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West African Agriculture and Climate Change:

A COMPREHENSIVE ANALYSIS — NIGER

YAYE HASSAN[1], A. DANGUIOUA[2], ABDULAI JALLOH[3], ROBERT ZOUGMORE[4], GERALD C. NELSON[5], TIMOTHY. S.THOMAS[5]

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CURRENT CONDITIONS

Three-fourths of Niger is covered by the Sahara desert. The rainy season lasts only three months, with total rainfall of 150–600 mm per year. Maximum temperatures are high (45^{0}C in the shade in April–May). Livestock production is a major component of farming. A wide range of crops is grown in semiarid areas, including millet, sorghum, cowpeas, pigeon peas, groundnut, green grams, phaseolus beans, and chickpeas. Millet is the most important crop, occupying nearly half of the total harvested area in the country.

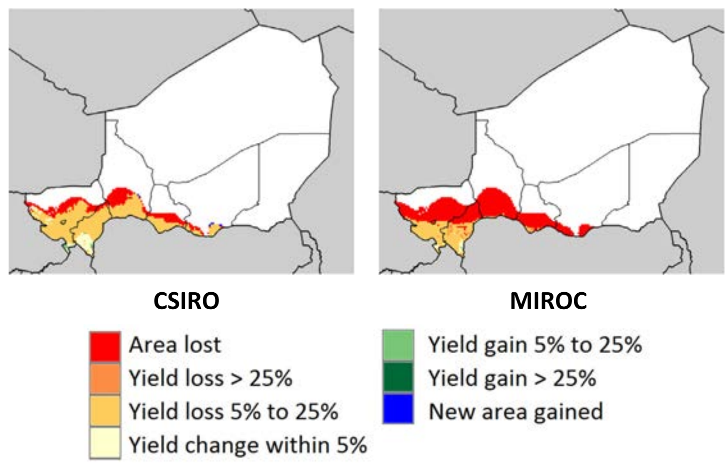
Niger's population is concentrated in the south. Since 1967, there have been several food crises (every three years on average), due mainly to unfavorable climatic conditions. Since the 1960s, the contribution of agriculture to GDP has declined from more than 70 percent, leveling out at about 40 percent in the 1980s. Life expectancy stagnated at about 40 years between the 1960s and the 1980s, but it gradually increased to about 55 years after 2000. The increase in life expectancy in the 2000s coincided with a decrease in infant mortality, from about 300 deaths per 1,000 births to less than 200 deaths per 1,000 births in 2008. The improvement in life expectancy and the decline in the mortality rate for children under five years may be a function of the gradual improvement in heath conditions, including vaccinations, as well as the increase in the world price of uranium in the 1990s. The malnutrition rate among children under five years is very high (39.9 percent in 2006). Population increase is a major challenge for Niger.

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, which project results for the change in annual rainfall by 2050. Both the CSIRO and ECHAM models predict little or no change in rainfall throughout the country. However, the CNRM and MIROC models predict an increase for the southern part of the country: The MIROC model predicts a precipitation increase of 100–200 mm, while the CNRM model projects an increase of 50–100 mm. The CNRM model also predicts increased rainfall over a greater area of the desert.

The CNRM and ECHAM models predict a uniform temperature increase of 2–2.5ºC between 2000 and 2050 for the average daily maximum during the warmest month. The CSIRO model predicts the smallest increase (1–1.5ºC across most of the country).The MIROC model predicts great variations in temperature increase for the country. In the southernmost part, it predicts an increase of 1–1.5ºC. Then, slightly further north, there is a band of 1.5–2ºC temperature change, followed by another band of 2–2.5ºC, and another band of 2.5–3ºC. Finally, in the northernmost part, there is a band of 3–3.5ºC

CHANGES IN YIELD WITH CLIMATE CHANGE: RAINFED SORGHUM



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. Both models predict yield loss of 5–25 percent over much of the area the can be cultivated in 2000, as well as areas which will no longer be able to be cultivated in 2050 at the northern end of the cultivatable area. The loss of area is somewhat lower in the projections of the CSIRO model than those of the MIROC model.

