FACT SHEET

FEBRUARY 2018

CLIMATE CHANGE VULNERABILITY AND ADAPTATION IN EAST AFRICA

CURRENT AND FUTURE CLIMATE CHANGE

BACKGROUND

The East Africa vulnerability, impacts, and adaptation assessment (VIA) was undertaken by the East African Community (EAC) with the support of the USAID/ Kenya and East Africa Planning for Resilience in East Africa through Policy, Adaptation, Research, and Economic Development (PREPARED) Project. The study adopted the Intergovernmental Panel on Climate Change (IPCC) assessment framework and used locally observed climate data and socioeconomic information for a 30-year period (1981–2010) together with future modeling results. The VIA provides essential information required to implement the EAC Climate Change Master Plan (2011–2031). That document links the EAC's Climate Change Policy, Climate Change Strategy, and Climate Change Master Plan, which commit the members of the EAC to specific actions to address climate change, with adaptation to change as a priority.

The VIA team, working through strategic regional institutional partnerships, applied innovative approaches to determine the local impacts of climate variability and change and the region's vulnerability to the current and expected future climate. What it found is evidence of dramatic and unprecedented changes in EAC's climatic patterns at regional, national, and community scale, with adverse impacts already being felt on social, physical, ecological, and economic systems. The impacts are more severe than reported by the IPCC in 2013 and 2016, data that were used to inform the current EAC and Partner States climate change strategic plans and visions, suggesting a need to revisit those documents.

The East Africa VIA covers five thematic sectors: water and aquatic ecosystems, terrestrial ecosystems, agriculture and food security, health and sanitation, and energy and infrastructure. All five are supported by analysis of the historic and projected future climate in East Africa and include analysis of existing and potential adaptive strategies. Detailed analysis for the VIA focused on the Lake Victoria Basin (LVB), the largest water body in the region, which is of particular importance to farming, fisheries, transportation, and water supply in the five EAC Partner States (Burundi, Kenya, Rwanda, Tanzania, and Uganda).

This brief captures the main findings of the seminal climate analysis work for the VIA. It covers a baseline study using data on the Partner States and the 1900 to 2014, which characterized current rainfall and temperature trends. The brief also covers a scenario study that used climate data for the region over the period 1950–2005, together with simulated data to project potential changes in climate over 2006–2100.

