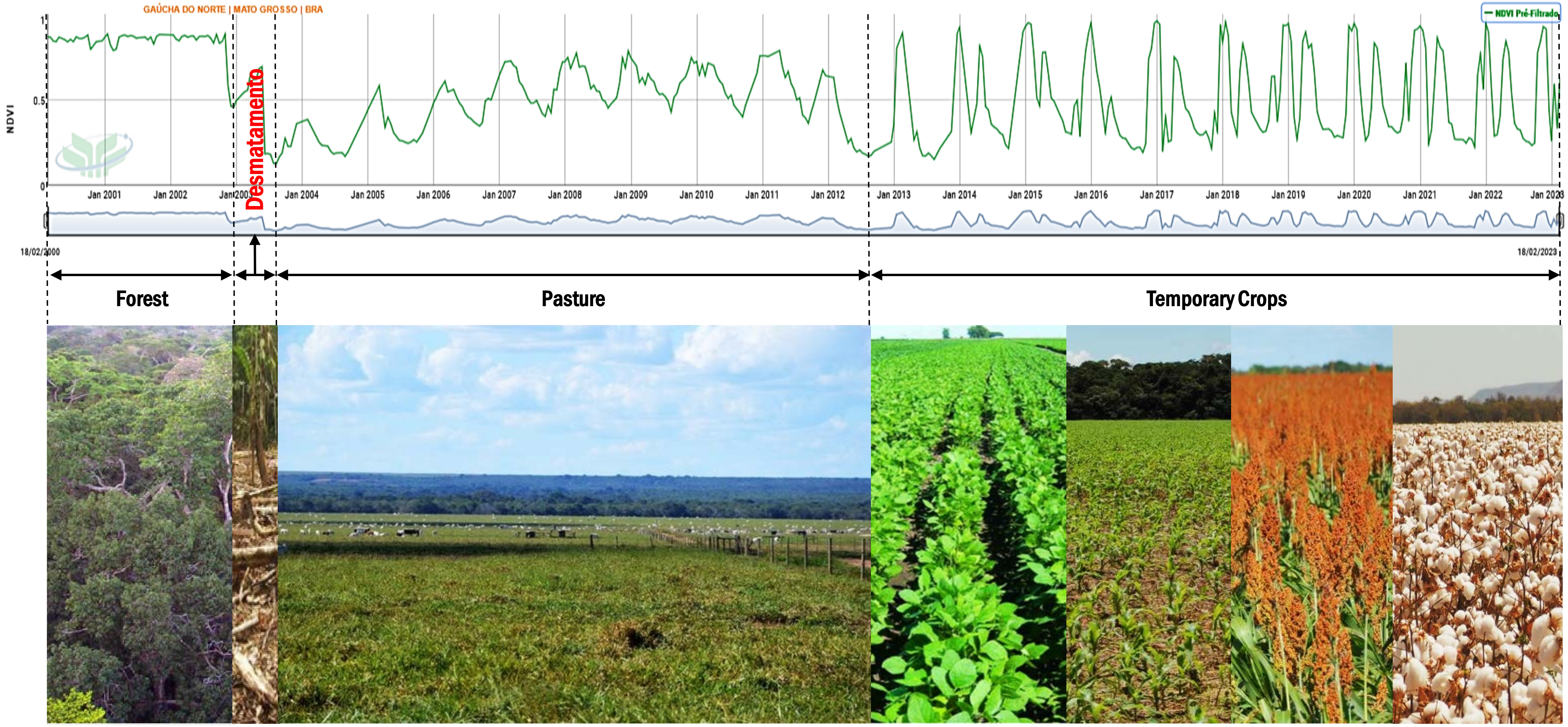
Sentinel-2

- Operational since 2015 (A) and 2017 (B)
- 13 Bands
- 290 Km Swath
- 5 days revisit
- Land cover mapping at 10 meters resolution
- Vegetation monitoring at 20 meters resolution
- mapping
- Cloud detection at 60m resolutions

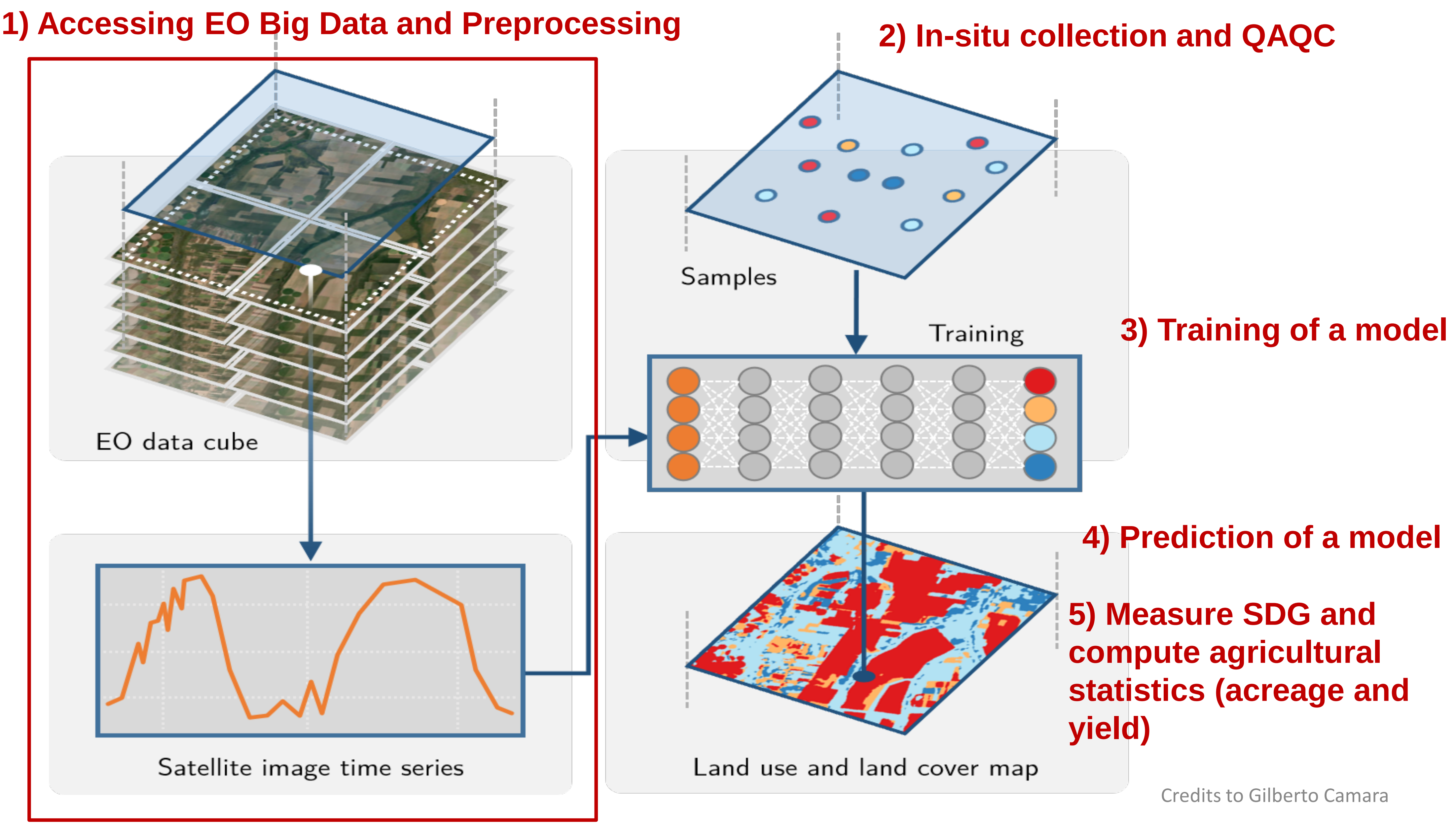
How Satellites “See” the Earth



Time series inform us on land use

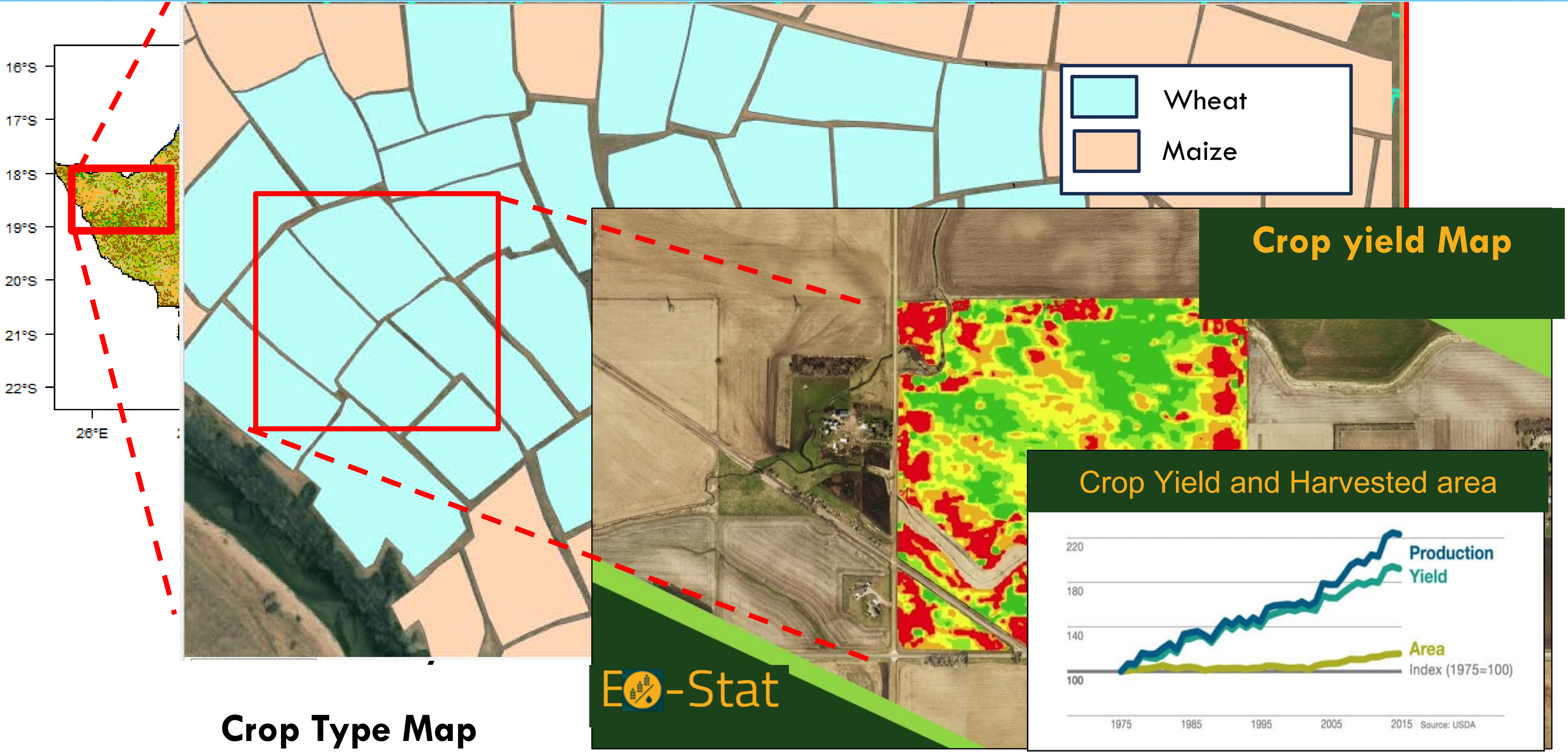


KEY STEPS to produce a Land Use Land Cover map (LCLU)



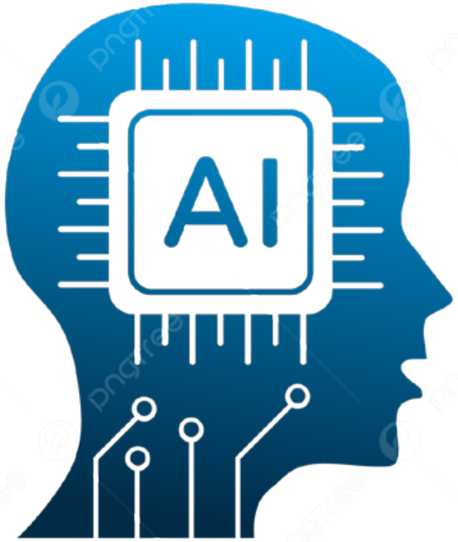
Credits to Gilberto Camara

From land cover to land use to production



Why Earth Observation & AI Are Crucial for Official Statistics

- Earth Observation enables consistent, scalable, and disaggregated SDG monitoring where statistical data are lacking.



