Climate Change in Eastern and Southern Africa

Impacts, Vulnerability and Adaptation

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Introduction

Africa is a continent of contrasts. It boasts an incredible diversity of ecosystems, natural resources, economic activities and types of settlements. It is also characterized by conditions of widespread poverty and human insecurity. Climate change represents a new threat and challenge to Africa because many households, social groups and regions have a limited capacity to adapt to climate variability and change. Eastern and southern Africa's vulnerability to climate change is shaped by the complex interaction of social, political, economic, cultural and environmental factors, all of which are likely to be affected by the projected impacts of climate change.

In its most recent assessment, the Intergovernmental Panel on Climate Change (IPCC) reported that all of Africa is likely to warm during this century, with the drier subtropical regions warming more than the moist tropics. Annual rainfall is likely to decrease throughout most of the region, with the exception of eastern Africa, where annual rainfall is projected to increase. These changes in the physical environment are expected to have an adverse effect on agricultural production, including staple crops such as millet and maize. The areas suitable for agriculture, the length of growing seasons, and yield potentials (particularly along the margins of semi-arid and arid areas) are expected to decrease. Diminishing fisheries resources in large lakes due to rising water temperatures are expected to further limit local food supplies. Due to the overall drying of the continent, between 75 and 250 million people are projected to be exposed to additional water stress by the year 2020. Towards the end of the 21st century, projected sea level rise will affect low-lying coastal areas with large populations, with associated costs estimated at least 5-10% of gross domestic product (GDP).

Africa as a whole is considered to be among the most vulnerable regions to climate variability and change due in part to a lack of financial, institutional and technological capacity. However, the role that non-climatic factors play in exacerbating or reducing the impacts of climate change creates a highly differentiated picture. A number of important finding have emerged from the climate change and development literatures, and from analyses of risks and hazards. These findings can be used to identify numerous entry points for reducing vulnerability to climate change in Africa. In this report we highlight five key themes that are important to efforts aimed at addressing climate change impacts, vulnerability and adaptation in eastern and southern Africa (Figure 1):

1. *Climate change poses serious threats and challenges to eastern and southern Africa*. It exacerbates existing risks such as water stress, the spread of infectious disease, and food security.
2. *Climate change interacts with many other types of changes*. Vulnerability can be attributed to a set of risks that is broader than climate change alone; conflict, disease outbreaks, economic degradation and other "creeping" factors are additional sources of vulnerability.
3. *Vulnerability to climate change is differential*. Whether considered in relation to the location, sector, state, or social group, vulnerability is context-specific due to differences in the set of social and environmental conditions, as well as the set of stressors to which each are exposed.

Figure 1: The focus of this report is eastern and southern Africa which includes the countries of Angola, Botswana, Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Seychelles, Somalia, Somalia, South Africa, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

4. *Indigenous strategies are insufficient to cope with the effects of climate change*. There is a rich set of indigenous strategies for coping with multiple threats, climate variability and environmental change, but they are not sufficient to reduce the negative impacts of climate change; nor are such strategies adequately supported by policy processes.
5. *Societal transformations are altering the context for adapting to climate change*. These transformations include urbanization, land tenure changes, and market reforms. In some cases these transformations are positive, but in other cases they may undermine adaptive capacity and increase vulnerability to climate change.

These points suggest that any single formula or policy will be insufficient for addressing climate change. Vulnerability reduction involves more than technological or engineering measures to reduce the biophysical impacts of climate change. It extends to a broad set of measures which address the multiple stressors that interact with climate change to generate vulnerability. A suite of strategies are needed that will address the factors that generate vulnerability. Responses must be both anticipatory and rapid, and focus on societal transformations so that individuals, communities and regions can cope with and adapt to the risks associated with climate change.

1. Climate Change Impacts

Recognizing the need for an objective source of information about the causes of climate change, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988. The IPCC's function is to assess the best available scientific, technical and socioeconomic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. Their assessments draw on the work of hundreds of experts from all regions of the world and are based on information primarily from academic, peer-reviewed literature.

IPCC reports are written by teams of authors, which are nominated by governments and international organizations and selected for specific tasks according to their expertise. These reports are viewed as the most authoritative body of knowledge on climate change. Its fourth assessment report was published in the spring of 2007 and stated that warming of the climate system is now "unequivocal"; human-induced climate change is observable and having a discernible influence on physical, biological and social systems throughout the world.

