Potential Impact of Climate Change on Cereal Suitability in West Africa using CORDEX-CORE Models

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Background

➢The impact of climate change is projected to affect food security in the future. Further warming is projected to aggravate the current risk and introduce new ones (Mora et al., 2013, IPCC,2021).

➢ West Africa, *whose* livelihoods and economy are *largely dependent on* rain-fed agriculture, is one of the most vulnerable and hotspot regions that has suffered significantly from climate change impacts with large impacts on food production owing to its low adaptive capacity.

➢Cereals contribute over 20% calorie consumption in West Africa (OCED/FAO, 2016)

➢The increase in global warming is projected will significantly affect agricultural production in West Africa with notable implication on suitable area for cereal cultivation which contribute largely to the economy of the region (FAO/OCED, 2016, IPCC, 2021).

➢CORDEX-CORE was developed to provide high resolution climate simulation datasets to assist in providing regional climate information at a finer scale. across the globe (Giorgi et al., 2021)

➢The aim of this study is to investigate the impact of climate change on cereal suitability in West Africa using CORDEX-CORE datasets.

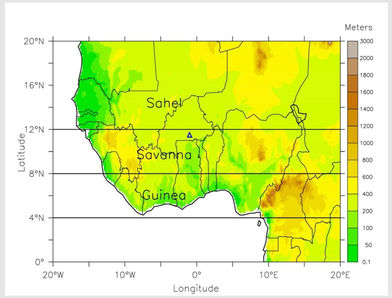


Figure 1: West African agro ecological zones, designated as Guinea, Savannah and Sahel, respectively. (Abiodun et al., 2012a) and crops distribution across the three Agro-ecological zones of West Africa

Data and Methodology

Data:

Climate Modelling experiments

➢CORDEX-CORE GCMs - CLM, GERICS-REMO2015 & ICTP-RegCM4.7

➢CORDEX-CORE RCMs – MOHC-HadGEM2, MPI-ESM and NCC-NorESM1 under RCPs 2.6 and 8.5

Crop Modelling

➢Ecocrop – crop suitability model

Climate Variables

➢monthly minimum and mean temperature

➢ total monthly precipitation

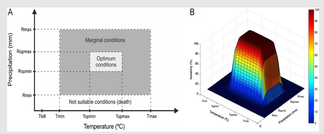
Crop types - Cereal (Maize, Pearl millet, Sorghum, Rice).

Methods

✓ All data were bias corrected using quantile-quantile as described in Cannon et al (2015)

✓ The total suitability ($Total_{suit}$) is calculated by the product of both rainfall *(Rsuit)* and temperature (T*suit*) suitability as shown in the equations below as described Ramírez-Villegas et al. (2013).

$$Total_{suit} = Rsuit * Tsuit$$



Results

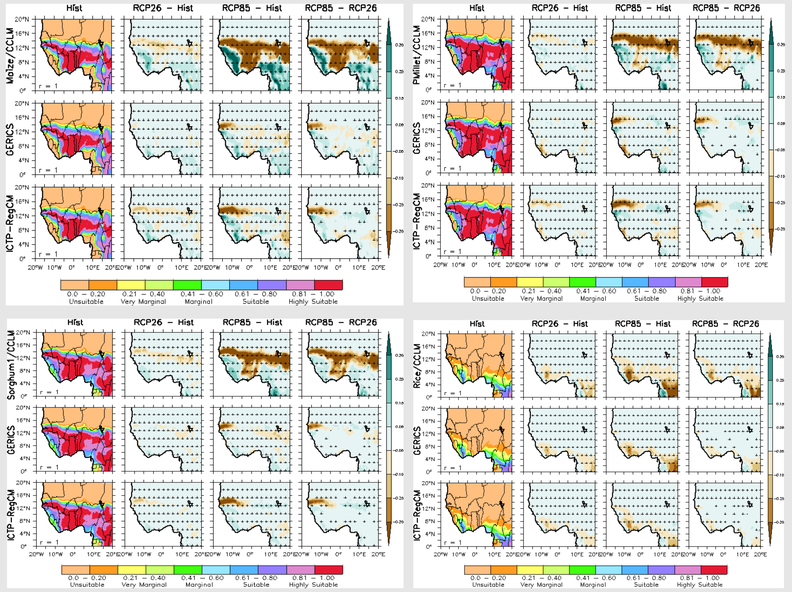


Figure 2: *The spatial distribution of cereal suitability for the historical period over West Africa (first column; 1979 - 2005) and their projected future changes in the period (2061 - 2090) under RCP2.6 and RCP8.5 (i.e. second and third columns, respectively). The effect of global warming WITH (RCP2.6) or WITHOUT (RCP8.5) ADAPTION on cereal suitability is presented in the fourth column.*