- AI enhances the value of EO by automating analysis and extracting actionable insights for decision-makers.

Integration with official Statistics

USE CASES for EO and AI for agricultural statistics

ECONOMIC EFFICIENCY

Use of EO data in the area estimation to maximize the accuracy of statistics (i.e. low variance) and/or to reduce cost (thanks to free data, "simple" methods)

GRANULARITY

Current sampling is often designed for the national level => use EO data to allow disaggregation of statistics in smaller administrative areas (province, county)

TIMELINESS

Statistics are usually available after the end of the campaign and once a year => use EO data and modelling to forecasts and provide seasonal estimates

SAMPLING DESIGN

Use EO data to support the construction of an area sampling frame (for land cover and environment related topics) and to find the optimal sample size and segment size. It optimizes the construction of EAs

DATA QUALITY CONTROL

Improve the quality of the database in the field (data collection protocol and quality control procedure)

SDG REPORTING

SDG 6 "Clean water and sanitation“ and support to SDG 2 "Zero Hunger"

OTHER

Early warning systems, water body map, soil suitability, comparison of yield statistics

SDG 15.4.2 Mountain Green Cover Index

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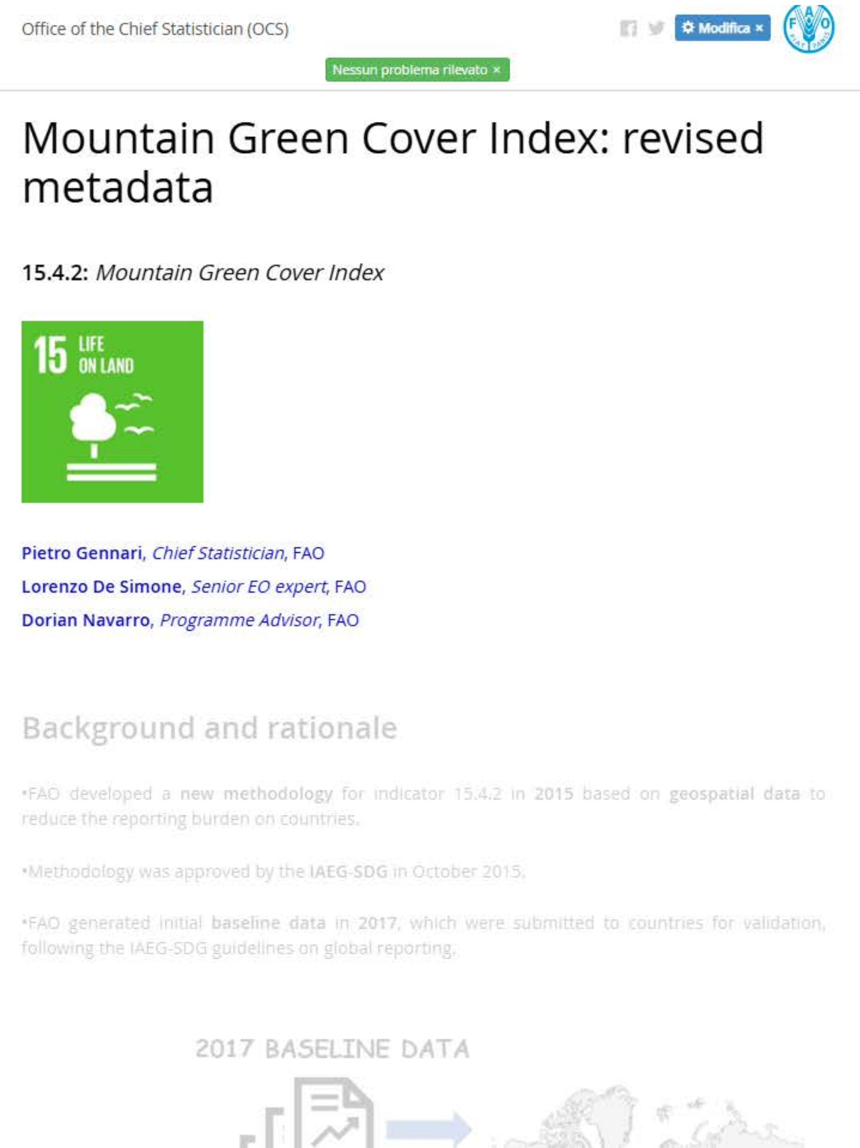

Office of the Chief Statistician (OCS)

Modifica ×

Nessun problema rilevato ×

Mountain Green Cover Index: revised metadata

15.4.2: *Mountain Green Cover Index*

15 LIFE ON LAND

Pietro Gennari, *Chief Statistician*, FAO

Lorenzo De Simone, *Senior EO expert*, FAO

Dorian Navarro, *Programme Advisor*, FAO

Background and rationale

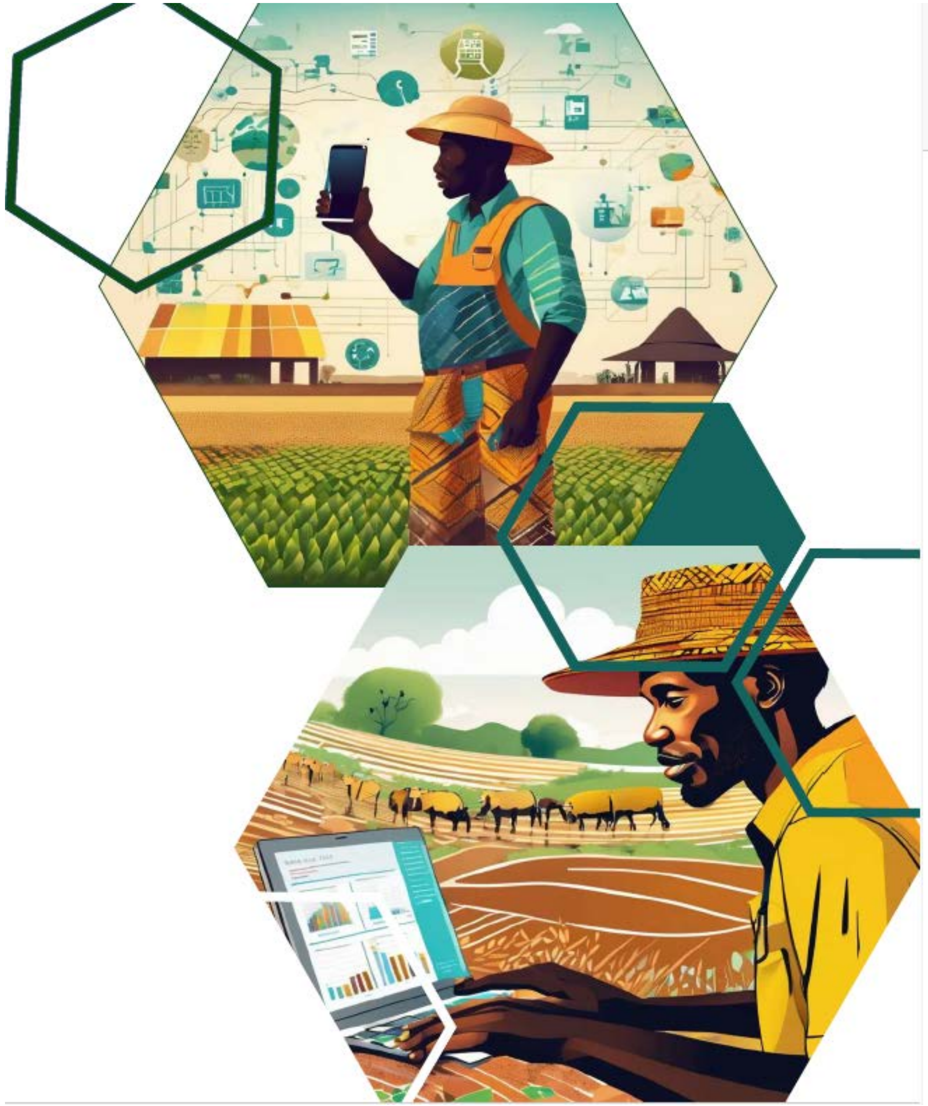
•FAO developed a **new methodology** for indicator 15.4.2 in **2015** based on **geospatial data** to reduce the reporting burden on countries.

•Methodology was approved by the **IAEG-SDG** in October 2015.

•FAO generated initial **baseline data** in **2017**, which were submitted to countries for validation, following the IAEG-SDG guidelines on global reporting.

