USAID
FROM THE AMERICAN PEOPLE

Climate Change Adaptation in ANGOLA

Climate change is a fundamental stressor that undermines past development gains and threatens future advances in core areas of human well-being. Advancements in areas such as education, food security, and health are central to strengthening communities' resiliency to climate change, so investments in sustainable development across a range of sectors are crucial to increasing adaptive capacity. There is also a pressing need for policies, programs, and projects designed and implemented specifically to address the current and projected impacts of climate change. By rigorously assessing vulnerability to climate change and responding in strategic ways, adaptation activities can respond to the areas of greatest need and cost-effectively limit the magnitude of harmful climate impacts. A crucial first step in this process is to gather information and data about how climate is changing and the potential consequences. Vulnerability assessments must ultimately shape adaptation policy and programming in Angola. This fact sheet provides a brief summary of what is known about how the Angolan climate is changing, the likely impacts on its people and ecosystems, and adaptation needs and opportunities.

Map of Angola. Source: Encyclopedia Britannica

RECENT CLIMATE CHANGE AND CURRENT CLIMATIC VARIABLITY

Temperature observations show that Angola has warmed significantly in recent decades. Mean annual temperature increased by about 1.5°C between 1960 and 2006, an average rate of 0.33°C per decade. The rate of increase has been most rapid in the winter, at approximately 0.47°C per decade, and slowest in summer, at about 0.22°C per decade. Mean annual rainfall over Angola has decreased at an average rate of around 2 mm per month (2.4 percent) per decade between 1960 and 2006. However, precipitation data is spatially limited and the causes of this trend are not fully understood.

While limited information exists on the costs of current climatic variability in Angola, studies within the country and other areas of Africa demonstrate that they are undoubtedly large. For example, irregular and abnormal rainfall between November 2003 and February 2004 caused extensive crop damage in the central highlands. The first rains arrived late and then, from November onwards, were very frequent, intense, and accompanied by heavy winds and even hail in some areas. This damaged crops, while the resulting continuously wet conditions hampered normal weeding and consequently productivity. At the same time, the runoff from the rains caused flooding in low-lying areas, causing a near total crop loss; increasing temperatures are likely to increase the probability of such events.

FUTURE CLIMATE CHANGE

- **Temperature projections for Angola vary based on differences between models and assumptions about future greenhouse gas emissions.** Without significant emission reductions mandated by regulatory or policy changes, median projections for the 2090s fall between 2.3°C and 4.5°C higher than the 1970-1999 average.
- **The majority of climate models project average temperatures increases of more than 1°C by the 2030s compared to the 1970-1999 mean.** The projected rate of warming is faster in the continental interior, eastern regions of Angola, and slower in the western, more coastal areas.
- **Projections indicate that extremely hot days (the hottest 10 percent of days in the observed record) will become two to four times more frequent by the 2060s.**
- **The effect of increasing temperatures on total precipitation is uncertain.** While annual precipitation in most of southern Africa is likely to decrease, Angola lies within the area of the tropics for which model projections widely vary in both positive and negative directions.

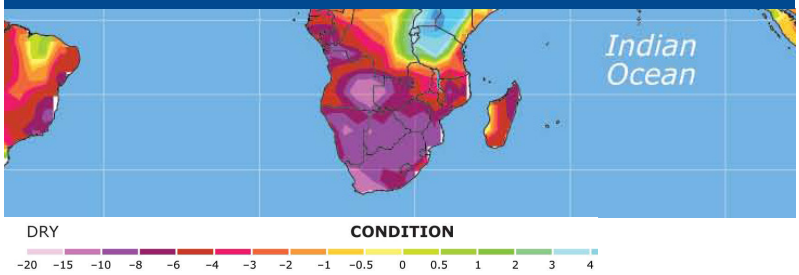
- **The lack of agreement between climate models does not imply that precipitation will not change.** Projections for annual precipitation range from -27 to +20 percent above or below the 1970-1999 mean by the 2090s, with median values of -1 to -6 percent.
- **As with temperature, changes in precipitation will not occur uniformly throughout the country because localized factors such as geography and vegetative cover exert a strong influence.** For example, the magnitude and timing of changes in the dry southwest region of the country may differ from the much wetter northeast.
- **The frequency and intensity of high-precipitation events is likely to increase with increasing temperature, elevating the risk of flooding and other damaging events such as landslides.**
- **Associated with an increased risk of extreme precipitation is an increase in the risk of land drying and drought** (See graphic below). Although somewhat counterintuitive, this is due to the fact that warming accelerates land surface drying while also increasing the water-holding capacity of the atmosphere. The result is more intense and heavy episodic rainfall events interspersed with longer relatively dry periods.

