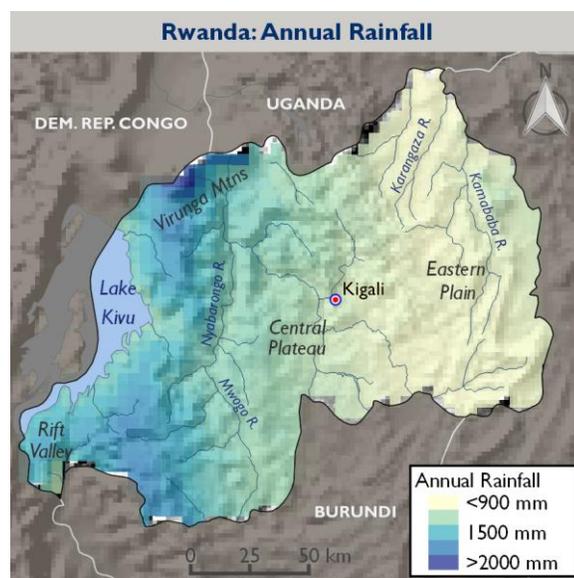


CLIMATE CHANGE RISK PROFILE RWANDA

COUNTRY OVERVIEW

Rwanda's strong economic growth in recent years has been accompanied by a drop in poverty, with GDP per capita growing almost fourfold from US \$201 to US\$748 between 2001-2017, a two-thirds drop in child-mortality, and near-universal primary school enrollment. These positive trends in the rural, landlocked, and densely populated country may be threatened by rising temperatures and variable rainfall, which are likely to impact rainfed agriculture, hydropower production, malaria transmission rates, and nature-based tourism. The drier east is considered the most vulnerable to climate impacts because dry spells are increasing in length, leading to food shortages. In 2016, drought affected Rwanda's Eastern Province, especially Kayonza, Kirehe, and Nyagatare districts, leaving 44,000 poor households (some 225,000 people) food insecure. In the west, rising temperatures are likely to force valuable tea and coffee production into higher, less productive lands. On the steep slopes that dominate much of the country, floods, landslides, and soil erosion already impact agriculture, infrastructure, and services. Heavy rains in 2012, for example, led to extensive flooding and an estimated loss of 1.4 percent of GDP. In 2016, floods and landslides blocked roads, destroyed bridges, and damaged 1,425 homes in Gakenke district. In rapidly growing urban areas, there is increasing concern about water shortages during longer dry spells and the impact of flooding and landslides on expanding informal settlements in risk-prone areas like steep slopes and flood plains. (5, 13, 20, 21, 22, 23, 24)



CLIMATE PROJECTIONS



1.4–2.3°C increase in temperatures by 2050



Increase in duration of heat waves and dry spells



Increase in frequency and intensity of heavy rainfall

KEY CLIMATE IMPACTS

Agriculture



Shift in production zones for key crops
Increased risk from pests and disease
Crop loss/land degradation and soil erosion

Water Resources



Reduced water quality
Increased flooding and sedimentation
Water shortage during longer dry spells

Human Health



Increased risk of water- and vector-borne diseases
Flood/landslide mortality, displacement

Ecosystems



Increased habitat degradation
Shifts in species habitat suitability
Loss of tourism revenues

Energy



Increased damage to reservoirs from siltation
Reduced hydropower production

February 2019

This document was prepared under the Adaptation Thought Leadership and Assessments (ATLAS) Task Order No. AID-OAA-I-14-00013 and is meant to provide a brief overview of climate risk issues. The key resources at the end of the document provide more in-depth country and sectoral analysis. The contents of this report do not necessarily reflect the views of USAID.