Seven climatic zones can be distinguished for Africa (Figure 2) and within these zones, altitude and other localized variables produce distinctive regional climates. The climates of eastern and southern Africa vary from humid equatorial regimes to seasonally arid tropical regimes. High variability, both seasonally and annually, characterizes the patterns of rainfall. The nature of atmospheric circulation over eastern and southern Africa means that the regional climate is highly sensitive to small changes in the global climate.

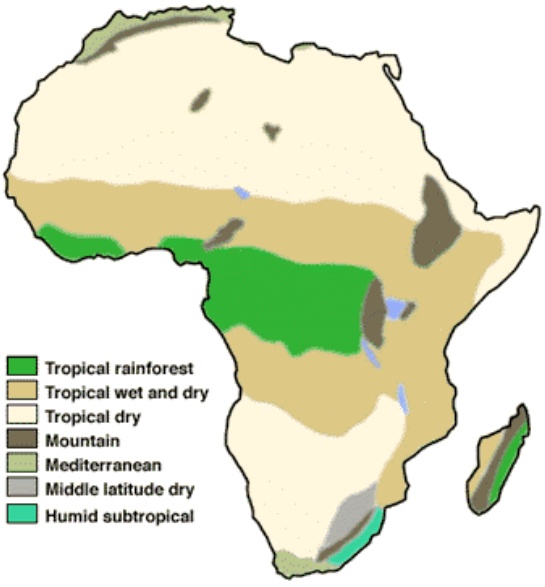

Figure 2: The climate zones of Africa.

Average annual temperatures in Africa have been rising steadily and during the 20th century the continent saw increase in temperatures of about 0.5°C. Countries in the Nile Basin had an increase of about 0.2°C to 0.3°C per decade during the second half of the century, while in Rwanda temperatures increased by 0.7°C to 0.9°C. Climate models project that across the entire continent and for all seasons, the median temperature increase by the end of this century will be between 3°C and 4°C,

roughly 1.5 times the global mean response. Future warming is likely to be greatest over the interior of semi-arid margins of the Sahara and central southern Africa.

Projected changes in precipitation will lead to a drying throughout southern Africa and increases in rainfall over parts of eastern Africa. Research on changes in extreme events in Africa is limited, however, there is evidence for an increased risk of intense rainfall events and associated flooding. In general, however, surface runoff (which is a product of both rainfall and increased evaporation due to higher temperatures) is likely to decrease over the next century. There is evidence that droughts are increasing in southern African drylands and are expected to increase further as a result of increased temperatures and reduced rainfall.

The IPCC has identified Africa as one of the most vulnerable continents to climate variability and change. Climate change will be a particular challenge for food production in the region. Farming in Africa is highly dependent on rain-fed agriculture. Increased droughts can seriously reduce crop yield and thus affect food security; people making a living in marginal areas area will be most severely impacted. Drought-prone areas of Namibia, Botswana, Zimbabwe, Sudan and Ethiopia are likely to be more vulnerable to climate change than the more humid areas of Tanzania or Zambia. For the region as a whole, net productivity reductions of more than 10% are possible in the case of maize and other major crops such as sorghum, millet, sugar cane, and wheat. In some parts of eastern Africa, commercial ranching may marginally improve as the result of increased rainfall, whereas communal ranching might be disadvantaged because of increased erosion and the incursion of woody weeds.

Water-related problems that already exist in the region are likely to worsen as a result of climate change. Intense rainfall events will increase the incidence of flooding in many areas, however, reduced runoff overall will exacerbate current water stress, reduce the quality and quantity of water available for domestic and industrial use, and limit hydropower production. Access to water in the Nile basin countries is dependent on runoff from the Ethiopian highlands and the level of Lake Victoria, both of which are sensitive to variations in rainfall. While the impact of climate change on water scarcity may be relatively minor compared to socioeconomic changes such as increased demand, land cover change and economic growth strategies, it may have international consequences and become a source of conflict.

The effects of climate change on human health continue to be a matter of scientific debate. Some assessments suggest that climate change can lead to an expansion of the areas suitable for malaria transmission, and thus increase risk of the disease. Others argue, however, that malaria risk must be interpreted on the basis of local environmental and socioeconomic development, where land use decisions and the ineffectiveness (or absence) of malaria control programs may in fact be driving risk.

