East African Agriculture and Climate Change:
A COMPREHENSIVE ANALYSIS — BURUNDI

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CURRENT CONDITIONS

Burundi is a small, landlocked country of which only 36 percent is arable. The country has two rainy seasons, which run from February to May and from September to November, as well as a short rain period for two weeks in January. The rainfall varies from 2,000 mm in higher altitudes to 1,000 mm in low-lying areas. The main staple crops are bananas, cassava, sweet potatoes, and beans. Bananas alone accounted for 29 percent of total cultivated area and 44 percent of the total value of crop production between 2006 and 2008.

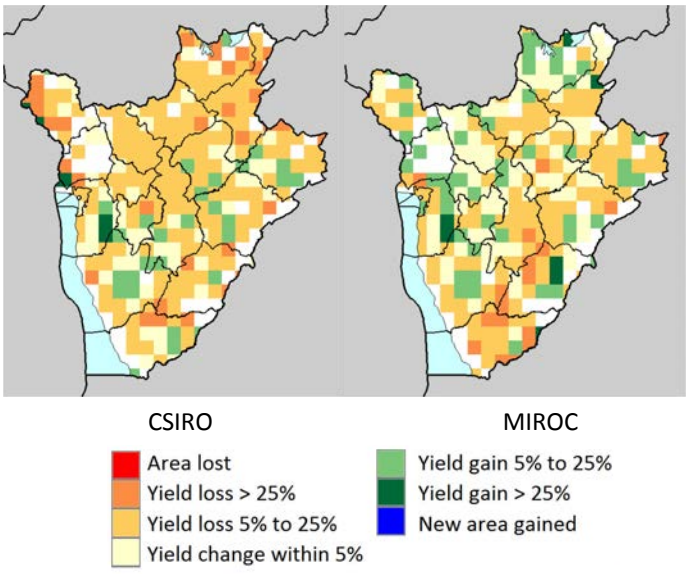
The malnutrition rate for children under five years is high; thirty-nine out of every 100 children weigh less than is normal for their age. Life expectancy at birth has improved from 40 years in the 1980s to 50–52 years in the 2000s. Although the infant mortality rate declined from more than 250 cases per 1,000 births in the 1960s to fewer than 200 per 1,000 in the 2000s, it remains very high. The main causes of death are malaria (40 percent), which predominately affects pregnant women and children under five years, diarrhea (3 percent), acute respiratory infections (19 percent), malnutrition, and HIV/AIDS.

Burundi's population of 8 million is young and growing rapidly: Nearly 7 out 10 Burundians are under the age of 15, and the annual growth rate is 2.8 percent. The growth rate in cities is generally higher than in rural areas, having risen sharply in the latter part of the last decade as more than 500,000 Burundians returned home following the cessation of war. Poverty is widespread, with 90–95 percent of the population living on less than $2 per day, particularly in rural areas.

CLIMATE CHANGE SCENARIOS & THEIR POTENTIAL EFFECTS ON YIELDS

For our analysis, we used four downscaled global climate models (GCMs) from the IPCC AR4. The climate change scenarios show diverging futures. The CSIRO model projects precipitation losses of 50–100 mm in the northern and eastern provinces, areas that already have a history of intermittent drought. The data suggest a need for drought-tolerant agricultural technologies in these regions in order to adapt to climate change. The MIROC model, by contrast, predicts that precipitation will increase by up to 200 mm in the western provinces, and by more than 200 mm in the rest of the country. This is favorable for crop production, but it could increase the risk of flooding, especially in the Central plateau and the Congo Nile Divide, where precipitation levels are already above average.

CHANGES IN YIELD WITH CLIMATE CHANGE: RAINFED MAIZE



All the models suggest that Burundi's climate will become warmer (by 1–2.5°C). The CSIRO model projects that temperature increases for the entire country will be in the 1–1.5°C range (the smallest increase of the four models used). Given Burundi's tropical humid climate, this would imply high evapo-transpiration rates, reducing the water available for plant growth and other uses.

The CSIRO and MIROC yield change figures above (computed with the DSSAT crop modeling software) show that without technological improvements, yields for rainfed maize over most of the country will decline by 5–25 percent, with a few areas showing yield increases of the same amount. Given that maize is one of the five most important foods in Burundi, yield losses would erode food security.

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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 scenario.

The projections for per capita GDP in the study anticipate slow growth for the first decade, possibly because significant reforms will be needed to bolster the post-conflict economy. Without measures to rein in the high population growth rate, the pessimistic scenario predicts per capita GDP of only $569 by 2050. Per capita GDP rises to $1,450 in the optimistic scenario. The effort to raise per capita GDP would also require productivity-enhancing investments for the key agricultural commodities—sweet potatoes, cassava, and maize—which would stimulate broad-based growth, especially if coupled with improved marketing infrastructure and services.

According to projections derived from the IMPACT mode, production of sweet potatoes will rise by about 300,000 metric tons (MT) by 2050, reflecting a growth in yield from 7.5 to 20 MT per hectare (ha). This outcome is comparable to yields obtainable under good management practices implying an increase in intensity of production.

Despite a projected doubling of yield, total cassava production is not projected to change much, because the harvested area is expected to shrink. With production mostly unchanged, Burundi will turn to imports to meet rising domestic demand. Production of maize will rise due to the balance of a roughly 80 percent increase in yield against a 25 percent reduction in area. Although the range of outcomes for net exports will be rather large by 2050, all scenarios and climate models considered project that Burundi will be an importer of maize in 2050. These results suggest that Burundi will not be self-sufficient in food, but the projected increases in per capita GDP should allow Burundi to import enough food, the likelihood of which is reflected in the trend toward lower rates of malnutrition and the increase in per capita calorie consumption (except in the pessimistic scenario).

The impact of future GDP and population scenarios on the absolute number of malnourished children under five years shows a decline from the baseline level of 780,000 to 630,000 in 2050 in the optimistic scenario. However, all scenarios showed decreases after 2040. Even with the population increasing, malnutrition rates will be slightly lower in 2050 than in 2010. Higher GDP growth, if sufficiently broad-based, would mean more available income for food purchases, even for net food buyers.

The daily per capita calorie intake rises to the standard of 2,000–2,250 calories recommended by the World Health Organization only under the optimistic scenario, and then only in 2050. Lower population growth may reduce demand for food and, hence, temper consumer food prices, thus enhancing access. As long as a large proportion of the population is dependent upon agriculture for employment, attaining food sufficiency for everyone in the country in the short term will require more than just growth in GDP; other factors, such as improved productivity and market access, will be needed to make rapid progress.

With the considerable rise in per capita GDP between 2010 and 2050, even in the pessimistic scenario, we might have expected a larger increase in mean calorie consumption. Some of the discrepancy is explained by the large increase in the price of staple foods.

RECOMMENDATIONS

To facilitate adaptation of agriculture to climate change, policymakers should:

- fund family planning programs;
- increase agriculture productivity by funding national agricultural research and extension services;
- promote income-earning options outside agriculture;
- invest in education;
- implement land reforms;
- promote sustainable land management;
- prioritize the agriculture sector by increasing its budget to at least 10 percent of the national budget; and
- implement sensitization and awareness campaigns on the potential impacts of climate change on agriculture.

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