CLIMATE SUMMARY

Situated in the equatorial zone, Rwanda has a mountainous terrain (950–4,500 m) and a temperate climate characterized by strong seasonality and high interannual variability. The country’s topography moderates temperature and rainfall, leading to large variations over short distances. Rwanda has two rainy seasons, a main season from March to May and a short season from mid-September to mid-December. The El Niño Southern Oscillation influences precipitation periodically: El Niño brings above-average rainfall and La Niña, below average rainfall. The four main climate zones are summarized below. (2, 5, 10, 11, 12)

Climate Zone	Average Temperatures	Annual Average Rainfall	Relative Climate
Western and northern highlands (Congo-Nile Ridge)	15–17°C	1,400–1,600 mm	Coollest and wettest
Central plateau	17.5–19°C	1,200 mm	Cooler and wetter
Eastern plateau	20–21°C	700–950 mm	Warmer and drier
Southwest lowlands	23–24°C	800 mm	Warmest and driest

HISTORICAL CLIMATE

High interannual and interdecadal climate variability and a lack of historical records make climate trends difficult to discern. The Rwanda meteorological agency has established a climate data library that brings together numerous data sources to create a more complete record. Limited analysis to date suggests:

- Regional increased average temperature of 0.29°C per decade from 1985 to 2015, with increased interannual variability in recent decades (e.g., 0.79°C average increase from 2012 to 2014).
- No clear rainfall trends.

FUTURE CLIMATE

Projected changes by the 2050s include:

- Increased average annual temperature of 1.4–2.3°C.
- Increased duration of heat waves by 7–22 days.
- Likely increase in average rainfall (range of -3 to +9 percent).
- Increased heavy rainfall event frequency (7–40 percent) and intensity (2–11 percent).
- Likely increase in the duration of dry spells with a range of 0 to +7 days.

SECTOR IMPACTS AND VULNERABILITIES

AGRICULTURE

Rising temperatures, more frequent and intense heavy rains, and potentially increased duration of dry spells threaten Rwandan agriculture. Agriculture accounts for more than 30 percent of GDP, employs about 70 percent of the population, and generates about 50 percent of the country’s export revenues. The majority of agricultural households still rely on rainfed cultivation and the sector is hindered by variable rainfall, poor infrastructure, substantial post-harvest losses, and lack of access to inputs and finance. Rising temperatures compromise the quality and productivity of highly lucrative, temperature-sensitive tea and coffee (which account for more than 20 percent of export earnings) as agro-ecological zones shift to higher elevations with less arable land. In contrast, temperature increases are likely to expand production potential through 2050 for maize, Irish potato, cassava, and sorghum. Bean

yields are projected to decrease under a warming climate, especially in the lower elevations of the east and far southwest.

Climate Stressors and Climate Risks AGRICULTURE	
Stressors	Risks
Rising temperatures	Reduced tea and coffee production due to heat stress and shifting agro-ecological zones
Increased duration of dry spells	Increased pest and disease incidence in crops and livestock
Increased frequency and intensity of heavy rainfall	Damage to crops, roads, and agricultural infrastructure; degraded agricultural lands; and loss of livestock from heavy rainfall, flooding, landslides, and soil erosion

Warming temperatures are also likely to expand the range of crop pests, such as the coffee berry borer beetle, and livestock diseases, such as Rift Valley fever. Projections of longer dry spells are particularly concerning in the east and south, where approximately 44,000 households suffered crop and

WATER RESOURCES

Situated in the upper reaches of the White Nile and Congo river basins, Rwanda has abundant lakes, rivers, and wetlands, and groundwater is an important water source in rural areas. These relatively abundant water resources face increased pressure from a changing climate. Warming temperatures and longer dry spells will likely diminish surface flows, leading to water shortages (particularly in the east and around Kigali) and reduce groundwater recharge. Dry season flows in the Nyabarongo River, which supports Kigali’s water supply, are expected to decrease in coming decades, exacerbating shortages already occurring in the capital city. Another climate risk is the increase in the proportion of annual precipitation falling in heavy rainfall events. An increase in heavy rainfall leads to rapid runoff and flooding, which reduces groundwater recharge because too much rain at one time exceeds soil absorption capacity. Heavy rainfall also increases siltation of rivers, lakes,

