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NOTE

Kenya Smallholder Climate Change Adaptation
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Climate Variability and Climate Change: Impacts on Kenyan Agriculture

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Characteristic of much of Sub-Saharan Africa, Kenya is highly vulnerable to climate change. The country and greater region already experience high temperatures and relatively low but highly variable precipitation while their economies remain dependent on rainfed agriculture. Adoption of modern technology is low; poverty remains widespread; and infrastructure under-developed. In order to devise adaptation strategies for smallholders in Kenya, researchers need to assess the impact of climate change and variability on the agriculture sector and economy. This project note is based on a report that gives an overview and analysis of climate variability, climate change, and their respective agricultural impacts.

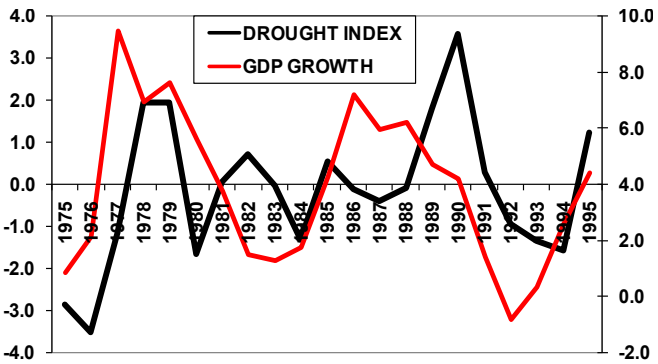
HISTORIC PERFORMANCE OF THE KENYAN AGRICULTURAL SECTOR

Kenya's climatic conditions vary from humid tropical regions along the coast to arid inland areas. Rainfall is highly variable, especially in the arid and semi-arid regions, and therefore unreliable for rainfed agriculture and livestock production. The rainy seasons can be extremely wet, bringing floods and inundation. Even the arid and semi-arid areas that comprise 80 percent of total land area are prone to floods despite their low levels of rainfall (between 300 and 500 millimeters annually).

Kenya also experiences major droughts every decade and minor ones every three to four years. The negative effects of these droughts are spreading among the increasingly dense population and fragile arid and semi-arid lands. Moreover, intensification and transition to mixed agro-pastoralist systems are increasingly marginalizing nomadic and pastoralist systems.

Climate is a robust determinant of agricultural sector performance and, in turn, general economic performance in Kenya and elsewhere in rainfed Sub-Saharan Africa. With agriculture accounting for about 26 percent of Kenya's gross domestic product (GDP) and 75 percent of its jobs, the Kenyan economy is highly sensitive to variations in rainfall. Figure 1 shows the close relationship between drought events and GDP growth. At the same time, rainfed agriculture is and will remain the dominant source of staple food production and the livelihood foundation of the majority of the rural poor in Kenya. Therefore, there is an urgent need to improve the scientific and economic capacity to better understand and cope with existing climate variability.

Figure 1. Linkage between the Palmer Drought Severity Index (PDSI) and GDP growth, Kenya, 1975–1995



Source: IFPRI 2006.

CLIMATE CHANGE PROJECTIONS

Climate model simulations under a range of possible greenhouse gas emission scenarios suggest that the median

temperature increase for Africa is 3–4°C by the end of the 21st century, which is roughly 1.5 times the global mean response. The situation is more complicated for precipitation, which is highly variable spatially and temporally with limited data available for analysis. Total annual precipitation projections for Kenya suggest increases by approximately 0.2 to 0.4 percent per year. Within Kenya, however, regional variations in precipitation are vast: the coastal region is likely to become drier while the highlands and northern Kenya are likely to become wetter. In addition, temperature increases will have a significant impact on water availability, thus exacerbating drought conditions. Thus, in the lowlands, increases in rainfall may not lead to increases in agricultural productivity since increases in temperature will also increase evapotranspiration and offset any potential increase in productivity.

Increases in rainfall variability and the frequency of extreme rainfall events will be increasingly important for Kenya's rural development. Extreme events are likely to become more intense over much of northern East Africa. In Kenya, "wet extremes" (defined as high rainfall events that occur once every 10 years) are projected to increase during rainfall seasons while dry extremes are projected to be less severe, at least in the northern parts of the country.

The coastal areas of Kenya will experience changes in sea level due to global warming. A rise in sea level will have damaging effects on the production of tree crops situated along the coast (including mangoes, cashew nuts, and coconuts), other agriculture-based enterprises, coastal ecosystems (including mangroves and coral reefs), fisheries, and tourism.

