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Climate Change in Eastern and Southern Africa

Impacts, Vulnerability and Adaptation

Siri Eriksen,
Karen O'Brien and
Lynn Rosentrater
Department of Sociology
and Human Geography
University of Oslo

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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 percent 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 findings have emerged from the climate change and development literature, 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 efforts aimed at addressing climate change impacts, vulnerability and adaptation in eastern and southern Africa (Figure 1):

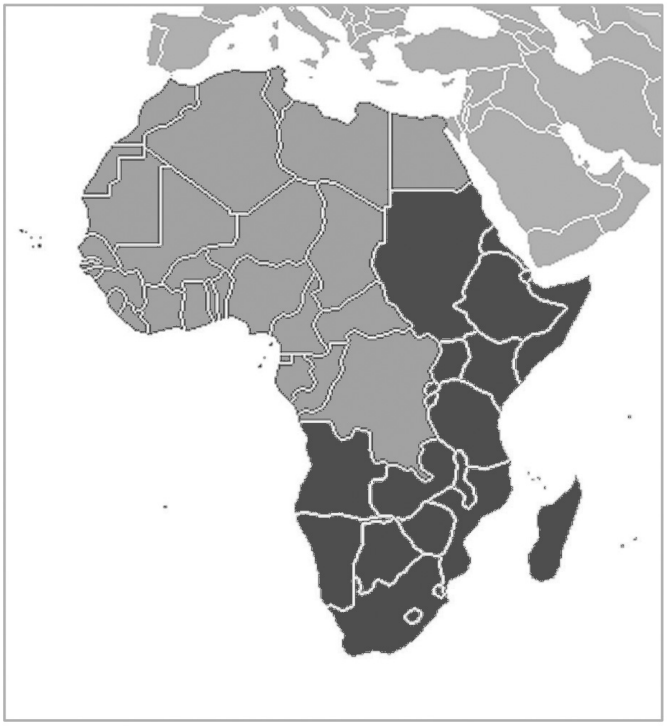

Figure 1: The focus of this report is eastern and southern Africa which includes the countries of Angola, Botswana, Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Seychelles, Somalia, Somalia, South Africa, Swaziland, Tanzania,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

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 diseases, and food insecurity.

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.

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.

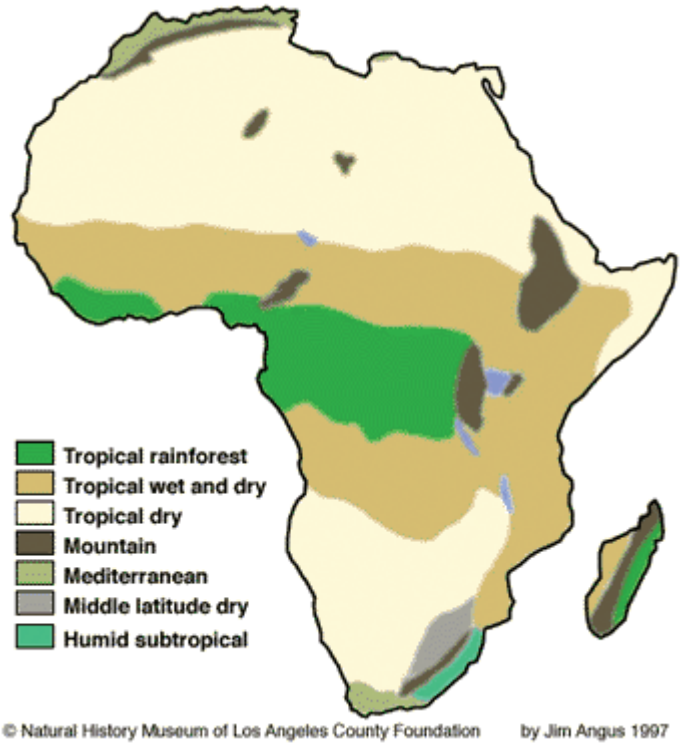

Figure 2: The climate zones of Africa.

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.

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. More frequent and prolonged droughts can seriously reduce crop yield and thus affect food security; people making a living in marginal areas 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 percent 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 diseases (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 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.

Table 1: Summary of climatic challenges, vulnerable sectors and vulnerability context by country. Note: Based on an assessment of available information which varies in quality between countries; there may also be large geographical variations in the variables within countries.

		Angola	Botswana	Burundi	Eritrea	Ethiopia	Kenya	Lesotho	Malawi	Mozambique	Namibia	Rwanda	South Africa	Sudan	Tanzania	Uganda	Zambia	Zimbabwe
Climatic challenges	Increase of temperature	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Increased incidence of droughts	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Decrease in rainfall		■						■	■			■				■	■
	Seasonal shifts in rainfall	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Heavy snowfalls and winds							■										
	Cyclones									■								
	Localized floods	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Overflowing of large rivers					■				■				■		■		
	Lakeshore flooding						■								■	■		
	Decline in lake levels			■			■					■			■	■		
	Decreased/varying river flow	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Wildfires	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■
	Sea level rise	■			■		■			■	■		■		■			
	Salt water intrusion	■			■		■			■	■		■		■			
	Coral reef bleaching				■		■			■					■			
	Landslides in mountainous areas			■			■	■	■			■				■		
Vulnerable sectors	Water scarcity		■			■	■	■			■		■	■		■		■
	Biodiversity loss/tourism	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Health/disease outbreaks	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Hydropower			■			■	■	■	■	■	■	■		■	■	■	■
	Coastal ecosystems, islands and cities				■		■			■	■		■		■			
	Infrastructure	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Fisheries	■		■	■		■		■	■	■	■	■	■	■	■	■	
	Agriculture and food security	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Livestock		■		■	■	■	■		■	■	■		■	■	■		■

