

Improvement of Agricultural Statistics in the cotton zone of Mali thanks to the synergy of the Sentinel 1 and 2 time series



By

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Agricultural censuses are large surveys (exhaustive or random) designed to collect and derive quantitative and qualitative data on national agriculture.

They mainly provide **information on the organization and structure of the agricultural sector**, the use of resources, agricultural production (areas, yields) and, in some cases, the number and structure of livestock (GSARS, 2015).

The **quality of these statistics** depends on several factors such as the size of the sample, the method of collection (David, 1998).



Scientific Background and Objectives

In Mali, Agricultural statistics are provided by several structures with different objectives scaly aggregated masking then local disparities

Currently, the annual statistics are provided with a significant delay and do not allow relevant decision-making at both political and scientific level to give appropriate responses to deficit areas or even to surplus areas

Since some years, Earth Observation Data (EOs) is widely use in many motoring by providing timely, synoptic and repetitive information on crop growing conditions to combat drought etc..



Scientific Background and Objectives

Mali is one of the pilot Sentinel-2 project for Agriculture (Sen2Agri) open source system.

Crop mapping was repeated in 2017 and 2018 over a more restricted area to assess the performance of the approach developed

Two challenges to solve

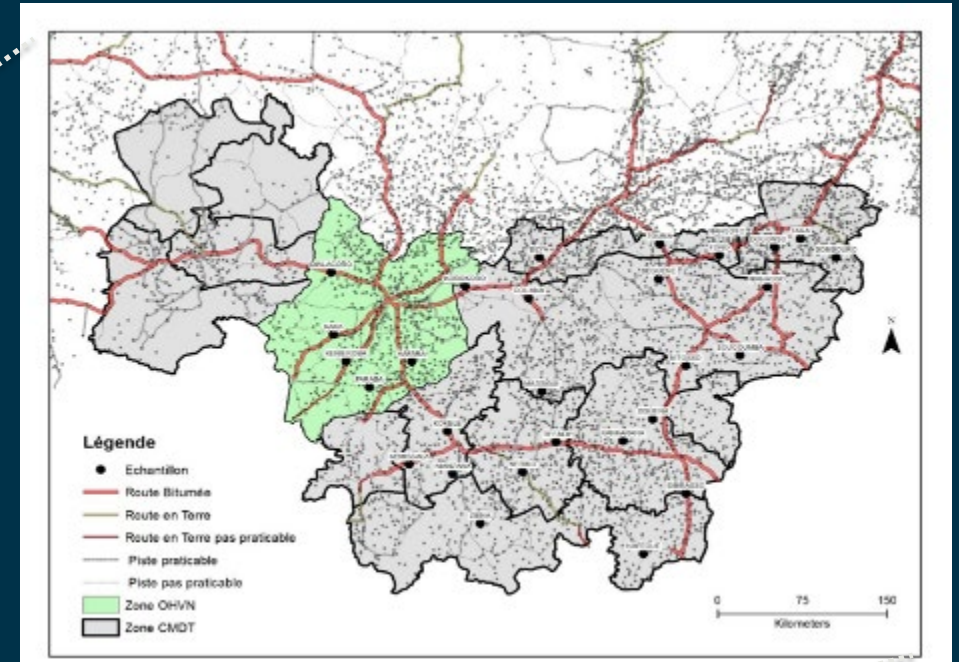
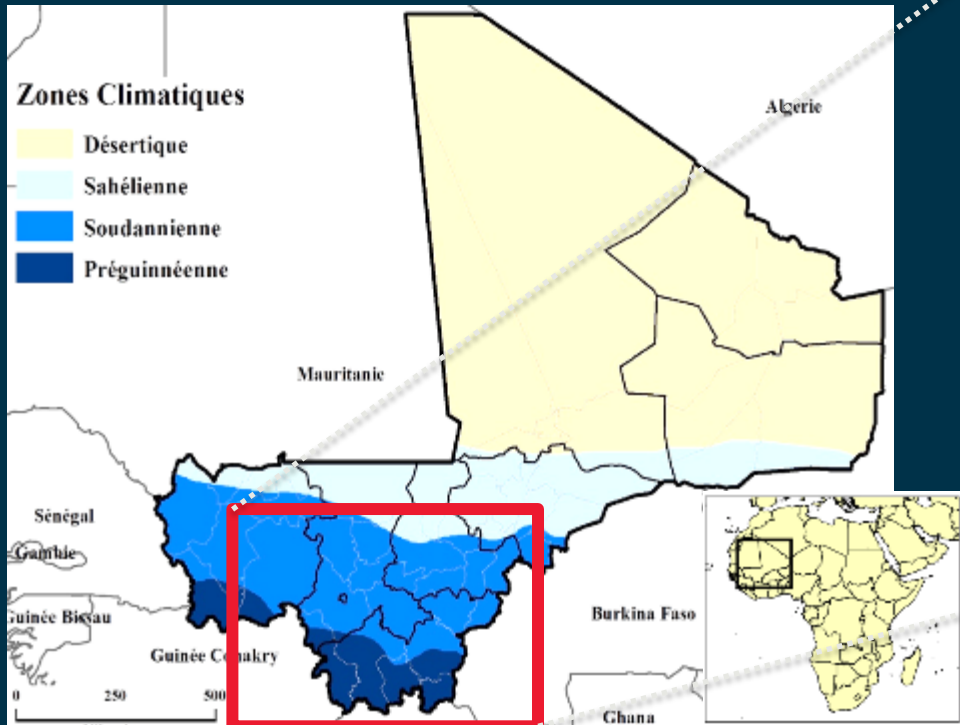
i) allow a precise comparison between the results obtained from Sentinel data and the agricultural statistics of the official services for five priority crops