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[1] BEFACREP (bureau d'études, de formation et d'appui-conseil à la réduction de la pauvreté) Niger; [2] BEFACREP (bureau d'études, de formation et d'appui-conseil à la réduction de la pauvreté) Niger; [3] Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles/West and Central African Council for Agricultural Research and Development (CORAF/WECARD); [4] CCAFS/ICRISAT;[5] International Food Policy Research Institute (IFPRI)

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 (or baseline) scenario.

The baseline and pessimistic scenarios follow a similar trend, with per capita GDP rising by around 190 percent and 160 percent, respectively, between 2010 and 2050. The optimistic scenario follows the baseline until around 2025 and then has a significant increase after that, reaching by 2050 more than 600 percent above the 2010 level.

The IMPACT model suggests that millet yield will almost triple between 2010 and 2050, taking the averages of model results for the three scenarios and four climate models. There are only small differences between scenarios, with the pessimistic scenario predicting a few percentage points higher yield change than the optimistic scenario. But there are large differences between predictions of climate models. For example, in the intermediate scenario, the highest predicted yield for a climate model is 21 percent higher than the lowest predicted yield of the four models.

Harvested millet area is projected to rise by around 24 percent, on average. The range, however, is quite large in 2050, with the highest projected yield 24 percent higher than the lowest projected yield (in the intermediate scenario, but very similar results for every scenario). That is, harvested area is sensitive to climate.

Production will increase, on average, by 250 percent between 2010 and 2050. The impact of climate models on production is less than that on yield or area, with only a 10 percent spread from lowest to highest. The difference in production between the highest (pessimistic scenario) and lowest (optimistic scenario) is roughly 4 percent.

All scenarios project a growing deficit of millet after 2020, with demand for millet outpacing production (the pessimistic scenario predicts the largest deficit, while the optimistic scenario predicts the smallest). Population growth seems to be the primary driver of the increased demand for millet, though increased income is also one of the drivers.

The story of sorghum yield is similar to that of millet yield. On average, yield will rise by 170 percent between 2010 and 2050, with the difference in yields between the low and high values for the four climate models is 19 percent. Sorghum harvested area also parallels that of millet, with area expanding by 36 percent, on average, with the spread of area based on different climate models being 22 percent. Sorghum production will increase, on average, by 270 percent, with the spread of lowest and highest values across climate models being only 9 percent.

The optimistic and intermediate scenario show net exports of sorghum growing, but the pessimistic scenario shows a dramatic decline in net exports after 2035, and rising between 2010 and 2035..

The number of malnourished children under the age of five increases in all scenarios through 2035. After 2025, the differences between the scenarios become increasingly pronounced, but in all cases the number of malnourished children is higher in 2050 than in 2010. While the absolute number of malnourished children will increase in the future, the percentage of malnourished children is likely to be lower in 2050 than in 2010 due to the large population increase projected in all scenarios.

Mean calorie consumption finishes higher in 2050 than it started in 2010 for all scenarios, with a much larger increase for the optimistic scenario than for the other two.

RECOMMENDATIONS

Among the recommendations advanced in the monograph from which this brief was drawn are the following. Policymakers should:

- support the monitoring of climate data and educate people about its impacts;
- consider policies for adequate housing, roads and other infrastructure, particularly those related to agriculture;
- support agricultural research and extension to develop resilient crop varieties and educate farmers about new agricultural techniques and technologies;
- support the management of rural areas and develop the most degraded lands;
- support the High Authority for Food Security to coordinate food production; and
- promote agricultural diversification, particularly crop livestock production systems that will provide flexibility in adapting to changing climates.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
2033 K Street, NW • Washington, DC 20006-1002 USA
T: +1.202.862.5600 • F: +1.202.467.4439
Skype: ifprihomeoffice • Email: ifpri@cgiar.org

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