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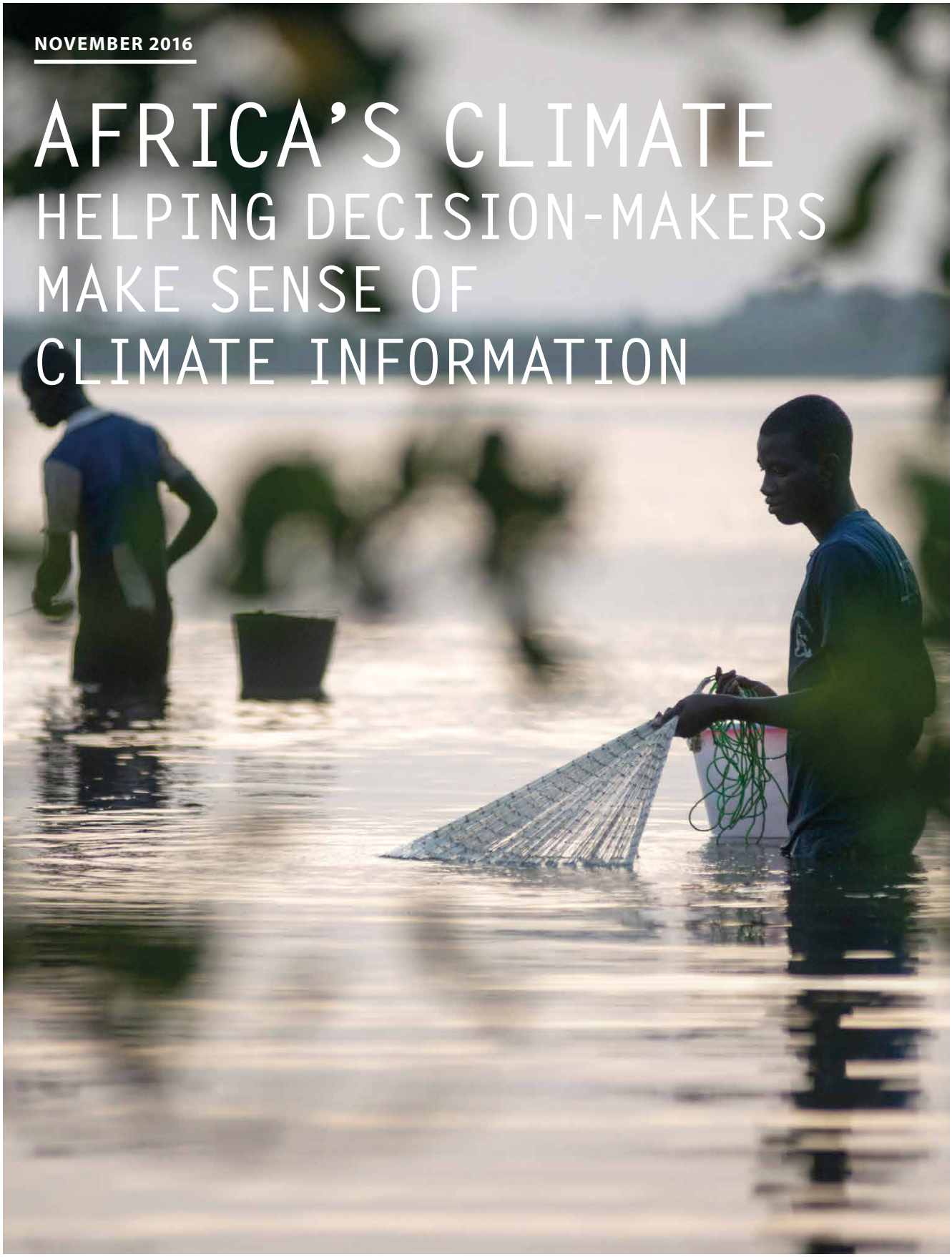
AFRICA'S CLIMATE
HELPING DECISION-MAKERS MAKE SENSE OF CLIMATE INFORMATION