Sea level rise represents another threat to the region through saltwater intrusion and coastal erosion, although these effects will only be felt toward the end of the 21st century.

Some of these climatic changes may have devastating effects where they add to existing stresses such as water scarcity and climatic variations such as decadal drying events. In addition, uncertainty regarding the direction and magnitude of changes in precipitation, river flows and lake levels in particular represent a challenge for adaptation to climate change.

2. Multiple Stressors

People do not experience climate change in an isolated or discrete manner. Many other changes are occurring simultaneously, creating multiple sources of human insecurity. The spread of infectious disease (e.g., malaria, tuberculosis and HIV/AIDS) is occurring alongside trade liberalization, water reforms, and political or social conflict. Together, all of these changes influence the capacity to respond to climate-related events, such as droughts, floods, or pest outbreaks. Yet simple compilations of threats and collective assessments of their impacts do not adequately capture the nature and dynamics of vulnerability. Instead, it is necessary to consider how processes *interact* to influence exposure to climate change and the capacity to cope with or adapt to climate variability and

long-term changes. Some individuals, households, social groups and regions in southern and eastern Africa are becoming more vulnerable to shocks and stressors of all types. A small climate event can trigger major impacts for some, just as a major climate event can have negligible consequences for others. Cascading stressors often create cumulative effects, leading to situations described as path dependency, the spiral of poverty, or chronic vulnerability. Some examples of the interactions of multiple stressors are presented below:

- The 2001-2003 drought in southern Africa had such a dramatic effect because HIV/AIDS had reduced labor availability and nutritional status, at the same time that cereal reserves had declined and market prices for maize increased. In Malawi, the combination of drought and HIV/AIDS has had a particularly strong impact on children. This conflation of stressors has led to what some have described as "new variant famines" in the region.
- Trade liberalization is creating new export opportunities, but also exposing many farmers to competition from cheaper imports. In the case of Botswana, grain imports from South Africa have combined with lower subsidies and reduced support for dryland farmers, forcing them to diversify away from cereal production. At the same time, agricultural loans were recalled in the mid-1990s, following payment failure after subsequent droughts. Lacking capital and machinery, it has become increasingly difficult to make a living from farming, and vulnerability to climate shocks has increased.
- Termination of the Multi-Fibre Agreement has led to a loss of jobs in the clothing industry, which is one of southern Africa's few export industries. In Lesotho, the loss of 10,000 jobs in 2005 affected the livelihoods of 40,000 people, increasing their vulnerability to climate-related shocks and stressors. Several years of consecutive drought have led to an increase in the price of maize, making it more difficult for the unemployed to access food.
- Privatization of agriculture and marketing in Zambia has diminished market access in many remote areas. The lack of investment in transport and infrastructure make it difficult to sell surplus production in good years, and access food in bad years. The 2007 floods in Zambia affected livelihoods in several districts and provinces as crops were washed away and/or submerged. Damage to infrastructure such as roads and bridges limited access to food, education and medicine. Although privatization has benefited some farmers, many farmers have become more vulnerable to climatic events.
- Conflict situations contribute to the transmission of infectious diseases through population displacement and disruption of health services. Conflicts, which include both military aggression and civil war, can undermine the ability of households or villages to cope with drought or adapt to long-term climate change, both during and after the conflict. For example, the civil wars and protracted social conflicts in Namibia, Angola, Mozambique and Zimbabwe, have left a legacy of landmines, rendering areas unavailable for use as arable or grazing land. Landmines may also restrict or endanger access to other crucial resources such as water. Poor health, displacement and exclusion from resources critical for coping interact to create very vulnerable groups.
- Localized conflicts can push some people into destitution and extreme poverty. In some areas of the Kenyan drylands, for example, conflict and insecurity lead to loss of assets, migration, landlessness, and exclusion from key resources such as dry season grazing areas, forests and drought water sources. This undermines people's capacity to sustain livelihoods in the face of a drought in the short term and changes in the climate in the long term. When political and social instability are interwoven with economic poverty and resource shortages, people's capacity to cope is diminished; even an unexceptional drought or heavy rainfall may trigger widespread suffering.
- Where conflicts and droughts coincide, effects can be particularly devastating on the population. This is exemplified by Darfur where the conflict and associated looting and destruction of assets, highly restricted population movements and disruption of markets and trade have restricted livelihood options and people's capacity to cope with drought. Most

livelihood strategies are now poorly remunerated and often associated with risk. The drying of Darfur in the 1980s and 1990s in Darfur has been attributed to changes in the global climate in terms of the pattern of ocean temperatures which influenced the African monsoon. Whether global warming or natural drifts in oceanic temperatures are to blame for the drought is less clear. The drying may contribute to vulnerability in an area already struck by conflict and violence. While drought and ecological scarcity may exacerbate existing tension, the actual causes of the conflict themselves are likely to be more complex.

