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Southern African Agriculture and Climate Change:
A COMPREHENSIVE ANALYSIS — SWAZILAND

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CURRENT CONDITIONS

Swaziland's climate is moderate, near-temperate, subtropical, and semiarid. The climate is localized, varying over short distances with changes in altitude. Swaziland is a middle-income developing country, with per capita GDP of $1,560. Most people living in rural areas depend on cash income to supplement own-farm income. Subsistence agriculture employs about 60 percent of the rural population and contributes about 16.2 percent of GDP. Maize is the staple food crop and is often used as an index of food availability in the country. Maize production showed a declining trend between 2004 and 2007, with some improvement in 2008–2009. Life expectancy has declined over the past two decades from 60 years in 1990 to just 45 years in 2005, driven by the high prevalence of HIV/AIDS and the impacts of poverty.

CLIMATE CHANGE SCENARIOS & THEIR POTENTIAL EFFECTS ON YIELDS

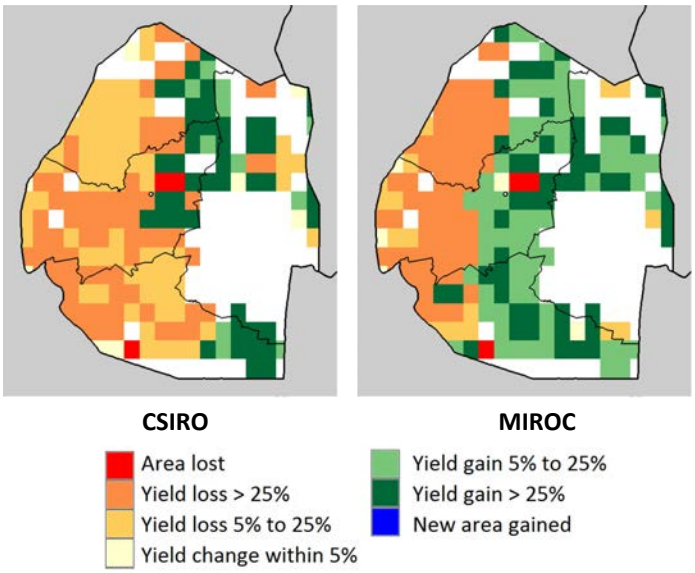
Of the four downscaled global climate models (GCMs) used in our study, all of which are from the IPCC AR4, the CSIRO model shows no significant change between 2000 and 2050 in the northeast (mainly the highveld), and an annual increase of 50–100 mm in the central and eastern part of the country (middleveld, lowveld, and Lubombo plateau). The MIROC model, however, showed a decrease of 50–100 mm in annual precipitation over much of the country.

The CSIRO model predicts a temperature increase of 1–1.5^{0}C across the country for the average daily maximum during the warmest month, while the MIROC model shows an increase of about 1.5^{0}C.

Less rainfall and warmer temperatures will likely mean an increase in shrubs and herbaceous cover and a reduction in tall tree cover. In the worst-case scenario, temperatures might rise by 2–2.5^{0}C, and precipitation might decrease by 200 mm. However, it would be premature to invest in preparing for such an outcome without more conclusive indicators.

The maps here 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.

CHANGES IN YIELD WITH CLIMATE CHANGE: RAINFED MAIZE



The climate change effects from both the CSIRO and MIROC models result in a reduction in maize yield of more than 25 percent in much of the western portion of the country, as well as an increase of more than 25 percent in some parts of the lowveld. The area where yields are projected to decline by more than 25 percent, in the traditional maize-producing regions (the highveld), is greater than the area where yields are expected to increase by more than 25 percent (the lowveld).

The areas for yield loss in the CSIRO map almost perfectly correspond to the current maize production areas, and so we conclude that climate change, without any technological change or adaptation, would result in production loss if this model accurately portrays the future. Since the MIROC model shows gains in some of the high production areas, the conclusion for the MIROC model is less clear.

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The substantial areas where yields are projected to rise by more than 25 percent suggest there may be opportunities to adapt to climate change by gradually shifting maize production to areas that should become more productive.

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 results indicate that maize yield will nearly double between 2010 and 2050, but the cultivated area will decline by almost 40 percent. The net effect will be an increase in production of about 20 percent. With increased demand from population growth and income growth, such a modest production increase will not be enough to meet domestic demand. By 2050, the country will import nearly 200,000 tons of maize. With the world price for maize projected to double, maize could become unaffordable for the majority of the population in the pessimistic scenario.

In support of the need for investment in agriculture to achieve the yield increases projected by IMPACT, several programs to boost production of maize and other crops have been initiated, including the Comprehensive African Agricultural Development Program (CAADP), the Swaziland Agricultural Development Program (SADP), and the Tractor Hire Pool program of the Ministry of Agriculture.

Sugarcane is produced mainly for export: Less than 5 percent of the sugar produced is consumed locally. Sugarcane production is expected to nearly triple to about 17,000 tons by 2050, a result of a near doubling of yields and an increase of almost 40 percent in harvested area. Land is already being converted to sugarcane production from other uses, such as grazing, cotton, and subsistence maize farming. The industry receives technical and agronomic support from organizations such as the Swaziland Sugar Association and SWADE.

The net export of sugar is expected to triple by 2050, bringing much needed foreign currency. The sugar processing industry is diversifying to produce ethanol from molasses and generate electricity from byproducts, an effort to offset fluctuations in the world price of sugar. Generating electricity would also reduce the operating costs of the industry.

In the optimistic scenario, the number of malnourished children under five years is expected to increase from about 33,000 to 44,000 by 2020, and then to decrease to 13,000 by 2050. The assumption is that GDP will increase after 2020, making food (as measured in kilocalories) more readily available.

Trends in available kilocalories per capita appear to be correlated with childhood malnutrition and per capita GDP. In the pessimistic scenario, the decrease in consumption reflects the steep increase in staple food prices, which dominates the effect of the modest growth in per capita GDP.

RECOMMENDATIONS

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

- educate local communities about climate change;
- support agricultural research to assess potential climate change impacts and to guide policy;
- emphasize research that accounts for the ways farmers and communities currently adapt to weather variability and extreme events;
- develop a climate change policy and an adaptation action plan, soliciting needed assistance (in the form of funding and expertise) from international organizations such as UNDP, UNFCCC, and FANRPAN;
- emphasize climate change as an issue in national agendas;
- ensure that National Meteorological Services produce simplified versions of seasonal weather forecast reports for farmers;
- train agricultural extension officers on climate change issues and interpreting seasonal weather reports;
- invest in the construction of small dams, especially in the lowveld area;
- prepare for shifts away from maize as a staple food;
- ensure that drought-tolerant seeds are available and affordable
- provide food and agricultural inputs for qualified vulnerable households.

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