FUTURE CLIMATE FOR AFRICA

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GENERAL READERS

EAST AFRICA
REGIONAL
OVERVIEW

EAST AFRICA'S CLIMATE: PLANNING FOR AN UNCERTAIN FUTURE

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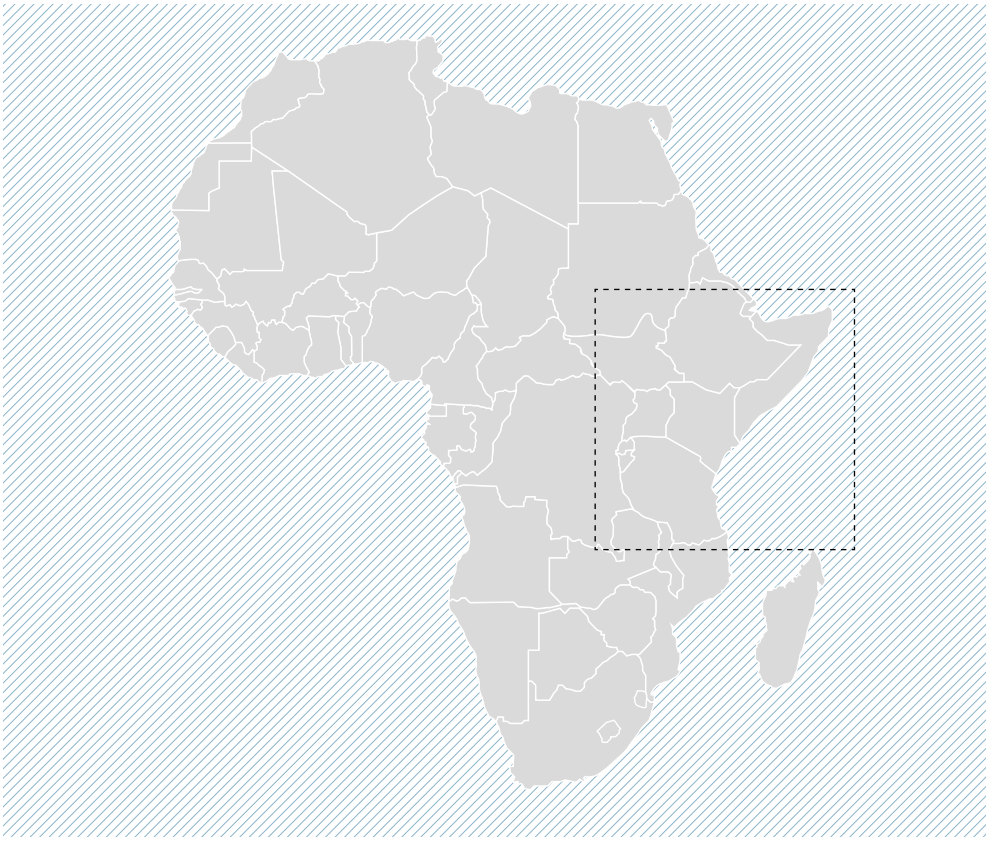

NEED TO KNOW

Rising temperatures and changing rainfall patterns will have significant impacts across east African society. Decision-makers need accessible information on likely climate change if they are to plan appropriately for this uncertain future.

This factsheet considers how the climate is likely to change in east Africa, and the likely implications for:

- water availability
- sanitation
- livelihoods, including agriculture and fresh water fisheries
- hydropower
- the potential for wind energy.

EAST AFRICA'S CLIMATE IS ALREADY CHANGING

The equatorial and southern parts of eastern Africa have experienced a significant increase in temperature since the early 1980s

The equatorial and southern parts of eastern Africa have experienced a significant increase in temperature since the early 1980s. Seasonal average temperatures have risen in many parts of the region over the past 50 years. Rainfall in the region is extremely variable across time and space. Several physical processes, including the El Niño Southern Oscillation, affect rainfall. Countries bordering the western Indian Ocean experienced a trend towards more frequent heatwaves, droughts, and storms between 1961 and 2008.[1]

There is a lack of evidence about observed trends in extreme temperature, extreme rainfall, and drought in east Africa. Changes in the Indo-Pacific oceans appear to have contributed to more frequent drought during the 'long rains' (from March to May) over the past 30 years. It is not clear whether these changes are due to human-caused climate change, or to natural climatic variability.[2]

FUTURE PROJECTIONS

Climate modelling indicates that east Africa is expected to warm in the next five to 40 years, although changes in rainfall are much less certain.

Temperature changes:

- maximum and minimum temperatures over equatorial east Africa will rise, and there will likely be an increase in warm days[3]

1 Climate & Development Knowledge Network. 2014. The IPCC's Fifth Assessment Report: What's in it for Africa?. Accessed on April 5, 2016 from: http://cdkn.org/resource/highlights-africa-ar5/

2 Ibid.

3 Ibid.

- the average annual temperature will likely increase by 1°C to 2.4°C by 2065[4]
- there will be a rise in warm nights in particular (an increase of about eight to 12 days per decade), and warmer days will likely happen more often.[5]

Rainfall changes

Tropical rainfall changes are challenging to project. Scientists must understand how the water content of the atmosphere will change as conditions warm, and also predict how storms form in response to the movement of heat and water in the atmosphere.