		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		■				■	■	■	■	■		■		■	■	■	■

The recognition of differential vulnerability and the distinction between vulnerability and poverty are important in terms of understanding the consequences of climate change, and formulating and targeting policy interventions:

- Within any country, vulnerability can vary from village to village. A comparison of climate vulnerability in two villages in Zimbabwe showed that unequal distribution and access to markets, power structures and breakdown of social networks affect vulnerability differentially. One village was more vulnerable to climate events because of poor infrastructure, lack of markets, limited institutional support, and a poor and deteriorating biophysical environment, in comparison to the other village, which had well-developed infrastructure and markets.
- Vulnerability can vary within villages, where droughts or floods often create both winners and losers. For example, some commercial farmers in southern Mozambique were able to pump irrigate their crops during the 2001-2003 drought, and profited from higher prices in regional and urban markets. Meanwhile, smallholder farmers had to resort to casual employment at marginal pay, collection of forest foods, or cultivation of crops such as pumpkins and sweet potato leaves in the river bed.
- It is not always the poorest who are most vulnerable to climate change. In the Limpopo Province of South Africa, irrigation farmers may be at greater risk from an increased frequency of droughts because they are less diversified, and they face a combination of both market and climate risks.
- It may be the case that one group's adaptation to climate variability and change increases the vulnerability of other groups. In one site in Kenya, some village residents rented out water wells to pastoralists during drought, providing an important source of income. Other residents who were dependent on free access to these wells found it increasingly difficult to access enough water for domestic consumption and livestock.

So who is most vulnerable to climate change? It is not simply a question of poverty, but of a combination of factors that render some vulnerable to even small perturbations or changes. The most vulnerable are often those who are unable to specialize in a non-risky activity, or unable to diversify their livelihoods. They may also include those who lack access to forests or productive land, and those who have been displaced from their homes due to floods, conflicts, or livelihood shocks without receiving adequate humanitarian assistance. The vulnerable often live in areas that are marginal in terms of services, leading to health problems, difficulty accessing water, and crop and livestock disease. These people are also often exposed to a breakdown of security in terms of theft and petty crimes during periods of climate-related stress. Households that are affected by HIV/AIDS, malaria, and other infectious diseases are often more vulnerable to climatic events, as they may experience labor shortages during critical periods or a breakup of the family.

4. Indigenous Response Strategies

There is a rich set of indigenous strategies to deal with multiple threats, variability and environmental change, but they are not sufficient for reducing the impacts of climate change. Processes such as land reform, new market opportunities and political changes are not only affecting the risks that people face, but also the way that people cope with and adapt to climate and other risks. People normally rely on a number of different activities for food and income in addition to, for example, agriculture. This diversification is common for most groups, whether smallholder farmers, pastoralists, rural or urban workers or unemployed slum dwellers. In particular during droughts or floods when farming fails, farmers engage in a diversity of activities. While sale of poultry and livestock, informal trade and casual employment are coping strategies common to most areas of eastern and southern Africa, the exact combination of activities in which a household engages depends both on the options available locally and the labor availability, education, skills, and access to capital of the household or individuals within it. In addition to resource access, strong local links between and within social groups and local knowledge of environmental processes are important for coping and adapting.

While people switch between strategies to secure livelihoods as a drought develops, floods have a more sudden and dramatic impact. In Uganda, the El Niño-induced high rainfall in 1997/98 destroyed many crops in some regions. Flooding resulted in the death of 1000 people, the displacement of 150,000 people and damage to trunk and rural road infrastructure estimated at USD 400 million. While early warning and formal emergency response systems are improving in the region, people's own strategies in terms of migrating to safe areas and relying on kinship and family remain the most important sources of survival.

The notion that Africa has low adaptive capacity due to a low financial, technological and institutional capacity needs to be nuanced by the fact that a wealth of coping and adaptation strategies exist at the household and village level. However, the existence of these strategies is no guarantee of successful adaptation in terms of securing basic needs in the face of climate variability and change. When a main activity such as agriculture fails, most people lack the skills, labor or capital necessary to specialize in another activity that can take agriculture's place as a reliable primary income source. Instead, most have to resort to a range of opportunistic activities, including collecting wild foods, producing charcoal and seeking casual employment. As a drought situation intensifies, the options often dwindle and more and more people are pushed into these few activities of marginal and decreasing returns. When faced with severe and prolonged climatic events, some of the most vulnerable people have to sell key productive assets such as land, livestock, farm tools, roofs from their homes or even resort to prostitution, thereby endangering their livelihoods in the long term, which for many leads to destitution.

