CLIMATE RISK COUNTRY PROFILE

UGANDA

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This profile is part of a series of Climate Risk Country Profiles developed by the World Bank Group (WBG). The country profile synthesizes most relevant data and information on climate change, disaster risk reduction, and adaptation actions and policies at the country level. The country profile series are designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and policy making. This effort is managed and led by Veronique Morin (Senior Climate Change Specialist, WBG) and Ana E. Bucher (Senior Climate Change Specialist, WBG).

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Climate and climate-related information is largely drawn from the Climate Change Knowledge Portal (CCKP), a WBG online platform with available global climate data and analysis based on the latest Intergovernmental Panel on Climate Change (IPCC) reports and datasets. The team is grateful for all comments and suggestions received from the sector, regional, and country development specialists, as well as climate research scientists and institutions for their advice and guidance on use of climate related datasets.

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FOREWORD

Climate change is a major risk to good development outcomes, and the World Bank Group is committed to playing an important role in helping countries integrate climate action into their core development agendas. The World Bank Group is committed to supporting client countries to invest in and build a low-carbon, climate-resilient future, helping them to be better prepared to adapt to current and future climate impacts.

The World Bank Group is investing in incorporating and systematically managing climate risks in development operations through its individual corporate commitments.

A key aspect of the World Bank Group's Action Plan on Adaptation and Resilience (2019) is to help countries shift from addressing adaptation as an incremental cost and isolated investment to systematically incorporating climate risks and opportunities at every phase of policy planning, investment design, implementation and evaluation of development outcomes. For all IDA and IBRD operations, climate and disaster risk screening is one of the mandatory corporate climate commitments. This is supported by the Bank Group's Climate and Disaster Risk Screening Tool which enables all Bank staff to assess short- and long-term climate and disaster risks in operations and national or sectoral planning processes. This screening tool draws up-to-date and relevant information from the World Bank's Climate Change Knowledge Portal, a comprehensive online 'one-stop shop' for global, regional, and country data related to climate change and development.

Recognizing the value of consistent, easy-to-use technical resources for client countries as well as to support respective internal climate risk assessment and adaptation planning processes, the World Bank Group's Climate Change Group has developed this content. Standardizing and pooling expertise facilitates the World Bank Group in conducting initial assessments of climate risks and opportunities across sectors within a country, within institutional portfolios across regions, and acts as a global resource for development practitioners.

For developing countries, the climate risk profiles are intended to serve as public goods to facilitate upstream country diagnostics, policy dialogue, and strategic planning by providing comprehensive overviews of trends and projected changes in key climate parameters, sector-specific implications, relevant policies and programs, adaptation priorities and opportunities for further actions.

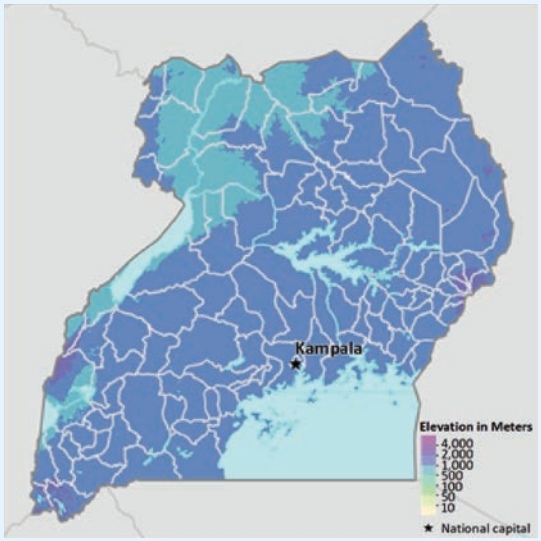
It is my hope that these efforts will spur deepening of long-term risk management in developing countries and our engagement in supporting climate change adaptation planning at operational levels.

Bernice Van Bronkhorst
Global Director
Climate Change Group (CCG)
The World Bank Group (WBG)

COUNTRY OVERVIEW

Uganda is a land-locked country located in East Africa and lies in both the northern and southern hemispheres, with approximate latitudes of 2°S to 5°N and approximate longitudes of 29.5° to 36.0°. The country is approximately 241,500 km^2 and is bordered by Kenya to the east, South Sudan to the North, Tanzania and Rwanda to the south, and the Democratic Republic of the Congo to the West. 17% of the country is covered by water and swamp land. The central part of Uganda is a plateau, surrounded by four main mountain ranges: Rwenzori, Elgon, Mufumbira, and Moroto; the tallest point is the peak of Mt. Rwenzori at 5,110 m.[1] Uganda has substantial natural resources, including relatively fertile soils; a high degree of biodiversity; rich vegetation; abundant water resources; small deposits of copper, gold, other minerals, and oil. However, the country also faces several developmental constraints such as high population growth (the second highest in the world),[2] post-conflict conditions in the North, soil erosion and degradation, and impacts of malaria and HIV/AIDS; added stressors from climate change are expected to exacerbate these challenges.[3] **Figure 1** shows the elevation for Uganda.

