

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

The Impact of Climate Change and Adaptation on Food Production in Low-Income Countries

Evidence from the Nile Basin, Ethiopia

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Growing consensus in the scientific community indicates that higher temperatures and changing precipitation levels resulting from climate change will depress crop yields in many countries over the coming decades. This is particularly true in low-income countries, where adaptive capacity is low. Many African countries are particularly vulnerable to climate change because their economies largely depend on climate-sensitive agricultural production. This brief is based on a study that used household survey data to analyze the impact of climate change on food production in the Nile Basin of Ethiopia. The study also examined the factors influencing adaptation and the implications of various adaptation strategies for farm productivity.

CLIMATE CHANGE AND AGRICULTURAL PRODUCTION IN ETHIOPIA

With a population of more than 70 million people and a gross domestic product (GDP) of slightly more than US\$10 billion, Ethiopia is one of the world's least developed countries. The agricultural sector, which is dominated by small-scale, subsistence farming, forms the foundation of the national economy and constitutes the primary source of livelihood for the overwhelming majority of the population. In 2003, the sector employed more than 80 percent of the labor force and contributed 45 percent of GDP and 85 percent of total export revenues. Ethiopian agriculture is almost exclusively dependent on rainfall, given that irrigated agriculture accounts for less than 1 percent of the country's total cultivated land. Thus, the amount and temporal distribution of rainfall and other climatic factors are key determinants of crop yields, and poor or excessive rainfall can induce food shortages and famine.

A recent mapping of vulnerability and poverty in Africa determined that, in terms of climate change, Ethiopia was one of the most vulnerable countries given its low adaptive capacity. Rainfall variability and associated drought have been major causes of the country's food shortages and famine. Nationally, the link between drought and crop production is widely recognized, but little is known about how climate change affects crop yields and what strategies households are using to adapt. Furthermore, few studies have analyzed the factors governing farmers' decisions to

adapt to climate change and the impact of those decisions on yields. This information is particularly important for the design of effective adaptation strategies for coping with the negative impacts of climate change.

CLIMATE CHANGE AND ADAPTATION IN THE NILE BASIN OF ETHIOPIA

The survey underlying the study on which this brief is based was designed to capture farmers' perceptions and understanding of climate change, as well as their approaches to adaptation. Data show that 68 percent of farmers perceived that mean temperatures had increased over the previous 20 years, whereas 4 percent perceived they had decreased, and 28 percent perceived that there had been no change. In terms of mean annual rainfall over the same timeframe, 62 percent of farmers reported a decrease, 18 percent reported an increase, and 20 percent reported no change. Overall, increased temperature and declining precipitation were the predominant perceptions in the study sites.

In response to perceived long-term changes, farm households implemented a number of adaptation measures, including changing crop varieties, adopting soil and water conservation measures, harvesting water, planting trees, and changing planting and harvesting periods. The remaining adaptation measures, which accounted for less than 5 percent of all measures, were nonyield related and included migration and a shift in farming practices from crop production to livestock herding or other sectors. However, about 58 percent of farmers took no action to adapt to long-term shifts in temperatures, and 42 percent took no action to respond to long-term shifts in precipitation. More than 90 percent of those respondents who took no action to adapt cited lack of information and shortages of labor, land, and money as the major reasons. In fact, lack of information was the predominant reason cited by 40–50 percent of households.

DETERMINANTS OF ADAPTATION

Results suggest that information about future changes in climate and access to formal and informal institutions strongly govern household decisions about adaptation. Households with access to

formal agricultural extension, farmer-to-farmer extension, credit, and information about future climate change are more likely to adjust their farming practices in response to climate change. Likewise, households in areas that experienced higher rainfall than average in the Belg (fall) season were also more likely to adopt adaptation strategies compared with households in areas receiving less rainfall. Nevertheless, households with higher than average rainfall during the key Mehere (summer) rainfall season were not more likely to adapt to climate change.

Significant differences were also observed across the country's various agroecological zones when it came to the likelihood that households would undertake measures to adapt to climate change: households in the highlands (Dega) and midlands (WeynaDega) were less likely to adopt adaptation measures compared with households in the lowlands (Kolla). Significant differences in responses were also observed based on household size and age and literacy levels of household heads. Larger households and those whose heads were older and more literate were more likely to adopt adaptation measures, indicating the importance of available labor on the one hand and experience and access to information on the other.

THE IMPACT OF CLIMATE CHANGE AND ADAPTATION ON FOOD PRODUCTION

Although the survey returned information on a total of 48 annual crops grown in the Nile Basin of Ethiopia, the first 5 major annual crops (teff, maize, wheat, barley, and beans) cover 65 percent of plots. The estimation of the production function that follows is limited to these crops.

Results show that farmers who adopted measures to adapt to climate change had higher levels of food production than those who did not: households that adopted adaptation measures tended to produce about 95–300 kilograms more food per hectare than those who chose not to adapt, which accounts for a 10–29 percent difference in output. In other words, adaptation measures substantially mitigated the effect of climate change on crop yields.

Farm-level climatic variation is a significant factor in explaining fluctuations in food production across farm households. Variations in household yield levels could not be explained by temperature. Variations in precipitation during the Mehere season did explain yield differences, although the effects of such differences were nonlinear. An increase in both Belg and Mehere

rainfall seemed to increase food production (controlling for agroecological and other major factors of production), but too much or too little rainfall during these seasons appeared to have a negative effect on food production in the study sites.

As expected, the use of improved seeds, fertilizers, manure, and additional labor tended to increase food production. Significant differences in yields were also observed across agroecological zones, with the highlands (Dega) producing the most food per hectare, followed by the lowlands (Kolla), and finally the midlands (WeynaDega).

CONCLUDING REMARKS

The above results indicate that farmers' decisions to adopt yield-enhancing adaptation strategies are influenced by informal and formal institutional support, the availability of information on future climate changes, the amount of rainfall during the Belg season, and the agroecological setting, as well as household-specific characteristics of size and age and literacy levels of the household head. This suggests that farmers need appropriate and timely information on predicted changes in climate to empower them to take appropriate steps to adjust their farming practices. Moreover, given that access to credit markets and government and farmer-to-farmer extension services was shown to facilitate adaptation, more effort should be made to extend these services to farmers in poor communities.

Averting the negative effects of climate change and achieving food security have become major priorities for development agencies, policymakers, and related stakeholders. Given that adaptation measures have a positive effect on crop yields, the adoption of yield-related adaptation strategies could significantly support these goals. Consequently, adaptation not only enables farmers to cope with the adverse effects of climate change and variability, but also increases the agricultural productivity of poor farm households.

FOR FURTHER READING

Yesuf, M., S. Di Falco, T. Deressa, C. Ringler, and G. Kohlin, *The Impact of Climate Change and Adaptation on Food Production in Low-Income Countries: Evidence from the Nile Basin, Ethiopia*, IFPRI Discussion Paper No. 828 (Washington, DC: International Food Policy Research Institute, 2008).

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