Crop Monitoring and Yield Estimation using Sentinel Products in Semi-arid Informal Irrigation Systems

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Tropentag 2022
September 14 - 16, 2022
Prague, Czech Republic

INTRODUCTION

- Africa's agriculture has low yields compared to similar agro-ecological zones (FAO and World Bank, 2009).
- Efforts for its intensification should be assessed by precise, consistent, and inexpensive means.
- Accurate and expected crop yield observations can improve food security and ecosystem services decisions.
- Crop monitoring focused on rainfed due to their prevalence.
- Irrigated systems, limited, sustain many people's livelihoods.
- Accurate statistics on irrigated crops ➔ effective management and decision-making

OBJECTIVE

Explore the use of **synthetic aperture radar Sentinel 1 (S1) and optical Sentinel 2 (S2) data** to map the extent and yield of irrigated crops in an informal irrigation scheme in Burkina Faso (West Africa).

STUDY AREA

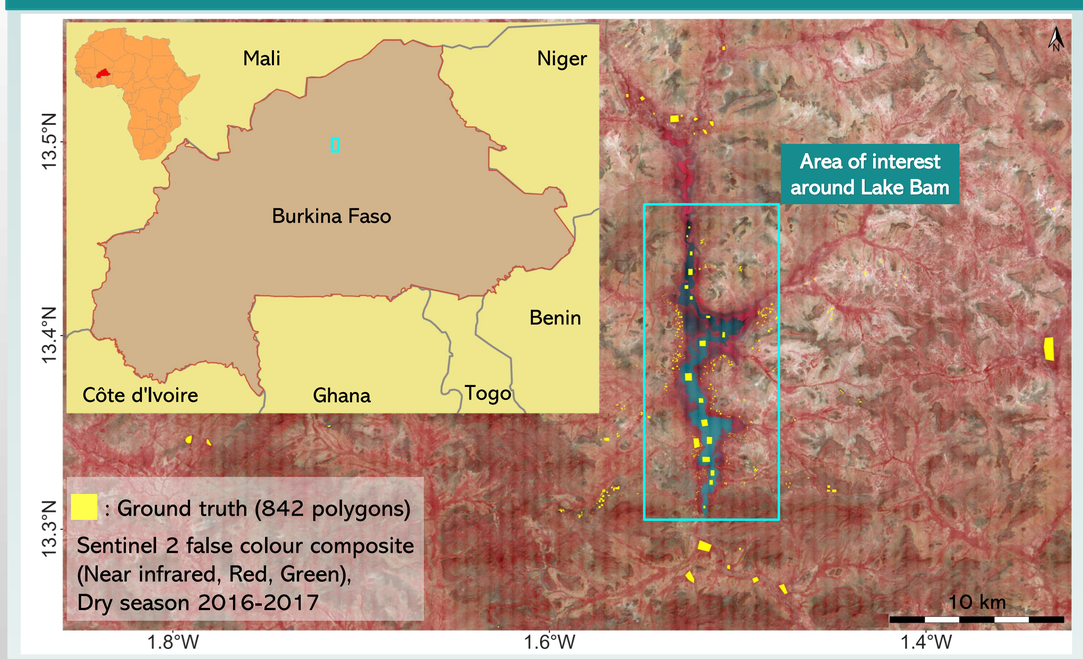

Figure 1: Location of the study area

Lake Bam ➔ Largest natural freshwater lake in Burkina Faso: loss of 1/3 of its depth during the last 40 years (Ouedraogo, 2010).