ii) examine the contribution of Sentinel-1 data to reduce the impact of cloud cover



Mali, Landlock country in West Africa

- Country size: 1 241 238 km²
- Population: 21 339 813 (worldometer, 2021, estimation)
- 4 Climatic zones (semi-arid climate)



Pilot site: Malian cotton belt (CMDT+OHVN zone)

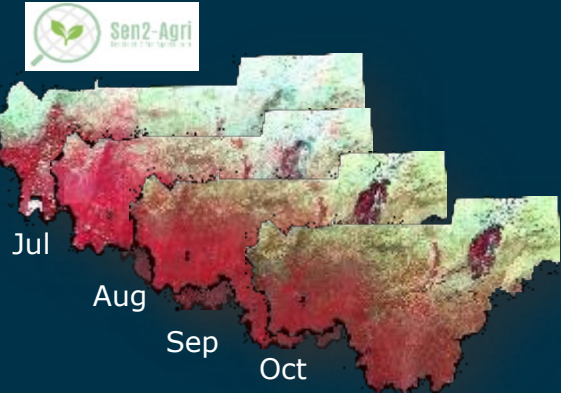
- ❖ **Size:** ~ 150 000 sq.km
- ❖ **Population:** 7.5 M. hbts (worldpop, 2021)
- ❖ **Major :** contribute to ~50% National crop production (CMDT-OHVN, 2013)
- ❖ **Main crops:** Cotton, Sorghum, Millet, Maize, Groundnut and Rice

