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Farmers' and academia's views"

Crops monitoring and yield estimation using sentinel products in semi-arid informal irrigation systems

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Abstract

The use of earth observation data for crop mapping and monitoring in West Africa has concentrated on rainfed systems due to their predominance in the sub-region. However, irrigated systems, though to a limited extent, provide critical livelihood support to many. Accurate statistics on irrigated crops are, thus, needed for effective management and decision-making. This study explored the use of Sentinel 1 (S^{-1}) and Sentinel 2 (S^{-2}) data to map the extent and yield of irrigated crops in an informal irrigation scheme in Burkina Faso. Random Forest classification and regression were used together with extensive field data comprising 842 polygons. Four irrigated crops (tomato, onion, green bean and other) were classified while the yield of tomatoes was modelled through regression analysis. Apart from spectral bands, derivatives (e.g. biophysical parameters and vegetation indices) from S^{-2} were used. Different data configurations of S^{-1}, S^{-2} and their derivatives were tested to ascertain optimal temporal windows for accurate irrigated crop mapping and yield estimation. Results of the crop classification revealed a greater overall accuracy (76.3 %) for S^{-2} compared to S^{-1} (69.4 %), with S^{-2} biophysical parameters (especially the fraction of absorbed photosynthetic active radiation i.e fAPAR) being prominent. For yield prediction, however, S^{-1} VV polarisation came up as the most prominent predictor in the regression analysis (Radj2= 0.63), while the addition of S^{-2} fAPAR marginally improved the fit (Radj2= 0.64). Tomato yield in the study area varies up to 1616 kg m^{2}, although about 83 % of the area have yields of less than 10 kg m^{2}. Our study revealed that early-season images (acquired in December) perform better in classifying irrigated crop compared to mid or late-season. On the other hand, the use of early to mid-season (December to February) images for yield modelling produced reasonable prediction accuracy. This indicates the possibility of using S^{-1} and S^{-2} data to predict crop yield prior to harvest season for efficient planning and food security attainment.

Keywords: Biophysical parameter, Burkina Faso, random forest, Sentinel, yield modelling

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