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Leveraging Space

to Accelerate Sustainable Impact on Earth

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Directorate of Earth Observation Programmes

Availability

Accessibility

Awareness

Knowledge Development

Acceptance

Capacity Building

Adoption

Skills Transfer

copernicus
Europe's eyes on Earth

eoworld
Earth Observation for Development

eo4sd
earth observation for sustainable development

GDA

Water Resources
KO Feb'23

Clean Energy
KO Dec'22

Agriculture
KO Sep'22

Marine Env. & Blue Economy
KO Jun'22

Urban Sustainability
KO Feb'22

Fragility, Conflict & Security
KO Jan'22

Climate Resilience
KO Dec'21

Disaster Resilience
KO Sep'21

Transport & Infrastructure

Forest Management

Health

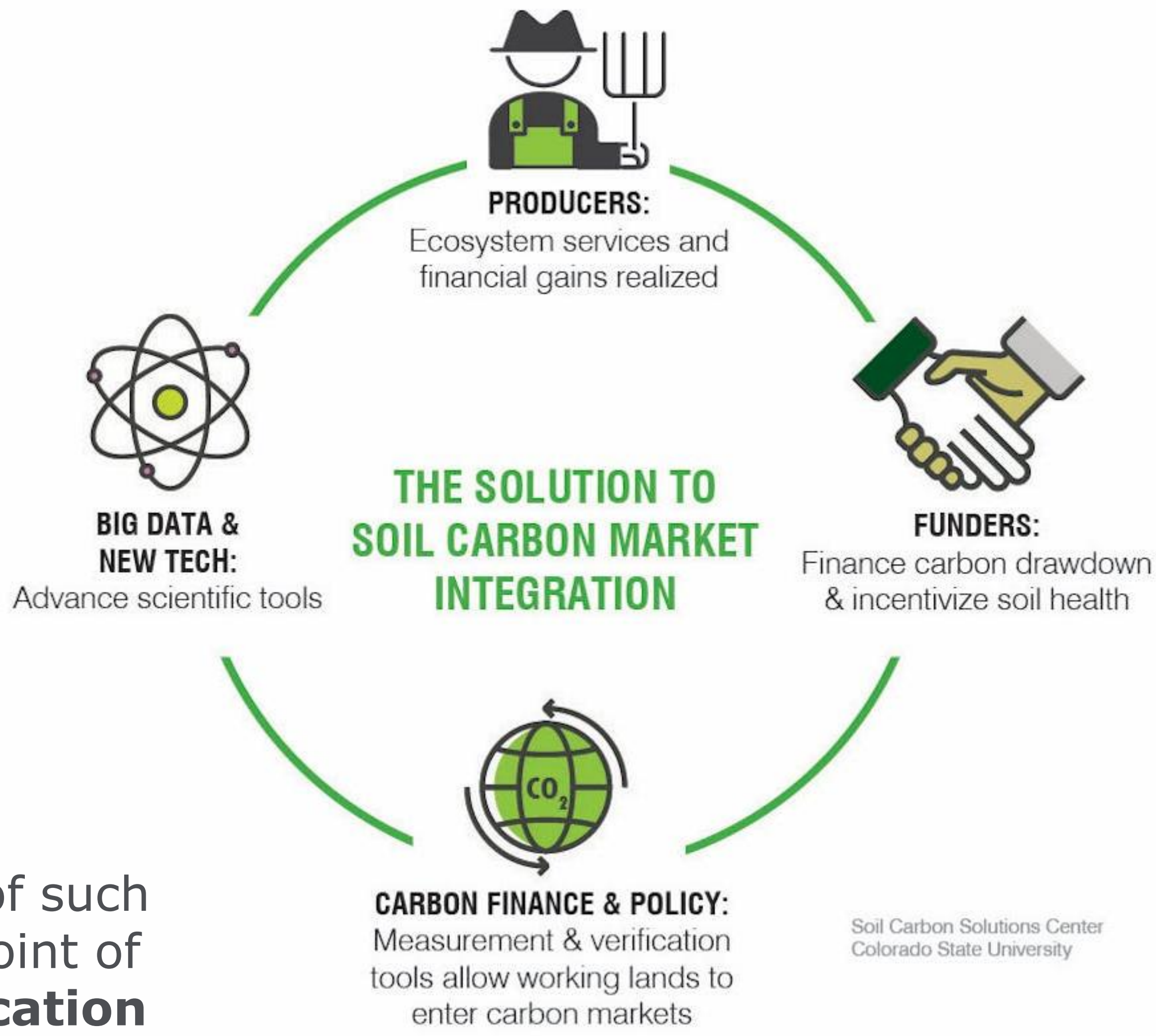
GDA AID

Agile EO Information Development

UC1: Carbon Farming

Rationale

- **Carbon farming**: agricultural practices that lead to carbon sequestration in the soil.
- From adjustments at farm level to changes in the entire farming system
- **Financial benefits**
  - Reduced expenses and higher yields from improved soil health
  - Earning and selling carbon credits through carbon markets



Aim & Objectives

The aim of this use case is to **deliver EO services for monitoring farming practices; assess the impact** of such practices from a carbon sequestration and soil health point of view and provide **input for Measurement and Verification**

UC2: Reduction of rice methane emission

Rationale

- Rice is responsible for about 16% of agricultural GHG emissions
- The amount of CH4 produced is affected by rice production methods, soil properties and weather patterns
- To minimize the CH4 emission while ensuring the sustainable production it is crucial to understand region-specific anthropogenic methane emissions using an advanced monitoring system
- The results could persuade nations to adopt more targeted national CH4 management policies.

