Monitoring drought indices for decision support concerning the management of cereal productivity in Tunisia

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ABSTRACT

Drought is one of the most worrying climatic phenomena in Tunisia. It has become a reality with direct repercussions on strategic sectors, including cereal production which contributes to the satisfaction of food needs. Drought makes farmers vulnerable, especially smaller ones. Given the stakes: security of cereal supplies, food security, financial difficulties of farmers to get out of the crisis, impacts on the milk and meat sectors and the agro-food sector of basic products, it led to putting in place a national drought insurance "the Fund for Compensation for Agricultural Damage Related to Natural Disasters (FIDAC)" managed by the Tunisian Agricultural Mutual Insurance Fund (CTAMA). Quantified indices are necessary to identify and describe the state of drought, for the choice of subscriptions to agricultural insurance for a cereal farmer, as well as to assess the provisions for an insurer. The study's objectives are to support drought-related agricultural risk management and to strengthen satellite imagery processing capabilities to adapt to this risk. The innovation of the work concerns the assembly of a set of drought indices that can be used by cereal farmers and the drought insurance system in Tunisia. To assess drought, two indices are estimated (1) the standardized precipitation index for the period of 3 months SPI-3 based on long series of precipitation (1950-2019). To identify the severity of drought: duration, intensity, and magnitude which correspond to the positive sum of the SPI for all the months within a drought event are calculated. (2) the water stress coefficient WSC which is the ratio of actual evapotranspiration ET to potential evapotranspiration PET driving from remote sensing sources. MODIS PET and ET data within eight days and 500 m resolutions are applied for 21 years of data (2000-2020). The two indices are compared to field evidence which is the percentage of drought-damaged areas per administrative unity (Imada) published by the National authorities. Results highlight that the SPI-3 reflects only one facet of the drought, the lack of rainfall. Other factors related to soil type and air temperature and crop type are not considered. For the WSC a bias correction method is then used to correct the WSC cumulative distribution. Results show that two thresholds are required to correct WSC maps to assign zero for low levels and one for high levels. In addition, quantile-quantile regression is worth completing WSC map correction. Through the Competitiveness Cluster of Bizerte who bring their expertise in university/industry interfacing, these results were disseminated among operators and the public to create a network of cereal users of these indices and to build the capacity of young and old technicians in drought expertise. Farmers benefit from this innovation upstream for monitoring the campaign and for readjusting the coverage requested and downstream for the recovery of damages.

Keywords: drought, agriculture insurance, SPI-3, water stress coefficient, FIDAC, CTAMA