Decision support system for adapting sowing dates for maximum productivity

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Background

Climate change impacts projected significant yield losses of key staple crops, such as maize, sorghum, millet, groundnut, and cassava, of between 8 and 22 percent by 2050 in Sub-Saharan Africa. Science-based decision-making processes are essential to guide strategies promoting the successful adaptation of the agricultural sector to climate change. This study aims to provide decision-making support on optimal sowing windows (management practices) for enhancing crop production under climate change scenarios.

Objective

- Identify and classify (high and low yield) rainfed maize cropping systems using remote sensing and global data sources through data-science methods.
- Derive sowing dates through the crop-growth curve patterns (from remote sensing platforms – LAI) using data-science methods over classified maize growing regions.
- Examine climate patterns over the successful historical crop growth period and develop an ISODATA match-finding algorithm to predict sowing dates.

Materials and Methods

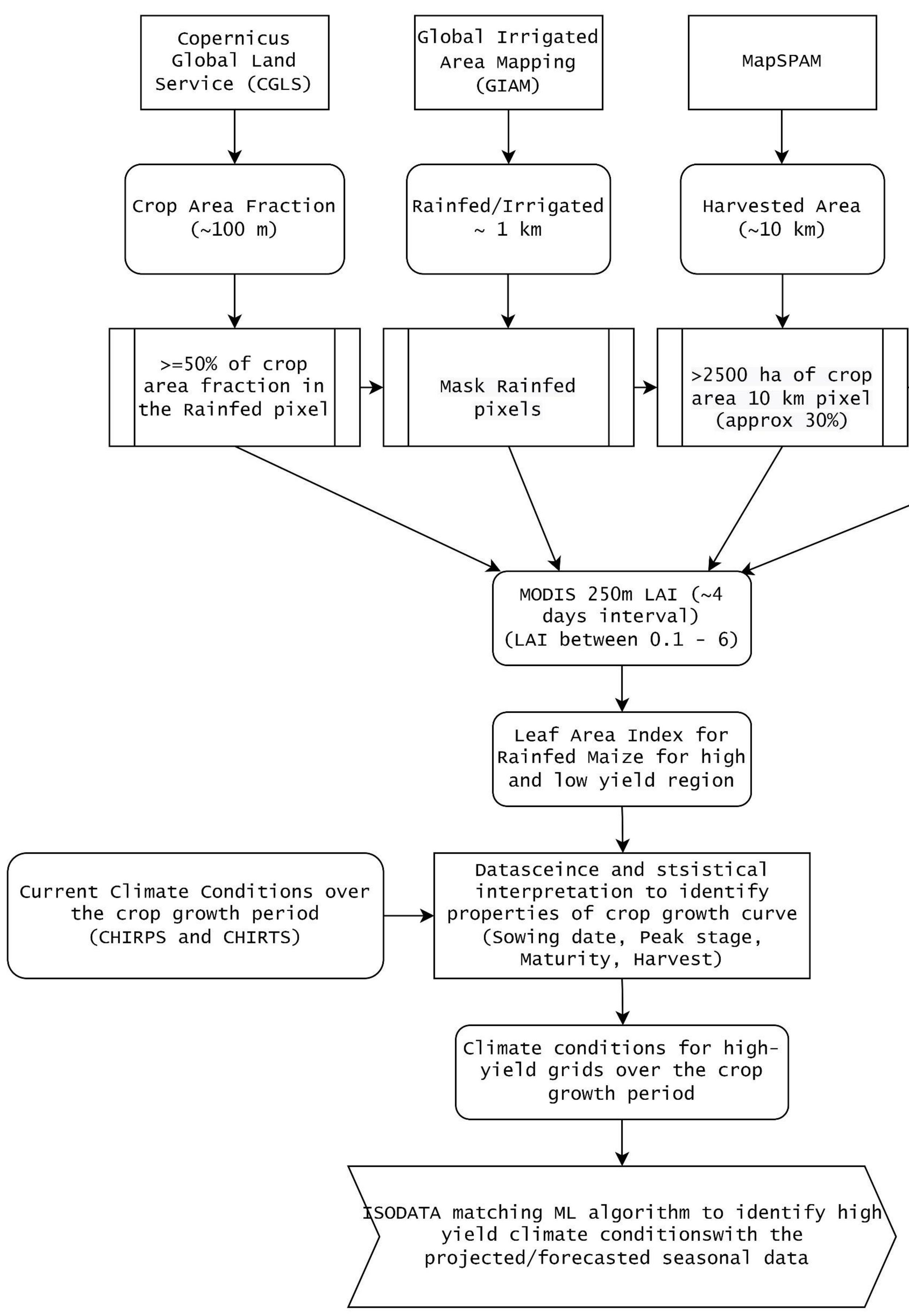


Figure 3. Stepwise methodology to achieve a decision support system for identifying optimal sowing dates

Results

Training data selection criteria

To develop the model, we used IWMI – Irrigated/Rainfed classification (Rainfed), Land Use Land Cover (Crop), MODIS LAI (0.1 to 6), productivity (>2.5 t/ha and <0.8 t/ha), and harvested area (>30%).

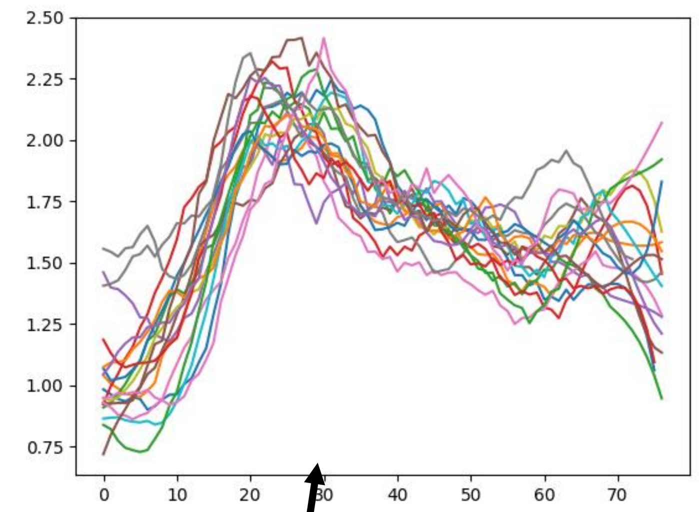


Figure 1. Crop growth curve for the years from 2003 to 2020 over higher productivity grids (>2.5 t/ha)

