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Applicability of crop models in the context of parametric insurance – a Caribbean case study

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Evaluating the impacts of weather events on the agricultural sector is of high importance. Weather has a huge influence on crop performance and agricultural system management, particularly in those countries where agriculture is mainly rainfed. Climate change is expected to further affect farmers' incomes since the risk of extreme weather events with a relevant impact on crop yields is predicted to increase.

Appropriate strategies to deal with the economic impacts of agriculture need to be developed, to enable farmers to quickly recover after a disaster. In this context, weather-based index insurance (also known as parametric insurance) plays a key role since it allows farmers to receive financial aid soon after a disaster occurs.

This study evaluates the applicability of crop models run with gridded data in the framework of index-based insurance to assess their added value in providing estimations of crop yield in case of drought events.

At first, the cropland area is identified using satellite data on Normalized Difference Vegetation Index (NDVI) and Leaf Area Index (LAI) retrieved from various sources, such as Sentinel and Landsat. Crop Type maps are then produced to identify the location of the different crops grown in a region. Then, weather data coming from stations are exploited to run the AquaCrop crop model and estimate the crop yield for the areas near the weather stations.

Since in many countries weather stations are often missing or do not record continuously, the AquaCrop model is also run with gridded data coming from reanalysis, specifically ERA, which is a product released by the European Centre for Medium Range Weather Forecast and has the advantage to provide daily estimation of multiple weather parameters on a 0.25° grid. In addition, ERA5 has a short latency time (in the order of days) and thus allows a near-real time monitoring of the crop growing season. The AquaCrop outputs obtained when the model is run with the station data are then compared to the ones obtained when the model is run with gridded data. The performance of the two model configurations (weather parameters coming from stations or from ERA5) in estimating yield reductions during drought events, previously identified using the Probabilistic Precipitation Vegetation Index (PPVI), are evaluated.

The framework was applied in the context of the Dominican Republic, a Caribbean country in which 52% of the national territory is devoted to agriculture. The Dominican agricultural industry has as main products cocoa, tobacco, sugarcane, coffee, cotton, rice, beans, potatoes, corn and bananas. Results shows that gridded data can be a valuable tool to provide near-real time estimates of the crop growing season and thus help in forecasting final crop yields in near-real time.