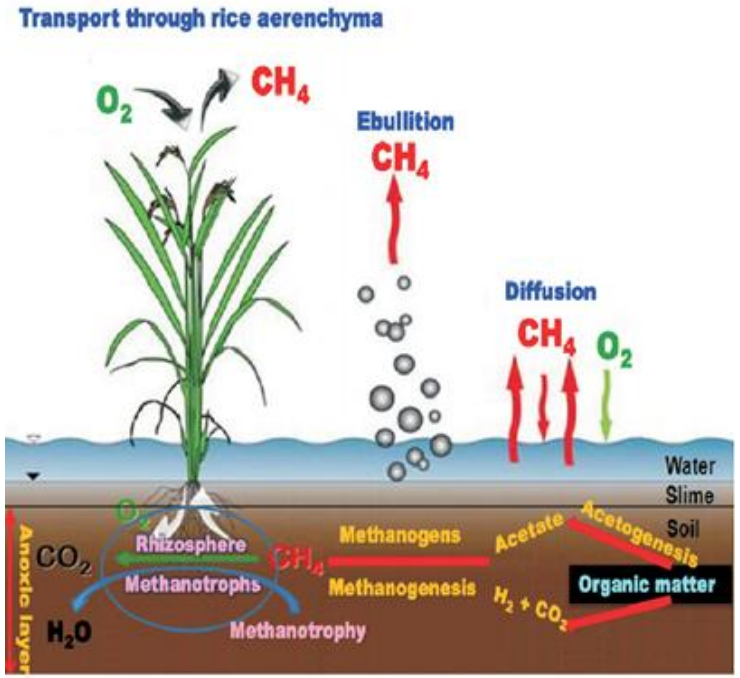


Figure 1: Schematic diagram of methane production, oxidation and

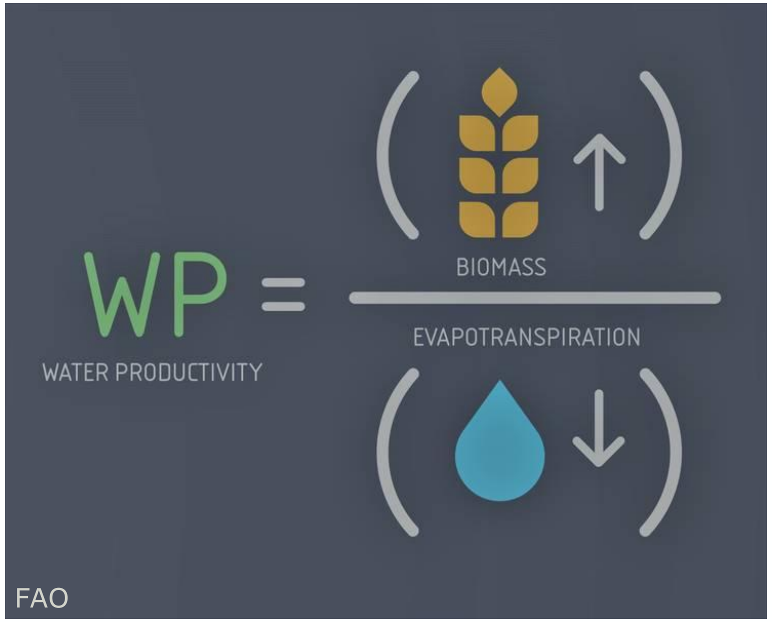
Aim & Objectives

Methane emissions from rice production are a significant contributor to GHGs.
The aim of this use case is to deliver Earth Observation services to support national Monitoring Reporting and Verification (MRV) schemes of methane emissions from rice paddy cultivation.

UC3: Irrigation management performance

Rationale

- Climate change and global warming have increased the severity of droughts
- Drought is the single greatest culprit of agricultural production loss
- Irrigation is increasingly in demand
- There is a need to improve water productivity



The agricultural sector is by far the largest user of water in the world.

- 80–90% of all the water is consumed in agriculture.
- Low water use efficiency with more than 50% water losses.

Aim & Objectives

- To deliver EO information services that allow getting insights on to which extent used amount of water contributed to yield ie. how productive was water usage in an selected AOI in order to improve irrigation management efficiency
- To provide a robust solution able to acquire data and infer information over large and diverse areas, even with low availability of field data.

UC4: Resilient and sustainable agricultural production

Rationale

- Minimizing human impact on the Earth's natural resources while avoiding land use triggered conflicts, requires the increase of agricultural productivity in a sustainable manner, from large scale agriculture to small-holders farming.
- Earth Observation is a powerful technique for continuously assessing the status of agricultural production on a wide range of spatial and temporal scales

Aim & Objectives

- To provide detailed information on the agricultural production areas, encompassing:
  - The current state of the agricultural land in general
  - Parcel-level information on the productivity as well as general management practices
  - Impact of weather extremes on the production
- To provide information in data-scarce regions where little information is available on productivity and resilience of the agricultural land

UC5: Food Security financing

Rationale

- In 2021, about 161 million people in crisis levels and 227 million people in stressed levels of acute food security
