East African Agriculture and Climate Change:
A COMPREHENSIVE ANALYSIS — DEMOCRATIC REPUBLIC OF THE CONGO

BLANDINE M. NSOMBO[1], TIMOTHY S. THOMAS[2], MIRIAM KYOTALIMY[3], AND MICHAEL WAITHAKA[3]

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CURRENT CONDITIONS

The Democratic Republic of the Congo, located in the south central part of Africa, is the continent's second-largest country. Forests blanket its northern region, while savannah covers the south. Its population has more than tripled from 16 million people in 1960 to 64 million people in 2010. Although roughly 70 percent of the population depends on agriculture for survival, only about 7 percent of the DRC's area is used for cropping and livestock activities. These areas are located around main cities and along major roads, especially in the eastern part of the country.

The main staple crops are cassava, maize, groundnuts, and rice. Cassava is produced in the southern half of the country, with reported yields averaging around 8 metric tons per hectare. Most maize is produced in the central regions, with average national yields of around 1.2 tons per hectare and up to 10 tons per hectare where inorganic fertilizers and improved seeds are used. Groundnuts and rice are produced in much smaller quantities and, despite high production potential, more than 90 percent of the rice consumed in the country is imported.

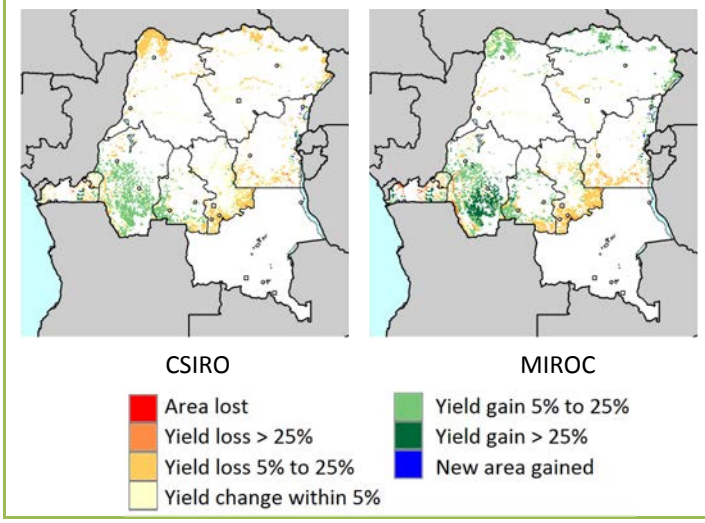
GDP per capita declined from the mid-1970s until around 2000 but has risen since then. However, the contribution of agriculture to GDP has trended in the opposite direction, peaking in the late 1990s and early 2000s, but declining steeply in recent years. The country is endowed with untapped raw mineral deposits, including tungsten, tantalum, tin, gold, diamonds, copper, cobalt, zinc, and oil. Assuming an end to civil conflict, the exploitation of these resources should lead to overall GDP growth. With the agricultural sector still dominant, small changes in climate patterns are likely to have a major impact on agricultural GDP and economic growth.

The malnutrition rate for children under five years is high: 34 out of every 100 children weigh less than is normal for their age. Life expectancy at birth remains roughly 48 years, as it has since the 1980s. Although the infant mortality rate declined from more than 250 cases per 1,000 births in the 1960s to fewer than 200 cases per 1,000 in the 2000s, it remains very high.

CLIMATE CHANGE SCENARIOS & THEIR POTENTIAL EFFECTS ON YIELDS

Predictions of average annual precipitation changes through 2050 vary from one global climate model to another. For our analysis, we used four downscaled GCMs from the IPCC AR4. The MIROC model predicts increases of up to 200 mm in the eastern portion of the country, while drier areas will be found around Kinshasa. The CSIRO model shows patches of rainfall reduction of up to 150 mm annually, with a large patch in the northeastern portion, as well as in the northwest.