One of the reasons that indigenous strategies are inadequate is the fact that they largely have to operate without any formal government support or facilitation. Since only a minority have access to formal employment and market-based options, most people rely on informal economic activities. The local knowledge, networks, customary institutions and local biodiversity that are used for coping are often ignored by the formal financial, technological and institutional framework of most countries. Social networks are often exhausted in areas where flood victims receive no government assistance. Furthermore, policies sometimes inadvertently undermine local coping capacity by restricting flexibility. There is a danger that agricultural development focused on the specialization of production for export increases sensitivity to climate changes and fluctuations in market prices while providing low and unreliable income for most. Takeover of the best agricultural lands by commercial agriculture, privatization of land, and the increase in protected areas restrict mobility and exclude people from many of the areas previously used during drought. In eastern Africa, formalizing traditional water uses and privatization of water services has led to loss of access to water by the low income groups. At the same time, the solutions on which many interventions focus, like switching crop types or promoting irrigation, are often inappropriate or simply unavailable to destitute groups because they entail high capital, technological and labor inputs and may close off other coping options.

- Diversification is a key strategy for coping with and adapting to the consequences of climate change. For example, in Uganda, fishers have diversified their strategies to adapt to fluctuations in lake levels and variations in fish productivity. In addition to fishing, they cultivate crops, maintain livestock, collect firewood, reeds and papyrus from swamp areas, and temporary migration and trade. They also reduce vulnerability by engaging in collective action for income-generating activities and access to markets, credit and relief. However, the poorest and weakest are often unable to gain membership in such groups and survive on casual employment, favors, gifts, or urban migration.

- Cash transfers and remittances play a key role in reducing vulnerability. In Namibia and South Africa, pension payouts have emerged as important coping strategies, while remittances are favored strategies in other countries. Remittances are, however, becoming less reliable due to an increase in informal and temporary employment situations. Considering the urban-rural linkages is critical to understanding coping and emerging vulnerability.
- Ecological diversification plays an important role to managing climatic variability and change. In Mozambique, for example, people have plots on high ground for when there is a lot of rain and on low ground for when there is little rain; they also use lakes or depressions for cultivation in the aftermath of rains. People typically grow a diversity of crops and fruits in addition to cash crops and also use communal forest areas for grazing livestock and extracting forest products.
- Livestock herding, including nomadic pastoralism, remains one of the indigenous strategies best adapted to frequent droughts in dryland areas such as in Namibia and Botswana. Seasonal movement of livestock, splitting up of herds, changing herd composition and distributing livestock among relatives and friends in different areas minimize risk from droughts, floods or diseases. Appropriation of the wetter areas and water sources for cultivation and fencing inhibit these crucial strategies, however.
- There are many traditional strategies for coping with or adapting to observed changes in climate. However, they require a certain degree of flexibility and "room for maneuvering" in order to successfully invoke them. In Burundi, strategies include migration to areas less affected by an extreme event, switching crops, adaptation of the agricultural calendar to the changing cycle of seasons, conservation and development of local genetic diversity of crops as well as cattle transhumance. Such room for maneuvering requires policies that enable, rather than inhibit, local and regional adaptation options, implying a shift away from adaptation policies that prescribe practices to those that enable greater local freedom to choose appropriate practices, in effect empowering local populations in their relations with policy makers.
- Some of the responses to climate change are political rather than technical in nature. For example, civil society responses in Kenya are undertaken to ensure peaceful relations and trade during times of drought. Trade between farmers and nomadic pastoralists has become the main source of income during drought for some and democratically elected peace committees therefore represent the most important adaptation strategy in those areas. Where these have succeeded in gaining legitimacy with both the local population and the government authorities, they have been instrumental in securing the appropriate and necessary government support and interventions during drought. Adaptation takes place through negotiation and forming and rearranging social relations and is fundamentally political in nature.

Experience from the region so far shows that real local participation and accounting for household coping strategies remain real challenges in the development of adaptation polices because there is a tendency for interventions to focus on sectoral transfers of technology based on physical impacts of projected changes in climate. There is a danger that adaptation solutions prescribed nationally without the participation of those intended to adopt the practices will actually limit rather than create spaces for local adaptation.

5. Societal Transformations

Africa is undergoing rapid transformations. Although change can be considered an important part of human history, it has been argued that the rate and extent of contemporary environmental, technological, social, and economic changes occurring throughout the world are unprecedented. Global environmental change, globalization, urbanization, the spread of infectious diseases, and other transformational processes are creating highly uneven effects, in part because individuals, households, communities or regions have different capacities to respond to change. Adaptations to climate change will be implemented or undertaken within this dynamic context. Here we draw attention to four transformations that are likely to influence climate change impacts, vulnerability and adaptation in the near future.