- Where to provide financial support for food security?
- A need for detailed information on the current state of the food production, and drivers of food insecurity
- Monitoring and evaluation of impact related to investments are an essential part of Food Security programs

Aim & Objectives

- To provide the end users with detailed information on the state of the agricultural production, as well as on environmental drivers of food production
- Information can be provided on different levels, depending on the urgency, such as:
    - Where is the current situation dire, and is help needed?
    - Where is food production under pressure, and can issues be expected in the short term
    - Identify areas where food security is expected to be recurring, and more systemic

UC6: Food System Value Chains

Rationale

- Sustainable value chains are a multifaceted issue
- Growing environmental concerns encouraged adopting sustainability goals via certification & moratoria, numerous initiatives, legislations & zero deforestation commitments
- To move from a commitment to action, monitoring of value chains is crucial
- Each monitoring system has its own pros & cons (National monitoring systems has a high degree of legitimacy but low salience)
- Developed monitoring system to track value chain impacts is needed (WB case in Cocoa monitoring in Côte d'Ivoire project)
- EO information development provide an intermediate solution

Source: What is Sustainable Agriculture?, UC Davis Sustainable Agriculture Research and Education Program

Aim & Objectives

Agriculture-driven deforestation and forest degradation is one major concern in tropical countries.
This use case aims to demonstrate what EO approaches using ESA data can potentially achieve in sustainable agricultural value chain development.

UC7: Locust monitoring

Rationale

Need for constant monitoring of the locust situation, related environmental conditions, and to **provide forecasts** for managing prevention measures.

Scale of phenomenon makes **local data collection a challenge**

Satellite capabilities can significantly improve the timeliness and accuracy of locust outbreak forecasting.

Early warning means countries can act swiftly to control a potential outbreak and prevent massive food losses.

