



Soil salinity assessment using temporal series of Sentinel2 satellite images in irrigated paddy fields of Western Africa

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Salinization and alkalinization are worldwide among the soil degradation threats in irrigated schemes affecting soil productivity. Niger River basin irrigated schemes in the Sahel arid zone are no exception (ONAHA, 2011). The use of remote sensing for identifying and evaluating the level of these phenomena is an interesting tool. The launching of the Sentinel2 satellite constellation (2015) brings new perspectives with high spectral and temporal resolutions images. The aim of this study was to develop a methodology for detection of salt-affected soils in this climatic condition.

To achieve our goal, we used two types of data: remote sensing and ground truth data.

Two complementary approaches were used: one by observing salinity on bare soil by the use of salinity index (SI) and the other by observing the indirect effects of salinity on the vegetation during eight (8) rice growth phases using vegetation index NDVI.

Remote sensing data were acquired from multi temporal sentinel2 images over 4 years (from 11/12/2015 to 30/11/2019). One hundred and fifty seven (157) images were downloaded (one image each 5 days) and corrected from atmospheric effects and some bands resampled to 5 m using python software. The salinity and vegetation indices were calculated. NDVI index was calculated and NDVI integral between NDVI curve and the threshold of 0.21 NDVI calculated for the eight growing cycles.

Ground truth data were collected in 2019 during the dry growing season (January – may 2019) from 24 calibration plots and 40 validation plots. One hundred and twenty (120) soil samples collected and analyzed for pH and electrical conductivity and finally forty six (46) biomass samples were collected, air dried and weighed for biomass yield and 46 grains samples collected for grain yield.

NDVI integral proved to be good indicator for yield variations and could distinguish crops behavior according to the growing period. It also makes it possible to distinguish plots which were not cultivated or with weak growth due to strong constraints of which the main one is salinity. It showed also that the effect of salinity on growth differs according to the growing season and the possibility of managing irrigation. Bare soil analysis distinguishes fields with different salinity indexes despite the low number of dates for which bare soil can be observed.

Ascending Hierarchical Classification (AHC) enabled to identify four classes of NDVI dynamics over time and bare soil salinity index. High saline soils according to direct soil measurements were related to the class characterized by high frequency of no-cultivation during the dry season and low NDVI integral during the wet season. Multi-temporal Sentinel2 images analysis enabled therefore to detect rice crop fields affected by salinity through its influence on crop behavior. This approach will be tested over the whole paddy schemes of the Niger River valley.