5.1 Global Environmental Change

Climate change has received increasing attention in recent years, but other environmental changes are also transforming the environment in eastern and southern Africa. The loss of species, ecosystem and genetic diversity has implications for climate change vulnerability and adaptation. Many of the region's terrestrial ecosystems are threatened or critically endangered, including riverine areas, estuaries, marine bio-zones, savannas, and tropical forests. Many species, including endemic species with limited distributions, are threatened due to land use changes, over-exploitation, and climatic changes. Biodiversity is critical to maintaining ecosystem services and for promoting resilience in the face of change. Changes to water systems are also occurring throughout southern and eastern Africa, influencing the local availability and quality of water resources. The implications of these changes are likely to be compounded by increasing climate variability and projected decreases in rainfall in many parts of the region. They also exacerbate vulnerability and limit the flexibility of adaptive responses to climate change.

- Land cover changes reduce ecosystem services and may exacerbate vulnerability to climate change. In the Eastern Arc Mountains of Tanzania, which is considered a hotspot for biodiversity due to the high number of endemic species, forest areas have declined as land has been converted to agricultural production. These mountains serve as water catchments for urban areas such as Dar es Salaam, Tanga, and Morogoro. In the future, land use changes may lead to increased urban flooding under climate change.
- Loss of biodiversity limits coping and adaptation options in the face of climate stress. Due to a variety of causes, Kenya is estimated to have lost 10 percent of its plant species in the past century. Hilltop forests in the drylands of Kenya are a particularly important source of coping with drought in the short term and climate change in the long term, providing a favorable micro-climate that enables diversified cropping, drought grazing and water sources, and wild foods, small game, materials for artisanal handicrafts, herbal medicines, timber and a diversity of other forest products. Biodiversity hence provides a crucial safety net for some of the most vulnerable households and individuals who do not have access to employment or other coping strategies.
- Land cover change and soil erosion may threaten pastoral livelihoods. In Sudan, a combination of drought, deforestation and pastoralists being displaced by mechanized agriculture into more fragile ecosystems, has led to the loss of important grazing species. Pastoralists can support only smaller herds and thus become more vulnerable to seasonal and multi-year droughts.

5.2 Urbanization

Africa is undergoing a rapid process of urbanization. The rate of urbanization in Africa—3.5 percent per year—is the highest in the world, resulting in more urban areas with larger populations, as well as an expansion in the spatial extent of urban areas. There are currently 40 cities in Africa with populations greater than one million, and it is expected that by 2015 seventy cities will have populations of more than one million. African cities account for 60 percent of the region's gross domestic product, and they represent important centers for employment, trade, and education. Within eastern and southern Africa, South Africa has the largest urban population, while Malawi has the highest rate of urbanization at 6.3 percent per year. The fastest growing cities include Dar es Salaam, Kampala, Luanda, Nairobi, and Maputo. The rapid growth of urban populations poses challenges for infrastructure and services, which are already notably lacking, particularly in informal settlements. Limited access to water, electricity, and sanitation can increase vulnerability to droughts and floods. Furthermore, many of these cities are located in coastal areas, and are vulnerable to sea level rise, storm surges, and flooding.

- The urban poor are vulnerable to multiple dimensions of climate change. For example, in Eritrea, the urban poor are vulnerable to heat stress, sea level rise, the destruction of coastal livelihoods, price volatility in local markets, water shortages due to drought and salt-water intrusion, and shortages of fuel wood.
- Urbanization is leading to an increased demand for rural prod-

ucts such as irrigated vegetables, forest products (including fuelwood and charcoal), and traditional medicine. The increased demand and commercialization of savanna products in South African cities such as Johannesburg and Durban, can increase the degradation of forests and savannah ecosystems.

- Strong urban-rural linkages mean that vulnerability of rural households may change in response to shocks in both rural and urban areas. For example, the loss of employment opportunities in Nairobi has increased drought vulnerability of rural households that depend on remittances as a coping strategy. In Mozambique, the loss of job opportunities in South Africa has had a similar effect on household vulnerability.

5.3 Deagrarianisation

The reduced viability of small-scale farming, combined with diversification into non-farm incomes and rural-urban migration, has contributed to deagrarianisation in many parts of eastern and southern Africa, including Sudan, Kenya and Malawi. Although diversification of livelihoods away from climate-sensitive agriculture could be expected to reduce vulnerability, vulnerability is instead increasing because non-farm incomes are often very marginal. Casual employment on farms or collection of wild foods rarely compensate for the loss of reliable food and income through farming. In addition, many of those migrating to cities end up in informal settlements and get only occasional employment, thus they are unable to send much money back to their rural families. Hence both the migrant suffers loss of living standard and the rural household loses access to labor, which is an important for undertaking coping mechanisms during climatic events.

- Structural economic changes have increased deagrarianisation processes. For example, in countries such as Ethiopia, Tanzania, and Malawi, the removal of subsidies and inputs have led to a reallocation of land and labor away from commercial agriculture by small-scale farmers, making alternative cash incomes increasingly necessary. Although new opportunities for cash income have become available, most alternatives are not accessible or reliable, thus households may be increasingly vulnerable to climate-related shocks, which contributes to increasing economic differentiation.
- Some have also argued that there is a reagrarianisation due to the poor employment prospects in cities. This has been observed in Mozambique, where the end of the civil war has led to a return to farm areas that were previously unsafe. However, most of the expansion of farming in Mozambique has been by commercial rather than small-scale farmers, who increasingly work as casual labor on commercial farms and experience little job security during times of climate stress.

