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Prediction of West African Cropland Dynamics under Climate Scenarios

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Context and objective

Under the current alarmist predictions in West Africa's global warming, differences in socio-political settings and biophysical characteristics are likely the key drivers to account for to devise resilient land use practices to increase crop production. A study was conducted to assess the aggregated impact of populations and climate change on food security in West Africa, using cropland as a proxy.

Sources of data

In this study the authors assess the relationships between population, food demand and cropland. Different sets of data have been used. The population and food demand datasets were extracted from the Global Food Demand projections based on the IPCC Special Report on Emissions Scenarios (SRES) storylines for the period 2005 until the year 2100.

Land use (cropland area) data were extracted from the HYDE 3.1 database which provides spatial data on world land use under different Representative Concentration Pathways (RCP) scenarios for the period 1700-2100 at 0.5° x 0.5°. Each RCP is simulated by an Integrated Assessment Model. So, the RCP 8.5 is simulated by the MESSAGE model, the RCP 6 by the AIM model, the RCP 4.5 by the GCAM model and finally the RCP 2.6 by the IMAGE model.

Table 1: Integrated Assessment Model used

| Integrated Assessment Model | RCP | Land-Use Data |
|-----------------------------|----------------------|-----------------------|
| MESSAGE | 8.5 W/m ² | Gridded |
| AIM | 6 W/m ² | Gridded |
| GCAM (minicam) | 4.5 W/m ² | Regional (14 regions) |
| IMAGE | 2.6 W/m ² | Gridded |

Impacts of climate scenarios on per capita food and per capita cropland demand

Given the rapid population growth, the per capita food demand in all SRES was found to be increasing (Figure 1). However, decreasing in national and the regional per capital cropland were observed during all scenarios from 2005 until 2080 when increasing per capita cropland was reported (Figure 2)

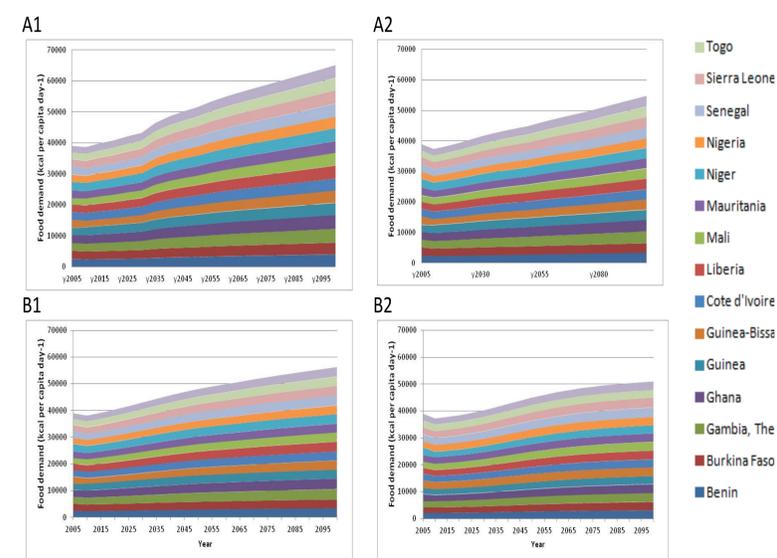


Figure 1: Evolution at country level of per capita food demand under the different SRES

Take-home messages

- Findings indicate that climate change will impact agricultural production in West Africa, but with contrasting intensity according to location
- Projected West Africa crop production cannot meet the future food demand, providing a basis for alternative agricultural policies
- Findings underscored coming food security challenge in the sub-region from 2005 to 2050.