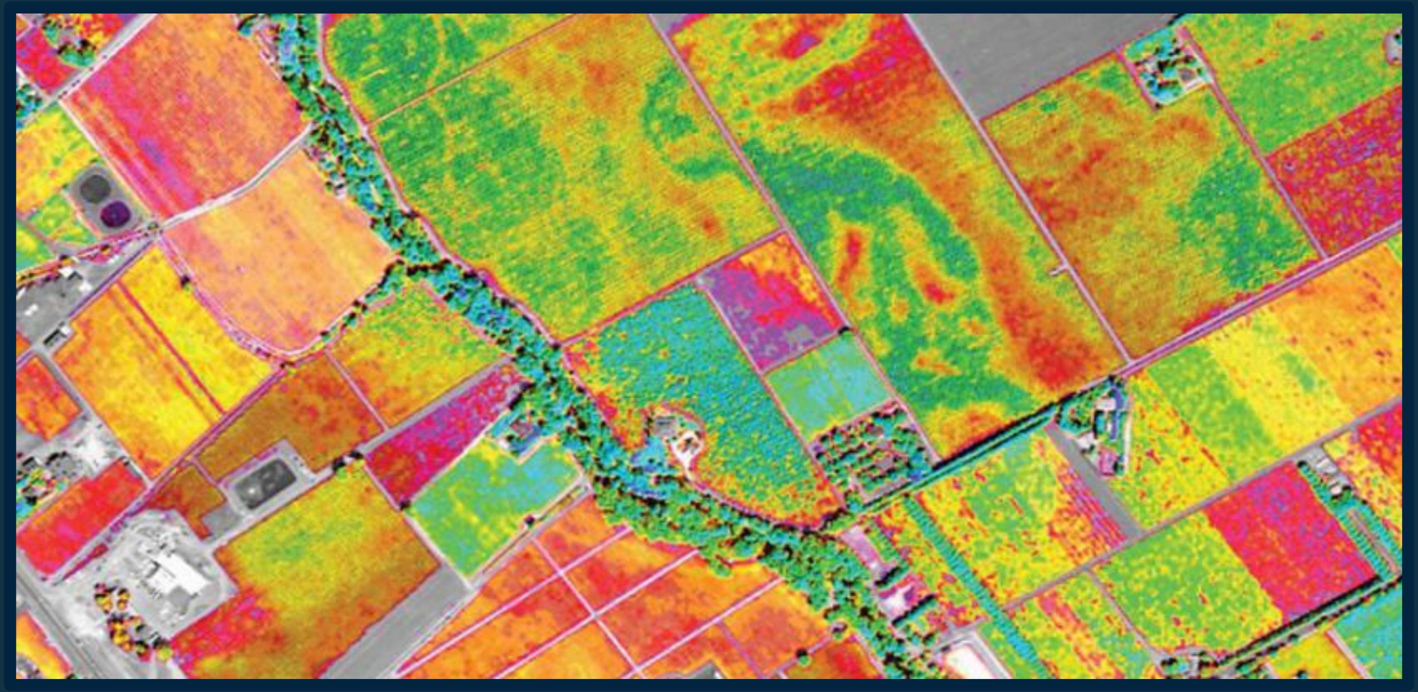
Aim & Objectives

To provide detailed information on he common building block of a Locust Management System:

