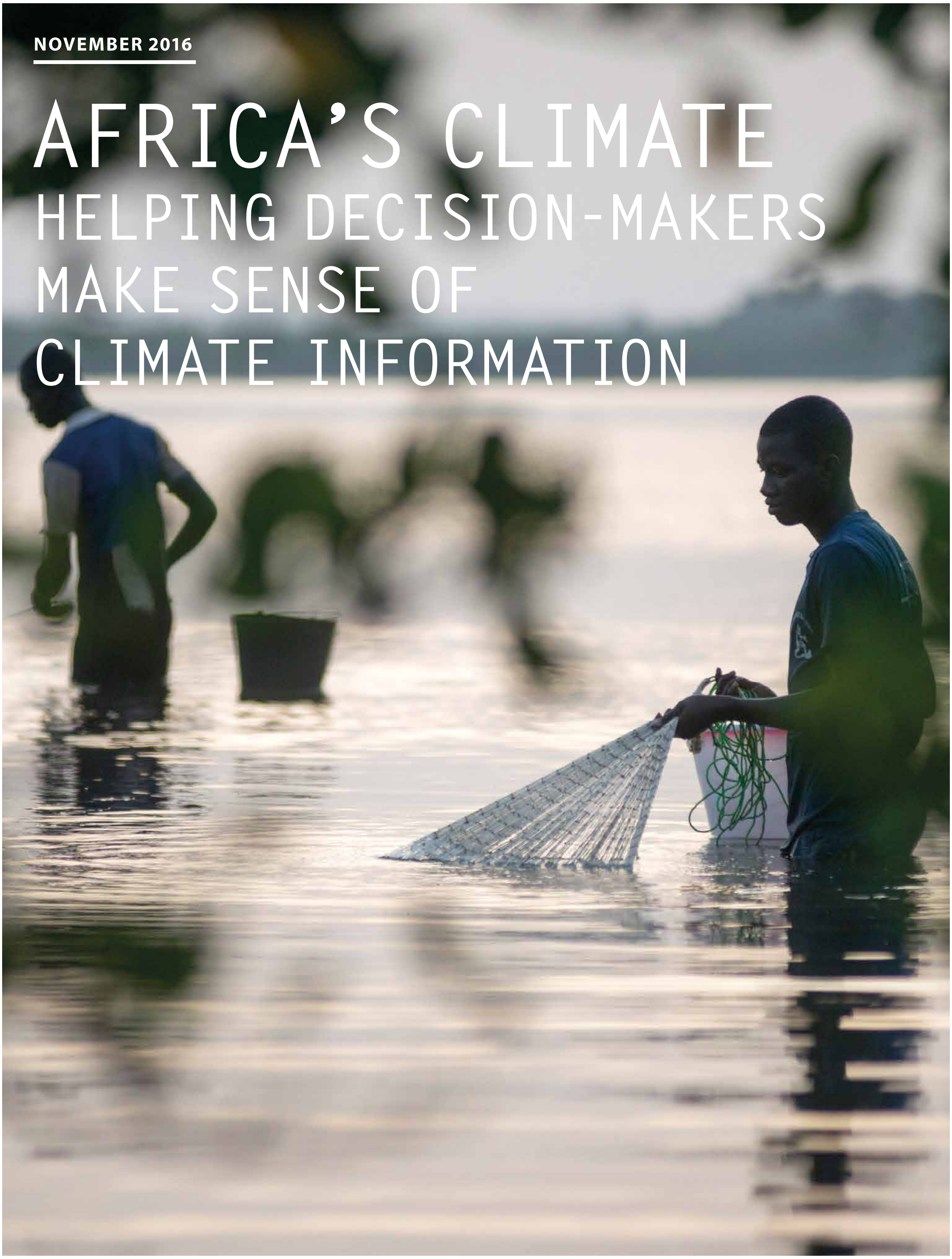
NOVEMBER 2016

AFRICA'S CLIMATE

HELPING DECISION-MAKERS MAKE SENSE OF CLIMATE INFORMATION



FUTURE CLIMATE FOR AFRICA

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GENERAL READERS

RWANDA
COUNTRY
FACTSHEET

CLIMATE INFORMATION FOR AN UNCERTAIN FUTURE

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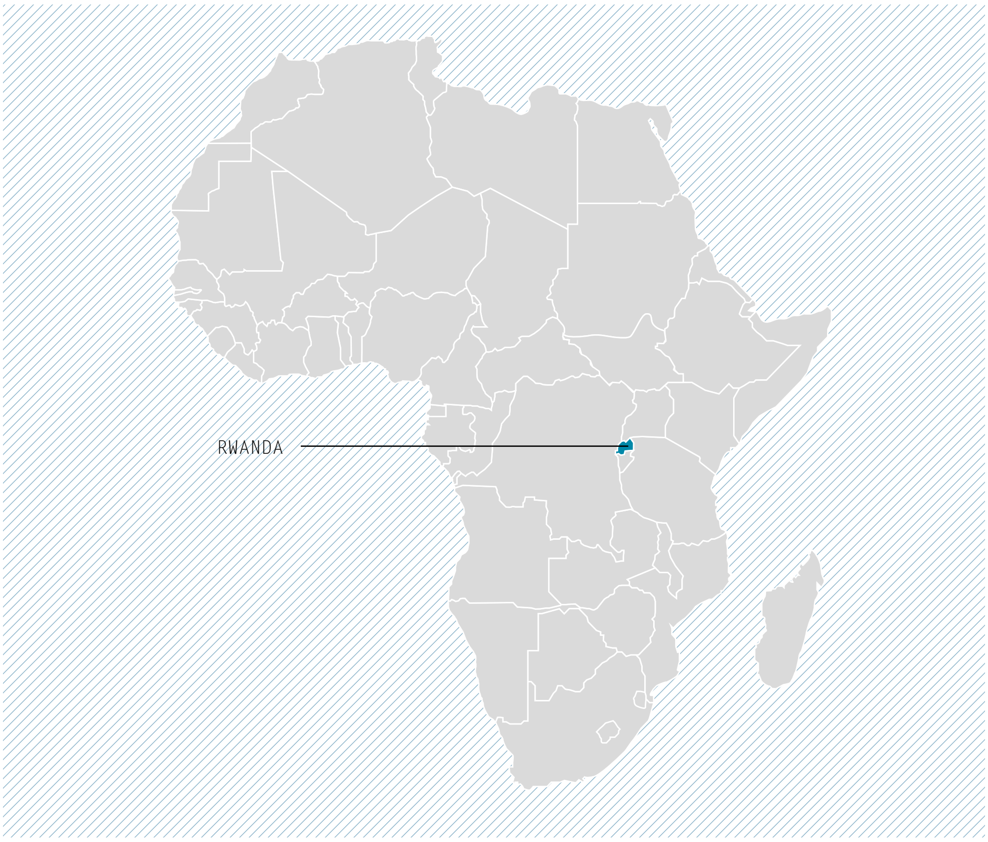


NEED TO KNOW

There are already noticeable changes in Rwanda's average temperature. Climate change is expected to further alter temperature and rainfall, and likely amplify the kinds of extreme events, such as flooding and drought, that the region already experiences.

This factsheet considers:

- Rwanda's current climate, and how it might change
- the likely impacts for the country and economy
- the type of climate information available to decision-makers, and how widely and effectively this is used.

RWANDA'S VARIABLE AND EXTREME CLIMATE

Rwanda's 'natural' climate is already variable, and prone to extremes. The rainfall varies throughout the year, and across the country, resulting in floods and landslides in the western and northern regions, but droughts in the east. Flooding has caused loss of human lives, and damaged crops and infrastructure. Similarly, historical drought events have caused famines.[1] The impacts of these hazards are exacerbated due to Rwanda's high population density. Addressing these current risks is a priority for early adaptation efforts.