1. EO consistent time series preparation

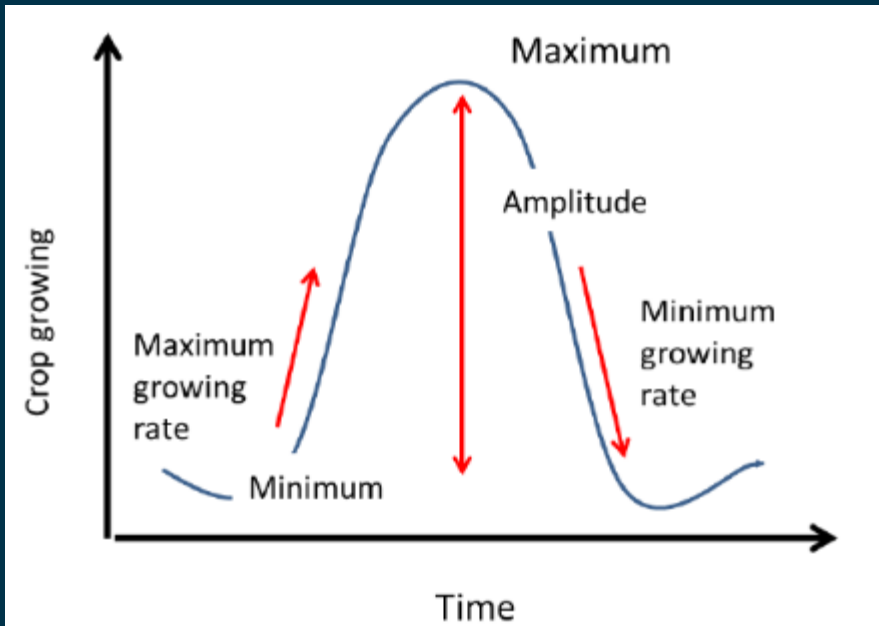
- Collection and processing of L8/L9 and S1/S2 for 2022 cropping season
- The time series of backscatter coefficients (including the VV/VH ratio) acquired by Sentinel-1 (GRD) will be processed by a spatio-temporal filter
- All images will then be subjected to quality control to ensure good signal consistency for the different time series

2. Field data collection

- About 11 200 crop samples will be collected in 28 areas randomly distributed in the Cotton Zone (~ 400/area).
- Windshield survey method will be used to collect data along the road using JECAM protocol (jecam.org/)
- Mobile phone with ODK tool will be used for data collection
- Final field boundary will be delineated using high resolution images



3. Calculation of crop growth monitoring indices and temporal metrics

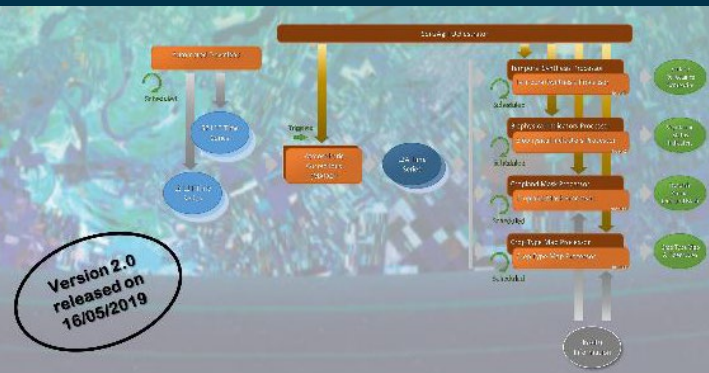


Different spectral indices and biophysical variables for monitoring growth (NDVI, LAI, fCover, fAPAR, Chlorophyll retrieval) will be calculated throughout the cycle of the cropping season

The contribution of biophysical variables such as the Leaf Area Index (LAI) and minRed will be evaluated as well as that of temporal metrics particularly suited to the S1 series (coefficient of variation, amplitude, max, etc.).