1. Monitoring habitat and potential breeding grounds
2. Mapping of potential expansion areas
3. Damage assessment

The Sen4Stat System

Crop mapping / Crop yield monitoring



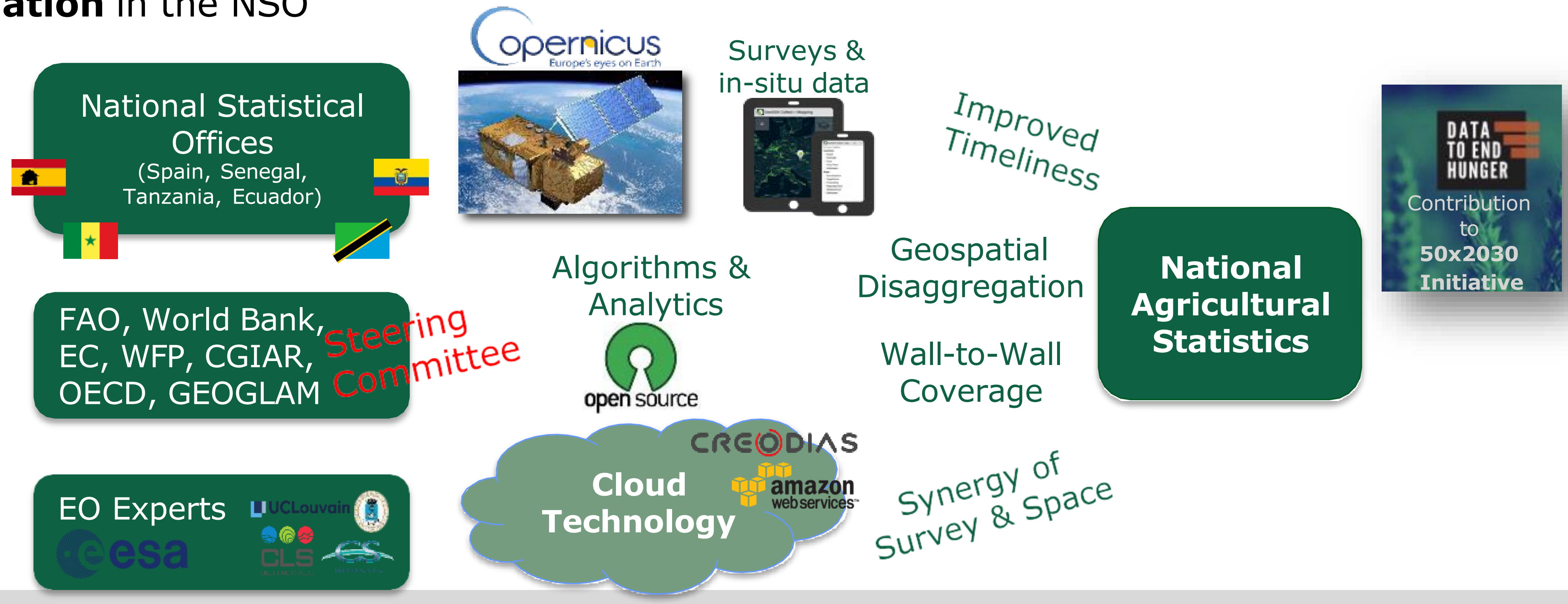
Fully Open Source

Sen4Stat
Sentinels for Agricultural Statistics

<u>Objective</u>: facilitate the uptake of Earth Observation technologies by NSOs and Ministries of Agriculture for the **production of agricultural statistics** with **increased accuracy, reliability, frequency and lower costs**.

ESA Sen4Stat – EO to support official agric. stat.

- Engage **agricultural National Statistical Offices (NSO)** to demonstrate the **benefit of EO information** within their operational workflows
- **Provide & demonstrate validated algorithms**, open source **tools, products** and **best practices** for national agricultural statistics with EO **facilitating the uptake of EO information** in the NSO



NSO requirements defining different use cases

COST EFFICIENCY
Using EO data in the statistical framework to maximize the statistics accuracy (i.e. low variance) or/and to reducet cost (thanks to free data, « simple » methods)

STAT. GRANULARITY
Current sampling often designed for national level => use EO data to allow statistics disaggregation at smaller administrative areas (province, county)

STAT. TIMELINESS
Statistics often available late after the end of the campaign and once a year => use EO data to forecast statistics and provide seasonal estimates

SAMPLING DESIGN
Use EO data to support the building of an area sampling frame (moving from LIST/POINT) and to find the optimal samples size and segments size

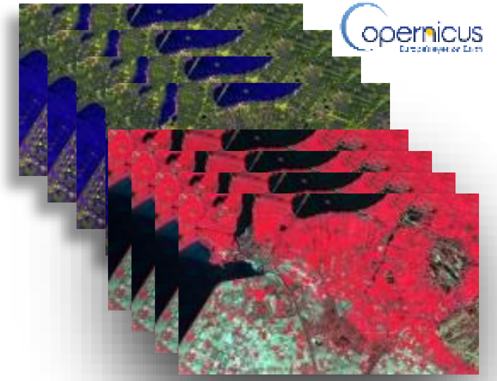
DATA QUALITY CONTROL
Improving the quality of the ground database (data collection protocol & quality control procedure)

