



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

Measuring Ethiopian Farmers' Vulnerability to Climate Change Across Regional States

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Ethiopia's agricultural sector, which is dominated by small-scale, mixed crop, and livestock farming, is the mainstay of the country's economy. It constitutes more than half the nation's gross domestic product (GDP), generates more than 85 percent of the foreign exchange earnings, and employs about 80 percent of the population. Ethiopia's dependence on agriculture makes the country particularly vulnerable to the adverse impacts of climate change on crop and livestock production.

This brief is based on a paper that analyzes the vulnerability of Ethiopian farmers to climate change by creating a vulnerability index and comparing vulnerability indicators across regions. A regional vulnerability index can assist in identifying the areas of Ethiopia that are most vulnerable to climate change and guide policymakers in determining where investments in adaptation may be most effective in reducing the future adverse effects of climate change.

VULNERABILITY

According to the Intergovernmental Panel on Climate Change (IPCC), a region's vulnerability to climate change depends on its adaptive capacity, sensitivity, and exposure to changing climatic patterns. Adaptive capacity describes the ability of a system to adjust to actual or expected climate impacts or to cope with the consequences of climate change. Sensitivity is the degree to which a system is affected—whether positively or negatively—by extreme weather conditions and associated climatic variations. Exposure refers to the degree to which a system is exposed to climate change and the nature of the climate stimulus.

The indicators chosen to reflect adaptive capacity include household wealth, access to and use of technology, availability of infrastructure and institutions, potential for irrigation, and literacy rates. Wealth enables communities to absorb and recover from losses more quickly. The livestock owned (number of heads), key assets owned (radios, refrigerators, and so on), and quality of residential homes are commonly used as indicators of wealth in rural African communities. Proximity to agricultural input supplies is identified as an indicator of technology. For instance, drought-tolerant or early maturing varieties of crops generally require access to complementary inputs, such as fertilizers and pesticides.

Well-developed institutions and infrastructure also play important roles in adapting to climate change by facilitating access

to resources. For instance, all-weather roads facilitate the distribution of necessary inputs to farmers and increase access to markets. Health services enable the provision of preventive treatments for diseases associated with climatic change, such as malaria, and the availability of microfinance supports the adoption of technology packages.

Irrigation potential and literacy rates are important factors contributing to adaptive capacity. Locations with more potentially irrigable land can adapt to climate change through improved water control. Regions with a higher literacy rate—a proxy for the level of education—are considered to have greater adaptive capacity.

Generally, increased frequency of droughts and floods negatively affects agricultural production, demonstrating agriculture's sensitivity to climate change. Finally, a region's exposure to climate change is represented by the predicted change in temperature and rainfall by 2050.

INDICATORS OF VULNERABILITY ACROSS ETHIOPIA'S ADMINISTRATIVE REGIONS

The study examined indicators of vulnerability across 7 of the 11 regions of Ethiopia: Afar; Amhara; Beneshangul Gumuz; Oromia; the Southern Nations, Nationalities, and People's Region (SNNPR); Somali; and Tigray. Data were not available for the Gambella region; and the urban centers of Addis Ababa, Dire Dawa, and Harari were excluded.

Regarding the indicators of wealth across the study regions, farmers living in the Amhara and Oromia regions have better quality housing compared with other regions. However, the share of people owning a radio is highest in Afar and lowest in Amhara. Livestock ownership is highest in Somali, given that most of the region's farmers are nomads whose livelihoods depend on livestock. Overall, few farmers in Ethiopia have access to nonagricultural income, gifts, and remittances.

Among the regions studied, farmers in SNNPR have the greatest access to technology, pesticides, fertilizers, and improved seeds, while farmers in the Somali and Afar regions have the lowest access.