2017 BASELINE DATA

Zimbabwe



National Crop Mask and Crop Type Map - Zimbabwe

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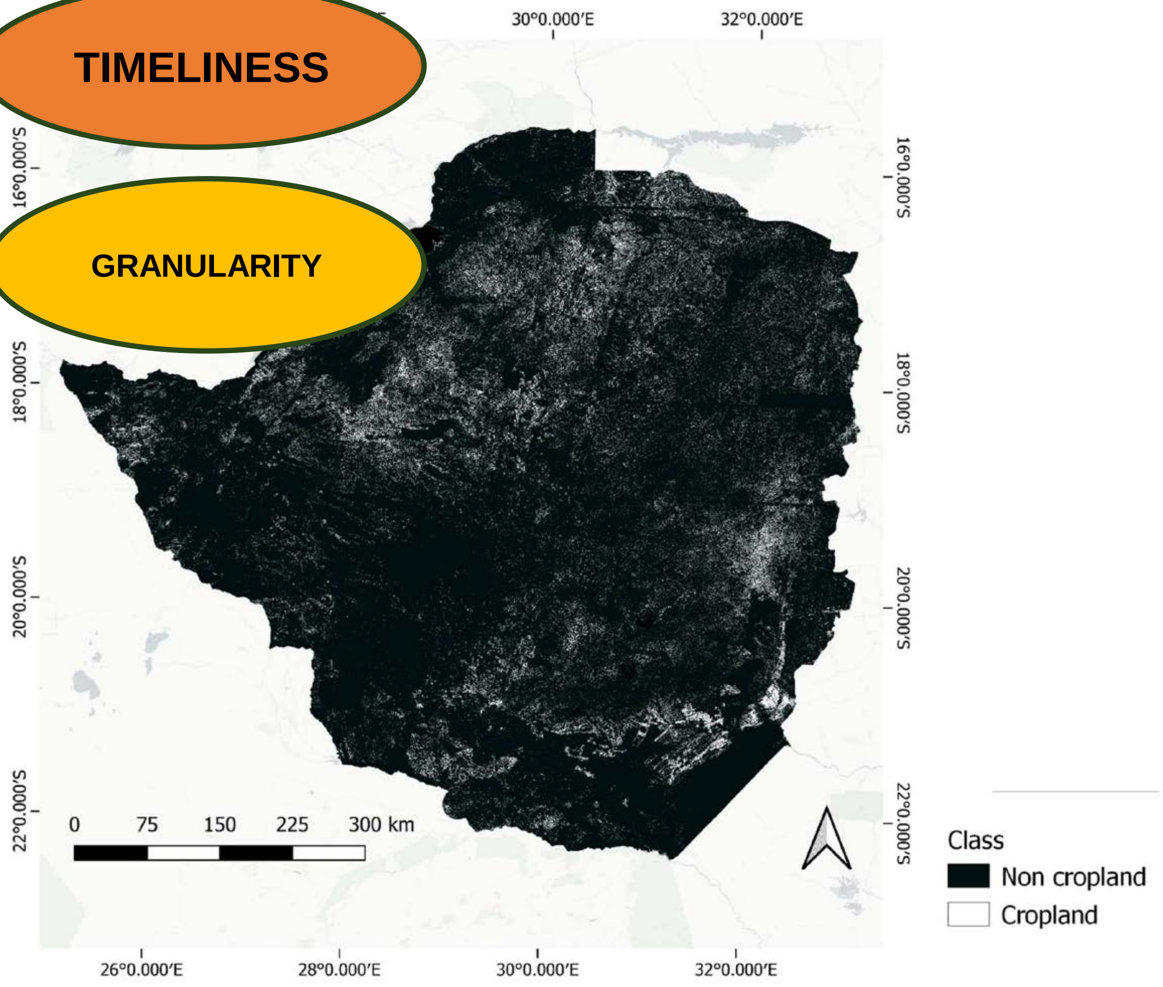
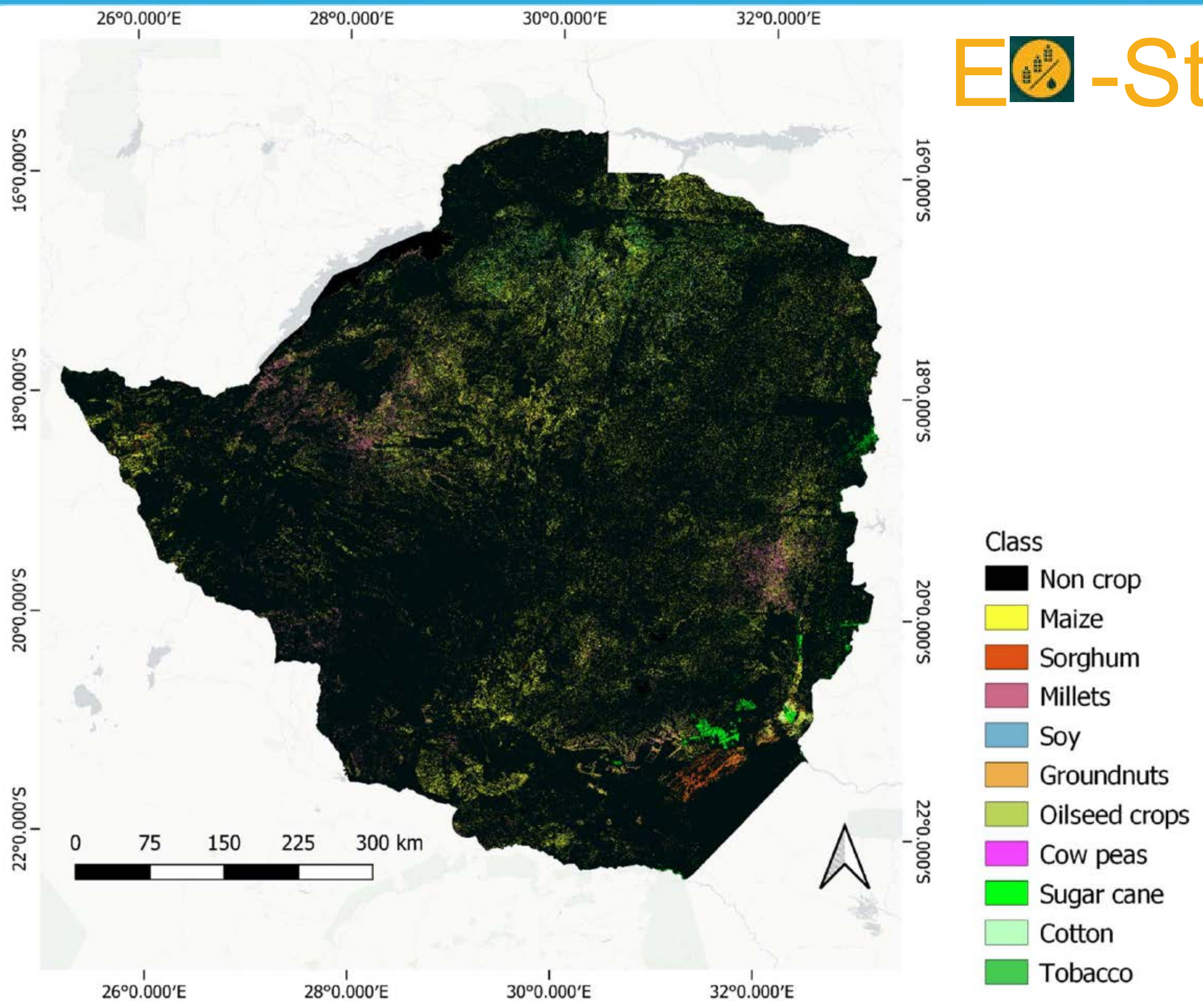
TIMELINESS

GRANULARITY



Crop Mask
Zimbabwe, summer season 2024

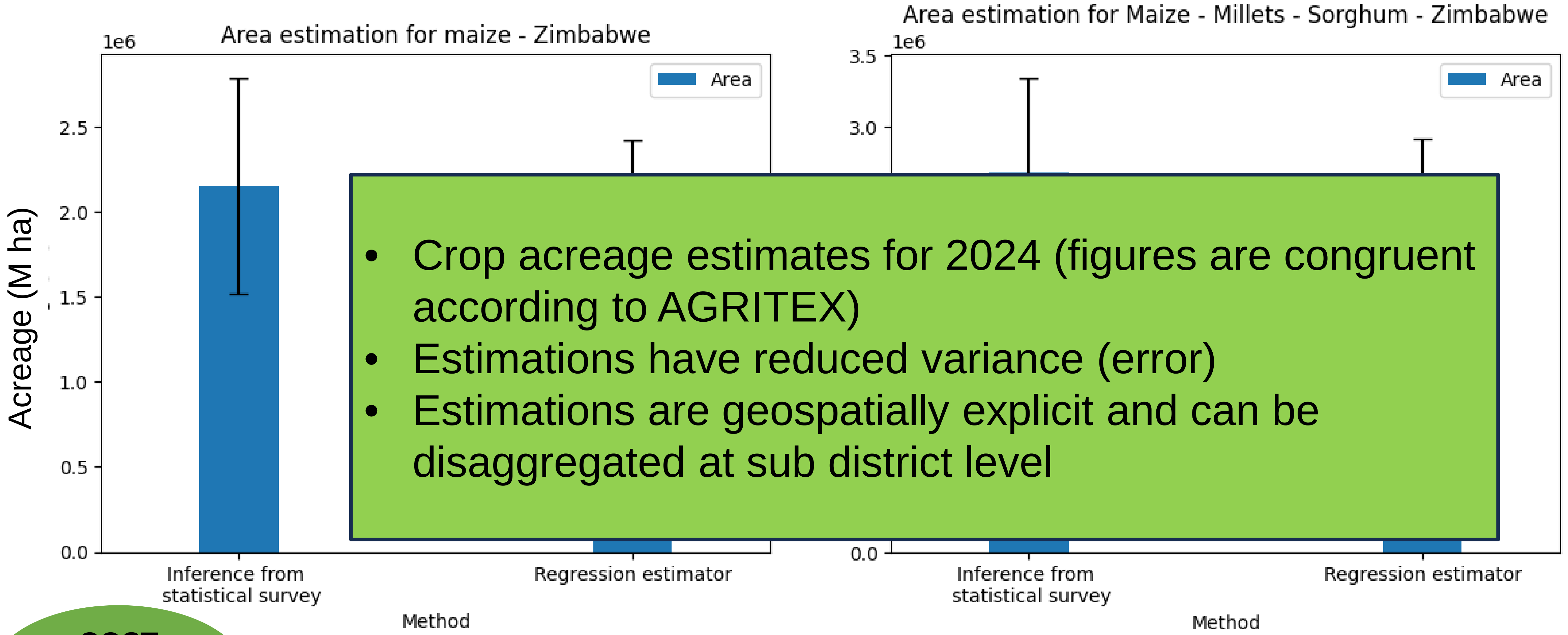


Crop Type Map
Zimbabwe, summer season 2024

UCLouvain ZimStat

Acreage estimate for main crops summer 2024

EO-Stat



- Crop acreage estimates for 2024 (figures are congruent according to AGRITEX)
- Estimations have reduced variance (error)
- Estimations are geospatially explicit and can be disaggregated at sub district level

COST EFFICIENC Y

Improving design-based **acreage** estimators by reducing the standard error while providing unbiased estimates => reducing the CoV without increasing the number of samples.