HUMAN HEALTH

Increasing temperatures and heavy rainfall are expected to escalate the incidence of vector- and waterborne diseases, which are leading causes of death in Rwanda. Rwanda has made impressive progress reducing the risk of malaria in recent years. However, a warmer and possibly wetter climate is expected to expand areas of malaria transmission farther into the highlands, increasing incidence by up to 150 percent by 2050. Water contamination from increased flooding is expected to raise the risk of diarrheal disease, typhoid, cholera, and hepatitis A — all particularly dangerous diseases for the 27 percent of the population without access to improved water sources. Warming surface water temperatures are also expected to increase the risk of schistosomiasis. Longer dry periods in the east (e.g., Bugesera, Mayaga, and Umutara regions) and increased heavy rainfall damage around the country

ECOSYSTEMS

Rwanda is home to mountain, forest, savannah, lake, and wetland ecosystems critical for the region’s

livestock losses in the 2016 drought. As 90 percent of crops are grown on steep slopes, increased heavy rainfall events will exacerbate soil erosion and further degrade cultivated lands. (3, 5, 6, 7, 9, 14, 16, 18, 19, 21, 25, 26)

and reservoirs, and contaminates industrial, agricultural, and domestic sources. These climate stressors are in addition to other pressures on water resources, such as increasing demand from a growing population, agricultural and industrial pollution, and years of persistent environmental degradation. (4, 15, 16)

Climate Stressors and Climate Risks WATER RESOURCES	
Stressors	Risks
Rising temperatures and increased duration of dry spells	Warmer surface water temperatures accelerate bacterial growth and diminish water quality
	Longer dry spells lead to water shortages and reduced flow increases contamination of rivers
Increased frequency and intensity of heavy rainfall	Increased flooding from heavy rainfall events threatens water infrastructure and quality

are likely to exacerbate local food shortages and malnutrition rates. Regular flooding and landslides (such as the March and April 2018 floods in the west and northeast) were responsible for death, displacement, and damaged homes and health centers. (5, 8, 12, 14, 25, 27)

Climate Stressors and Climate Risks HUMAN HEALTH	
Stressors	Risks
Rising temperature	Expanded area and duration of transmission of vector-borne diseases, e.g., malaria
Increased duration of dry spells and heat waves	Flooding leads to increased drowning, displacement, and diarrheal and other waterborne disease
Increased heavy rainfall	

rich biodiversity, tourism industry, local fuel and food supplies, and hydrological regulation. Expanding

settlements and cultivation, displacement during the genocide, mining, and poaching have taken a heavy toll on the country’s natural resources. Sixty-four percent of forest cover was lost from 1960 to 2007 (although reforestation efforts in the last decade have increased forest cover). Increasing temperatures, heavy rainfall, and longer dry periods are likely to exacerbate soil erosion and land degradation, increase fire risk, shift distributions of native species (such as the giant senecio trees), and expand the range of invasive species such as the water hyacinth. Rwanda already experiences high rates of soil erosion that is depleting top soil in forests and riparian corridors, with the mountainous Gishwati ecosystem (which contains high numbers of threatened reptiles and amphibians) particularly vulnerable. Rising temperatures also threaten plants and wildlife through increased physiological stress and disruption of pollination and predator–prey relationships. An estimated 107 mammal, 199 bird, 31 fish, 34 amphibian, and 79 plant species in the Albertine Rift region are highly vulnerable due to

thermal sensitivity and/or changes in habitat suitability induced by climate change. Among the animals affected are the hippo, African wild dog, western rift puddle frog, grey-crowned crane, and the critically endangered mountain gorilla. These threats to biodiversity are likely to decrease tourism, a key source of foreign earnings and economic diversification. (1, 14, 17, 28)