- Land tenure changes and replacement of customary institutions has created local tensions as well as weakening of local resource management and made land rights more insecure for some pastoralists and small-scale farmers. For example, in Sudan some mechanized commercial farms have engulfed smallholder farms and former rangelands. This has contributed to landlessness and migration to urban areas, creating new groups that are vulnerable to climate variability and extremes.

The consequences of infectious disease, institutional reforms, trade liberalization, urbanization, and conflict have implications for how climate variability and change are experienced in southern and eastern Africa, and they influence responses to climate change.

3. Differential Vulnerability

Africa is often considered to be highly vulnerable to climate change because of widespread poverty. However, not everyone and every place in eastern and southern Africa is equally vulnerable to climate change. Vulnerability to climate change varies greatly among regions, sectors and social groups in southern Africa. There are differences between countries in the region, as described in Table 1. For example, the agricultural share of employment varies substantially by country. In Tanzania, Mozambique, and Malawi, more than 80 percent of the population is employed in agriculture, in contrast to South Africa and Mauritius, where less than 20 percent of the population is dependent on agriculture. Nevertheless, it is important to recognize that differences may actually be much larger within countries. Differential vulnerability is related to current climatic and geographic heterogeneity, as well as to the variety of social factors influencing vulnerability. For example, the provision of services and access to alternative livelihoods may vary dramatically between villages and even between households in the same village. The majority of southern and eastern Africa's farmers are smallholders who engage in low-input farming, in addition to other livelihood activities, whereas only a minority are involved in high-input commercial farming. Farmers, livestock herders, and urban populations will all be affected by climate change in different ways, depending on a complex interplay of processes.

Furthermore, poverty and vulnerability are not identical. Some of the factors that generate vulnerability to climate change are indeed closely associated with poverty. It has been pointed out that poor people are often the ones to suffer injury, loss, death, or harm from droughts, floods, or other extreme events, and they have less capacity to recover. However, within any area, it is not always the poorest that are the most vulnerable. As explained by Coetzee:

> *"…poverty and vulnerability do not coincide in the same way in all cases. People experiencing vulnerability are not necessarily poor; and amongst the poor, there may be varying levels and patterns of vulnerability - depending on the multitude of dynamic processes through which individuals and households respond to changes in the environment, adopt and adjust strategies, and reconfigure their relative well-being".*[1]

[1] Page 5 in Coetzee, E. 2002. 'Urban vulnerability: A conceptual framework'. In: Nomdo, C. and Coetzee, E. (eds.) *Urban vulnerability. Perspectives from southern Africa,* Cape Town, Periperi Publications, 2-27.

		Angola	Botswana	Burundi	Eritrea	Ethiopia	Kenya	Lesotho	Malawi	Mozambique	Namibia	Rwanda	South Africa	Sudan	Tanzania	Uganda	Zambia	Zimbabwe
Vulnerability context	Urbanization	■			■		■	■	■	■			■	■	■	■		
	Spread of cash crops		■						■	■	■			■				
	Shift from pastoralism to cultivation		■				■							■		■		
	Shift of pastoralism and cultivation into drier areas						■		■					■				
	Conflict/post-conflict/insecurity	■		■	■		■			■	■	■	■	■		■		■
	Inequitable land distribution						■						■					■
	Low education	■		■	■	■	■		■	■		■		■	■	■	■	
	Poor infrastructure	■		■	■	■	■	■	■	■		■		■	■	■	■	
	Gender inequality	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Dependence on climate-sensitive resources	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Poor water access by population	■			■	■	■			■					■	■	■	
	Poor health status	■	■	■		■	■		■	■		■		■	■	■	■	■
	HIV/AIDS		■				■	■	■	■	■		■		■	■	■	■