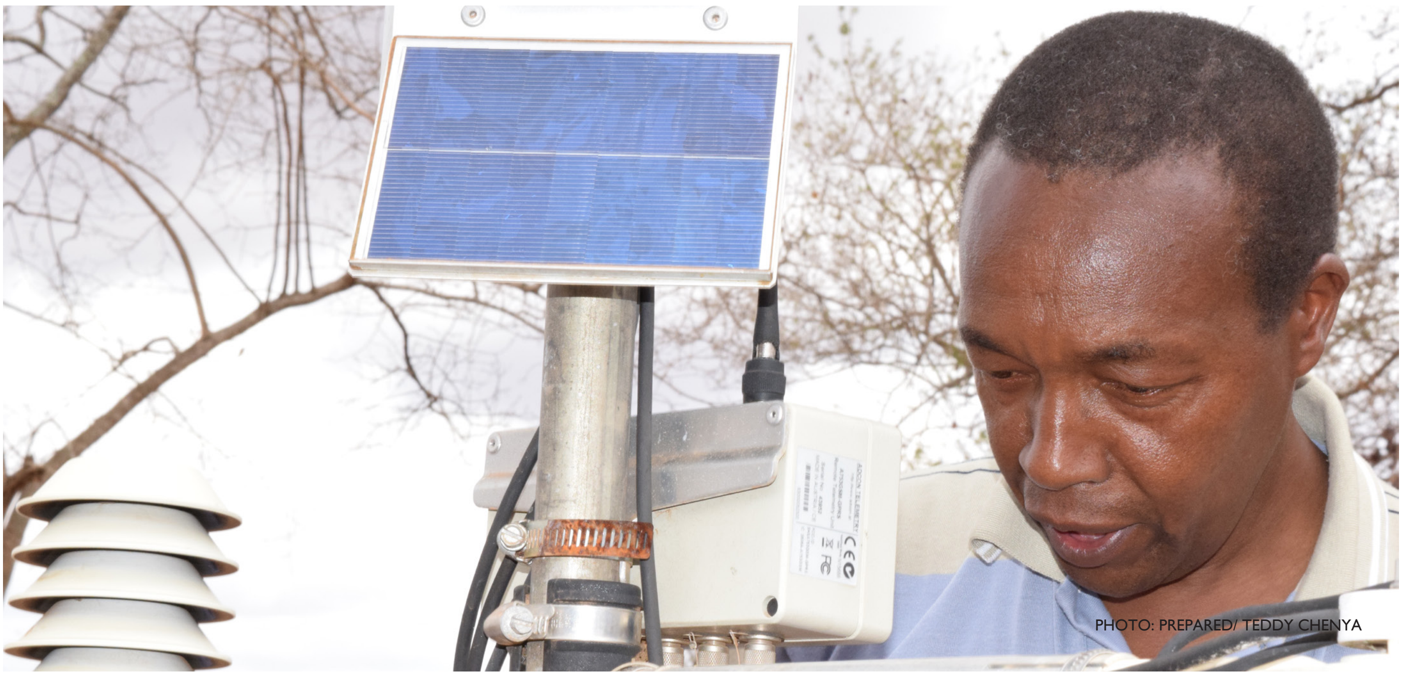

PHOTO: PREPARED/ TEDDY CHENYA

KEY FINDINGS

Understanding of climate change and variability in the EAC region is hindered by deficiencies in long-term historical data for temperature and rainfall. This is mainly because the number of meteorological stations providing data have declined from a high of about 2,400 in the 1980s to about 500 today. To overcome this challenge, climate scientists use a combination of observed station data and satellite data, which allows interpretation of historical climate trends and variability and enables the generation of future climate scenarios.

To conduct its historical and scenario analyses, the EAC Climate Change Coordination Unit and regional and international climate centers worked together to develop and adapt a variety of geospatial analytical tools. This has enabled the meteorological services in each Partner State to generate local climate datasets using GeoCLIM and GeoMOD, monitor seasonal climate change and provide early warning through GeoCOF, monitor agricultural risks with GeoWRSI, and create vulnerability index maps for various socioeconomic sectors. The VIA developed its own regional gridded database by combining local station data with data from the Climate Hazards Group Infra-Red Precipitation with Station (CHIRPS) dataset and adding overlays of socioeconomic data.

HISTORICAL TRENDS

East Africa has been getting hotter and drier over the past 50 years, and has experienced frequent episodes of either excessive or deficient rainfall. Historical surface temperature trends in Nairobi and its environs, for example, rose more than 2.50°C over 50 years and the East African highlands have also been warming.

Rainfall, meanwhile, has declined by 20–100 millimeters per decade over the period and rainfall patterns have become more variable, but trending toward longer dry spells, and shortened growing periods for staple foods. Marginal agricultural areas in southeastern Kenya have experienced successive rainfall failures. This means that the seasonal rains most important for agricultural production are becoming more erratic and unreliable for most farmers, making it difficult for them to plan.

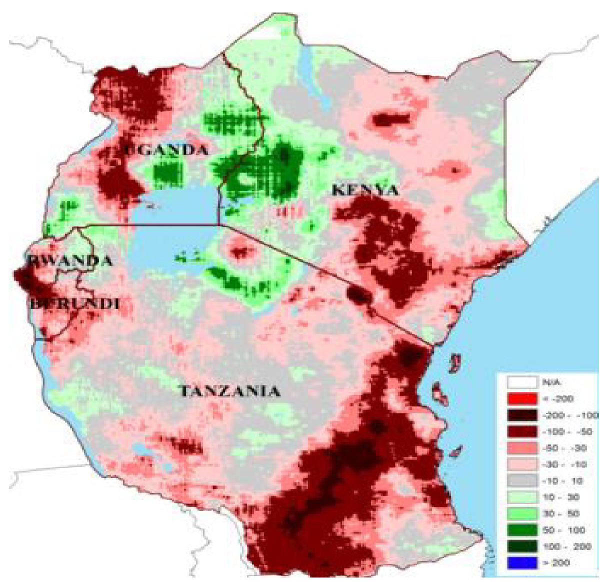

Figure 1. Declining rainfall trends (mm/decade) for March–June in most parts of EAC countries