5.4 Regional Shift from Livestock to Commercial Crop Cultivation

There is a general commercialization of agriculture in many parts of eastern and southern Africa, concomitant with a shift from livestock to farming. Commercial farmers have been prioritized in several countries through the promotion of mechanized irrigated agriculture. Very few services are available to small-scale farmers, who are often pushed out of agriculture or down the ecological gradient into drier areas. The loss of a reliable source of food/income, or moving into areas with less favorable climate, has increased vulnerability to climate change. Pastoralists have also been pushed into more marginal areas by commercial agriculture. Small-scale farmers have also been forced to commercialize as livestock numbers have dwindled. Neoliberal economic policies have exacerbated these transformations. Formal jobs have disappeared as public services have cut down on employees, and state farms have been dismantled, forcing some industries to close down (e.g., cashew and sugar in Mozambique). New jobs in commercial agriculture or agro-processing are often casual and very poorly paid. Although liberalization of trade has had some positive effects on small-scale farmers and improved their position in the market, many have lost subsidies and support and have become more vulnerable to climate variability.

- The loss of livestock due to drought, conflict, exclusion from pastures and water sources has been compounded by a lack of veterinary services and restocking programs. For example, in Sudan, many pastoralists have been unable to re-establish herds as the result of these changes, and some are pushed into rain-fed agriculture or else intensify their agricultural practices by expanding into new areas. Cash crops that may be more climate-sensitive (and sensitive to market price volatility) are grown and many sell food crops such as maize for cash income, even if the harvest is not sufficient to feed the family.
- Official policy interventions to settle pastoralists with the goal of increasing incomes and access to services may make people more vulnerable to climate variability and change. In Kenya, government and aid interventions to develop alternative economic activities, such as fisheries and irrigation, have increased the dependence of some newly-settled pastoralists on various types of external support, while weakening traditional coping strategies.

These societal transformations are influencing vulnerability and the capacity to respond to climate-related shocks and long-term changes. Vulnerability is dynamic, and some households and social groups are becoming less vulnerable to climate change over time, while others are becoming increasingly vulnerable. Since changes are happening quickly, responses must be rapid and anticipatory. Actions that limit the consequences of climate change for the most vulnerable must address the dynamic context in eastern and southern Africa.

6. Implications for Climate Change and Development Policies

Research and assessments of climate change impacts, vulnerability and adaptation show that climate change will have important consequences for southern and eastern Africa, but that they will be unevenly distributed, both regionally and socially. Of key concern is the possibility that new groups may emerge as the most vulnerable to climate change. Below, we consider some of these new vulnerable groups, and discuss the sources of their vulnerability.

6.1 New Vulnerable Groups and Sources of Vulnerability

The dynamic social and environmental context of eastern and southern Africa means that vulnerability to climate change is more than a direct outcome of the biophysical impacts of climate change. New and sometimes unexpected groups may emerge as vulnerable to climate variability and change, and new threats may develop in response to wider societal transformations. For example, orphans and the elderly are emerging as a particularly vulnerable group, due to the consequences of HIV/AIDS.

Democratization and conflict are also changing the landscape of vulnerability. New markets are emerging—sometimes quickly—and can have important consequences for local livelihoods. International developments such as the emergence of a market for biofuels can drive land use changes and dispossession, which may aggravate vulnerability. It may, however, also provide new income opportunities that reduce vulnerability to climate change while contributing to mitigation if careful attention is paid to vulnerable groups and their needs.

6.1.1 Elderly Populations and Orphans

Changing household structures associated with increased rural to urban migration have had a profound influence on family support networks, especially since migration flows can leave elderly in rural areas with a reduced pool of potential caregivers, while at the same time increasing the burden on the elders, since grandchildren often remain in the family home when parents migrate for work. In many parts of eastern and southern Africa, HIV/AIDS has contributed to a loss of working-age adults, who are often both parents and main earners for households. A growing number of orphans are vulnerable to food insecurity, malnutrition and poor health. Often they have to drop out of school to work and support siblings. Orphaned children pose new challenges to the elderly, as they have roles as both care givers and receivers. Elderly women in particular may be more vulnerable than men due to lack of productive employment and income, widowhood status, and low education—factors that make them dependent upon others and less empowered to voice their needs and problems. The health-related effects of climate change are thus likely to be experienced by an increasingly vulnerable rural elderly population in less developed countries—with potentially a strong gender dimension.

6.1.2 Urban Residents

Although increasing attention is being paid to vulnerability within many urban areas in eastern and southern Africa, there is generally a lack of planning for disasters related to climate variability and change. A growing urban population may be vulnerable to heat waves, flooding, vector-borne diseases, power outages, and water scarcity. The expansion of urban populations has not been met with a sufficient expansion of infrastructure and services, and many settlements are located in highly vulnerable (e.g., flood-prone) areas. Low and unreliable incomes combined with a lack of formal rights can increase vulnerability of some urban residents. Because of these factors, small changes in climate variability may have large consequences in urban areas.