METHODS

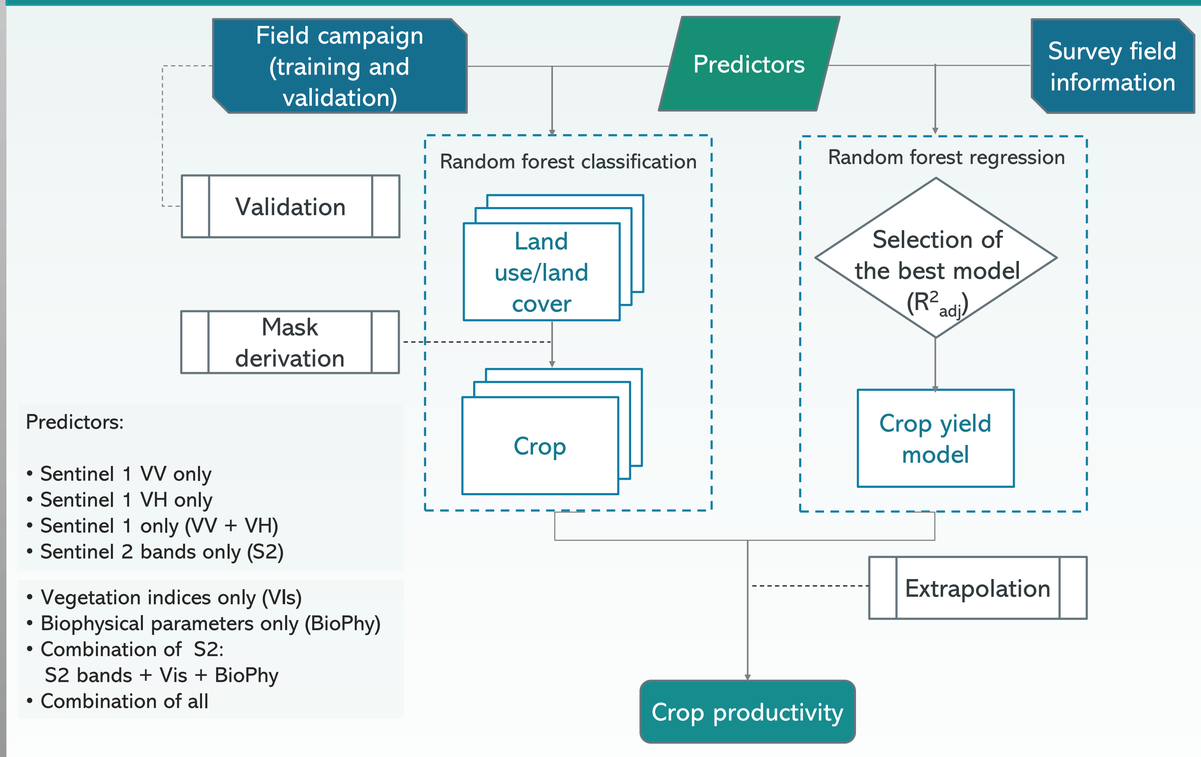

Figure 2: Yield analysis flowchart

RESULTS

Image classification

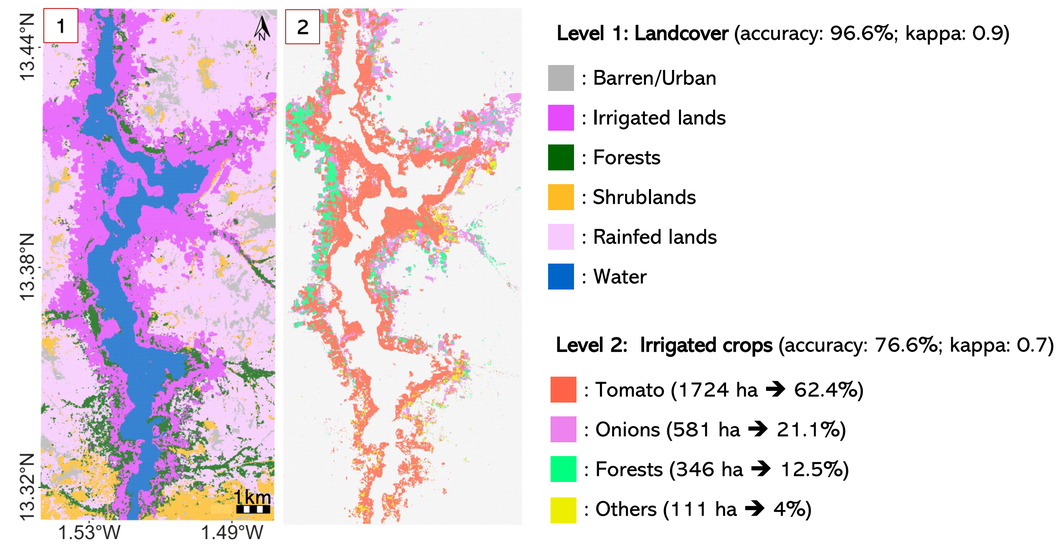

Figure 3: Two-stage random forest image classification at 10 m. (1) landcover map; (2): irrigated crops.