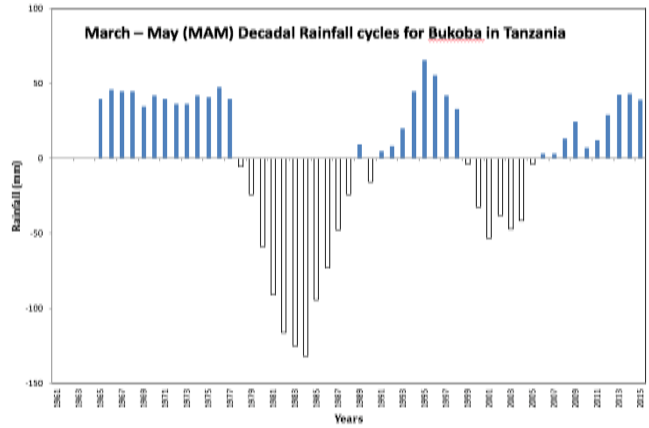

Figure 2. Ten-year cycles dominate rainfall patterns in most of the region

Annual precipitation trends for 1981–2016 for the EAC region show significant areas with declining rainfall (Figure 1). Drier periods are getting longer and more pronounced during the long rains of March–June (MAMJ). Rainfall trends have been decreasing over Burundi and Rwanda, northern and eastern parts of the Kenya, and Uganda's LVB region. Increased rainfall has been experienced in the southern and eastern portions of the Tanzania LVB region. Distinct 10-year cycles of dry and wet periods have appeared over East Africa, with wet periods in the 1960s, 1970s, and 1990s and dry periods in the 1980s, 1990s, and 2000 to 2010s (Figure 2).

Analysis of surface temperatures for the 1930–2016 period, using CHIRPS and GeoCLIM datasets indicates significant increases within the five LVB countries, ranging between +0.7°C and +1.2°C for average monthly maximum temperature and between +1.0°C and +1.1°C for the average monthly minimum temperature.

FUTURE SCENARIOS

Modeled climate scenarios indicate that substantial warming trends will likely continue. Analysis of future climate scenarios using outputs from 50 km by 50 km resolution Rossby Centre Regional Atmospheric model downscaled by using Coupled Model Inter-comparison Project Phase 5 (CMIP5) global circulation models paint an equally unfavorable scenario of the EAC's future climate. The analysis is based on historical data (1951–2005) for maximum and minimum temperature and downscaled future scenarios and projection (2006–2100) periods for the RCP2.6, RCP4.5, and RCP8.5 scenarios, which represent low, mid, and high levels of greenhouse gas emission concentrations.

Rainfall is projected to increase over East Africa under all the future scenarios except for the June–September (JJAS) period, which may receive up to 50% less precipitation by 2050. Rainfall will generally increase across most of the region during the short rains and in the southeast of the region during the long rains. Mean annual maximum surface temperature may increase by 1.0°C to 2.0°C over most of the EAC by 2030 and could increase up to 3.5° C and 4.5° C under the RCP8.5 scenario (no mitigating actions) by 2070. The projected warming extent will be greatest in March–May (MAM) and JJAS and the least in October–December (OND). Projections also indicate that East Africa can expect that rainfall and temperature events will become more extreme, episodic, and intense in the future.

VULNERABILITIES AND RISKS

Long-term changes in climate have potential risks for the five major themes covered in the VIA. The vulnerabilities are described below.

WATER AND AQUATIC ECOSYSTEMS

The quantity and quality of surface water and groundwater throughout East Africa will be affected by the projected trends in temperature and precipitation. Higher temperatures increase evaporation and reduce available water. Warmer temperatures also alter precipitation amounts, magnitude, and timing of runoff, as well as the intensity and frequency of floods and droughts. Increased precipitation, especially heavy rainfall, can create flooding that washes away sanitation facilities, increases sediment loads, and raises the levels of chemical pollution in water flows from agricultural lands, affecting the quality of water in rivers, lakes, and wetlands and potentially contaminating groundwater resources. Changes in precipitation also alter groundwater discharge, storage, saltwater intrusion, and biogeochemical reactions. Water supply infrastructure, including water treatment plants, pipelines, and dams used for irrigation, are vulnerable to floods, sedimentation due to excessive runoff, and other hazards. Changes in climate affect aquatic systems by increasing water temperature, altering stream flow patterns, and increasing storm events. These changes have profound effects on the functioning and productivity of aquatic ecosystems and the species that rely on them.

