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Crop planting date optimization: An approach for climate change adaptation in West Africa

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Agriculture is the main source of income for population and the main driver of economy in Africa, particularly in West Africa. West African agriculture is dominated by rainfed agriculture. This agricultural system is characterized by smallholder and subsistence farming, and a limited use of crop production inputs such as machines, fertilizers and pesticides. Therefore, crop yield is strongly influenced by climate fluctuation and is more vulnerable to climate change and climate variability. To reduce climate risk on crop production, a development of tailored agricultural management strategies is required. The usage of agricultural management strategies such as tailored crop planting date might contribute both to reduce crop failure and to increased crop production. In addition, unlike aforementioned crop production inputs, the usage of tailored planting dates is costless for farmers. Thus, efforts to improve crop production by optimizing crop planting date can contribute to alleviate food insecurity in West Africa, in the context of climate change.

In this study, the process-based crop model GLAM (General Large Area Model for annual crop) in combination with a fuzzy logic approach for planting date have been coupled with a genetic algorithm to derive Optimized Planting Dates (OPDs) for maize cropping in Burkina Faso, West Africa. For a specific location, the derived OPDs correspond to a time window for crop planting. To analyze the performance of the OPDs approach, the derived OPDs has been compared to two well-known planting date methods in West Africa.

The results showed a mean OPD ranging from May 1st (South-West) to July 11th (North) across the country. In comparison with well-known methods, the OPD approach yielded earliest planting dates across Burkina Faso. The deviation of OPDs from planting dates derived from the well known methods ranged from 10 days to 20 days for the northern and central region, and less than 10 days for the southern region. With respect to the potential yields, the OPD approach indicated that an average increase in maize potential yield of around 20% could be obtained in water limited regions in Burkina Faso.

Further investigations are carried out to evaluate both climate change and OPDs impact on crop productivity. Climate change scenario RCP45 and RCP85 data from eight regional climate models are used to perform crop yields simulation using GLAM in combination with OPDs.