Rwanda's climate

Rwanda has a temperate climate, with considerable differences across the country owing to the varying topography: mountains, valleys, and low-lying areas influence the temperature and rainfall. It is typically cooler and wetter in the west, mainly because of the high mountains, and warmer and drier in the east, where the elevation is lower.

The warmest annual average temperatures are found in the eastern plateau (20°C to 21°C) and Bugarama Valley (23°C to 24°C), and cooler temperatures in the central plateau (17.5°C to 19°C) and highlands (less than 17°C).[2] Rwanda has two rainy seasons, the 'long' rains from March to May, and the 'short' rains from September to December. However, there are large variations in rainfall between years, driven by global and regional weather systems.

1 [MIDIMAR] Ministry of Disaster Management and Refugee Affairs. 2015. The National Risk Atlas of Rwanda. Accessed on August 10, 2016 from: http://midimar.gov.rw/uploads/tx_download/National_Risk_Atlas_of_Rwanda_electronic_version.pdf

2 McSweeney R. 2011. Rwanda's climate: observations and projections Appendix E. United Kingdom: www.smithschool.ox.ac.uk/library/reports/Rwanda_Climate-data- final_proofed.pdf

HISTORIC TRENDS IN RWANDA'S CLIMATE

Weather records show that Rwanda is becoming hotter: the annual average temperature has increased 0.35°C per decade between 1971 and 2010.[3] Minimum and maximum temperatures have increased over the past few decades, with the minimum temperature having a greater increase and thus implying a reduction in the diurnal temperature range. There are no clear trends for rainfall change, although there are some signs that the variation between years is becoming greater.

RWANDA'S FUTURE CLIMATE

Future climate change is likely to lead to new risks: the negative impacts seen from today's climate variability are likely to become worse. We expect that temperatures in Rwanda will continue to rise, with an increase in the number of hot days.[4] This may reflect at different scales across the region, from the broader east African, to a local point in Rwanda.[5] Global Climate Models (GCMs) indicate that Rwanda's temperature may increase by 0.9°C to 2.2°C by the mid-21st century, relative to the period 1970 to 1999.[6]

Predicting regional rainfall changes in the tropics is a major challenge for climate science, and so rainfall projections are more uncertain. Whilst on average, models project a slight increase in annual mean rainfall; some project of both an increase and decrease, and therefore no robust indication of direction and magnitude of change rainfall by the 2060s (22% increase, and a 10% decrease, Table 1[7]). The same message can be said for the main rainy seasons occurring in the March to May and October to December months.

It is likely that climate change will increase the intensity of heavy rainfall events, owing to the likely increase in temperature by the mid-21st century. Other changes are less certain, i.e. whether average and seasonal rainfall will change, and whether the frequency and length of dry spells or droughts will increase. It is clear, at least, that the periodic droughts that happen today are likely to continue.

Trends in future temperature show clear changes in weather extremes that, along with current climate trends, will lead to impacts

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 these different scenarios, or be flexible enough to allow responses to change. Trends in future temperature show clear changes in weather extremes that, along with current climate trends, will lead to impacts, i.e. from current climate variability. Addressing these options will provide benefits today and build resilience to future climate change. Early planning to better understand and prepare for this is also an important and early priority.

3 McSweeney R. 2011.

4 Hot days are the daily maximum temperature that is exceeded on the highest 10% of days in that season for the baseline period 1961 to 2000 (McSweeney, 2015).