- Overall accuracy : Sentinel 2 (76.3%) > Sentinel 1 (69.4%)
- Sentinel 2 biophysical parameters (particularly the fraction of absorbed photosynthetic active radiation, **fAPAR) being significant**
- Challenges: crop calendar, planting dates, landscape heterogeneity
- African crop area discrimination needs higher spatial resolution (Planet, 5m)

Yield modelling

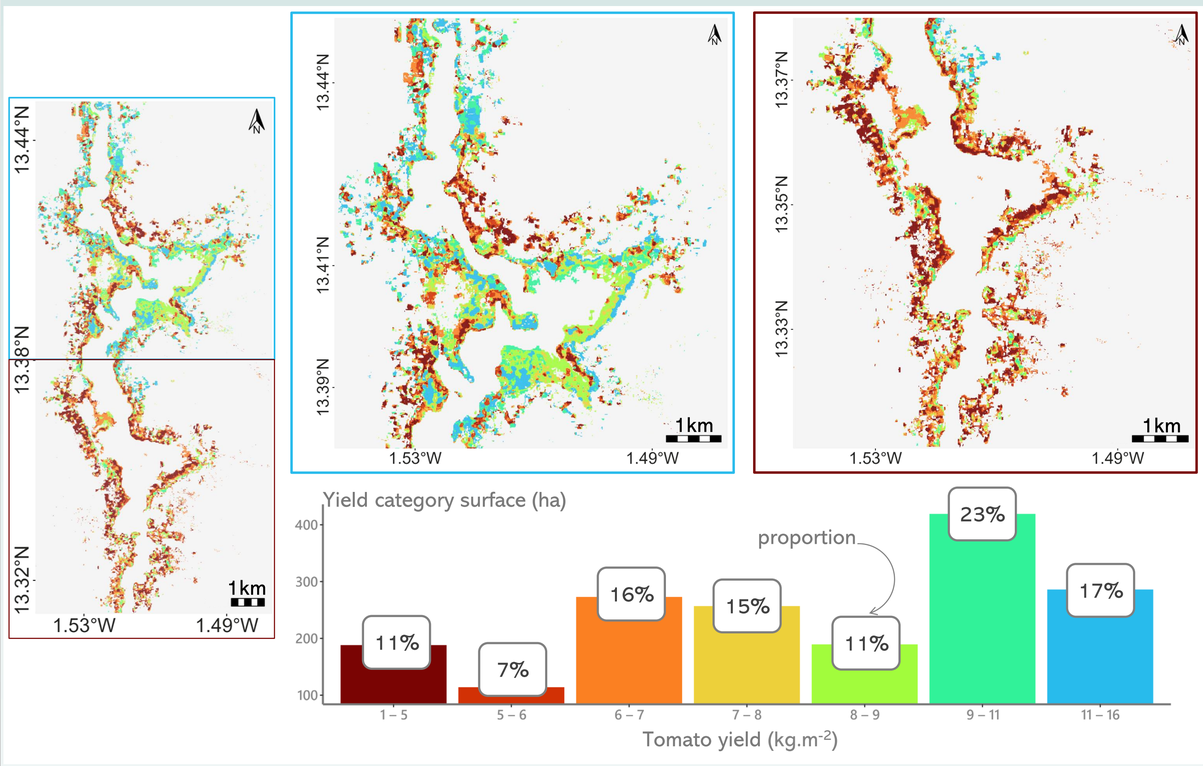

Figure 4: Example of tomato crop productivity

- Most predictive factor: Sentinel 1 VV (R^2_{adj} = 63%)
- Sentinel 1 VV + fAPAR ➔ better fit (R^2_{adj} = 64%).

Predictor importance

Variable importance for crop classification
biophysical parameters > vegetation index > spectral bands

Best timing (temporal windows) for:
- crop classification: **early season images (December) >** mid or late-season
- yield modelling: **early to mid-season (December to February)** ➔ best prediction accuracy.

CONCLUSION

Random forest algorithms ➔ satisfactory results (classification and regression)

Predict agricultural production using S1 and S2 data before harvest for efficient planning and food security

Recommendation for yield prediction using remote sensing input in the semi-arid region irrigated system: **Sentinel 1 VV + fAPAR**

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FAO, & World Bank. 2009. Awakening Africa's sleeping giant: Prospects for commercial agriculture in the Guinea Savannah Zone and beyond.

Ouedraogo, R. (2010). The dying Lake Bam in Burkina Faso: Save people or save the lake? (p. 43). Vienna, Austria. Retrieved from www.oeaw.ac.at/vid/download/col100601ro.pdf on 7th June 2017

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Federal Ministry of Education and Research
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