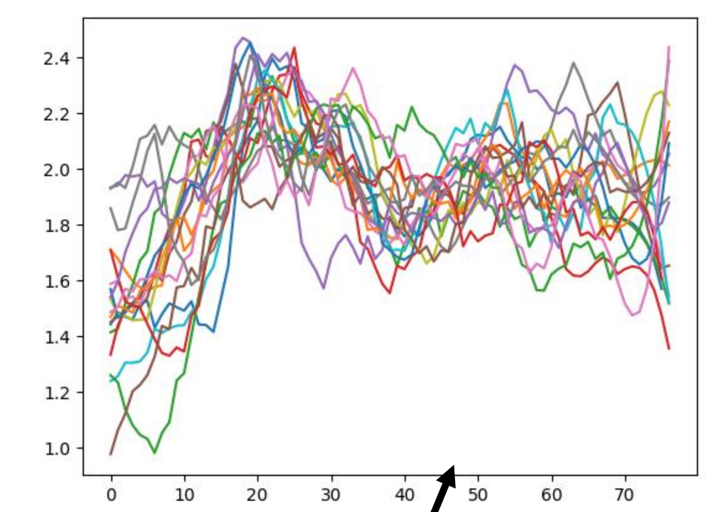
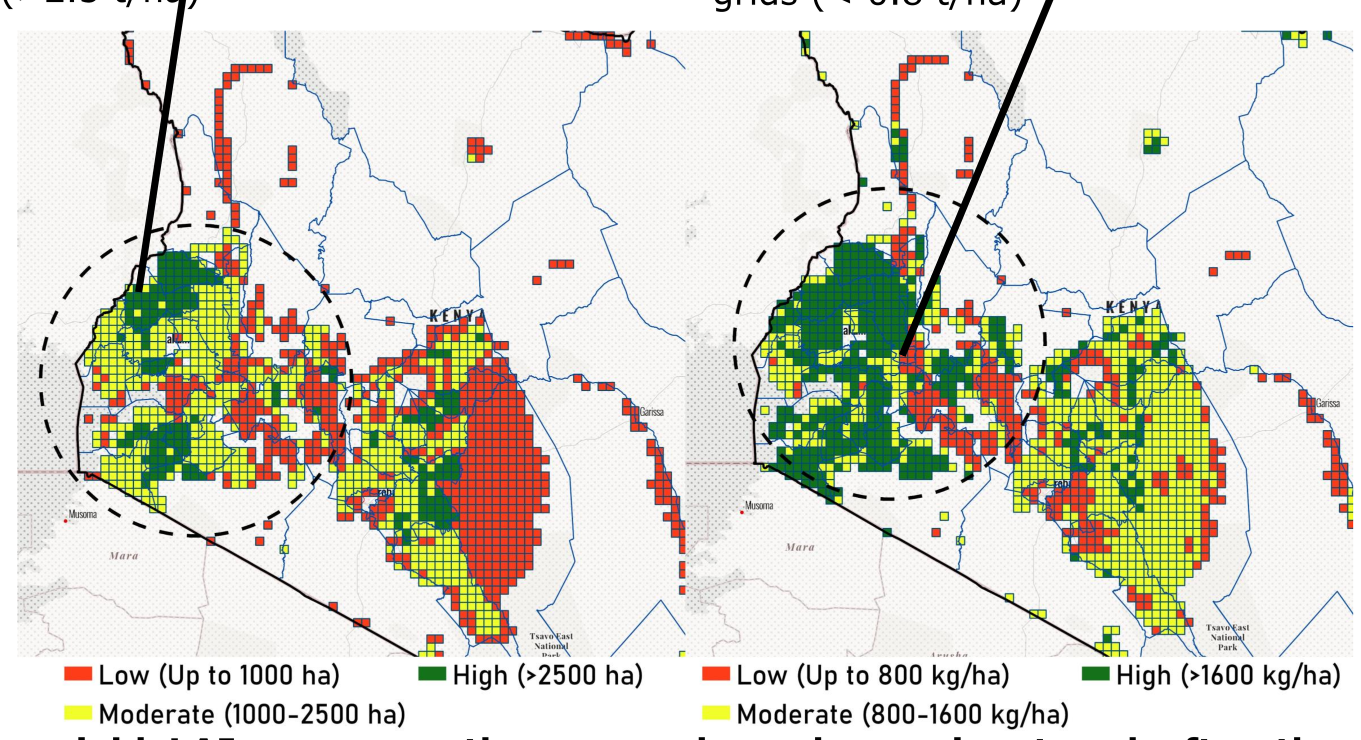


Figure 2. Crop growth curve for the years from 2003 to 2020 over lower productivity grids (< 0.8 t/ha)



Higher yield LAI crop growth curves show decreasing trend after the peak stage, which is optimal for higher grain production. In lower yield cases, the LAI crop curve shows an unchanged trend after the peak stage, which could inform us of higher biomass production, which leads to less grain production. An initial assumption could be higher rainfall during and after the peak stage lead to more biomass production rather than grain production. Planning late sowing would be beneficial to achieve higher production.

i.e., Model development (successful crop growth curves)

Climate Indicators	Pre-sowing	After peak vegetation
Rainfall intensity (Total Rain/Rainy Days)	5mm/day	10 mm/day
Solar Radiation	2.6 W/m2	2.8 W/m2
Relative Humidity	71%	60%
Water Holding Capacity	2.6 kg/m3	2.6 kg/m3

Source: ISIMIP3b

Further steps to accomplish the project

- ISODATA matching algorithm will be applied to find a matching climate pattern (above climate pattern) in the future.
- The developed model will be applied in the climate scenarios as a case study and analyzed to identify if there is a shifting pattern.
- The model (decision rules) could be of better use in planning sowing dates on seasonal forecasts.

Acknowledgements

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