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

# Mapping the South African Farming Sector's Vulnerability to Climate Change and Variability

## A Subnational Assessment

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In southern Africa, by the middle of the 21st century climate change is expected to cause temperature increases of 1–3°C, broad summer rainfall reductions of 5–10 percent, and an increase in the incidence of both droughts and floods. Consequently, climate change has significant potential to negatively affect crop production in South Africa, and in turn the well-being of the country's farmers.

This brief is based on a study that examines the level of vulnerability to climate change in South Africa's farming sector by developing a nationwide provincial-level vulnerability profile. Particular attention is paid to the underlying socioeconomic and institutional factors that determine how farmers respond to and cope with climate hazards.

### CONCEPTUAL FRAMEWORK

In this study, vulnerability to climate change is conceptualized as a function of three factors: exposure, sensitivity, and adaptive capacity. Exposure can be interpreted as the direct danger (the stressor) together with the nature and extent of changes in a region's climate variables (temperature, precipitation, and extreme weather events). Sensitivity describes the human–environmental conditions that exacerbate or ameliorate the hazard, or trigger an impact. Exposure and sensitivity are intrinsically linked and mutually influence potential impacts. Adaptive capacity represents the potential to implement adaptation measures in efforts to avert potential impacts (Figure 1). Several indicators representing these three components were selected to facilitate the study's examination of vulnerability in South Africa. The selected indicators—drawn from an extensive review of the literature—represent both the biophysical conditions of the farming regions and the socioeconomic conditions of the farmers.

### RESULTS OF VULNERABILITY ASSESSMENT

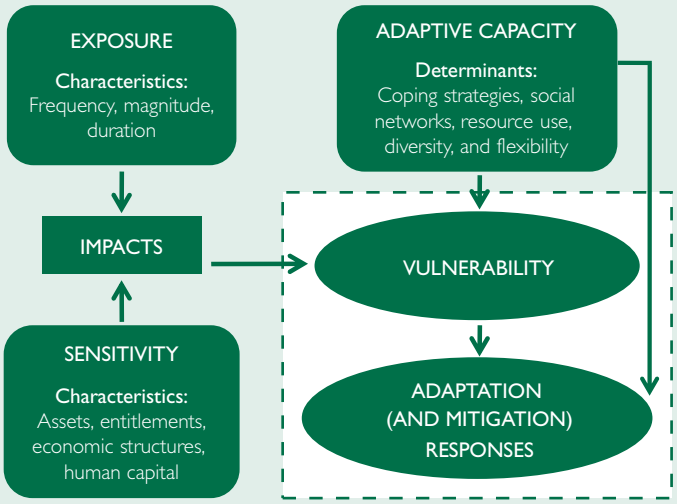
Analysis of vulnerability indicators shows that provinces in South Africa demonstrate vast diversity in environmental and socioeconomic conditions. The coastal provinces of the Eastern Cape, KwaZulu-Natal, and the Western Cape exhibit the highest frequency of extreme events (droughts and floods) over the past century, whereas the desert region of the Northern Cape and the steppe arid regions of the North West and Free State provinces exhibit the lowest frequency. The highest incremental temperature increase by 2050 is found in the desert region of the Northern Cape and the steppe arid regions of Free State and Mpumalanga, and rainfall changes are predicted to be greatest in the Gauteng and North West provinces.

The most sensitive provinces—mainly due to their high proportion of smallholder subsistence farmers—are the Eastern Cape, KwaZulu-Natal, and Limpopo. Smallholder farmers constitute 70 percent of the farming population in the Eastern Cape, KwaZulu-Natal, Mpumalanga, and the North West province, and inappropriate land uses in these regions have severely degraded land and reduced production capacity. The Eastern Cape and Limpopo provinces have the highest shares of agricultural GDP, the lowest average farm-asset values, the lowest literacy rates, and the highest unemployment rates.

The least-sensitive provinces are the Western Cape, Gauteng, and Free State. A common feature of these regions is that they have a low percentage of subsistence farmers and the least-populated rural areas. Gauteng and the Western Cape have greater infrastructure development, high levels of literacy, and lower unemployment rates. The Western Cape is the least sensitive province, largely due to a high degree of crop diversification, low levels of land degradation, and high reliance on irrigation.