4. Production of cultivated area and crop maps and area estimation

Sen2Agri System

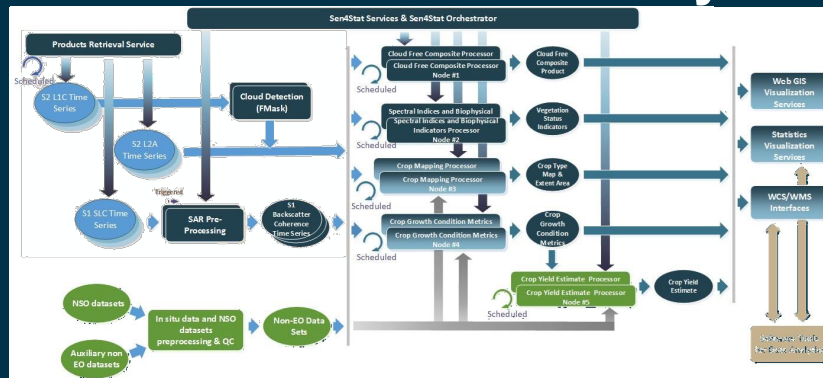


<http://www.esa-sen2agri.org/>

Production of crop type map for dominant crops in the area based on collected field data through Sen2Agri chain

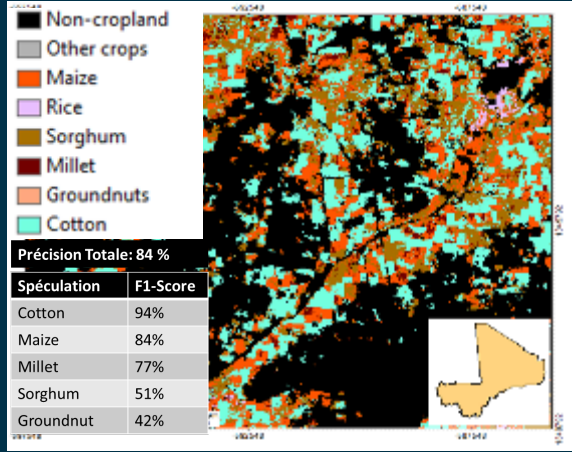
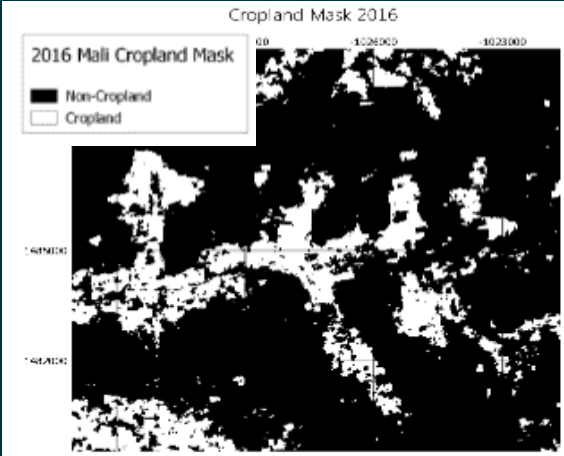
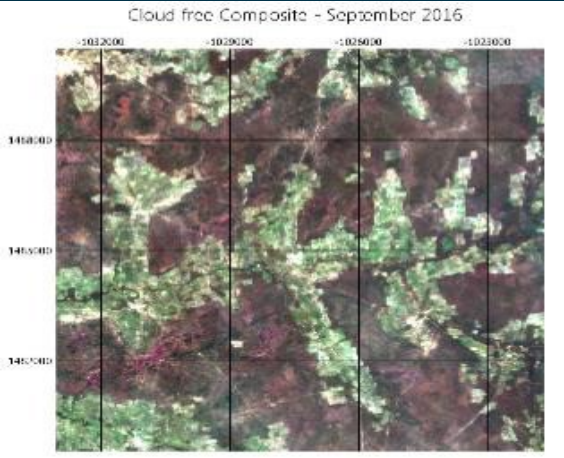
Validation of the results using confusion matrix

Sen4Stat System



EOs crop type areas will be compared with the areas of static services (correlation and bias correction by regression estimator) at different levels of aggregation

Expected outputs



Monthly cloud free surface reflectance composite at 10-20m for the cropping period (may-October)

Vegetation status map (NDVI, LAI) at 20m delivered for each cloud free observation

Binary map identifying annually cultivated land at 10m. First produced at the mid-season, then updated every month

Crop type map at 10m for the 5 main crops first produced at the mid-season and, produced again at the end of the season



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Aw ni ce!

Thank you !

Merci !

Danke !

Gracia !