For eastern Africa, the 'long rains' season has recently experienced a series of devastating droughts, whilst most of the climate models predict increasing rainfall for the coming decades. This is the so-called 'east African climate change paradox'.

Future change can have serious implications for livelihoods in east Africa as water availability, sanitation, and energy are all influenced by the climate

This may be explained by the difficulty in modelling the change, or that models do not incorporate all factors driving this change. This is an area of active research.[6] Currently, global projections suggest that by the end of the 21st century, the climate in eastern Africa may be wetter or drier, but more likely to be wetter (with rainfall changing by between -6% and 17%).[7] The projections suggest a wetter climate during October to December, and March to May. By mid-century, the 'long rains' season may shorten for Ethiopia, Somalia, Tanzania, and southern Kenya. However, the 'short rains' season in southern Kenya and Tanzania (from October to December) may lengthen.[8]

Extreme rain events over most of the mid-latitude land masses and over wet tropical regions will very likely become more intense and more frequent by the end of this century, as temperatures warm,[9] and dry spells may increase.

While there is often uncertainty in the projections, this should not be a reason for inaction. Instead, these projections mean that adaptation measures should be robust for different scenarios, or be flexible enough to allow responses to change.

Society-wide impacts

Future change can have serious implications for livelihoods in east Africa as water availability, sanitation, and energy are all influenced by the climate.

4 IPCC, 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T. F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P. M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

5 Ibid.

6 Rowell, D. P., B. B. Booth, S. E. Nicholson, P. Good, 2015. Reconciling Past and Future Rainfall Trends over Eastern Africa. J. Climate. 28, 9768–9788. DOI: 10.1175/JCLI-D-15-0140.1.

7 IPCC, 2013.

8 Climate & Development Knowledge Network. 2015. The IPCC's Fifth Assessment Report: What's in it for Africa?. Accessed on April 5, 2016 from: http://cdkn.org/resource/highlights-africa-ar5/?loclang=en_gb

9 IPCC, 2013.

The implications of climate change for east Africa will be wide, including landslides in mountainous regions, complex ecosystem changes, and intensification of socio-political pressures. Therefore, climate change information must be integrated into decision-making and governance at all levels, and across traditional sectors and national boundaries.

Water availability

The uncertainty in climate projection makes it difficult to predict the precise impact on water resources. If there are to be more extended dry spells and a higher proportion of rainfall occurring as intense events, this could have a significant detrimental impact on the reliability of surface water stores, environmental flows, and soil water. This could have important implications for water supply, agriculture, and energy policy and development in a region where terrestrial water stores are already highly spatially variable.

Likewise the timing of groundwater recharge, and therefore the seasonal dynamics of groundwater stores, may be altered. This is particularly important in areas with hard rock aquifers which have low storage capacity and which cover much of east Africa.

More intense rainfall is likely to lead to an increase in surface flooding, more extreme river flow dynamics, and less predictable surface water stores. In some regions with relatively low annual average rainfall (less than 1000mm per annum), there is some evidence that this may lead to enhanced recharge of aquifers.

While groundwater resources are modest across the region, they are more buffered from climate variability compared to surface water, and may grow in importance regionally to meet future changes in water resource demands. Monitoring of groundwater resources is essential to ensure that in low storage aquifers, the groundwater resources are not overexploited.

Water supply and sanitation

The main climate-linked challenge relating to urban sanitation is flooding, which is expected to increase in frequency and intensity.

The main climate-linked challenge relating to urban sanitation is flooding, which is expected to increase in frequency and intensity. Direct impacts of this include: wash out of pits and tanks, causing contamination at the local level; overflow of sewers (where combined sewers are used), resulting in by-passing or wash out of treatment facilities (local or centralised); and wash out and destruction of sewers and treatment plants.

In addition, flooding may result in the isolation of areas with on-site sanitation, which then cannot be emptied, as well as an increase in transport costs for trucking excreta due to flooded roads and access points.

Where changes in climate result in increased waterlogging, this is likely to cause pits, tanks and sewers to be inundated with groundwater, which will impact on treatment processes.

The combined result of all of these factors will be an increase in the outbreak of water-borne diseases.