SDG'S REPORTING
SDG's 2 "Zero Hunger" and 6 "Clean Water and Sanitation"

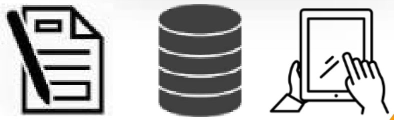
OTHER
Early warning systems, water body map, soil suitability, comparing yield statistic estimates

Sen4Stat: an open source system to couple EO and statistical surveys for improved statistics

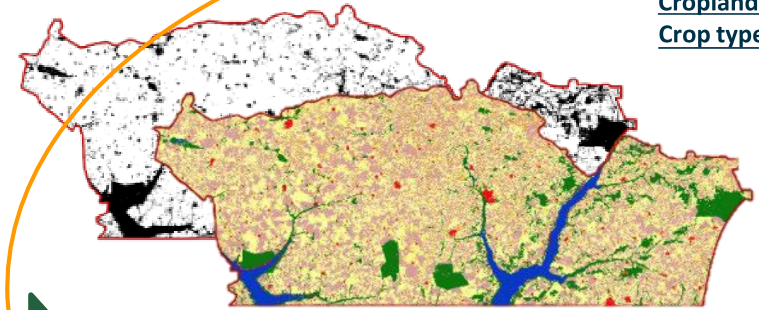
Sentinel-1 and -2



Agri. surveys

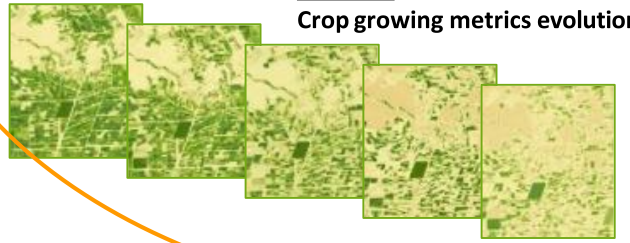


EO products

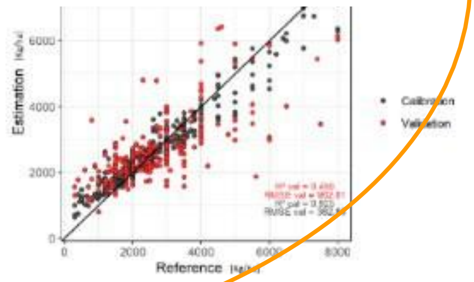


SENEGAL – NIORO DU RIP
Cropland – non cropland map
Crop type map
OA: 88,2 %
F-Score Groundnut : 95,2%
F-Score Mil : 83,8 %
F-Score Maize : 54,8%

SENEGAL
Crop growing metrics evolution



SPAIN – CASTILLA Y LEON
Soft wheat yield estimation



COST EFFICIENCY

STAT. GRANULARITY

STAT. TIMELINESS

SAMPLING DESIGN

DATA QUALITY CONTROL

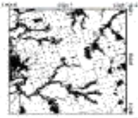
SDG'S REPORTING

An ESA SAR and optical toolbox for operational crop mapping and agricultural statistics at national scale

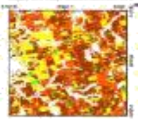
- Processing Sentinel-1, Sentinel-2 and Landsat-8&9 time series according to the state-of-the-art including advanced SAR products (coherence, gamma naught,…)
- Delivering automatically or on request **5 types of products** (*processors*) in near real time along the satellite data acquisition or off-line :

1. **10m optical cloud free temporal synthesis and SAR temporal synthesis**

2. **time series of spectral indices** (NDVI, coherence,…) and **biophysical variables** (LAI, fCover, fAPAR)



