West African Agriculture and Climate Change:
A COMPREHENSIVE ANALYSIS — GHANA

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CURRENT CONDITIONS

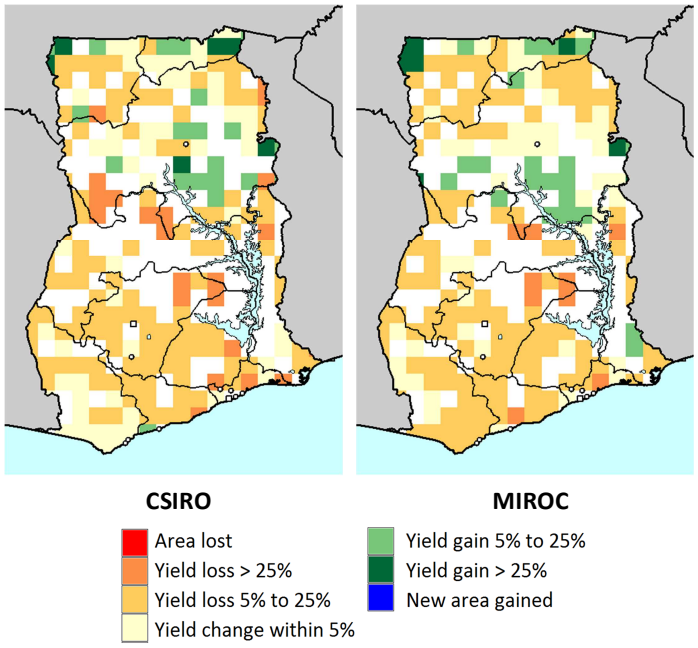
The agricultural sector in Ghana is mostly rainfed and includes crops, livestock, and fisheries. More than half the country's workers are employed in agriculture. Cocoa remains the single most important cash crop in Ghana, while the two most important food crops are cassava and maize. Moving from the rainforest zone in the south to the Sahel in the north, rainfall generally decreases and temperature increases. The share that agriculture contributes to GDP has continued to decline, while per capita GDP has increased. Improvements in access to formal education are reflected in the 2007 adult literacy rate of 65 percent. Life expectancy rose from 45 years in 1960 to 57 years in 2009. Malnutrition, estimated at 19.9 percent in 2008, is one of the lowest in the region. However, poverty is endemic in the three northern regions, where more than 95 percent of the population lives on less than $US2 a day. Moreover, the large increase in population anticipated by 2050 is a concern for food availability and conservation of the natural resource base.

CLIMATE CHANGE SCENARIOS & THEIR POTENTIAL EFFECTS ON YIELDS

The four downscaled global climate models (GCMs) from the IPCC AR4 showed diverse projections for changes in annual rainfall by 2050. The CNRM and ECHAM models predict little change in annual precipitation throughout most of the country. However, the ECHAM model showed an increase in the southeastern part of Ghana. The CSIRO model predicts a general reduction in annual rainfall of 100–200 mm in the middle belt, 50–100 mm in the northern savanna, and 50 mm or more in the southwestern corner. Similarly, the MIROC model predicts decreased precipitation in the south but increased precipitation in the north. These last two scenarios would pose significant challenges for agriculture in Ghana.

The climate model results show a range of potential increases in the average daily maximum temperature during the warmest month by 2050. The CNRM model predicts a uniform increase of 2–2.5°C across Ghana, while the ECHAM model predicts an increase of 1.5–2°C over most of the country. The CSIRO model predicts an increase of 1.5–2°C in the north and 1–1.5°C in the south, while the MIROC model predicts an increase of 1–1.5°C over most of the country.

CHANGES IN YIELD WITH CLIMATE CHANGE: RAINFED MAIZE



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 results for the CSIRO model are very similar to those of the MIROC model. The show a general loss in yield over almost the entire country, with most losses between 5 and 25 percent.

DSSAT also computed crop yields for rainfed rice and rainfed groundnuts. The yield projections were very similar to those for rainfed maize.

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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 (or baseline) scenario.

In the optimistic scenario, Ghana's per capita GDP reaches about $5,000 by 2050, while the baseline and pessimistic scenarios project GDP of $2,800 and $1,000, respectively. The optimistic scenario is the only one in which Ghana achieves its goal of attaining middle-income status by 2020, with per capita GDP of $1,000. Any condition that reduces economic growth rate or increases the population growth rate will impede the achievement of this development goal.

IMPACT projects that maize yields will grow by close to 60 percent between 2010 and 2050 under all scenarios. There is very little difference in yield projections between climate models, suggesting that technological improvements and consumer demand are driving the growth in productivity. Harvested area is not anticipated to grow by more than 10 percent. Together, the growth in area and yield lead to increased production of almost 80 percent.

With consumer demand growing with increasing populations and income, net exports will likely rise up though 2035, and then level off and perhaps drop off a little through 2050. The world market price of maize appears to rise throughout the period, doubling (on average) between 2010 and 2050.

The productivity effects for cassava are less than those of maize, with yield rising only by 30 percent. Harvested area will only grow by around 7 percent, and production will rise by around a third. While this will keep pace with demand until around 2025, after that point demand will outstrip supply, and imports will increase.

For yams and sweet potatoes, IMPACT predicts that yields will increase by 54 percent on average. In the intermediate scenario, some differences between climate models surface, with almost a 30 percent difference between the lowest yield and the highest yield from different climate models. Harvested area is projected to expand by only 5 percent, implying a 60 percent increase in total production between 2010 and 2050. As for maize, this means that exports will rise for a time, then level off and fall off slightly as demand outpaces supply by 2050.

Yield of groundnuts will grow by around 37 percent, but area is expected to decline by 8 percent, leading to a sluggish growth in production of 27 percent, which only keeps up with increased demand until 2020, at which time net imports will increase.

The number of malnourished children under five years will decline under the intermediate and optimistic scenarios, but will rise slightly under the pessimistic scenario. Once population growth is taken into consideration, we note that the percent of children who are malnourished will decline even under the pessimistic scenario.

The per capita calorie consumption parallels that of the number of malnourished children, with calories rising in the intermediate and optimistic scenarios, and falling slightly in the pessimistic scenario. The latter case reflects food price increases outpacing income increases

RECOMMENDATIONS

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

- consider expanding irrigation infrastructure to support year-long production of a wider range of crops;
- improve collaboration between agricultural and meteorological institutions to provide better climatic information to farmers;
- invest in research to enhance rained agriculture;
- improve the road infrastructure and consider developing alternative transport systems to link rural and urban centers;
- consider zoning regulations that would create peri-urban green areas to feed urban populations; and
- Establish internationally-recognized, tourist-accessible protected areas to increase the vegetative cover and provide opportunities for ecotourism.

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