5 [CDKN] 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 [CSAG] Climate Systems Analysis Group. 2016. Climate Information Portal. Accessed February 3, 2016 from: http://cip.csag.uct.ac.za/webclient2/datasets/africa-merged-cmip5/

6 McSweeney R. 2011.

7 Ibid.

Table 1: The changes in rainfall, temperature, and number of hot days for Rwanda, by the 2050s, represented by season. Dashed lines indicate where no data is available, pale blue colour indicates an increase, while dark blue colour indicates a decrease. Min, Med and Max represent the minimum, maximum and median values of the data range.[8]

		Annual			January to February			March to May			June to September			October to December		
		Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Temperature (°C)	High	1.3	1.8	2.2	–	–	–	–	–	–	–	–	–	–	–	–
	low	0.9	1.4	1.9	–	–	–	–	–	–	–	–	–	–	–	–
Hot days % Frequency	High	–	–	–	48	66	72	54	75	85	63	76	85	51	66	71
	low	–	–	–	46	55	60	47	59	71	57	63	77	44	51	57
Rainfall (%)	High	-6	3	17	–	–	–	-10	9	19	–	–	–	-7	3	19
	low	-4	5	15	–	–	–	-9	5	22	–	–	–	-4	4	12

IMPACTS OF CLIMATE CHANGE FOR RWANDA

Cost to the economy

Although there is uncertainty associated with the future climate projections, climate change will have significant economic impacts in Rwanda. Given the high levels of uncertainty, it is difficult to accurately determine the economic cost of climate change. However, model estimations indicate that the additional net economic costs (on top of existing climate variability) could be equivalent to a loss of almost 1% of GDP each year by 2030, though this excludes the future effects of floods and other extremes.[9] This estimate is therefore conservative. There are indications that heavy precipitation – such as the number of heavy rainfall days, or intensity of rainfall – may increase, raising the potential risks of floods, landslides, and soil erosion. This could mean that current flooding and landslides that occur in the western areas will likely continue and could increase in future. Major flood events that occurred in 1997, 2006, 2007, 2008, and 2009 have caused fatalities, as well as infrastructure and crop damage.[10] The impacts of these events are economically significant, with the 2007 flood causing an estimated direct economic cost of $4 to $22 million (equivalent to around 0.6% of GDP) for two districts alone.[11]

8 Adapted from McSweeney, 2011.

9 [SEI] Stockholm Environmental Institute. 2009. The economics of climate change in Rwanda. Accessed from www.weadapt.org/sites/weadapt.org/files/legacy-new/knowledge- base/files/4e2572b33fe5bPresentation_summary.pdf

10 Ibid.

11 Ibid.

Future climate change could also significantly increase the health burden of malaria in Rwanda. Since malaria is restricted by temperature, rural populations living at higher altitudes have previously been at lower risk of contraction. Since future projections will result in warming of areas at higher altitudes, the risk of contraction may increase by 150% by 2050s. The increase in the disease burden is significant, and could lead to full economic costs that are over $50 million/year.

Table 2: Extreme weather, climate events, and associated impacts[12]

Extreme	Area affected	Impacts
Droughts	Affects livestock, wildlife, agriculture, water resources	Deaths of people and animals, lack of food, amongst others
Dry spells	Damage to crops	Crops diseases, lack of food
Floods	Damage to crops, shelter, infrastructure	Loss of lives, water resources, water quality, soil erosion, landslides
Hailstones	Damage to crops, damage to property	Loss of crops, stock, and human live
Lightning	Damage to shelter and infrastructure	Loss of life and aircraft
Strong winds	Damage to property, water transport	Loss of life
Extreme temperatures	Damage to crops and health	Lack of comfort, human and crops diseases
High humidity	Effect on human health	Lack of comfort, diseases
Fog	Affects road and air transport safety	Loss of life and property

CLIMATE INFORMATION USE IN RWANDA

Current climate models do not capture all the fine features of Rwanda's varied climate and terrain, but despite this limitation, provide valuable information. There is also a lack of information and observational data on current climate and risks across the country, which limits decision-makers' ability to contextualise future projections.

There are, however, efforts to make climate information more available, and use it appropriately in strategic planning.[13]

12 Mutabazi A. 2004. Generation and Application of Climate Information, Products and Services for Disaster Preparedness and Sustainable Development in Rwanda. Chapter 1: Weather and Climate.