TERRESTRIAL ECOSYSTEMS

East Africa has some of the world's most spectacular landscapes and animal populations, but they are threatened by climate change, interacting with human drivers such as deforestation. Changes in vegetative cover are already notable, with satellite imagery for 2001 to 2009 showing that the area under woody savanna has increased, while natural vegetation has decreased, especially land under forests, shrublands, and grasslands. These changes have negative consequences for agriculture and pastoralism as well as for tourism. According to one study, 25–40 percent of mammal species in East Africa's national parks, a major tourism attraction, have become endangered.

Changes in temperature and precipitation on the scale projected will compound these problems. The changes will contribute to losses of vegetation, forest, and wildlife populations, with irreversible consequences for wildlife-based tourism, biodiversity, and other resources. Habitat for wild animals and pasture for livestock will be affected, leading to increased competition between species as well as human-wildlife conflicts. Shifts in ecosystems due to increased warming have the potential to alter species composition, in some cases leading to the extinction. Land use shifts due to socioeconomic processes affected by climate change may result in increased deforestation and the blockage of migratory corridors.

AGRICULTURE AND FOOD SECURITY

The trend toward a warmer and drier East Africa, together with high inter-seasonal rainfall variability, especially in marginal agricultural areas, has contributed to a reduction of arable land suitable for staple food production, shifts in agro-ecological zones, and declines in the productivity of farmers, pastoralists, and fisheries. These trends not only have negatively effects on local livelihoods and economic security but also threaten food security as the region's population grows at a rapid annual rate of 2.3 percent.

Agricultural production will be directly and indirectly affected by future projected changes in rainfall and temperature, which will determine the continuing suitability, rate of growth, and potential yield of crops, livestock, fisheries, and aquaculture. The yields for many important crops in the region are already low, with maize producing 1.6 tons per hectare; dry beans, 2 tons per hectare; cassava, 8.3 tons per hectare; sorghum, 1 ton per hectare; and tea, an important export crop, 1.5–3 tons per hectare. Livestock productivity is below international benchmarks, with average dairy cattle productivity of 410 kilograms per animal compared to the global average of 2,197 kilograms per animal. In contrast, fisheries have been growing rapidly, with 17–20 percent increases in fish catch between 2007 and 2013 for the EAC and an expanding aquaculture industry. Under future climate change scenarios, critical food crops, particularly maize, will be further reduced by excessive heat and water shortages or excesses that effect growth. Average, minimum, maximum, and seasonal variations are also crucial in growth, regeneration, and survival of livestock. Very high temperatures, beyond 30°C, will reduce the extent of pasture as well as the quality of fodder available for animals. Such high temperatures affect animal physiology, by reducing body mass, and result in increased threat from parasites and diseases like East Coast Fever and Rift Valley Fever. The seasonality of biological processes in fish has been changing in recent decades, altering marine and freshwater food webs, with unpredictable consequences for fish production.

HEALTH AND HUMAN SETTLEMENTS

Climate change affects important determinants of health, such as clean air, safe drinking water, sufficient food, and secure shelter. Climate change also affects the biology and ecology of disease vectors and intermediate hosts, and consequently the risk of disease transmission and new disease patterns. The combination of higher temperatures, prolonged droughts, and extreme weather-coupled with scarce water resources and poor sanitation-increases vulnerability to outbreaks of cholera and other waterborne diarrheal diseases. Respiratory infections, which follow seasonal patterns, typically occur during the rainy season, which will be altered by climate change with consequences for the incidence of childhood pneumonia and for mortality from pneumonia. Increasing temperatures in the East African highlands have already resulted in an expansion of malaria into this previously malaria-free area and increased rainfall will create more habitat for mosquitos.

The size and characteristics of rural and urban human settlements also could be affected by future climate change, resulting in much greater urban populations as rural populations find it increasingly difficult to survive. However, urban areas will not be spared either, climate-related hazards that affect urban areas-floods, flash floods, tropical cyclones, drought, fires, and heat waves-are expected to increase in frequency and intensity with climate change and sea level rise. Increased urbanization will increase the population exposed to such risks.