CHANGES IN YIELD WITH CLIMATE CHANGE: RAINFED MAIZE



The temperature change predictions between 2010 and 2050 were more consistent between models than were the precipitation predictions, although there are differences. Temperatures are expected to rise by 1–3°C. The CSIRO model projects very modest increases for most of the country, averaging 1.4 °C, while the MIROC model projects slightly higher temperatures. Projections from the other two models were even higher than MIROC.

The maps above depict the results of the Decision Support System for Agrotechnology Transfer (DSSAT) crop modeling software projections for rainfed maize, comparing crop yields for 2050 with climate change to yields with 2000 climate.

The data suggest that climate change will produce yield losses in some areas, but these seem to be offset by increases in yields in

[1] University of Kinshasa; [2] IFPRI; [3] ASARECA.

other parts of the country. It is expected that with the increase in temperatures, incidences of pests and diseases will be intensified. In the map above, there is agreement between the GCMs that maize yields will generally increase in Bandundu province and parts of Kasai-Occidental, while falling elsewhere. We also see agreement between the models concerning yield increases for rice in Bandundu, as well as agreement about yield increases in the eastern portion of Kivu province.

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, a pessimistic scenario with low per capita income growth and an intermediate scenario.

Cassava, the country's leading crop, is the pillar of food security. The IMPACT model projects that cassava yield will increase on average by about 60 percent between 2010 and 2050. There is a very small difference in yields between scenarios, but there is a slightly great difference in yields between climate models for a given scenario, with the high yield model being about 7 percent higher than the low yield model. Harvested area is projected to grow by around 30 percent, which together with yield lead to more than doubling production. However, it also predicts that the country will need to continuing importing cassava through 2050 to meet rising demand.

Maize is among the major cereals consumed in the country. It is produced mainly by small farmers in mixed-cropping systems. The IMPACT model projects that yields will increase by about 70 percent, reaching around 1.2 tons per hectare, which is still relatively low. Very little variation is noted between scenarios or between climate models. Maize area is not projected to grow very much. The 70 percent increase in production will at first be able to keep up with demand, but after 2025 will increasingly fail.

Rice yield is projected to more than triple, which together with a modest area increase results in a quadrupling of production. Groundnuts, on the other hand, will have a modest yield increase of around 30 percent, but a large area increase in harvested area, almost doubling in the intermediate scenario.

The results indicate that in all scenarios there will be an increasing trend in the number of malnourished children under the age of five until 2025 or 2030. Even in the intermediate scenario, the absolute number of malnourished children is projected to be higher in 2050 than in 2010. However, the proportion of malnourished children should decline slowly over the entire period for all scenarios, once population growth is factored in.

The data suggest a relatively large increase in available kilocalories per capita in the optimistic scenario, although the intermediate scenario predicts no appreciable change and the pessimistic scenario projects a decline. While incomes rise in all scenarios, so do food prices, especially staple foods in the pessimistic scenario. The increase in prices will offset some income gains.

For any given scenario, kilocalories per capita varies between climate models, with a 10 percent difference between the climate model with the lowest calorie consumption and the one with the highest. This is due to the difference in production of staple foods between climate models.

RECOMMENDATIONS

To minimize the impacts of climate change, strategies are needed to enhance agricultural productivity and promote investments in agricultural research and extension. Policymakers should:

- decide how much, if any, of forest areas should be allowed to be converted to agricultural land, considering the possibility of conserving forests for carbon sequestration and carbon trade;
- consider encouraging settlement agriculture, adopting high-yield crop varieties, crop protection, and improved post-harvest techniques, as well as more environmentally friendly agriculture techniques such as agroforestry;
- support further study of interactions among soils, livestock, crop production, and agroecosystems (not only because of their important role in agriculture, but also to minimize the potential contribution to climate change through methane emissions); and
- consider increased funding to strengthen the agricultural research and extension system so that technologies can be tested and adapted to the local environment and the resulting knowledge shared with farmers.

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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