FAO UCLouvain ZimStat

EO Integrated Farmer Registry

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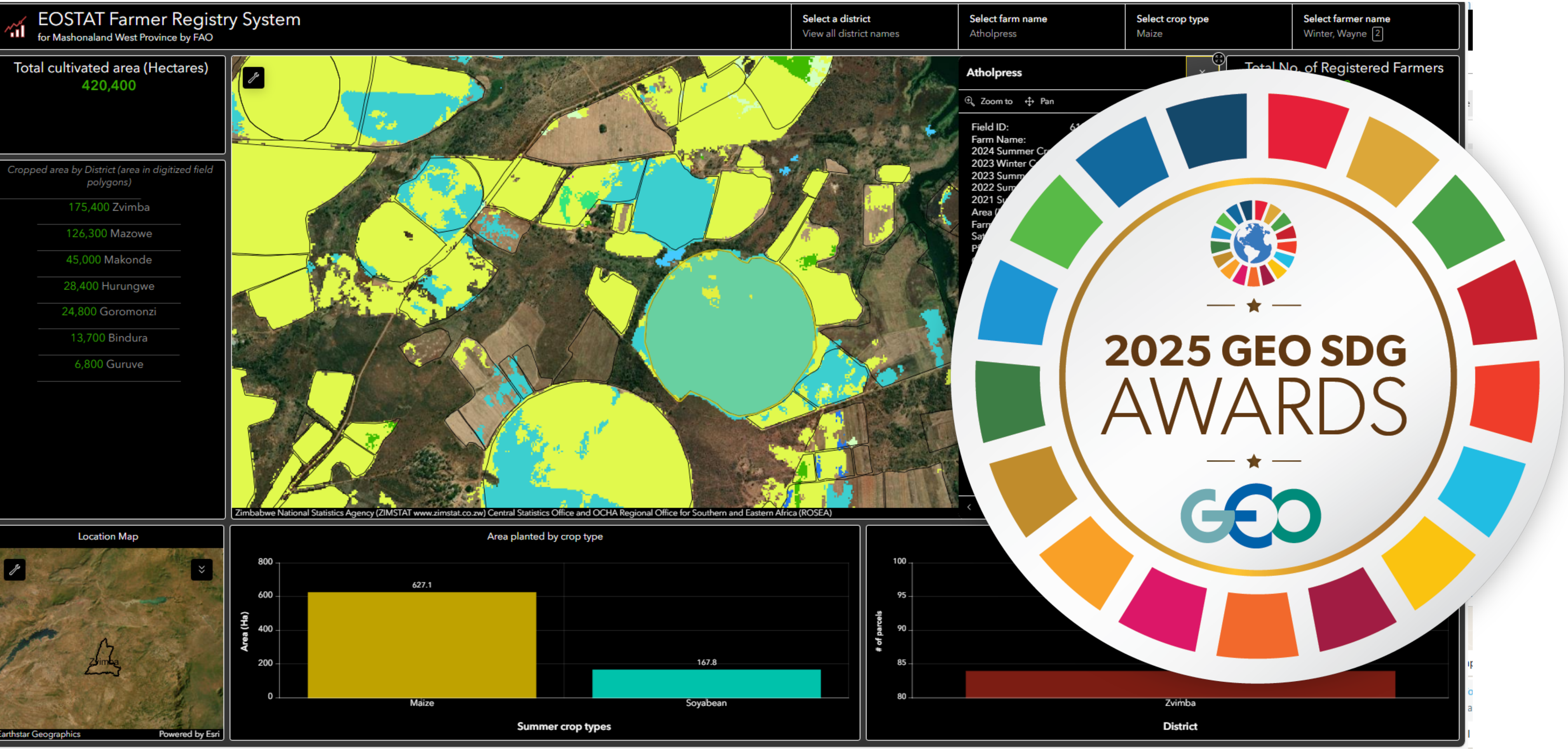
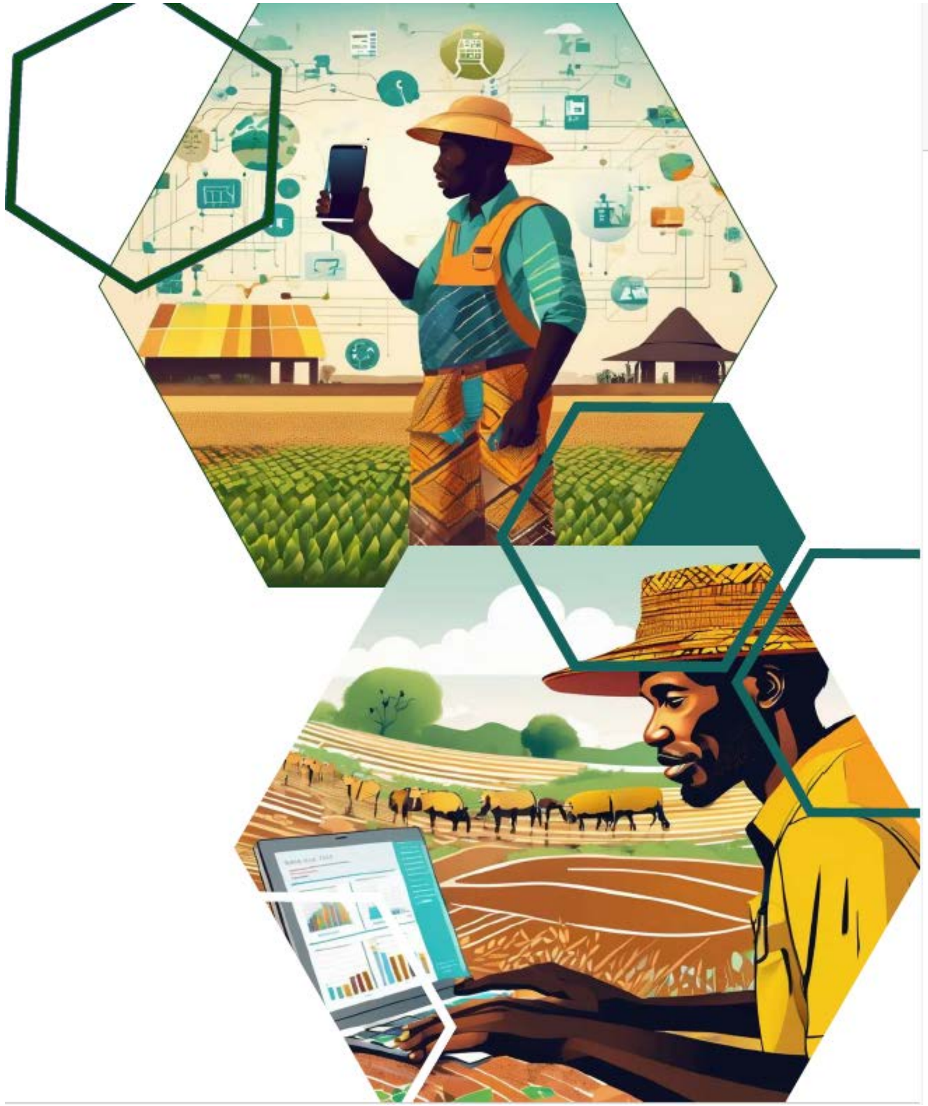