Combining the indicators for sensitivity and exposure, KwaZulu-Natal, Limpopo, and the Eastern Cape are predicted to suffer the largest impacts of climate change and variability. With the exception of Limpopo, these provinces have both the largest exposure

**Figure 1 Vulnerability framework**



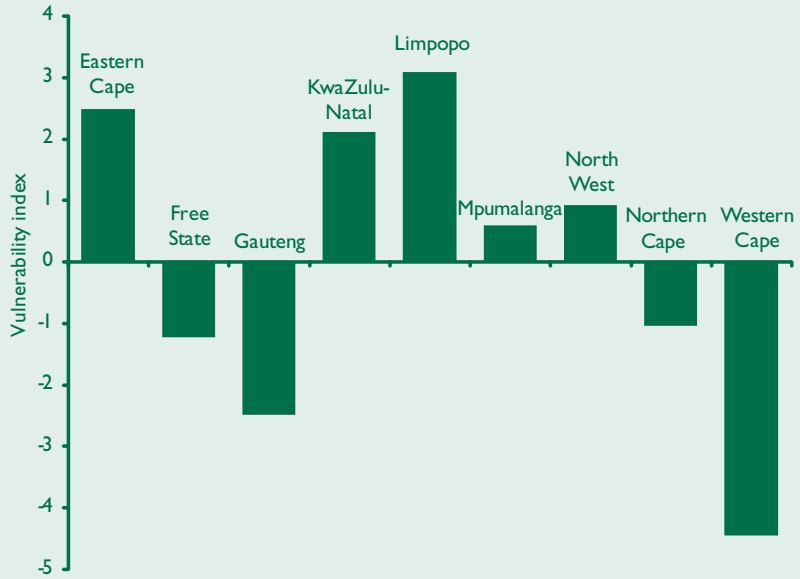
and the highest sensitivity. The Mpumalanga and North West provinces fall within the mid range of vulnerability based on these two indicators, whereas the Northern Cape, Western Cape, Free State, and Gauteng have the lowest risk of negative impacts because of the prevalence of commercial farming and the lack of land degradation.

Indicators of adaptive capacity differ considerably across the nine provinces. Capacity is greatest in the Western Cape due to the combined effects of well-developed infrastructure, high literacy rates and income levels, low unemployment rates and HIV prevalence, and relatively high capital wealth. Gauteng and the Northern Cape fall within the mid-range for this indicator, whereas adaptive capacity is low in KwaZulu-Natal, the Eastern Cape, Free State, Limpopo, and North West due to high dependence on agriculture, high unemployment rates and HIV prevalence, and low levels infrastructure development.

Assessing results based on all three components of vulnerability, Limpopo, the Eastern Cape and KwaZulu-Natal are the most vulnerable provinces; Mpumalanga, the North West, Gauteng, and the Northern Cape fall within the mid range of vulnerability; and the Western Cape has the lowest level of vulnerability. The vulnerability of Free State is considered indeterminate because it exhibits both low exposure and low adaptive capacity.

Figure 2 presents the results of a quantitative vulnerability index based on 19 indicators. As expected, the Western Cape and Gauteng have low vulnerability scores; the Free State, Northern Cape, Mpumalanga, and North West provinces fall within the mid range of vulnerability; and the most vulnerable provinces are the Eastern Cape, KwaZulu-Natal and Limpopo.

**Figure 2 Vulnerability ranking in South Africa by province**




## POLICY IMPLICATIONS

In examining vulnerability at the province level, caution must be taken given enormous heterogeneity in household-level resource access, poverty levels, and adaptive capacity. Ideally, future household-level research will facilitate improved targeting of policies to reduce climate change vulnerability. That said, the results of this study show that the provinces deemed most vulnerable to the effects of climate change and variability do not always equate with the most vulnerable populations. Rather, results suggest that the overall vulnerability of the South African farming sector is characterized by a combination of medium-level exposure risk coupled with medium to high levels of social vulnerability.

In light of large spatial differences in vulnerability, policymakers should tailor policies to local conditions. In highly vulnerable regions, such as Limpopo, KwaZulu-Natal, and the Eastern Cape, policymakers should enact measures (1) to support the effective management of environmental resources (for example, soil, vegetation, and water resources); (2) to promote increased market participation, especially within the large subsistence-farming sector; (3) to stimulate both agricultural intensification and livelihood diversification away from risky agriculture; and (4) to enact social programs and spending on health, education, and welfare to help maintain and augment both physical and intangible human capital. Policymakers should also invest in rural infrastructure development. In areas of high exposure, such as the coastal zones, priority should be given to the development of accurate early warning systems, as well as appropriate relief programs and agricultural insurance.

## FOR FURTHER READING


Gbetibouo, G.A. and C. Ringler. *Mapping South African farming sector vulnerability to climate change and variability: A subnational assessment.* IFPRI Discussion Paper No. 885 (Washington, DC: International Food Policy Research Institute, 2009).



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