6.1.3 Fishers

People who earn their livelihoods from climate-sensitive resources may become increasingly vulnerable to climate change, as sea level rises and lake levels decline or become more variable. Artisanal fisheries are vulnerable to sea level rise in different ways, including through low harvests that result from erosion and sedimentation of the coral reefs and mangroves, which are breeding sites for fisheries. Lake fisheries are vulnerable to the changes in water temperature and fish productivity, and some smaller lakes may dry up due to increased drought, higher evaporation rates, and land use changes.

6.2 Existing Adaptation Initiatives

Climate change has become increasingly visible on the international political agenda, and numerous efforts are underway to facilitate adaptation to current and future climate change. These efforts include National Communications to the UNFCCC and National Adaptation Programmes of Action (NAPAS), which aim to assess vulnerability and adaptation options at the national level. Other ongoing or planned adaptation projects have been funded through the Global Environmental Facility (GEF) Trust Fund, the Special Climate Change Fund (SCCF), the Least Developed Countries Fund (LDCF) and the Adaptation Fund under the Kyoto Protocol. Some funding that may also support adaptation is linked to other Multilateral Environmental Agreements (MEAs), such as the Convention on Biodiversity (CBD),

the UN Convention to Combat Desertification (UNCDD) and the Ramsar Convention on the Conservation of Wetland Resources.

Some examples of ongoing or planned adaptation projects in eastern and southern Africa include:

- Incorporating Climate Change in Integrated Water Resources Management in Pangani River Basin, Tanzania, funded by the Special Climate Change Fund;
- Coping with Drought and Climate Change (in Kenya, Mozambique, Zimbabwe, and Ethiopia), funded by the GEF's Strategic Priority on Adaptation;
- Integrating Vulnerability and Adaptation to Climate Change into Sustainable Development Policy Planning and Implementation in Eastern and Southern Africa (in Kenya, Mozambique, and Rwanda, with Tanzania and Madagascar as observer countries), funded by GEF's Strategic Priority on Adaptation.
- Community-based Adaptation (CBA) Programme (includes Namibia), funded by GEF's Strategic Priority on Adaptation and to be implemented by UNDP.

Development agencies and NGOs are also funding a number of projects and initiatives in the region. For example, the International Development Research Council (IDRC) in Canada and the Department of International Development (DFID) in the UK have funded a Climate Change Adaptation Support Programme for Action-Research and Capacity Development in Africa (CCAA), which aims to support African countries in their efforts to address vulnerability of the poor to climate change. A number of other regional groups and networks are addressing climate change through various initiatives. For example, the Southern Africa Climate Outlook Forum (SARCOF), and a similar regional climate forum in the Greater Horn region, provide seasonal forecasts and climate information that can be used in agriculture, water, health, and other planning processes. Assessments of Impacts and Adaptations to Climate Change (AIACC) were undertaken to enhance scientific capacity on the assessment of climate change vulnerability and adaptation, as well as to generate and communicate information for adaptation planning and action. The Linking Climate Adaptation (LCA) network, funded by DFID, aims to help communities, policy-makers, practitioners, and academics to share knowledge on climate change adaptation.

The examples described above represent just some of the many initiatives underway to address climate change impacts, vulnerability, and adaptation in eastern and southern Africa. However, new and innovative initiatives and activities will be needed to address emerging vulnerable groups, as well as changing adaptive capacities linked to societal-scale transformations in the region. Development agencies are well placed to change the context in which vulnerability is being created, and to guide societal transformations in a direction that increases the capacity to respond to climate change. New networks and boundary organizations, such as the Southern Africa Vulnerability Initiative (SAVI), link scientists, policymakers and practitioners working in diverse areas, in an effort to understand how multiple processes of change influence vulnerability in the region. SAVI serves as a platform for combining knowledge from health, agriculture, disasters, water, trade and economic development, urban planning, and other areas, and thus serves as a nexus for generating new understandings of how climate change will affect vulnerability in the region, and for identifying sustainable adaptation strategies. These types of boundary organizations are increasingly useful for addressing new and non-traditional challenges, such as climate change.

6.3 Comprehensive Adaptation: A Three-Pronged Approach

Given the dynamic societal and climatic changes, responses need to be anticipatory and rapid, empowering and enabling individuals, communities and regions to cope with and adapt to the risks associated with climate change. It is unlikely that a single formula of policy will be sufficient; instead a suite of strategies are needed to address vulnerability and promote adaptation in eastern and southern Africa.

Interventions exist that may contribute to vulnerability reduction, including measures aimed at environmental improvement and livelihood security such as conservation agriculture and rangeland rehabilitation as well as poverty reduction measures. However, these measures can also increase the vulnerability of certain groups unless conscious and specific consideration of the vulnerability context is made. Comprehensive and targeted measures are required that take the factors that create vulnerability and local coping strategies into account and which create room for maneuver and flexibility at the local level to facilitate adaptation. There is a need to understand the effect of various policies, including development policies in general and adaptation policies in specific, on the poorest and most vulnerable and to identify who are the winners and losers from such changes.