References

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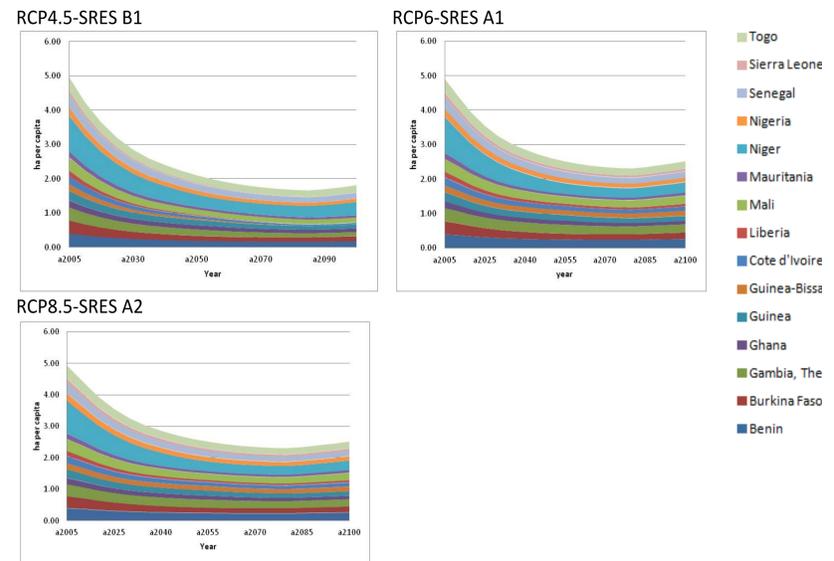


Figure 2: The impacts of climate and socio-economic scenarios on per capita crop area

This study further identified three critical periods for food demand in West Africa in the context of climate change: (i) rapid (2005 – 2050), low (2050 – 2080) and constant (2080 – 2100) increases (Table 2).

Table 2: Variation of food demand in the period 2005-2050, 2050-2080 and 2080-2100 in the in the different RCPs at regional scale

| RCP-SRES | Year | 2050 | 2080 | 2100 |
|-----------|------|---------|---------|-------|
| RCP4.5-B1 | | -57.86% | -20.17% | 8.06% |
| RCP6-A1 | | -43.95% | -11.75% | 8.92% |
| RCP8.5-A1 | | -50.67% | -12.10% | 8.92% |

Impacts of climate scenarios on cropland at regional scale

Increase in cropland area is observed in the Central Eastern Sahel (east of ~0°) whereas cropland decrease in size in Western Sahel (west of ~0°) of West Africa (Figure 3).

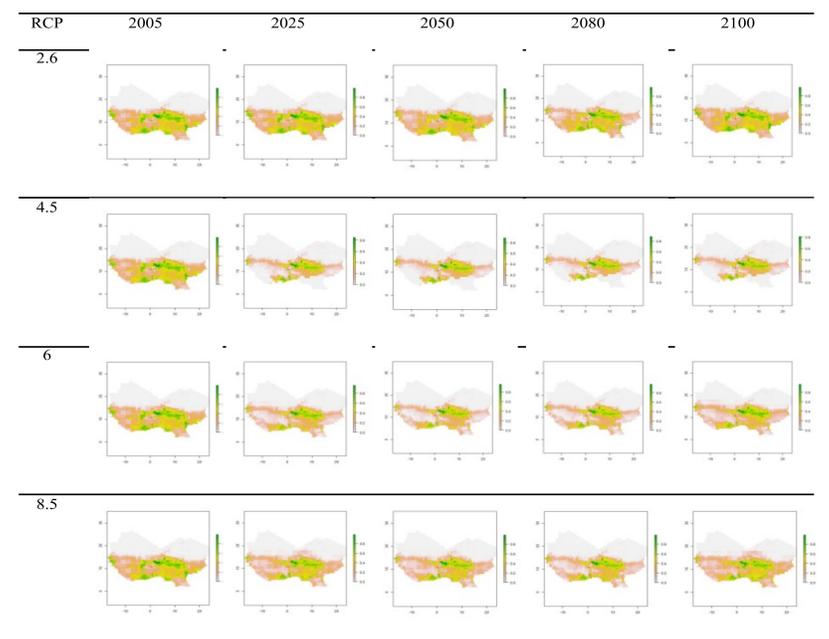


Figure 3: The spatio-temporal variation of crop area in West Africa under the different RCPs