The consequences of the increases in average and extreme temperatures that are projected by climate models are likely to be: changes in the incidence of several critical excreta-related diseases; an increase in water consumption (this is also impacted by the availability and quality of urban water supply which in turn is influenced by the climate); and the extent and rate of algal growth in nutrient-enriched surface waters.

All of these considerations need to be integrated into decisions on urbanisation, water supply, and sanitation and drainage.

Rural livelihoods

The implications for productivity of food and cash crops, and lake fisheries will be profound, likely negatively impacting livelihood patterns and household incomes for farmers and fishing communities within the Lake Victoria Basin (LVB).

Many factors make long-term predictions problematic, including uncertainty about future climate, population dynamics, productivity, prices, employment, and other factors influencing such highly variable and complex livelihood systems.

Support for rural livelihoods and adaption to climate change will need better information on income and livelihood patterns, both within and between different populations across the region. Crops and fisheries will need to be monitored, along with their sensitivity to changes in climate, surface and ground water availability, government policies and active year-to-year management of impacts. Such information is key to developing sound strategies for land and water resource management.

Smallholder farmers with limited capital for investment in alternative income sources face multiple challenges: climate change; issues of market confidence; and lack of short-term security, which overrides longer-term investment decisions. Strategies aimed at improving access to and functioning of market systems could help increase the demand for, and supply of, affordable goods and services. Meanwhile, this will enable the rural poor to participate in markets and benefit from economic opportunities. Irrigation plans and strategies for diversification of food and income sources will be key.

Hydroelectric energy industry

Changing rainfall variability will impact on water levels in rivers and lakes, highlighting the importance of adapting the water 'release rules' followed by the hydropower sector

Hydroelectric energy is important for many states in east Africa. For example, hydroelectric schemes provide most of Uganda's industrial energy, and some is exported to Kenya. Climate change may increase or decrease water availability for hydropower. Energy planning must take this into consideration.

Changing rainfall variability will impact on water levels in rivers and lakes, highlighting the importance of adapting the water 'release rules' followed by the hydropower sector. For example, the current release rule at the source of the Nile means that the release from the Nalubaale Dam should follow the natural flow from Lake Victoria that would have existed prior to the existence of the dams.

Alternative release rules have been proposed that would save water during high rainfall years, to use in times when there is less rainfall. This may become more important with climate change. The research community has already used climate model projections to rank the release rules proposed by the Ugandan Ministry of Energy to minimise load shedding in future decades. Certain climate models can help refine this prioritisation of the proposed release rules, and assist government with developing new regulatory strategies and decisions in planning for the optimal mix of energy sources for the future.

Wind power over Lake Victoria

The need to slow climate change provides a strong incentive to develop renewable power sources, such as wind energy. Exploration and exploitation of wind power should help east African nations to meet their green energy targets for climate mitigation.

Studies have successfully determined the potential for wind power throughout most of east Africa. This has led to investment in large wind power plants over the northeast region of Kenya, with similar plans for central Tanzania. Paradoxically, these studies haven't enabled wind power investment over the LVB, which is one of the most powerful atmospheric circulation systems in the world. Climate scientists are working on advancing climate models that incorporate the interactions of land, lake, and atmospheric forces in order to better understand how climate change could affect the availability of wind energy across east Africa.

FCFA'S HyCRISTAL PROJECT

Project objectives

The availability of water is fundamental for development in east Africa. However, this vital resource is already under stress from land degradation, pollution and overfishing. Climate change adds to these problems, greatly increasing the vulnerability of the poorest people in the region.

Climate projections show a warming trend in east Africa in the decades ahead, but changes in rainfall and weather extremes are currently uncertain. HyCRISTAL will tackle current uncertainties which exist around climate change projections for the region, concentrating in particular on what they mean for the availability and management of water.

HyCRISTAL will develop new understanding of climate change and its impacts in east Africa, working with the region's decision-makers to manage water for a more climate-resilient future. See www.futureclimateafrica.org/project/hycristal/

The institutions involved in HyCRISTAL are:

- University of Leeds
- African Centre for Technology Studies
- British Geological Survey
- Centre for Ecology and Hydrology (UK)
- Evidence for Development
- Jomo Kenyatta University
- Loughborough University
- Met Office (UK)
- National Centre for Atmospheric Science (UK)
- National Fisheries Resources Research Institute (Uganda)
- North Carolina State University
- Practical Action
- Stony Brook University
- Tanzanian Meteorological Agency
- Ugandan National Meteorological Authority
- Ugandan Ministry of Water Resources
- University of Connecticut
- Makerere University
- Maseno University
- Walker Institute
- University of Reading (Africa Climate Exchange)

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