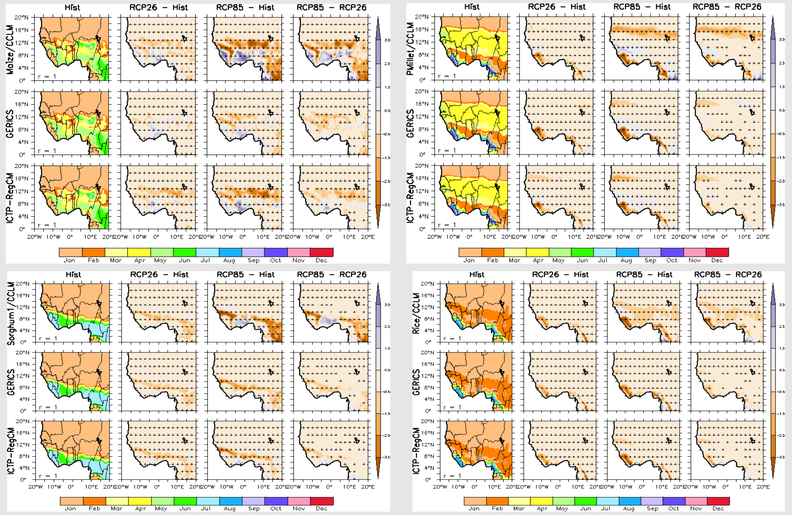


Figure 3: The spatial distribution of cereal planting season for the historical period over West Africa (first column; 1971 - 2000) and their projected future changes in the period (2061 - 2090) under the SSP245 and SSP585 and G6sulfur (i.e. second and third columns, respectively). The impact of sulfur injection induced effect on global warming on cereal planting season is presented in the fourth column

More Results

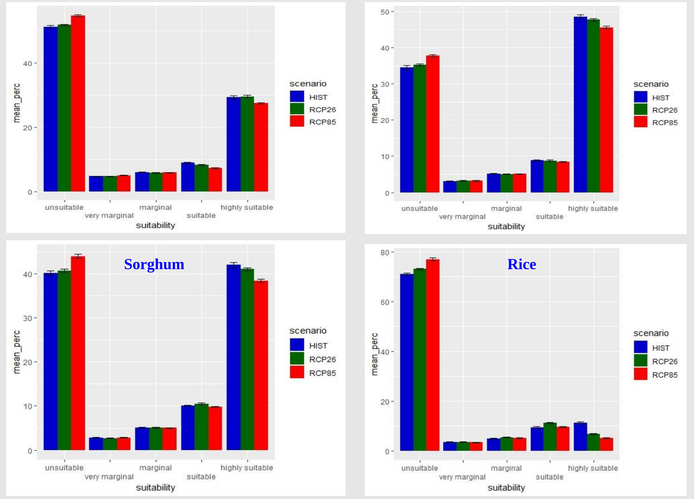


Figure 4: A bar chart of percentage grid point distribution of Maize and Pearl millet suitability over West Africa for the historical period (1979-2005) and under the impact of GHG (RCP26 and RCP85 respectively) for the period (2069-2095) using the CORDEX-CORE Models

Conclusions

✓ All cereal crops are suitable with a suitability index above 0.5 across the three agro-ecological zones of West Africa.

✓ In general, no change significant change is expected in cereal suitability in most part of West Africa under RCP2.6 except for Rice in the Guinea zone

✓ Significant projected change in cereal suitability could lead to an increase (≥ 0.2) for all the crops along the south-west coast and south Coast of Nigeria under RCP8.5 (No adaptation at all).

✓ Projected decrease (up to 0.3) in cereal suitability is expected over Savana-Sahel and central Guinea-savanna zones for all crops except Rice with similar decrease in the Guinea zone.

✓ GHG could lead to early planting season of cereals in the Guinea-savanna zones for Pearl millet, sorghum and Rice but a delayed planting for maize in the coastal Guinea zone.

✓ GHG with adaptation (RCP2.6) could lead to an increase in highly suitable areas for sorghum and Pearl millet relative to global warming and a decrease in unsuitable lands for the three crops over West Africa.

References

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