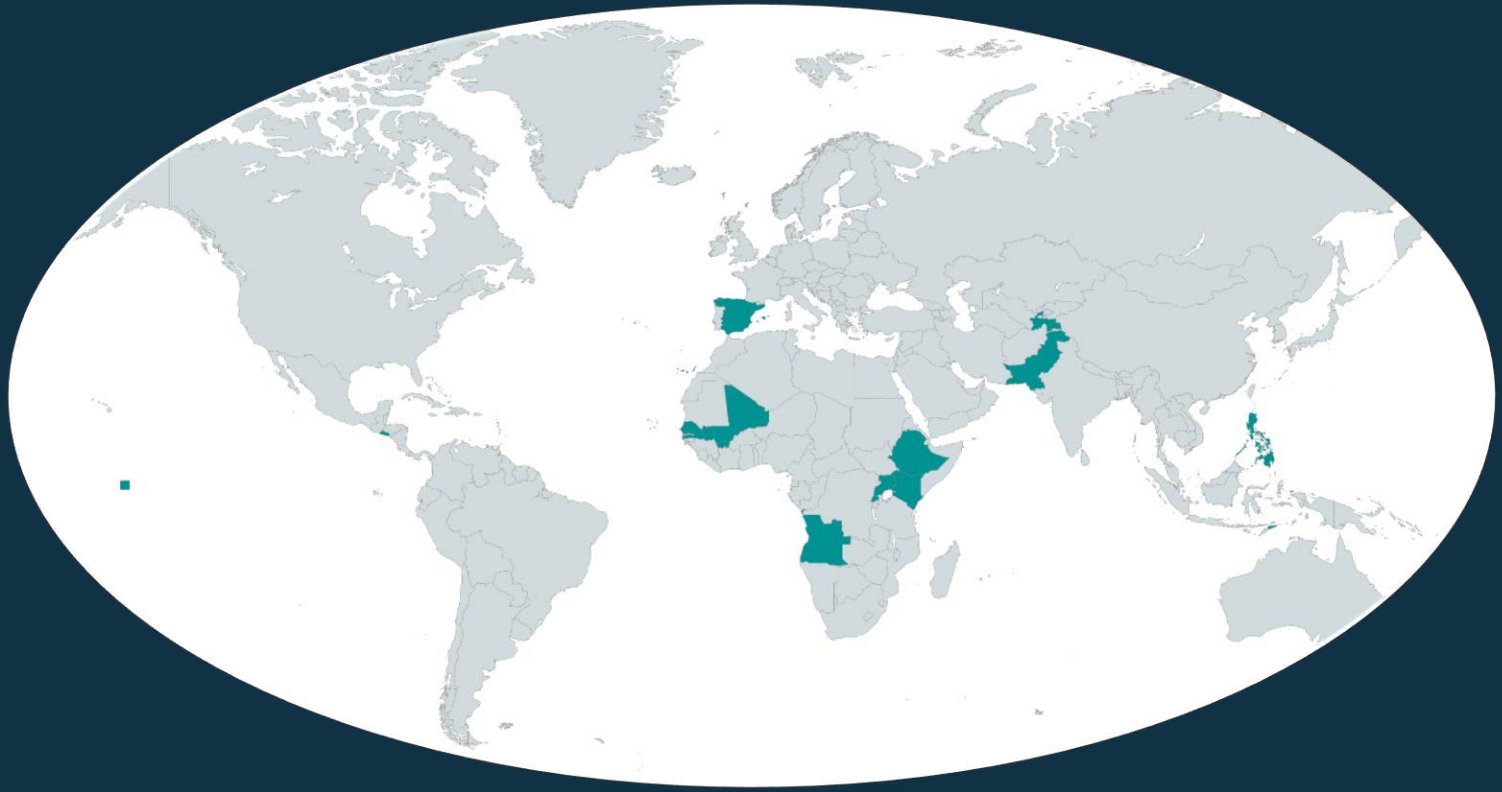
3. **10m crop type maps** along the season based on in situ dataset and stratification



4. **a large set of crop growth conditions metrics** (including even meteorological data)

5. **crop yield estimation** at various aggregation levels (national, regional, …)

The system is currently being deployed in 13 countries



- Philippines
- Senegal
- Pakistan
- Angola
- Ethiopia
- Mali
- Rwanda
- El Salvador
- Uganda
- Tajkistan
- Timor Leste
- Kenya
- Spain