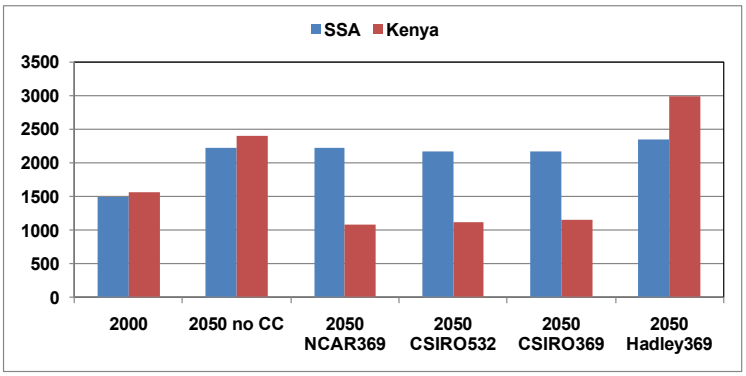
IMPACTS OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTION IN KENYA

Changes in temperature and rainfall patterns influence local seasonal and annual water balances; which, in turn, affect the growing season and production outcomes. Therefore, fluctuations in the length of the growing period are a good indicator of the impacts of climate change on crop yields and production.

A range of climate change scenarios and models suggest that many parts of Kenya are likely to experience a decrease in the length of growing periods, and, in some areas, the decreases may be severe. Some of the largest losses and gains are predicted for arid areas, which have too few growing days for crop production but remain important for pastoralists. There are also a few areas, especially in the highlands, where the combination of increased temperatures and rainfall changes may lead to an extension of the growing season. Although the projected increases in rainfall might appear to be good news for arid and semi-arid districts, increased evapotranspiration due to rising temperatures means few if any increases in the length of growing periods and rangeland or crop productivity.

Based on most climate change scenarios, an analysis of the production of four key staple crops in Kenya (maize, wheat, groundnuts, and irrigated rice) through 2050 shows that Kenya will experience country-wide losses due to increased evapotranspiration in large cropland areas; coupled with modest increases in maize and bean production in the Kenyan highlands. There is large uncertainty about the magnitudes of these production losses, but maize yields are expected to decline by 50–55 percent for three out of four scenarios analyzed while increasing by 25 percent under the fourth (Hadley) scenario (see Figure 2). The value of production loss from maize alone could reach US$100-200 million annually by 2050 under three out of four scenarios examined.

Figure 2. Maize yield based on historic climate data and alternative climate change scenarios (in kilogram per hectare)



Note: The numbers 369 and 532 refer to atmospheric carbon dioxide: The level was 369 parts per million in 2000 and is expected to reach 532 parts per million in 2050. NCAR= National Center for Atmospheric Research (NCAR-CCSM3); CSIRO = Commonwealth Scientific and Industrial Research Organisation (CSIRO-Mk3.0); Hadley = Hadley Centre Coupled Model version 3 (HadCM3). -

While there is great uncertainty about the changes in climate variability, a simulated increase in variability, leading to more than one drought every five years, could cause significant, irreversible decreases in livestock numbers in arid and semi-arid lands due to the increased mortality and poorer reproductive performance of the animals. Pastoralists whose food security and livelihood depends solely on livestock would obviously be severely affected under these conditions.

IMPACTS OF CLIMATE CHANGE ON THE ECONOMY IN KENYA

Climate change affects the agriculture sector directly and indirectly through impacts on crop productivity and production. This results in shocks to the economic system and changes in local and international prices, which, in turn, affect

food demand, calorie availability, and, ultimately, human well-being. Analysis shows that climate change would likely lead to increased food imports by Kenya. At the same time, higher food prices will dampen demand for food, as affordability of nearly all agricultural commodities—including basic staples and livestock products—declines. As a result, per capita calorie availability in Kenya is likely to decline, translating into increases in malnutrition, especially of young children. These effects will be exacerbated in areas of high vulnerability, namely arid and semi-arid lands.

CONCLUSION

As a result of climate change, Kenya could see significant areas where cropping is no longer possible and the role of livestock as a livelihood option increases. Even under moderate greenhouse gas emission scenarios, the patterns of African cropping and livestock keeping will likely see substantial shifts by the middle of this century.

Major changes within the agricultural system may be required in order to protect livelihoods and ensure food security. Responses to climate change need to encompass several levels, including crop and farm-level adaptations; collective action at the community level; and supporting policies and investments at national, regional, and global levels. This will require the involvement of all stakeholders.

Potential strategies include infrastructural investment, water-management reform, land-use policy, and food trade. Diversification of income sources is also a key adaptation strategy that should be encouraged further. This may include highly targeted efforts to promote livestock ownership, facilitate risk management, and broaden income-generating opportunities.

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