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Southern African Agriculture and Climate Change:
A COMPREHENSIVE ANALYSIS — SOUTH AFRICA

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CURRENT CONDITIONS

The climate of South Africa is unique, with a steep rainfall gradient from West to East, as well as three different rainfall regimes. Some parts of South Africa are prone to drought. The agricultural sector in South Africa experiences multiple stressors: variable rainfall, widespread poverty, environmental degradation, uncertainties surrounding land transformation, limited access to capital (including markets, infrastructure, and technology), and HIV/AIDS.

Primary commercial agriculture contributes about 3 percent to the country's GDP, and about 7 percent to formal employment. Maize is the most important crop as a dietary staple, a source of livestock feed, and an export crop.

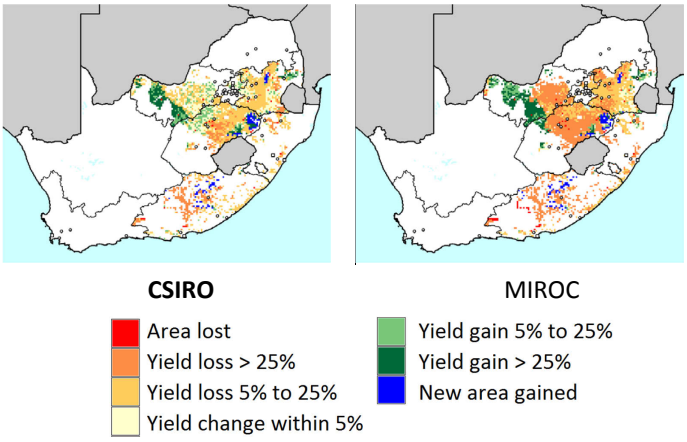
CLIMATE CHANGE SCENARIOS & THEIR POTENTIAL EFFECTS ON YIELDS

The four downscaled global climate models (GCMs) used in our study, all of which are from the IPCC AR4, show rainfall changes to be regionally complex, especially in areas of strong topographical variation. Several general trends are apparent. The data suggest increased annual rainfall along the east coast during summer, while the west coast will receive less precipitation. The southwest is projected to grow drier in both summer and winter.

While the west-east pattern of precipitation response seems consistent across models, there is considerable uncertainty in the magnitude of the response. The CSIRO model predicts that annual rainfall will decrease by about 100 mm in much of Eastern Cape, Northern Cape, Free Stata, and North West provinces, while there will be no change elsewhere. The MIROC model projects that annual rainfall will decline by about 100 mm across the entire country.

The CSIRO model predicts that temperatures will increase by less than 2^0C across the country for the average daily maximum during the warmest month. The MIROC model projects that temperatures will rise by 2–3^0C, with the greatest increase occuring in the country's interior.

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 most significant losses will be in medium- to high-yield areas, impacting food production. The areas where yields may improve are currently marginal. Both the CSIRO and MIROC models show areas of significant yield increases in Northwest province and significant losses in Free State. However, there are some areas in Free State and Eastern Cape that are currently too cold for maize where maize production will become viable with climate change.

For wheat, three out of four GCMs show large areas of increased wheat yield in Free State and Mpumalanga. However, with scenarios showing likely decreases in rainfall, yields are seriously under threat in the Western Cape region.

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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.

The model results for maize are that the harvested area will decrease between 2010 and 2050 by around 25 percent, while yields will rise by around 60 percent on average. There is very little difference in yields between scenarios, but there is around a 15 percent difference from the climate model with the lowest yield to the climate model with the highest yield. At first, total maize production will rise with yield increases. After 2035, these gains will be offset by the loss in area, resulting in 2050 production at a level only slightly higher than in 2010.

Exports are projected to increase through 2020, declining thereafter to a point were South Africa will become a net importer of maize. It is cause for concern that total production will decline dramatically if the expected yield increases do not materialize. Climate change is thus expected to impact the security of maize supply, especially during years of extreme weather.

The crop model did not compute yield changes for wheat in the Western Cape, the IMPACT model is generally optimistic about technological change being able to compensate for the losses of yield in wheat due to higher temperatures. The increase in world price would insulate South Africa against external pressure, as long as domestic production meets demand. This would be the case as long as the assumptions about technological improvement prove to be true. On the other hand, if not, South Africa would need to import wheat. This seems likely in light of the divergence between production and consumption since 2001.

Sugarcane appears to be the most resilient of the field crops to the potential range of climate outcomes. Both yield and harvested area are projected to increase. Yield is projected to increase by around 55 percent and area is projected to increase by around 16 percent, increasing total production by around 80 percent. The difference in yields between the least favorable and most favorable climate models is only around 5 percent, as is the difference in yields between the pessimistic and optimistic scenarios.

Under all scenarios, the IMPACT model predicts the number of malnourished children under five years will increase in the short term and then drop off. In the baseline scenario, that number will drop below the current level by 2035; in the optimistic scenario, it will drop below the current level by 2030. In the pessimistic scenario, we note that the malnutrition rate is slightly higher in 2050 than in 2010. This is due to the small increase in income in that scenario coupled with dramatically higher food prices.

It is of concern that the pessimistic scenario also shows a 16-percent reduction in available kilocalories per capita. With higher incomes in the intermediate scenario, calories consumption remains unchanged, while there is an increase in the optimistic scenario.

RECOMMENDATIONS

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

- educate South Africans about the implications of climate change for agriculture;
- identify and address specific vulnerabilities through adaptation frameworks and actions (particularly for vulnerable regions like KwaZulu-Natal, Limpopo, and the Eastern Cape);
- tailor policies to local conditions;
- encourage sustainable practices to manage environmental resources (soil, water and natural vegetation);
- support agricultural intensification and diversification, avoiding marginal agriculture;
- promote alternative livelihoods in degraded areas; and
- facilitate increased participation in markets within the small-scale sector.

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