Climate Stressors and Climate Risks ECOSYSTEMS	
Stressors	Risks
Rising temperature	Reduced and shifted ranges for native species leading to biodiversity loss
Increased duration of heat waves and dry spells	Increased physiological stress and disruption of wildlife and plant relationships
	Increased wildfire severity
Increased frequency and intensity of heavy rainfall	Habitat degradation from heavy rainfall events, particularly following longer dry spells
	Decreased tourism revenue as wildlife and habitats are impacted

ENERGY

With more than 7 million people lacking access to electricity (mostly in rural areas), Rwanda is expanding generation capacity to achieve universal access by 2024. This goal depends heavily on growth of hydropower, which currently accounts for more than half of Rwanda’s electricity generation capacity. Production is at risk from increased flood damage to dams and turbines, reservoir siltation, and river flow variability during longer dry spells. (5, 12, 20)

Climate Stressors and Climate Risks ENERGY	
Stressors	Risks
Increased duration of dry spells	Decreased hydropower production during dry spells
Increased frequency and intensity of heavy rainfall	Increased siltation reduces hydropower production capacity and damages turbines

POLICY CONTEXT

Rwanda has a forward-looking climate policy framework in place to guide climate change response. The country’s Green Growth and Climate Resilience Strategy (2011) outlines Rwanda’s vision of being a developed, climate-resilient, low-carbon economy by 2050. The country has an operational climate fund (FONERWA) and is mainstreaming climate change into medium-term planning and sector and district development plans. Rwanda is in the process of developing a National Adaptation Plan. (5, 14)

INSTITUTIONAL FRAMEWORK

The Ministry of Environment is responsible for designing and monitoring national climate policies. The Rwanda Environment Management Authority (REMA) is under this ministry and is responsible for climate policy implementation through its Department of Climate Change and International Obligations. FONERWA, also in the Ministry of Environment, aims to mobilize domestic and

international financing to environment and climate change projects. The Ministry of Environment has been accredited as an implementing entity for the Adaptation Fund and Green Climate Fund.

NATIONAL STRATEGIES AND PLANS

- [Second National Communication, UNFCCC](#) (2012)
- Intended Nationally Determined Contribution (2015)
- [Green Growth and Climate Resilience Strategy](#) (2011)

- [Green Growth and Climate Resilience Strategy Sectoral Working Papers](#) (2011)
- [National Adaptation Programmes of Action](#) (2006)
- [Organic Law on the Environment](#) (2005)

KEY RESOURCES

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- Map resource. WorldClim Global Climate Data and Hijmans, R.J. et al. 2005. Very high resolution interpolated climate surfaces for global land areas.

SELECTED ONGOING EXPERIENCES

Below are selected projects focused on climate change adaptation, or some aspect of it, in Rwanda.

Selected Program	Amount	Donor	Year	Implementer
Strengthening climate resilience of rural communities in Northern Rwanda (SCRNRP)	\$33.2 million	Green Climate Fund	2018–2024	Ministry of Environment
Increasing the Capacity of Vulnerable Rwandan Communities to Adapt to Adverse Effects of Climate Change	\$6.3 million	GEF, LDCF	2017–ongoing	Rwanda Energy Group
Rwanda Climate Services for Agriculture	na	USAID	2016–2019	CGIAR Research Program on Climate Change, Agriculture and Food Security
Assessing sustainability and effectiveness of climate information services in Africa	na	USAID	2016–2018	Winrock
Programme of Support to Agriculture in Rwanda	£43 million	DFID	2014–2019	IBRD, International Development Association, WFP
Reducing Climate Change Vulnerability in Rwanda through Community Based Adaptation	\$9.97 million	Adaptation Fund	2014–2018	Ministry of Environment
Provision of finance to the Rwanda Fund for Climate Change and Environment	£22 million	DFID	2013–2018	WYG International, KPMG Rwanda, FONERWA