CLIMATE CHANGE IMPACTS BY SECTOR

Food Security

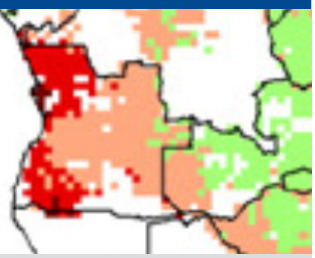
Studies focused specifically on Angolan agriculture are sparse, presenting an area of urgent research need. It is already clear, however, that climate change poses threats to Angolan production systems, infrastructure and markets, and therefore livelihoods and food security. One recent study evaluates the impact of climate change on the production of six key crops—cassava, maize, sorghum, rice, wheat, and millet—and finds that Angola is one of seven countries in which climate change would result in a reduction of total crop yield by the 2030s for all studied climate scenarios. The graphic at right shows potential reductions in the yield of cassava, an important staple crop. Another study from the journal *Science* reports reductions of up to approximately 30 percent in the yield of maize and wheat throughout southern Africa by the 2030s. Thorton et al. (2006) find a reduction of over 20 percent in the length of the growing period for many areas of southern and western Angola where livestock systems dominate. These and other quantitative impact assessments do not typically account forthe potential impacts of indirect climate change effects such cropland inundation, erosion, and salinization caused by sea level rise, altered crop resistance to insect damage, and the response of pests and pathogens to climate change, all of which could further exacerbate climate-induced challenges to food security. At the continental scale, agricultural production in many African countries is projected to be severely compromised, with potential implications for the price of imported foods within Angola.

Potential Drought Extent in 2090-2099



Potential drought extent in 2090-2099 in southern Africa for a medium-growth (A1B) emissions scenario. The color scheme is based on the Palmer Drought Severity scale, which assigns negative numbers when conditions are unusually dry. A reading of –4 or below is considered extreme drought. Figure adapted from Wiley Interdisciplinary Reviews, courtesy of UCAR.

Cassava Yield in the 2030s



Red indicates reductions in yield of 25 percent or more, pink 0-25 percent. Adapted from Liu et al. (2008).

Health

Globally, changing weather patterns already contribute to the burden of disease and premature deaths. In Angola, as throughout the region, the potential health impacts of climate change are especially acute due to high levels of vulnerability and a relative lack of adaptive capacity with respect to technology and medical services. The effects of climate change on health are likely to include a greater incidence of heat-related mortality, increased numbers of people at risk of death, disease, and injury due to floods, storms, and other extreme events, and a possible increased burden of malnutrition due to agricultural impacts. The prevalence of malaria in the Angolan highlands, which currently has a low rate of malaria transmission, could increase substantially by the 2080s, while malaria transmission rates in more low-lying areas could increase after periods of heavy rainfall. At the same time, periods of drought can affect the transmission of some mosquito-borne diseases by increasing size of the population without immunity. In areas with poor sanitation infrastructure, any increase in flooding will likely increase the incidence of a range of infectious diseases including cholera, typhoid fever, cryptosporidiosis, and diarrhoeal disease.

Coastal Zones

Approximately 30 percent of Angola's population lives within 100 km of the coast and migration to urban coastal areas has accelerated in recent decades. While sea-level rise projections vary based on emissions scenario, choice of model, and how ice melting is accounted

for, the most recent research indicates that sea levels in Angola could rise by more than a meter by the end of the century. Sea level rise of anywhere near this magnitude would render some low-lying areas of the Angolan coast uninhabitable and amplify damage from floods and storm by providing a higher base for storm surges, potentially exposing hundreds of thousands of Angolans to more coastal flooding and related damages.

Fishing is an important livelihood activity in rural Angola, especially in the southern provinces of Benguela and Namibe where the cool waters of the Benguela current provide a rich diversity of marine life. The coastal ecosystem alongside these provinces is dependent on the nutrient-rich upwelling of the current. Any changes in the frequency, timing or distribution of upwelling would influence production and likely biodiversity. The evidence indicates that the frequency of warming events along the coast may increase, raising serious concerns about the impact on marine biodiversity and productivity.