A broader set of measures is required than that which has been the focus of adaptation efforts so far (see Table 2). Comprehensive adaptation entails focusing on three types of measures that target the interface between poverty and vulnerability:

- those measures that target the risk posed by climate change to poverty, such as functioning of water and social infrastructure and viability of cropping systems and other sources of livelihoods;
- those measures that aim to strengthen the capacity to cope and adapt to climate stress, such as engaging in alternative sources of income during drought, accessing forest products, or seasonal movements of livestock for grazing;
- those measures that address the causes of vulnerability, such as poor market relations in trading in niche drought products, or poor health facilities and the spread of infectious diseases such as HIV/AIDS and ensuing household labor scarcity.

Table 2: Measures that may address climate risk, adaptive capacity and vulnerability processes among the poor: examples within four dimensions of poverty/basic needs.

	Measures targeting the risk posed by climate change	Measures enhancing the capacity to cope and adapt	Measures addressing the causes of vulnerability
Income and material needs	Climate risk assessment tools Changing cropping patterns and herding practices Planting windbreaks Take climate change into account in designing roads to avoid cutoff during floods Insurance mechanisms to replace lost productive assets Plan for urban disaster management Invest local tax revenues in local market facilities	Enhance urban employment opportunities Strengthen reliability of channels for sending remittances Improvement of storing techniques Introducing diversified crops Building foodgrain banks Enable mobility across regional and international borders Enhance access to common pool resources Interventions carried out ensuring local income-generating activities	Enhancing on and off-farm conservation and access to indigenous plants Reduce entry barriers to non-farm livelihood activities Enhance market position of economic activities adjusted to local climatic conditions Reduce disease outbreaks that reinforce effect of climate stress on livelihoods Address barriers to technology access Enhance local energy sources
Health and basic education	Plan for climate variability for water supply and sanitation Restoration of infrastructure after floods Adjust school fee timing/system	Adjust education to labor needs and local diversification Strengthen school feeding during drought Reduce cost of health services Promote links between indigenous and formal knowledge HIV/AIDS treatment to enhance health status of infected people	Improving health infrastructure and capacity to deal with climate shock/change related illness Enhance local education opportunities, including adult education programs, including relevant climate and adaptation information Enhance water supply and sanitation, suitable to local climatic variations
Rights and empowerment	Formalize flexible tenure and rights systems adjusted to climatic variability and ensuring rights of the poor Shift aid focus to longer term adaptation and reducing the need for emergency aid Emphasize role of multiple stressors and contexts causing vulnerability in adaptation policies	Strengthen local coping strategies that less powerful groups have access to Strengthen local democratic participation in, for example, management of water Increased collaboration between formal institutions and informal networks, such as women groups with traditional drought coping roles Incorporate access to drought resources into conservation strategies	Address monopolization of power by elites Target mechanisms that lead to loss of rights and exclusion Strengthen rights to move across national boundaries Installing transparent systems to gain access to land Highlight 'non-climatic' drought factors Strengthen customary rights (e.g. to biodiversity) and collective management of common pool resources
Social and cultural affiliation and security	Active social building and access by poor Disaster interventions to take account of social and cultural ties Ensure social rights of all ethnic groups and both genders in drought and flood interventions and policies Support infrastructure (roads and paths) that can remain open during floods	Distribute emergency aid in such a manner that social networks are not exhausted Find alternatives to massive relocation during emergencies Generation of local knowledge including that related to climate signals/forecasts and conservation of seed types, e.g. seed banks	Institutional reforms or identify mechanisms to allow poor entry into social networks of non-poor Address exclusion to drought/ emergency resources based on gender/ethnicity/class etc Link formal and informal knowledge systems to improve relevance of local knowledge to new geographic areas

This means that climate change adaptation involves more than technological or engineering measures to reduce the biophysical impacts. Importantly, there is a need to identify how societal transformations affect vulnerability and how these transformations can be shaped in such a way as to contribute to vulnerability reduction. For example, one way of shaping the land reform process so that adaptive capacity is strengthened could be to ensure access by rural populations to forests, communal land areas and other sources of forest products and other important sources of coping strategies. Land reform could also be carried out in such a way as to ensure access by pastoralists to drought grazing areas and watering points as well as migration routes. New market opportunities, such as commercialization of savanna products could be addressed by creating marketing and service infrastructures aimed at ensuring niche products, especially those that are well adapted to local climatic conditions, a direct and favorable market position rather than one based on risky sales and exploitative bargaining position. Hence, flexible livelihoods and diversification could be supported. Democratization processes could focus on representation of vulnerable groups in local development committees, real local power in management of local environmental resources used in coping with climatic and other risks, and the building up of peace committees and civil society representing the voice also of marginalized and vulnerable groups.

Comprehensive adaptation puts new demands on institutional frameworks. The multi-sectoral and regional implications of climate change may require new institutional arrangements (see Box 1). New institutional arrangements may be needed at national and local levels, too. Since adaptation is political and involves the negotiation of outcome for different groups, representation of varying interests in policy making becomes an adaptation in itself. It is important to place the poorest and most vulnerable on the agenda as their interests are often ignored in policy contexts, including adaptation policy contexts. Creating flexibility and room for maneuver for local adaptation, as opposed to the national government prescribing technical solutions to local households, implies local empowerment in relation to the state, as exemplified in the strengthening of civil society and peace committees. It also means an increased need for boundary organizations that can act as a bridge and inform policy processes across geographic scales (from local to national and regional) and across sectors.