Tajikistan



Tajikistan – Assessment of cropland and acreage

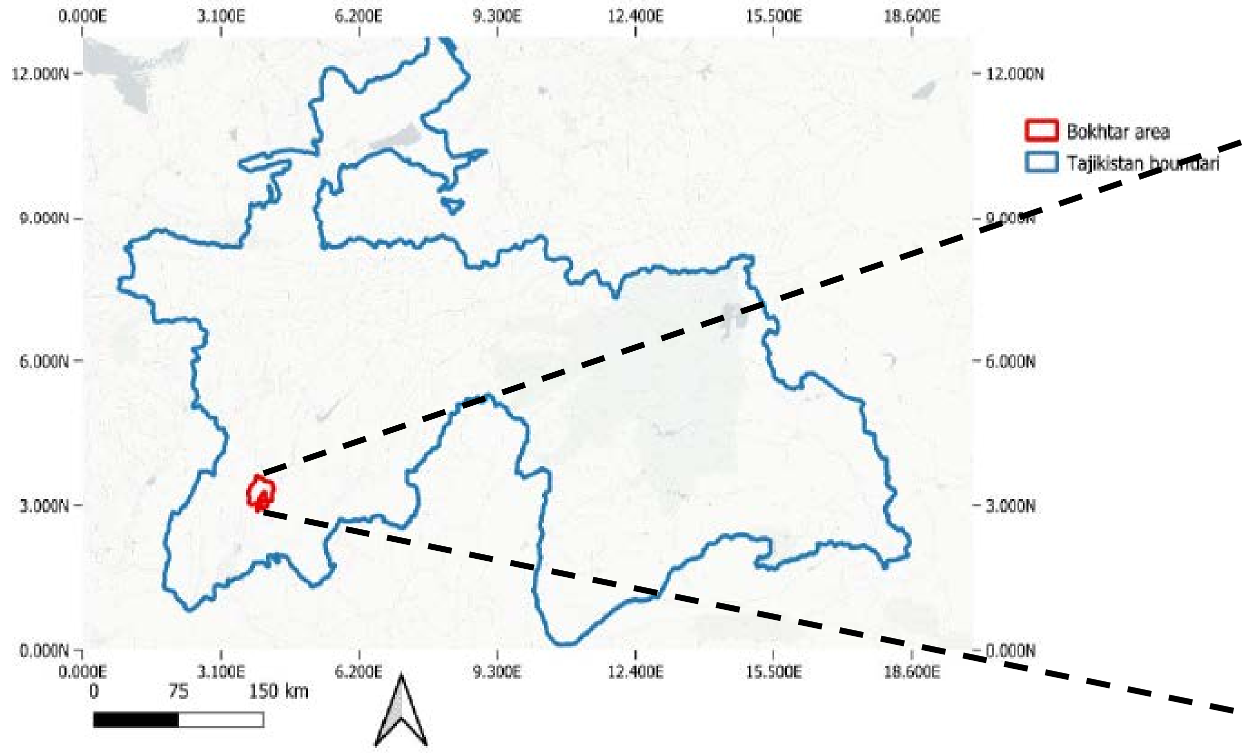


Figure 10-2. AOI for the pilot study: Bokhtar

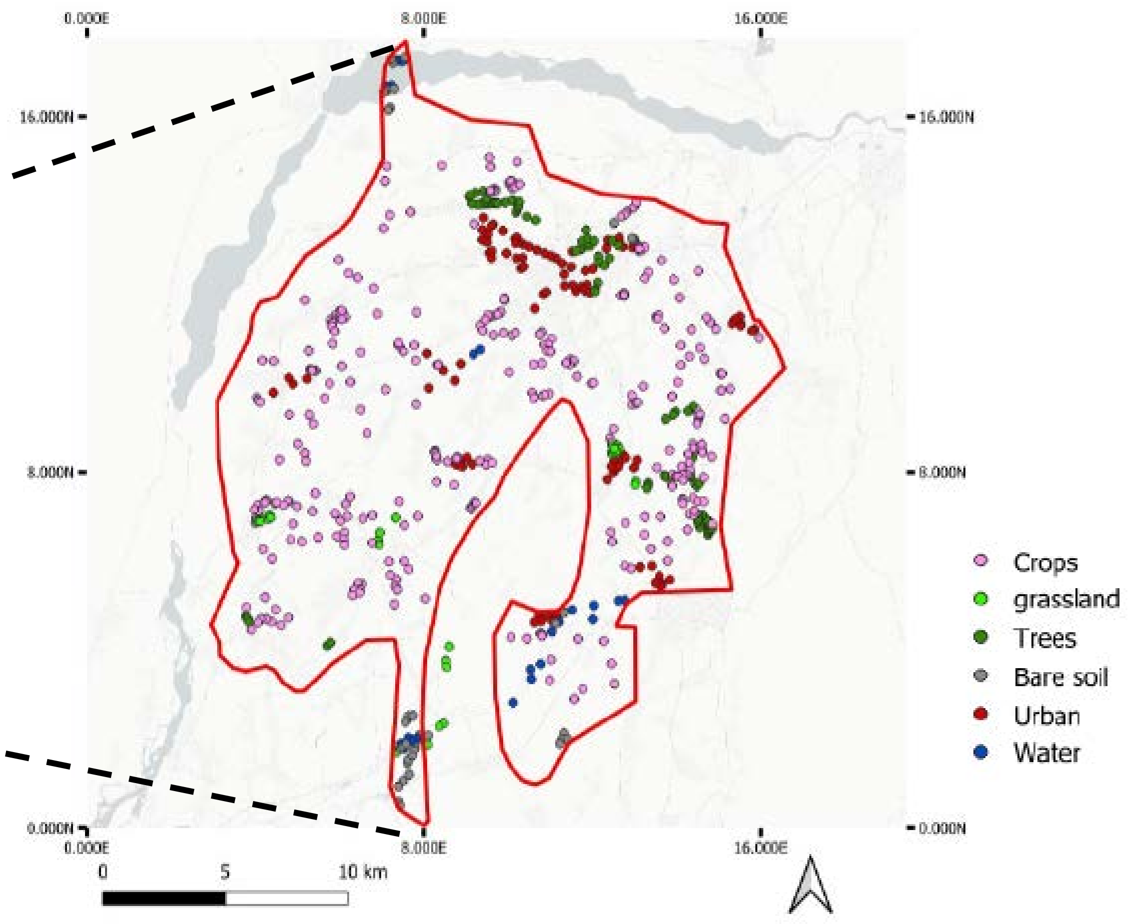


Figure 10-3. In-situ data taken over the AOI for the pilot study

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Tajikistan – Assessment of active cropland