Summary of Possible Impacts in Key Sectors

Projected Impacts / Sectors	More Extremely Hot Days and Nights	Increased Drying and Drought	More Frequent and Intense Heavy Rainfall Events	Overall Impact
Human Health	Increased heat-related morbidity and mortality.	Increased incidence of some infectious and respiratory diseases, including epidemic meningitis.	Increased burdens of infectious diseases including cholera and typhoid fever; increased child mortality due to diarrhoeal disease.	Many more deaths and disease than would occur in a world without climate change.
Agriculture and Food Security	Reduced yields of some crops; some crops become unviable in certain locations.	Reduced or destroyed crop yields; possible changes in resistance to insect damage; decreases in livestock production.	Reduced crop yields; in some cases flooding causes complete crop failure.	Increased hunger and malnutrition with consequences for health and livelihoods; potential for regional or economic-scale economic losses.
Infrastructure and Settlements	Vulnerable populations experience increased heat-related stress and associated illness.	Communities face increased water stress and risks to food security.	Coastal areas face increased damage from storm surges layered on sea level rise; livelihoods at elevated risk from heavy rainfall and floods.	Increased damages to homes, livelihoods and infrastructure; potential for forced relocations.
Ecosystems	Increased species displacement and loss; increased wild fire risk; stressed fisheries.	Stress to flora and fauna contribute to species shifts and possible extinctions.	Increased soil erosion and flooding affect biodiversity distribution and resiliency.	Food security at risk from fishery stress and reduced livestock productivity; possible impacts on fuel and fodder availability.

The above chart provides a qualitative summary of some of the potential impacts to health, food security and other key sectors of a roughly 1.5°C rise in average temperatures, which projections indicate could occur within Angola by the 2030s. As temperatures rise toward and then beyond this threshold, the severity of impacts will increase concurrently. Note that available data for Angola currently constrain the ability to quantitatively assess risk in a rigorous, spatially explicit way, presenting an area of pressing research need.

ADAPTATION NEEDS AND OPPORTUNITIES

While climate policy in Angola is in a relatively nascent phase, Angola is nearing completion of its National Adaptation Programme of Action (NAPA), which will guide efforts to identify and promote actions aimed at meeting pressing adaptation needs and improving resiliency. On the basis of previous assessments and stakeholder input, areas of particular need and opportunity are likely to include:

- Financial, technical and capacity support for improved monitoring and recording of observational climate data and projections of future climate change and impacts.
- Improved, more fine-scaled climate modeling to provide climate information for impact studies, especially in areas characterized by a diverse and heterogeneous land surface.
- Capacity building and training on climate science, vulnerability and adaptation assessment, effective governance systems for implementing adaptation, and data collection and analysis.
- Climate information, training, and analysis in Portuguese.
- Strongly analytic, risk-based vulnerability assessments that identify geographic regions and economic sectors which are particularly threatened, in order to inform the development of adaptation policies and measures.

- The design and implementation of adaptation policies and measures that are cost-effective, targeted to the areas of greatest need, and improve the ability of vulnerable populations to respond to climate challenges. Priority policies and activities will be identified in Angola's NAPA but may include, for example, changes in land-use planning that account for projected sea-level rise; improved agricultural extension services that encourage diversification; soil-conserving agroforestry techniques, or crop shifts; and proactive health efforts that respond to likely shifts in the malaria burden.

KEY SOURCES

McSweeney, C., New, M., and Lizcano, G., UNDP Country Climate Profiles: Angola. 2008. [cited 10 July 2011]. Available from: http://country-profiles.geog.ox.ac.uk/index.html?country=Angola&d1=Reports.

World Food Programme, Vulnerability Assessment in Rural Areas: National Overview. 2004. Available from: http://ochaonline.un.org/rosa/FoodSecurity/tabid/5034/language/en-US/Default.aspx

Christensen et al., Regional Climate Projections. In: Climate Change 2007: The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climage Change. http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter11.pdf

DAI, 2010, Drought Under Global Warming: A Review. Wiley Interdisciplinary Reviews: Climate Change. http://onlinelibrary.wiley.com/doi/10.1002/wcc.81/full

Liu et al., 2008. A spatially explicit assessment of current and future hotspots of hunger in Sub-Saharan Africa in the context of global change. Global and Planetary Change, 64: 225-235.

Lobell et al., 2008. Prioritizing Climate Change Adaptation Needs for Food Security in 2030. Science, 319: 607-610

Thornton et al., 2006. In: Boko et al., 2007: Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter9.pdf

Mueller et al., 2011. Climate Change Risks for African Agriculture. PNAS, 108: 4313-4315

Confalonieri et al., 2007. Human Health. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contributions of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter8.pdf

Nicholoson, 2007. A Low-Level Jet Along the Benguela Coast, An Integral Part of the Benguela Current Ecosystem. Climate Change, 99: 613-624