Box 1: International Implications of Adaptation in River Basins

Existing planning processes, and particularly the use of hydrological methodologies in such processes, need to be improved to deal with the uncertainties of climate change. Uncertain and potentially dramatic effects in river flow affect the feasibility of hydropower and irrigation, the development of which can actually increase countries' sensitivity to climate change. Massive expansion of irrigation can reduce flexibility of a whole basin and increase exposure to future water shortage and inability to meet demand for water and may therefore be maladaptive. Furthermore, decadal variations and long-term changes in river flow in eastern and southern Africa have implication for international planning and agreements. Current treaties, which reflect colonial, Cold War and particular national interests, are often based on assumption of unchanged river flows, fixed rather than proportional shares of river volume between countries. Climate change may affect cooperation processes by its effect on scarcity, but for some river basins future river flow is not well known. However, many treaties are unrecognized by one or more of the riparian states, and countries such as Ethiopia, Uganda and Sudan are likely to begin to develop Nile water projects which will impact flows and availability of water.

7. Conclusion

This report highlights some of the challenges of adapting to climate change in eastern and southern Africa. In addition to large changes in temperatures, there is a need to adapt to uncertainty regarding the magnitude and direction of precipitation changes, as well as changing climate variability. Social vulnerability is increasing in some areas of eastern and southern Africa, such that very small meteorological events (such as a minor drought) may have severe impacts on households, social groups, and regions. Multiple stressors interact with climate change to generate vulnerability, which is highly differentiated among places and groups. Although a rich set of indigenous responses exist for coping with climate variability, these strategies are not sufficient in the face of societal transformations and climatic changes. Consequently, there may be some unexpected outcomes of climate change, which generate new vulnerable groups. Interventions may also create unplanned outcomes, and may even increase vulnerability for some, if the broader vulnerability context is not taken into account. There is currently a gap between local needs and ongoing and planned adaptation interventions. The most vulnerable groups of eastern and southern Africa are generally not included in these projects, nor are the sources of their vulnerability being adequately addressed.

The relationship between vulnerability reduction and poverty reduction is non-linear, and poses challenges to both national climate policies and development policies. In short, there is no ''one-size-fits-all'' response to poverty and climate change vulnerability. Addressing vulnerability and adaptation requires new institutional arrangements and innovative approaches that go beyond identifying technical solutions. Instead, this report concludes that a comprehensive approach to addressing vulnerability and adaptation is required—a three-pronged approach that targets risks, builds local adaptive capacity, and confronts the social processes that generate or exacerbate vulnerability.

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Summary of Key Climate Change Terms

Adaptation: Adjustments in practices, processes, or structures to take into account changing climate conditions, to moderate potential damages, or to benefit from opportunities associated with climate change. Includes measures to reduce the sensitivity of a system, such as making agriculture less drought-sensitive, as well as increasing capacity to cope with an event, such as drought.

Adaptive capacity: The potential or ability to institute adaptation; the capacity of a system to adjust practices, processes or structures to moderate or offset the potential damage or take advantage of opportunities created by a given change in climate.

Climate change: Changes over time in the values for climate parameters such as temperature, precipitation, wind speed and direction, and humidity. In the context of this study, this refers to the current increases in global temperatures due in part to human-induced emissions of greenhouse gases.

Coping: The immediate actions in the face of an event or changes and ability to maintain welfare (in contrast to adaptation which refers to long-term adjustments to the framework within which coping takes place).

Coping capacity: The ability to prepare for an anticipated event, respond to that event once it takes place, and recover from its effects, such as through accessing alternative sources of food and income when agriculture fails.

Impacts: The effects of climate change, from the first order (direct effects of increased CO2 concentrations in the atmosphere as well as changes in climate parameters on plants, animals and human beings), to downstream effects of such changes on ecosystems and societies.

Mitigation: Human interventions to reduce the emissions of greenhouse gases or enhance the sinks of greenhouse gases in order to reduce the extent of global climate change.

Sensitivity: The degree to which a given change in climate will lead to positive or negative changes in a system, such as to the functions of an ecosystem or output from a particular type of agricultural production.

Vulnerability: The extent to which a natural or social system is susceptible to sustaining damage from climate change, determined by exposure, sensitivity and coping capacity (as well as structural processes).

Global Environmental Change and Human Security (GECHS)

GECHS is a core project of the International Human Dimensions Programme on Global Environmental Change. The goal of GECHS is to promote an understanding and recognition of global environmental change as an issue of equity, sustainability and human security. We situate environmental changes within the larger socioeconomic and political contexts that cause them, and which shape the capacity of communities to cope with and respond to change. Our research focuses on the way diverse social processes such as globalization, poverty, disease and conflict combine with global environmental change to affect human security.

GECHS International Project Office

Department of Sociology and Human Geography
University of Oslo
P.O. Box 1096 Blindern
N-0317 Oslo, Norway

Tel.: +47 22 84 43 86
Fax: +47 22 85 52 53

info@gechs.org
www.gechs.org

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