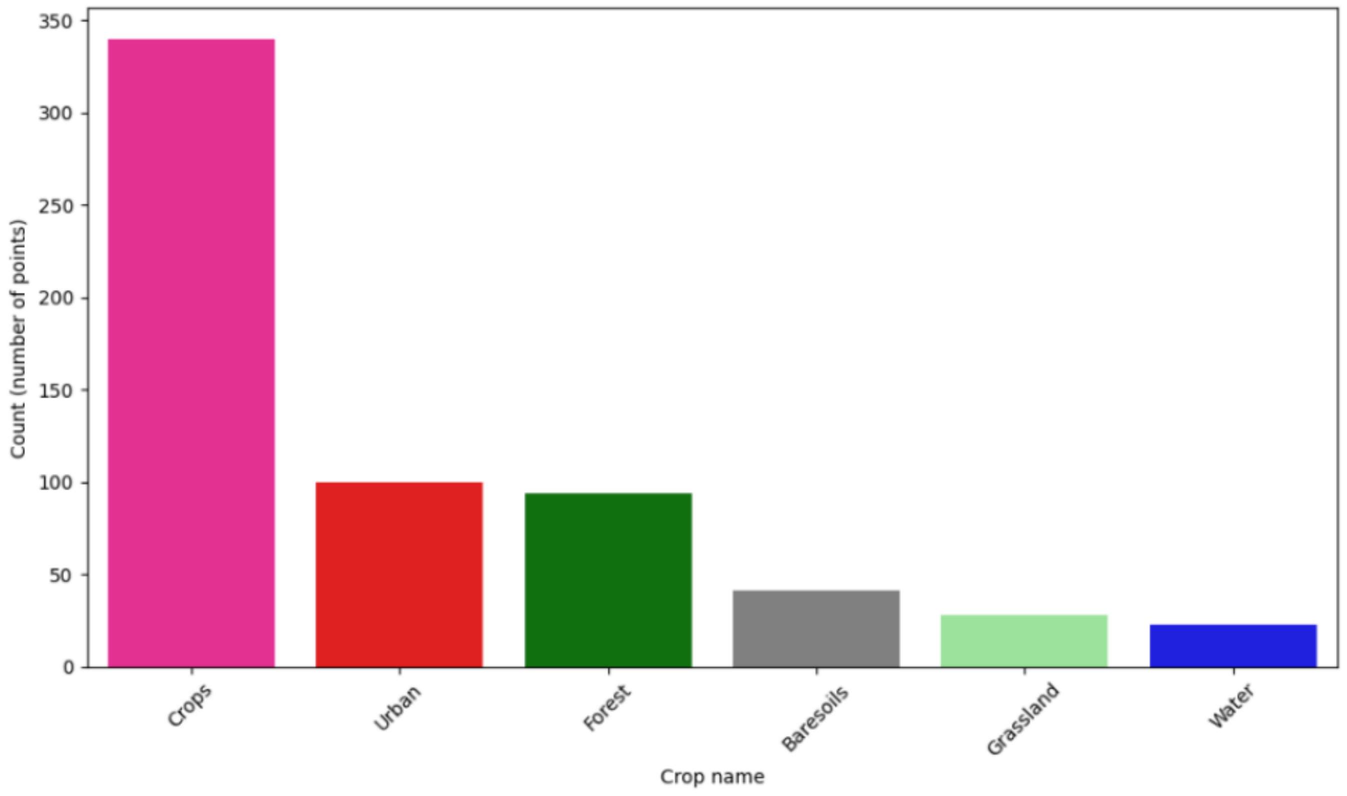


Figure 10-4. Distribution of the reference points in terms of land cover class

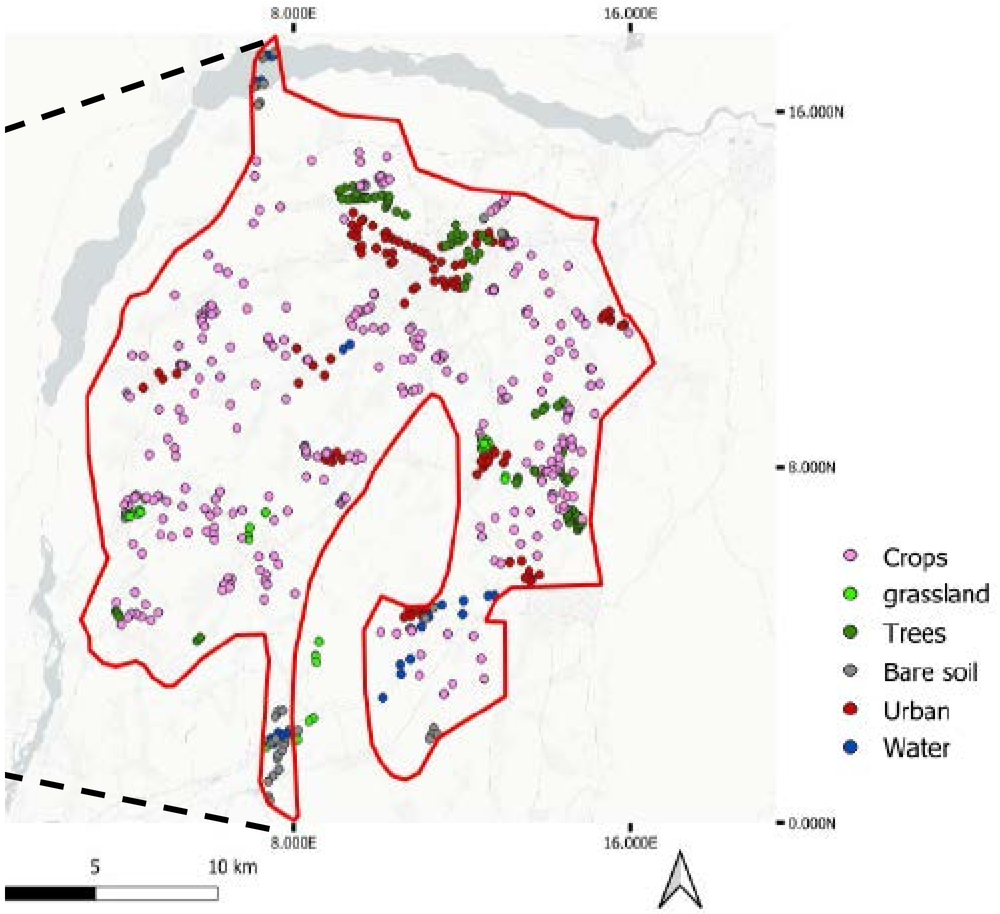


Figure 10-3. In-situ data taken over the AOI for the pilot study

Tajikistan – Crop Mask

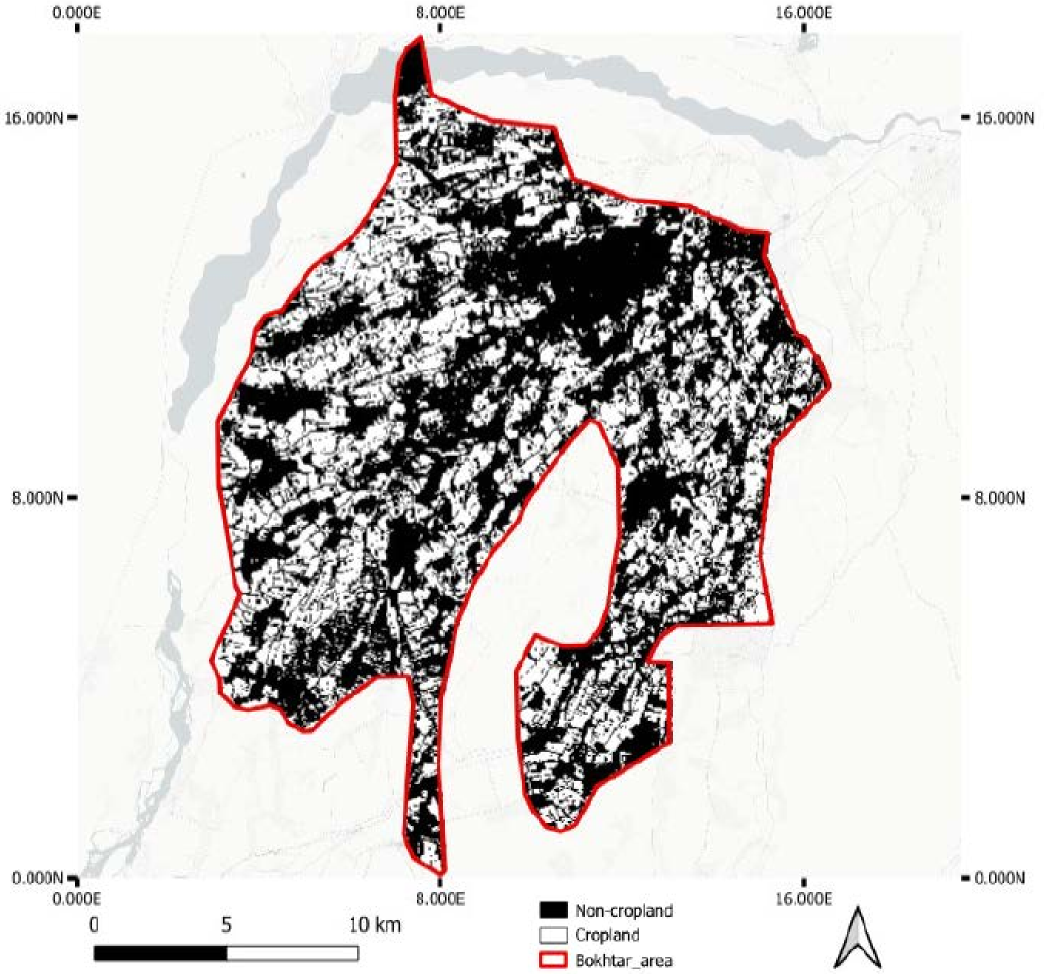
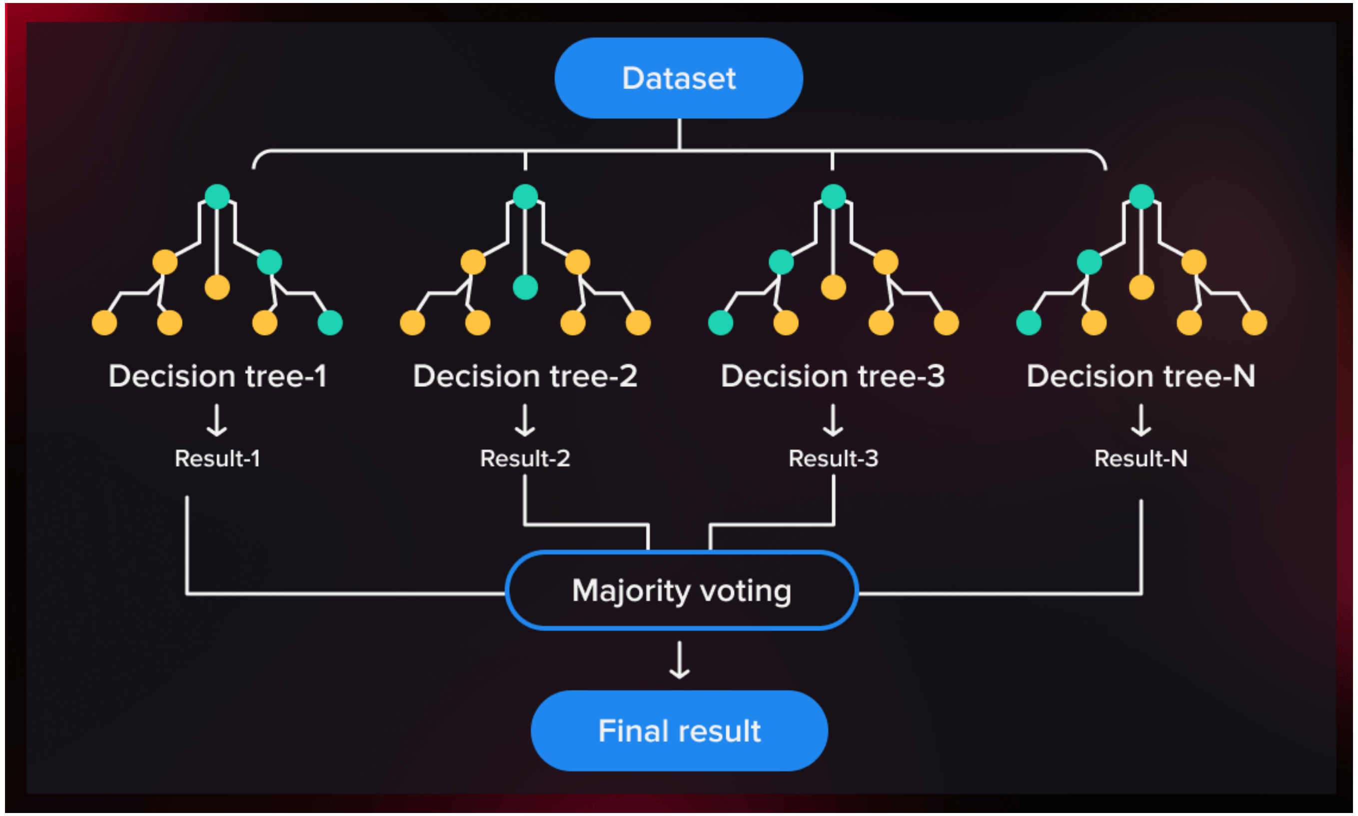


Figure 10-5. Cropland mask over Bokhtar area



Overall accuracy of the cropland mask **88%**,
F1-score:

- **89%** for cropland
- **87%** for non-cropland

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Tajikistan – prototype for area frame

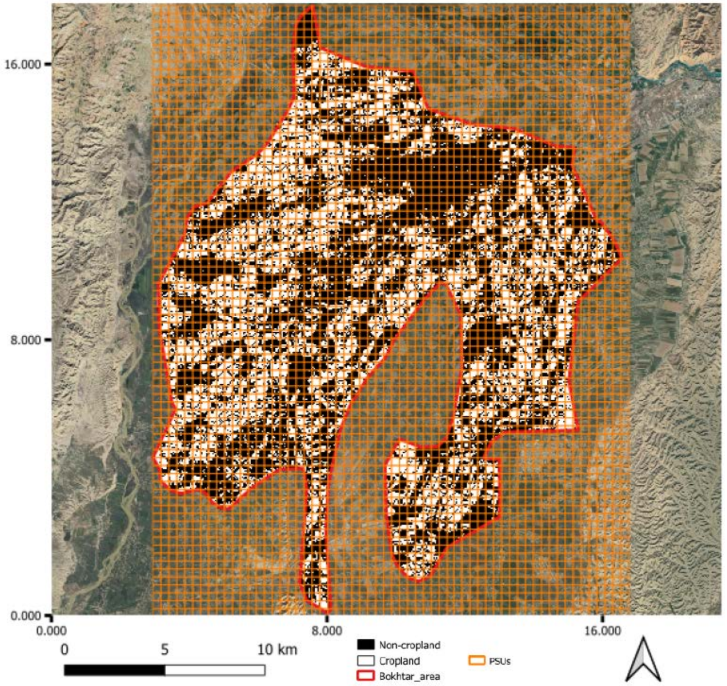


Figure 10-6. Grid of PSUs over Bokhtar

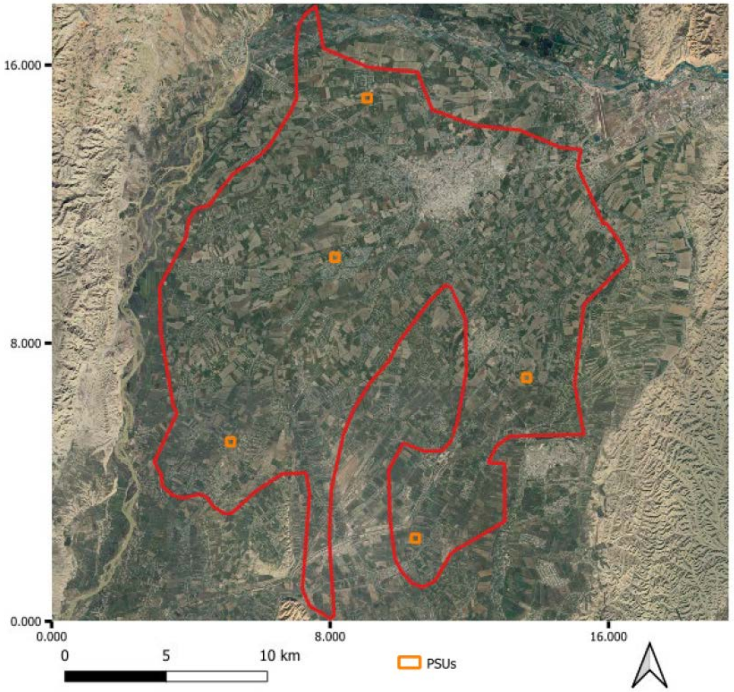


Figure 10-7. Selected PSUs over Bokhtar

Figure 10-8. Zoom over one selected PSU with SSUs

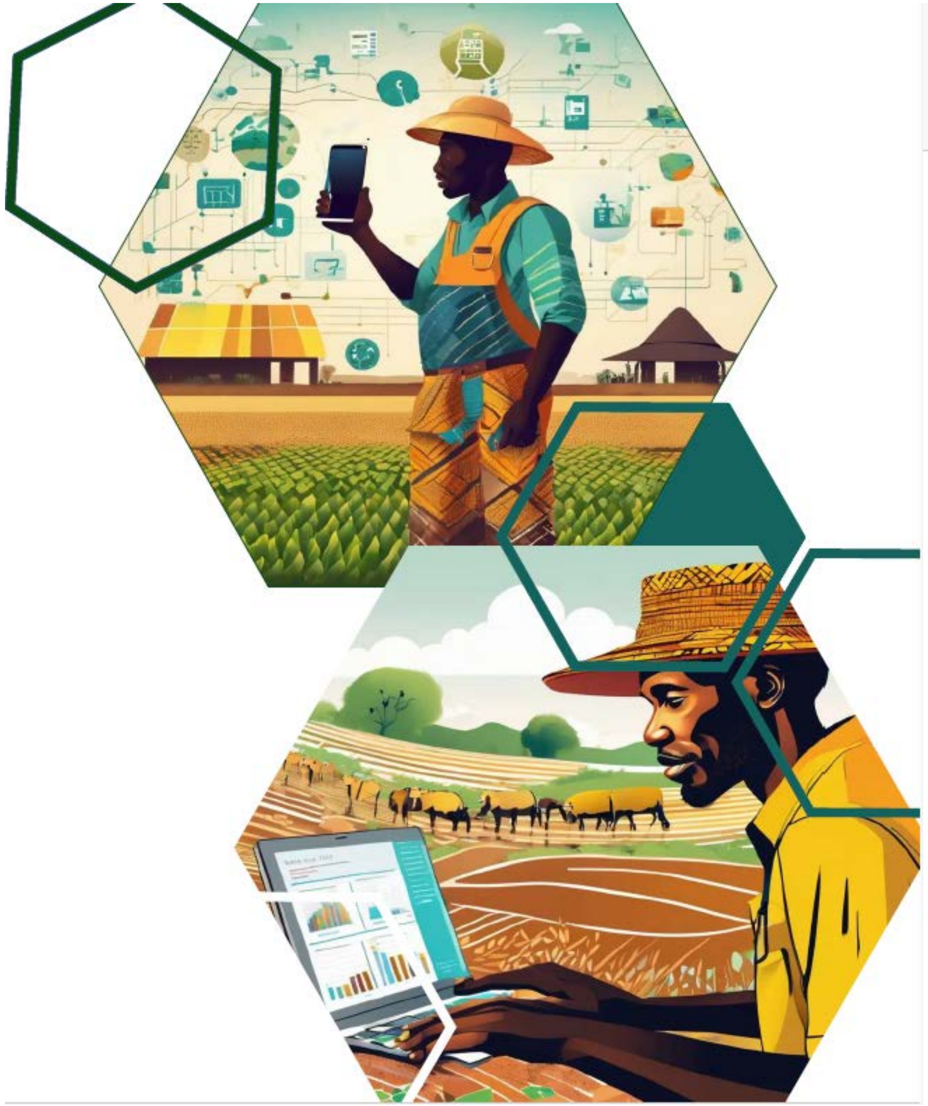
Independent survey using an area frame

This scenario introduces an independent survey approach, utilizing a simplified area frame sampling design. The study area is divided into square grids, such as 500m x 500m cells, with stratification based on the proportion of crops in each grid. Strata are categorized as low, medium, high, or very high, depending on the proportion of crop pixels identified in a prior crop/non-crop map (with at least one crop pixel required for inclusion in the stratum).