From feasibility studies to fully integrated & operationalized systems

Implemented by Government of Pakistan with financing of

3M EUR

2 years

GDA coordinated co-implementation with grant

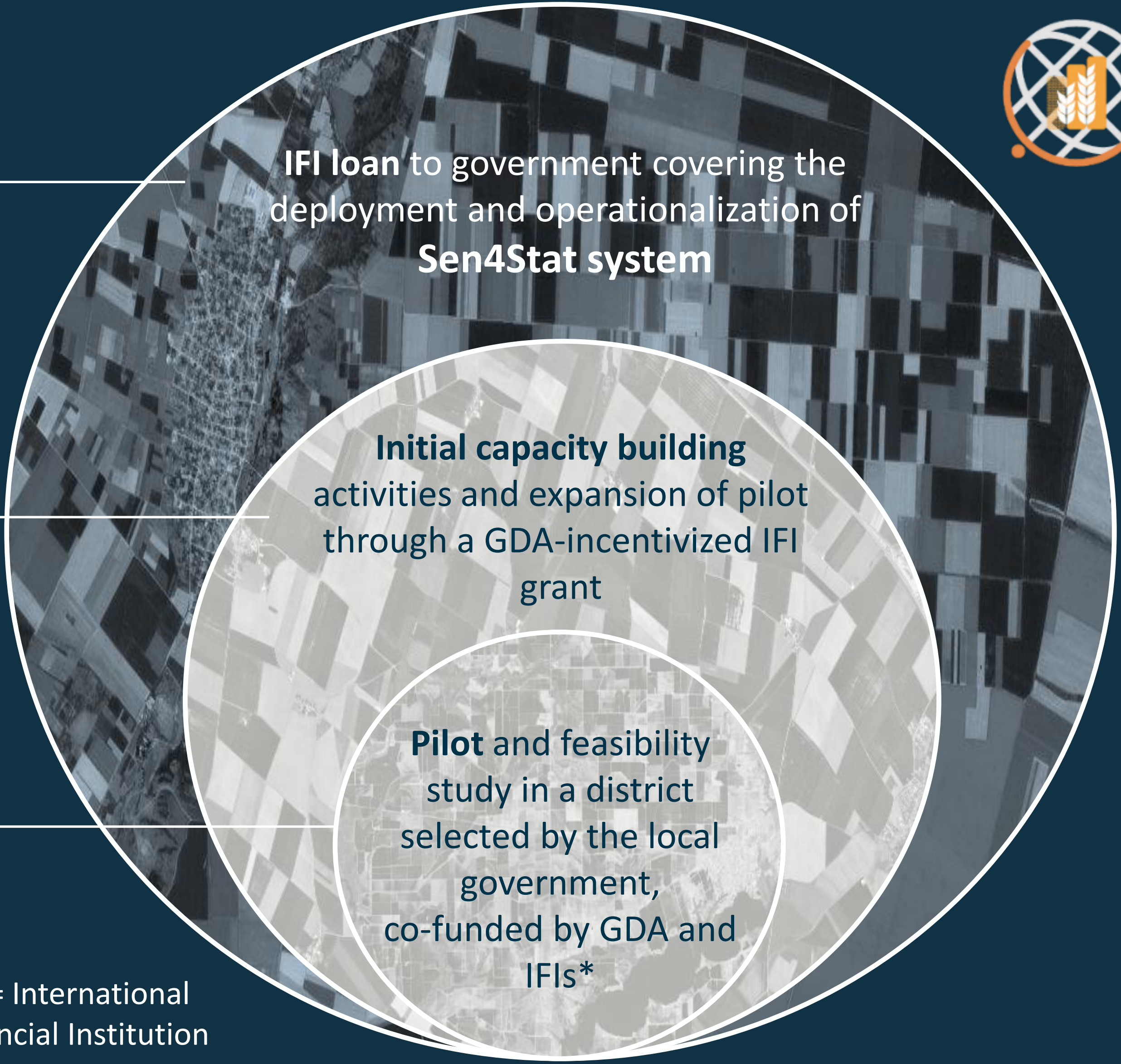
100k EUR

6 months

GDA coordinated co-implementation & co-funded by

50k EUR

6 months



*IFI= International Financial Institution