13 [FCFA] Future Climate For Africa. 2015. Final Report: Rwanda Pilot. Accessed on August 10, 2016 from: www.futureclimateafrica.org/resource/rwanda-technical-report

Climate risks have generally been given a low priority when compared to other issues, such as socio-economic drivers

The gaps in climate information

Currently, most policy-makers are not using quantitative future climate projections for adaptation decisions, and instead rely on qualitative narratives of future change. The complex issue of understanding and communicating uncertainty is still limiting climate information usage in Rwanda. In many cases, decision-makers omit uncertainty messages, even when this is included in the primary studies and portals that they cite. Thus, sometimes the needs of the end user are not adequately met by the information generated from the climate science producers.

Decision-makers are interested in information on climate extremes and agro-meteorological and hydro-meteorological outputs, as well as average future trends. They are also much more interested in the next five to 15 years, than longer time periods. In some cases, a lack of time, resources, and capacity to include detailed climate information, has prevented decision-makers from using future projections.

Important socio-institutional issues also enhance or hinder the use of information in decisions. For example, often the decision window for addressing adaptation is short; it is therefore important to provide timely information during these windows of opportunity. In many cases, existing adaptation activities have not yet considered medium- or long-term climate information. Similarly, climate risks have generally been given a low priority when compared to other issues, such as socio-economic drivers.

Where climate information is used well

There are cases where Rwandan decision-makers plan to use climate information; which is evident in the energy sector. A policy objective has been developed to integrate climate and hydrological information into the planning, design, construction, and operations of Rwanda's hydroelectric power facilities. Climate information is currently informing the design of the Rusumo Falls hydroelectric plant. Interestingly, the use of climate information can differ between the public and private sectors. This is evident in Rwanda's hydropower projects, where it is far more difficult to encourage the use of climate information – and resilience – by the private sector for long-term decisions.

Rwanda's climate change and environment fund, FONERWA, is at the forefront of climate information usage in the country. The key decision context is on the appraisal process for adaptation projects, and the inclusion of climate change information into project fund applications, as well as the cost-benefit analysis that they are evaluated against.

FCFA'S HYCRISTAL PROJECT

Project objectives

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.

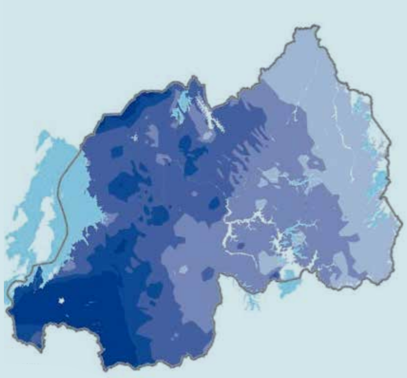
HyCRISTAL will develop new understanding of climate change and its impacts in east Africa, working with the region's decision-makers to manage water for a more climate-resilient future. See www.futureclimateafrica.org/project/hycristal

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)

FIGURES

Figure 1
Rainfall classification map for Rwanda[14]



Legend

Country boundary

Lakes

Scale

0 10 20 30 40

Date 16 December 2014

Source
Rwanda Natural
Resource Authority

Rainfall (mm/year)

<1,000

1,000–1,200

1,200–1,400

1,400–1,600

>1,600

Coordinate system: WG584 TM Rwanda
Projection: Transverse Mercator
Datum: WGS 1964

False Easting: 500,000.0000
False Northing: 5,000,000.0000
Central Meridian: 30.0000
Scale Factor: 0,9999

Latitude of Origin: 0.0000
Units: Metre

14 [MIDIMAR] Ministry of Disaster Management and Refugee Affairs. 2015. The National Risk Atlas of Rwanda. Accessed on August 10, 2016 from: http://midimar.gov.rw/uploads/tx_download/National_Risk_Atlas_of_Rwanda_electronic_version.pdf

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