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HOW CAN AFRICAN AGRICULTURE ADAPT TO CLIMATE CHANGE? INSIGHTS FROM ETHIOPIA AND SOUTH AFRICA

Climate Change Impacts on Food Security in Sub-Saharan Africa

Insights from Comprehensive Climate Change Modeling

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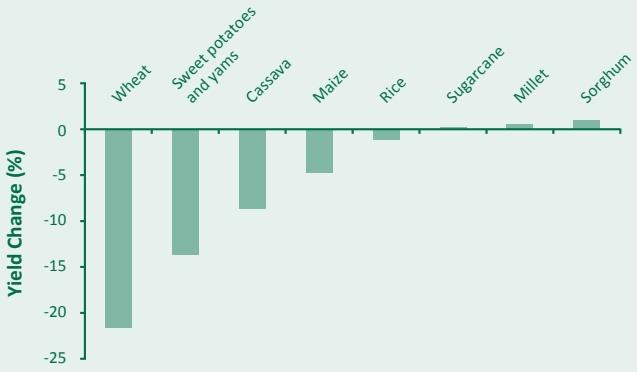
According to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, warming in Sub-Saharan Africa (SSA) is expected to be greater than the global average, and rainfall will decline in certain areas. Global circulation models (GCMs), which provide an understanding of climate and project climate change, tend to agree that temperatures are increasing across the region, but models vary widely regarding predicted changes in precipitation—with the exception of some agreement that precipitation decreases from June to August in southern Africa and increases from December to February in eastern Africa. Whether the Sahel will be more or less wet in the future remains uncertain. Given the limited agreement of GCMs, the University of Illinois and the International Food Policy Research Institute (IFPRI) developed a global comprehensive climate change scenario combining 17 models selected for their past performance in predicting temperature and precipitation.

This brief is based on a study that integrates these results with a process-based crop simulation model and IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) to assess climate change outcomes for SSA. The modeling approach employed for the study considered three possible climate change impacts on crop production: (1) direct effects on rainfed yields through changes in temperature and precipitation, (2) indirect effects on irrigated yields from changes in temperature and available irrigation water (including precipitation), and (3) autonomous adjustments to area and yield due to price effects and changes in trade flows. Overall, results indicate that climate change impacts, as evidenced by declining crop yields, are less severe in SSA compared with other regions like Asia because yield levels are much lower to start with, and fertilizer application is limited. These same conditions make SSA much more vulnerable to climate change, particularly because low yield levels and limited agricultural inputs are combined with a high dependence on rainfed agriculture and high poverty levels.

Figure 1 Projected changes in Sub-Saharan African crop yields due to climate change, 2050



Source: Compiled by authors based on IFPRI IMPACT modeling projections.

THE IMPACT OF CLIMATE CHANGE ON FOOD OUTCOMES

Cereal production growth for a range of crops in SSA is projected to decline by a net 3.2 percent in 2050 as a result of climate change. Increased area expansion of 2.1 percent partially compensates for an overall yield growth decline of 4.6 percent. The largest negative yield impacts are projected for wheat—of which the region grows very little—followed by sweet potatoes. Overall, millet and sorghum yields are projected to be slightly higher under climate change, probably given their higher tolerance to higher temperatures and drought stress (see Figure 1).

World prices are a key indicator of the effects of climate change on agriculture and, even more importantly, on food affordability and security. Food prices increase for all staple crops because climate change acts as an additional stressor on the already tightening price outlook. Under climate change, maize, rice, and wheat prices in 2050 are projected to be 4, 7, and 15 percent higher than under the historic climate scenario. Moreover, prices of other important crops in the region also increase—for sweet

potatoes and yams by 26 percent, cassava by 20 percent, millet by 5 percent, and sorghum by 4 percent.

Higher food prices are projected to dampen demand for food, as the affordability of nearly all agricultural commodities, including basic staples and livestock products, declines under climate change. As a result, per capita calorie availability across SSA is projected to decline by 1.3 percent, or 37 kilocalories per capita per day. While this change appears comparatively small, distributional effects are likely to be significant, and those who can least afford to reduce caloric intake are likely to be hit the hardest. The largest drop in calorie availability, at 2.6 percent, is projected for the central zone, which already had the lowest per capita calorie availability to begin with. Under these conditions, on average, the central zone would be close to the minimum per capita daily calorie availability of 2,000 kilocalories recommended for a healthy and productive life.

Climate change increases the number of malnourished children in both 2030 and 2050. Without climate change, child malnutrition levels in SSA are projected to decline from 28 percent in 2000 to 24 percent in 2030 and 19 percent in 2050, while the absolute number of malnourished children would still increase from 30 million children in 2000, to 38 million in 2030, before reverting to 30 million in 2050, given the continued rapid increase in population growth in the region. Under climate change, child malnutrition would increase by an additional 0.5 million children in 2010, would be higher by 1 million children in 2030, and would still be higher by 0.6 million children by 2050.

Changes in agricultural trade flows as a result of climate change are driven by changes in the local biophysical and socioeconomic environment, as well as a wide-ranging set of local, regional, national, and international trade policies. Across SSA, little change in net cereal imports is expected as a result of climate change because small increases and decreases in net cereal imports of particular countries effectively balance each other out. At the subregional level, eastern Africa is projected to experience the largest increase in net cereal imports due to climate change (15 percent) as a result of declining maize yields. For the Sudano–Sahelian zone, a steep decline in net cereal imports is also projected (6 percent), again driven by local changes in maize yields.

POLICY CONCLUSIONS

Even without climate change, SSA remains the most food-deprived region worldwide and the only one with projected increases in childhood malnutrition over the next two decades despite recent increases in economic prosperity and gross domestic product, which were generated through agriculture. Compared with historic climate records, climate change will cause shifts in yield and area growth and increased food prices, thereby lowering food affordability, reducing calorie availability, and increasing childhood malnutrition. Cereal production growth in the region is projected to decline by 3.2 percent as a result of climate change, with increased area expansion of 2.1 percent partially compensating declines in yield growth of 4.6 percent. The most potent force for reducing malnutrition—particularly in SSA—is raising food availability and rural incomes through increased agricultural productivity. Agricultural productivity enhancements will thus be critical in counteracting the adverse impacts of climate change in the region.

FOR FURTHER READING

Ringler, C., T. Zhu, X. Cai, J. Koo, and D. Wang. 2010. *Climate Change Impacts on Food Security in Sub-Saharan Africa: Insights from Comprehensive Climate Change Scenarios*. IFPRI Discussion Paper No. 1042. (Washington, DC: International Food Policy Research Institute, 2010).

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