Primary Sampling Units (PSUs) are selected randomly from the grid, with a minimum distance threshold to ensure spatial dispersion. The number of PSUs, ranging between 30 and 50, is allocated equally across strata.

Within each PSU, enumerators perform systematic sampling of **Secondary Sampling Units** (SSUs), collecting data from 25 points per PSU. This method aims to provide a statistically robust and representative sample of agricultural plots.

Peru



Register of Agricultural Producers - farmers (PPA)

- Padrón de Productores Agrarios (**PPA**)
- **2+ million farmers** registered
- Originated from the need to create a producer database for distributing subsidies
- Collects **38 strategic georeferenced variables**, providing a detailed economic, social, and productive profile of farmers.

- The goal is to have 100& of producers registered into the PPA, and at least 50% of producers of cacao, coffee and palm oi with their parcels being georeference using the **Farmer Digital Identify App**

Identidad Digital del Productor Agrario

The **Farmer Digital Identify App** (IDPA)

- Free mobile application managed by MIDAGRI, available to any farmer (producer) in the country
- Farmer manages his digital identity obtained through the PPA
- Visualize and update information about his parcels his agricultural activity and his production
- The app enables farmers to map plots and access services.
- EO data ensures real-time monitoring and compliance with EU deforestation rules, and supports alerts, subsidies, and credit eligibility. (was the plot obtained by deforestation after 2020?)

- Digital identity using the QR code of the farmer
- Economic value assessment of the agricultural capital
- Notification to beneficiaries of fertilizers
- Notification of credits from AgroBanco
- Reporting of damages for natural disasters
- Updating crop information for agricultural survey
- EO monitoring of the parcel
- And much more!

EOSTAT Crop Mapper

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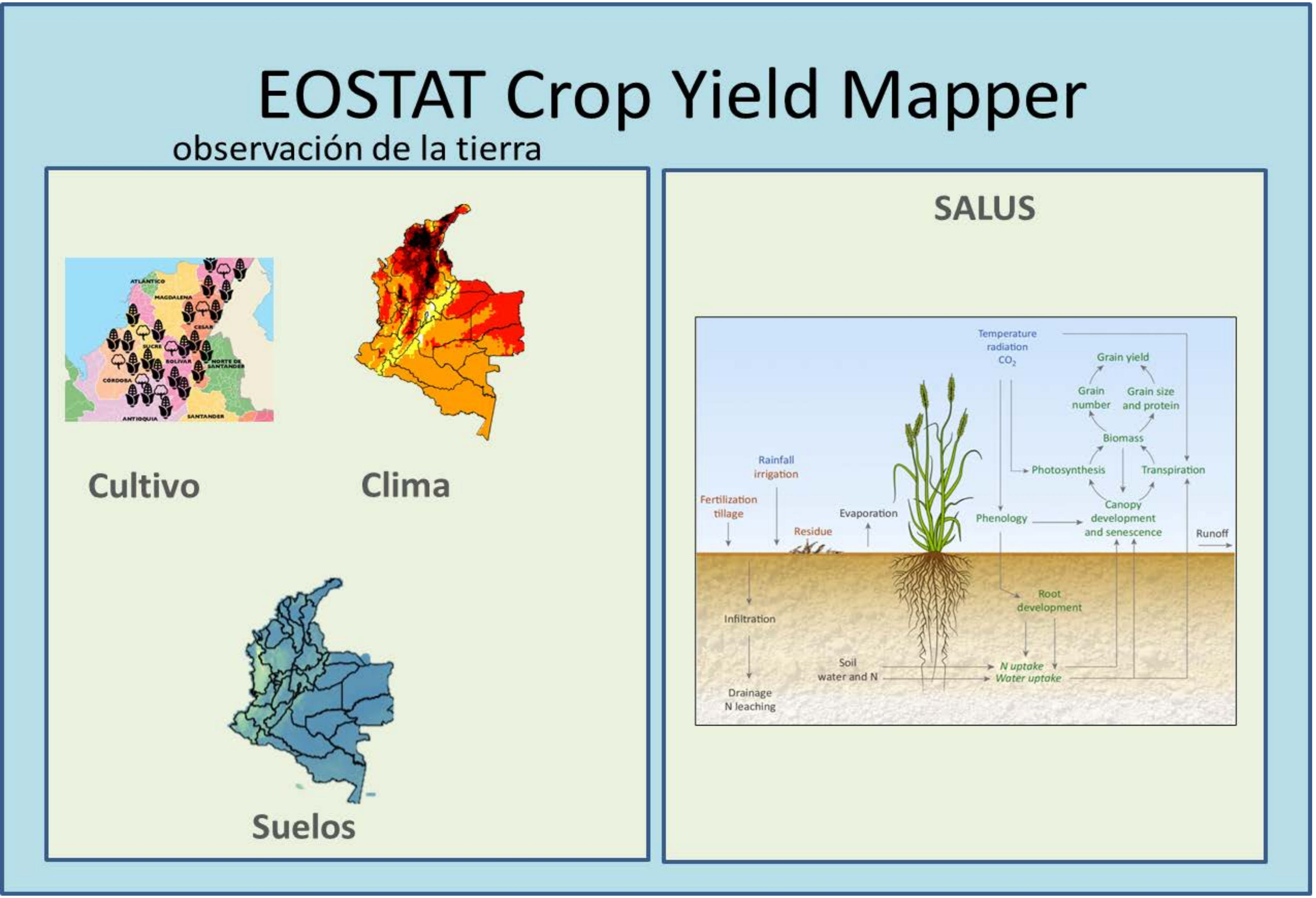


Data collection:

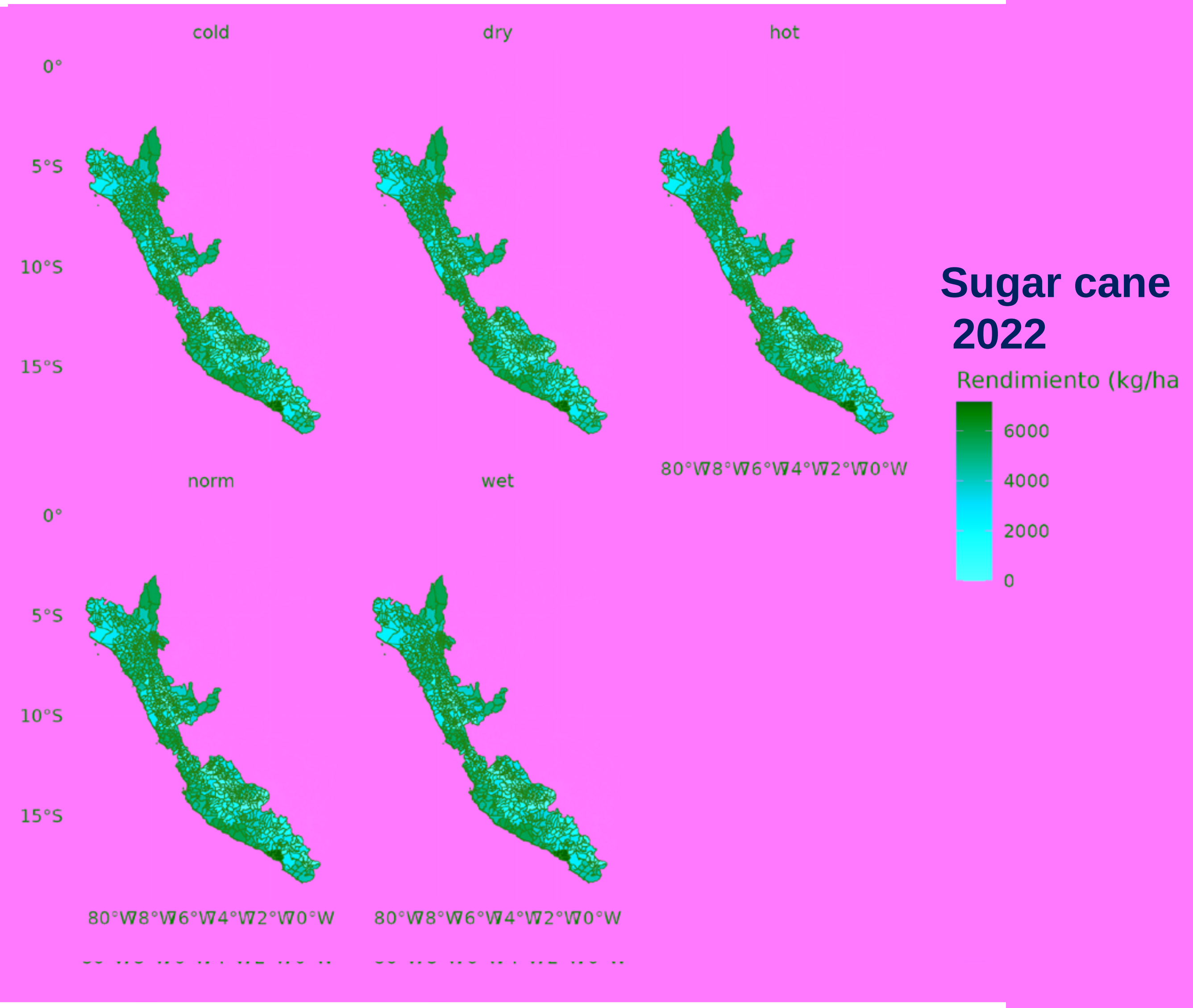
- Yield, Management
- Soil
- Climate

Simulations

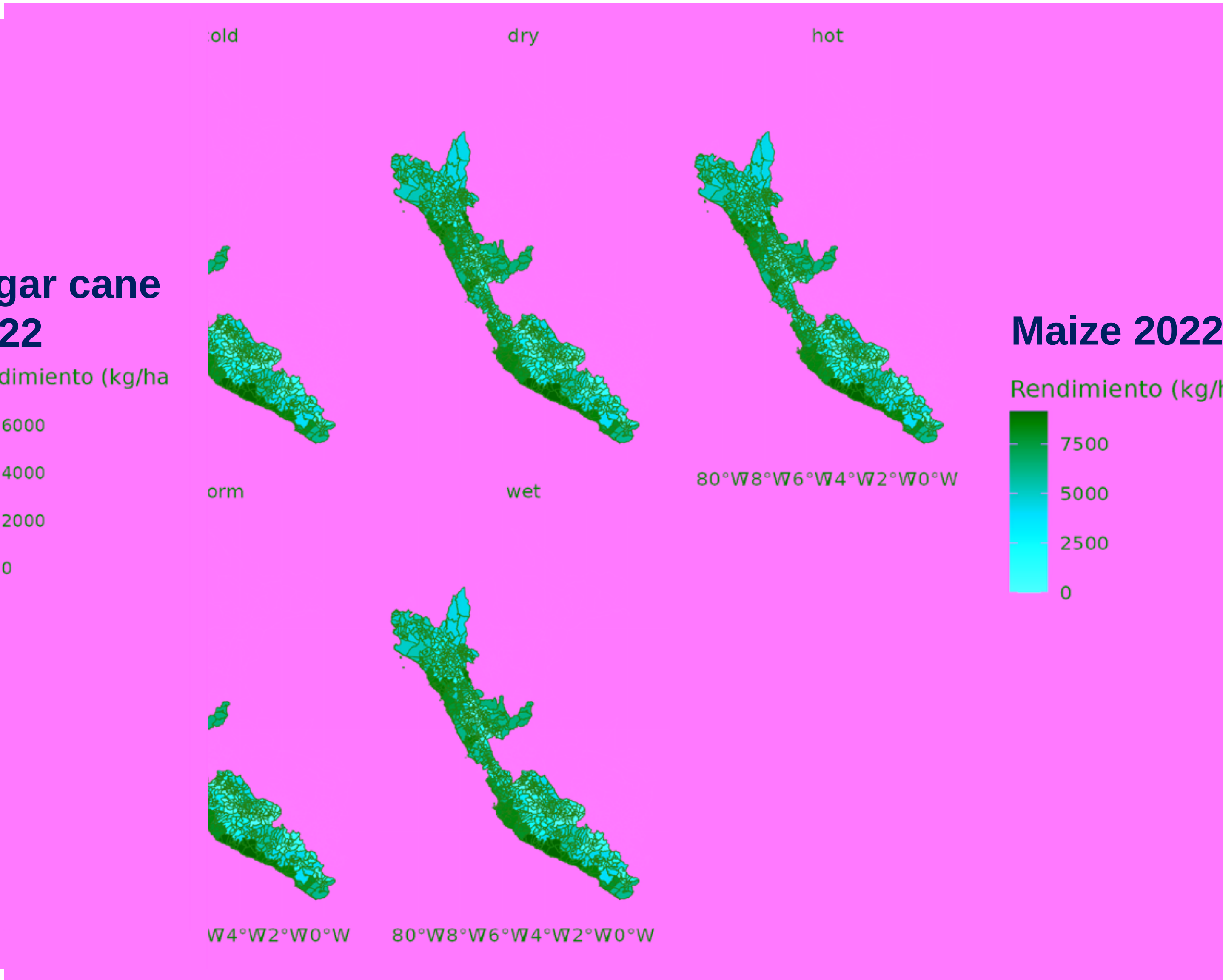
- Maize
- Rice
- Papa
- Sugar Cane

EOSTAT Outputs

Annual crop yield forecasts at 10 meters spatial resolution under different climatic scenarios for 5 main crops



Sugar cane 2022



Maize 2022

EOSTAT Crop Mapper

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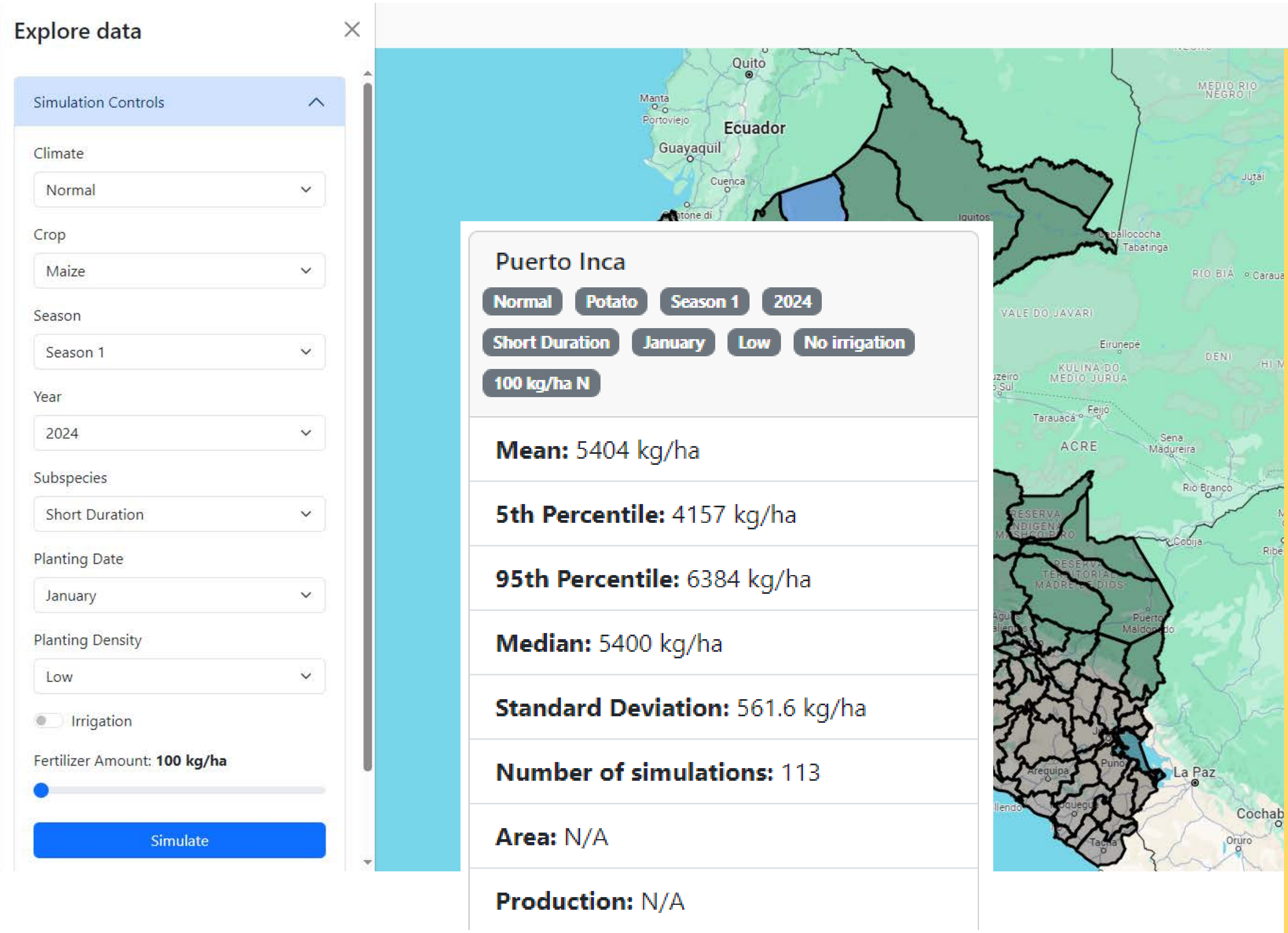

- Aplicación de usuario final
- Aplicación de administrador
- Simulaciones para arroz, maíz, caña da azucar y pata
- Opciones para el clima, la estación
- Opciones para la gestión agrícola

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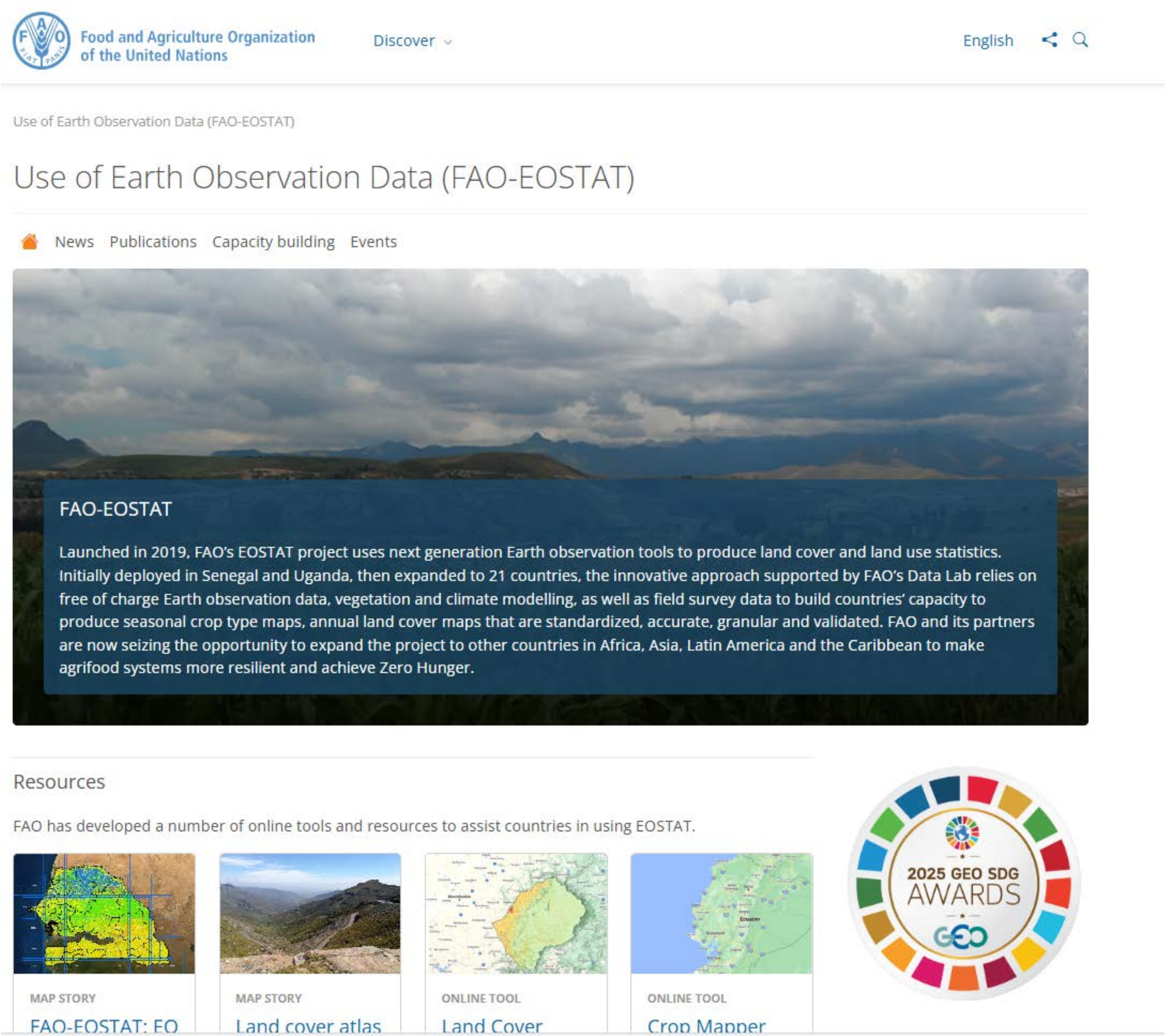

- 23 Countries
- Field survey design
- EO applications
  - Crop type mapping
  - Crop yield mapping
  - Field boundary mapping
  - Drought monitoring
  - Flood mapping
  - Farmer credit scoring
  - Farmer registry
- Capacity building
  - Webinar
  - In person training
  - On the join training
  - E-Learning

Thank you

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