

West African Agriculture and Climate Change: A COMPREHENSIVE ANALYSIS – NIGERIA

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CURRENT CONDITIONS

About half of the working population in Nigeria is engaged in agriculture. Cassava is the most important food crop. Other major food crops include yam, sorghum, and maize. The share that agriculture contributes to GDP has declined from about 50 percent in 2000 to about 30 percent.

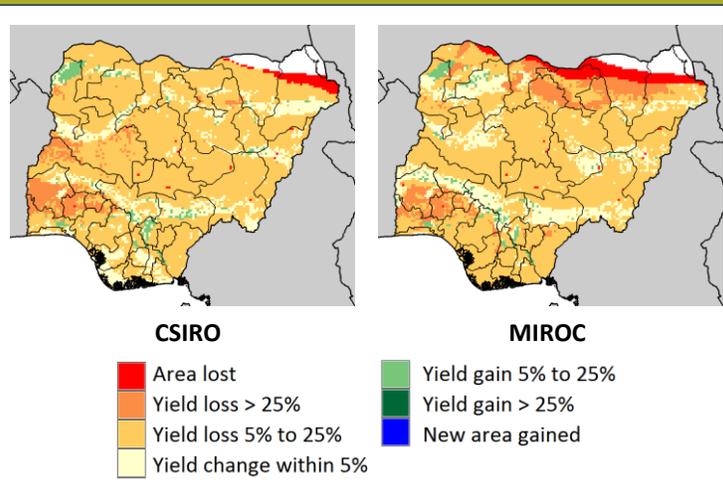
Life expectancy improved between 1960 and the late 1990s, while mortality rates among children under the age of five have been declining. The number of malnourished children under five years is high (estimated at 27.2 percent in 2003). The population living on less than US\$2 a day is very high (91 percent). This group is the most vulnerable to climate change because more than half depend on subsistence agriculture. The country's population has become increasingly urban over time, and population densities are highest across southern Nigeria.

CLIMATE CHANGE SCENARIOS & THEIR POTENTIAL EFFECTS ON YIELDS

As a basis for our analysis, we used four downscaled global climate models (GCMs) from the IPCC AR4. They make diverse predictions for annual rainfall in Nigeria. The CNRM model predicts an increase in precipitation of between 50 and 100 mm across all but the central region, where there is no significant change. The ECHAM model predicts a 50 to 100 mm increase in rainfall, primarily along the coast and the southeast, with no change in the north. The CSIRO model predicts a decrease in precipitation in the center and the southwestern half of the country, ranging from 50 to 200 mm, and no change elsewhere. The MIROC model predicts changes in bands running east to west, with rainfall decreasing in the south (up to 240 mm) and increasing in the north (up to 240 mm). Because of the relatively large changes in some areas, if the MIROC model proves to be correct, farmers may need to switch to new crops or varieties that are tolerant of the new rainfall patterns.

The CNRM model predicts a temperature increase of 2–2.5°C for the average daily maximum during the warmest month. Both the CSIRO and MIROC models predict a relatively uniform increase of 1–1.5°C, while the ECHAM model predicts an increase of 2–2.5°C in the northern half of the country and an increase of only 1.5-

CHANGES IN YIELD WITH CLIMATE CHANGE: RAINFED SORGHUM



2.0°C in the southern half. The higher the temperature change, the more adaptation will likely need to take place.

The maps above depict the results of the Decision Support System for Agrotechnology Transfer (DSSAT) crop modeling software projections for rainfed sorghum, comparing crop yields for 2050 with climate change to yields with 2000 climate. All data suggest a decrease in harvested area in the northern Sahelian zone, which is already prone to desertification. Except in pockets in Kebbi and some inland valleys, all predicted yield loss is within 5–25 percent, with a few areas showing even greater losses.

Maize performs relatively better in the face of climate change. The estimated gain in yield is 5–25 percent over large portions of the country, with a few areas where yields are projected to rise by more than 25 percent. The loss of harvested area is projected to be greater for sorghum than for maize. In addition to areas of yield gain, there are also significant areas where yield will decline.

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CLIMATE CHANGE & FOOD SECURITY SCENARIOS

The research used the IMPACT global model for food and agriculture to estimate the impact of future GDP and population scenarios on crop production and staple consumption, which can be used to derive commodity prices, agricultural trade patterns, food prices, calorie consumption, and child malnutrition. Three GDP-per-capita scenarios were used – an optimistic scenario with high per capita income growth and low population growth, a pessimistic scenario with low per capita income growth and high population growth, and an intermediate (baseline) scenario.

In all scenarios, per capita GDP is projected to increase over time. In the pessimistic scenario, per capita GDP will grow by 155 percent between 2010 and 2050. In the intermediate scenario, it will almost quadruple, while in the optimistic scenario, it will increase by 558 percent.

IMPACT projects that on average (across the 3 scenarios and 4 climate models), cassava yield will grow by 47 percent between 2010 and 2050. While there is little difference in yield projections between scenarios, in the intermediate scenario, the difference between the lowest yield climate model and the highest yield climate model is 31 percent, reflecting the importance of climate on agriculture. Harvested area is projected to grow by 40 percent, resulting in total production more than doubling. Production grows faster than demand, causing the net exports to rise.

IMPACT projects sorghum yields to increase by 83 percent between 2010 and 2050. Unlike the case for cassava, there is virtually no variation in yield predictions across scenarios or across climate models. Harvested area is expected to grow by 20 percent, resulting in the total production growing by 117 percent. This results in net exports rising steeply.

The DSSAT crop model predicted yield declines for sorghum, while the IMPACT model predicts the opposite. The main difference between the two is that IMPACT allows for adaptation and technological improvement, while neither of these are accounted for in the DSSAT model.

Sweet potatoes and yams, in the IMPACT model, are expected to see yields rise, on average, by 64 percent between 2010 and 2050. Climate models make a big difference, with yields in 2050 in the intermediate scenario projected to differ by 35 percent between the lowest yield and highest yield of the four climate models.

Harvest area of sweet potatoes and yams is projected to rise by only 13 percent. Together with yield changes, the model anticipates production rising by 85 percent. This will outpace rising demand brought about by an increasing population with increasing income.

In both the optimistic and baseline scenarios, the number of malnourished children under the age of five is projected to decrease. In the pessimistic scenario, however, an initial increase in the number of malnourished children is projected, and the number in 2050 will be slightly higher than at present. While the absolute number increases slightly in the pessimistic scenario, the optimistic scenario projects a decrease by 2020, and the baseline scenario shows a decrease by 2030. With population growth, the percentage of malnourished children decreases in all scenarios.

All models project that the per capita availability of calories will not improve under the pessimistic scenario, while there will be increased availability in the optimistic scenario, as well as in the baseline scenario after 2030.

RECOMMENDATIONS

We recommend policymakers to consider the following to assist of farmers in adapting to climate change:

- improve meteorological services and integrate indigenous knowledge of climate and early warning;
- improve the national agricultural database;
- support agricultural research and extension;
- bolster the national food reserve and storage programs; and
- promote rural development to reduce urban migration.

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