The Afar region has the highest proportion of all-weather roads and health services, whereas Somali has the lowest proportion of health services, and Amhara has the lowest proportion of all-weather roads. Market access is highest in SNNPR and lowest

in Somali and Amhara. Primary and secondary schools are equally distributed across the regions except for Somali, which has proportionally fewer schools. Telephone service is most available in rural Afar and least available in Beneshangul Gumuz. Tigray has the highest proportion of microfinance and veterinary services, whereas Somali has the lowest proportion of both these services. Irrigation potential and literacy rates are highest in SNNPR and Tigray and lowest in Afar and Somali.

Over the past century, Amhara has suffered most from droughts and floods, with Oromia and Somali following closely behind, whereas Beneshangul Gumuz and Afar have experienced the lowest number of droughts and floods. The predicted increase in temperature by 2050 is greatest for Afar and Tigray and lowest for SNNPR, and the change in precipitation is highest for Somali and lowest for SNNPR.

VULNERABILITY TO CLIMATE CHANGE BY REGION

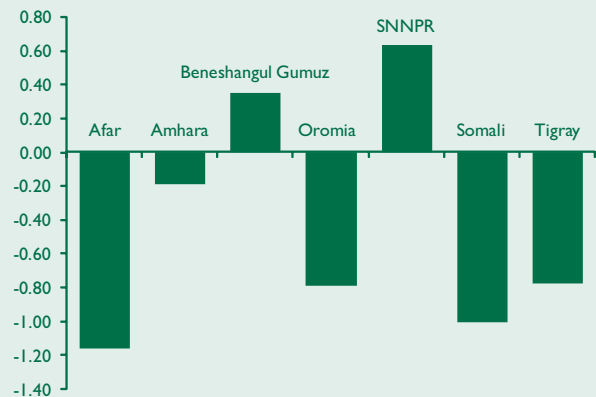
The study calculated vulnerability to climate change by region as the net effect of sensitivity, exposure, and adaptive capacity. Results indicate that Afar, Somali, Oromia, and Tigray are relatively more vulnerable to climate change than the other regions. The vulnerability of Afar and Somali is attributed to their low level of rural service provision and infrastructure development. Tigray and Oromia's vulnerability to climate change can be attributed to the regions' higher frequencies of droughts and floods, lower access to technology, fewer institutions, and lack of infrastructure. SNNPR's lower vulnerability is associated with the region's relatively greater access to technology and markets, larger irrigation potential, and higher literacy rate.

POLICY IMPLICATIONS

While the results of the study identify the regions of Ethiopia most vulnerable to climate change, each region covers a large area with diverse socioeconomic and environmental characteristics. Future research should focus on uncovering localized vulnerability. Nonetheless, the findings from the regional study can help identify policies that may help stabilize national and regional food production in the face of the anticipated adverse effects of climate change.

In general, Ethiopia's vulnerability to climate change is highly

Figure 1 Vulnerability indicators of seven regional states in Ethiopia



SOURCE: Deressa, T. T., R. M. Hassan, and C. Ringler, *Measuring Vulnerability of Ethiopian Farmers to Climate Change across Regional States*, IFPRI Discussion Paper (Washington, DC: IFPRI, 2008 forthcoming).

NOTE: Positive values indicate low vulnerability. Indexes are constructed using the principal component analysis method.

correlated with poverty. Integrated rural development schemes aimed at alleviating poverty would increase the country's capacity to adapt to climate change. Policymakers would do well to prioritize poverty alleviation in the least-developed regions of the country, Afar and Somali, and the relatively more populated regions of Oromia and Tigray.

Likewise, investing in irrigation in areas with high potential, such as in SNNPR, could promote adaptation to climate change. Strengthening the ongoing micro-level adaptation programs implemented by governmental and nongovernmental organizations, such as water harvesting and other natural resource conservation programs, can also boost the adaptive capacities of farmers.

FOR FURTHER READING

Deressa, T. T., R. M. Hassan, and C. Ringler, *Measuring Ethiopian Farmers' Vulnerability to Climate Change Across Regional States*, IFPRI Discussion Paper No. 806, <http://www.ifpri.org/pubs/dp/ifridp00806.asp> (Washington, DC: IFPRI, 2008).

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