ENERGY AND INFRASTRUCTURE

East Africa is endowed with abundant and diverse energy resources. The principal energy resources are hydropower, biomass, geothermal, solar, wind, liquid natural gas, peat, and coal. Biomass is the predominant form of energy used by rural population while electricity and petroleum are the key drivers of modern economic sectors. The members of the EAC already struggle to provide sufficient electrical power to support their growing economies, Kenya exemplifies the situation, with potential hydropower demand of 6,000 MW equivalent against an installed supply of 827 MW equivalent. Electricity access is low across the region (a high of 50 percent in Kenya, and a low of 9 percent in Uganda), rural populations still rely heavily on biomass, including wood, peat, and agricultural waste, as a source of energy. Climate change is a major cause of loss of vegetation and wood biomass, affecting energy access for local communities. Rainfall enhances vegetation growth and biomass supply; but decreased rainfall coupled with increased temperature and wind may trigger forest fires, adversely affecting natural forests, water catchments, and their ecosystem.

Changes in the frequency and intensity of precipitation and intensity of temperature will affect the reliability of hydropower and the quantity of hydropower-generated electricity. Decreases in precipitation alter the volume and flow of rivers, with negative effects on the electricity production levels of hydropower plants. Heavy rainfall leading to floods has a significant impact on electricity generation and transmission infrastructure. Increased rains increase runoff and consequent siltation, thus increasing the costs to maintain dams. Above-normal rains also lead to downstream flooding due to overflow from dams.

Climate change, together with deforestation, meanwhile will affect the abundance and quality of biomass to support the energy needs of rural areas and the increasing demand for charcoal in urban areas. While wind and solar energy have tremendous potential in the region, they have so far been too costly to capture any of the market.

PROPOSED POLICY ACTIONS

The findings of the VIA were used to develop of the Lake Victoria Basin Climate Change Adaptation Strategy and Action Plan (2018–2023), which seeks to enhance climate resilience in the LVB and to reduce the vulnerability of natural and social systems to climate change.

AGRICULTURE, FOOD SECURITY, LIVESTOCK, AND FISHERIES

- Strengthen regional and national early warning systems to be more responsive to users' needs;
- Promote climate-smart agriculture and risk management programs;
- Support and strengthen agricultural value chains through public-private partnerships;
- Harmonize and coordinate climate change initiatives for optimal use of limited resources; and
- Strengthen natural disaster and risk management.

WATER AND AQUATIC ECOSYSTEMS

- Develop sustainable funding mechanisms and policy frameworks to support water security;
- Develop and implement community-based climate change resilience programs on water catchment management;
- Develop a decision support system that integrates climate change and integrated water resources management information; and
- Develop sustainable funding mechanisms and regional policy frameworks that support water security; and
- Enhance technological advancement for water resources harvesting, storage, processing, and use.

TERRESTRIAL ECOSYSTEMS, FORESTRY, WILDLIFE AND TOURISM

- Apply a climate lens across key transboundary ecosystems, especially biologically significant areas such as Serengeti-Mara, Mount Elgon, Sango Bay-Minziro, Nyungwe-Kibira, and Greater Virunga;
- Analyze options for mitigation and adaptation for various governments in the LVB (national and regional), private sector and local communities;
- Prepare a regional approach in the LVB to address community-based climate change impacts on wildlife, forests, and tourism; and
- Develop a climate change information hub in the EAC and LVB Commission.

ENERGY AND INFRASTRUCTURE

- Develop an all-encompassing Specific, Measurable, Achievable, Relevant and Time-Bound (SMART) regional renewable energy policy that reviews and harmonizes existing strategies that support participation of the private sector and nongovernmental organizations;
- Research and invest in alternative energy, including the establishment of regional standards and setting up an internationally accredited energy laboratory;
- Develop incentives and funding framework for regional energy project incubation and start-ups; and
- Develop community-based biomass reduction and efficient best practice models for the region.

HEALTH AND HUMAN SETTLEMENTS

- Build the capacity of the health workforce on climate change preparedness and response;
- Strengthen and institutionalize surveillance, early warning and communications systems on climate-sensitive diseases;
- Strengthen research and interventions (prevention, preparedness, response) that address climate-sensitive sanitation and diseases; and
- Use climate-appropriate technologies for health and sanitation infrastructure.

EAST AFRICAN COMMUNITY

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