FIGURE 1. Elevation of Uganda[4]



A low-income country, Uganda has a population over 44.3 million (2019), with an annual population growth rate of 3.6% (2019).[5] Uganda's population is projected to reach 63.8 million by 2030 and 105.7 million by 2050.[6] The country has a Gross Domestic Product (GDP) of $35.1 billion (2019), growing at an average annual rate of 4.5% over the past five years. The national poverty rate increased to 20% in 2017, however, the poorest region: the Northern region, decreased its poverty rate from 44% (2013) to 33% (2017).[7] According to 2019 data, the country's GDP is primarily comprised of the agriculture sector, which contributed 23.1% to GDP, the industry sector (including mining, construction, electricity, water and gas), which contributed 26.3% of GDP, the export of goods and services which contributed17.2% to the country's economy;[8] tourism which contributed 6.6% to GDP in 2016.[9]

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1 Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

2 World Bank Open Data (2021). World Development Indicators. Uganda. URL: http://databank.worldbank.org/data/reports.aspx?source=2&country

3 USAID (2012). Uganda – Climate Vulnerability Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/uganda_climate_vulnerability_profile_jan2013.pdf

4 World Bank (2019). Internal Climate Migration Profile – Uganda.

5 World Bank Open Data (2021). World Development Indicators. Uganda URL: http://databank.worldbank.org/data/reports.aspx?source=2&country

6 World Bank Data Bank (2021). Health Nutrition and Population Statistics: Population estimates and projections – Uganda. URL: https://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics:-population-estimates-and-projections

7 The World Bank (2020). Uganda Overview. URL: http://www.worldbank.org/en/country/uganda/overview

8 World Bank Open Data (2021). World Development Indicators. Uganda URL: http://databank.worldbank.org/data/reports.aspx?source=2&country

9 World Travel & Tourism Council (2017). Travel and Tourism Economic Impact 2017-Uganda. URL: https://www.wttc.org/-/media/files/reports/economic-impact-research/countries-2017/uganda2017.pdf

Uganda submitted its Nationally-Determined Contributions to the UNFCCC in 2016, in support of the country's efforts to realize its development goals as laid out in its Poverty Reduction Strategy Paper (2010) and its National Climate Change Policy (2015). Uganda was one of the first countries to mainstream the Sustainable Development Goals into its development plan and developed the Uganda Green Growth Development Strategy in order to operationalize green growth planning into the country's development plans.[10] Uganda is particularly focused on protecting its economy and the livelihoods of its population, which is highly dependent upon natural resources and as such the government is working to reduce vulnerability.[11] Priorities are focused on increased adaptation for key sectors of agriculture, water, energy and health, and specifically to increase sustainable agricultural and livestock production, improve forestry management, improve infrastructure, and continue to strengthen its disaster risk management activities.[12]

Green, Inclusive and Resilient Recovery

The coronavirus disease (COVID-19) pandemic has led to unprecedented adverse social and economic impacts. Further, the pandemic has demonstrated the compounding impacts of adding yet another shock on top of the multiple challenges that vulnerable populations already face in day-to-day life, with the potential to create devastating health, social, economic and environmental crises that can leave a deep, long-lasting mark. However, as governments take urgent action and lay the foundations for their financial, economic, and social recovery, they have a unique opportunity to create economies that are more sustainable, inclusive and resilient. Short and long-term recovery efforts should prioritize investments that boost jobs and economic activity; have positive impacts on human, social and natural capital; protect biodiversity and ecosystems services; boost resilience; and advance the decarbonization of economies.

CLIMATOLOGY

Climate Baseline

Overview

Uganda's climate is largely tropical with two rainy seasons per year, March to May and September to December. The northern region, which forms one quarter of the country lies outside the tropical belt, and hence experiences only one rainy season, March to October. The rest of Uganda lies within a relatively humid equatorial climate zone, and the topography, prevailing winds, and lakes and rivers cause large differences in rainfall patterns across the country.[13] It's location in the tropics and across the equator results in the country's weather and seasons being determined by the large-scale Indian Monsoon, Congo air mass, Indian Ocean Dipole (IOD) and the Inter Tropical Convergence Zone

[10] Uganda National Planning Authority (2018). The Uganda Green Growth Development Strategy, 2017/18–2030/31. URL: https://www.undp.org/content/dam/LECB/docs/pubs-reports/undp-ndc-sp-uganda-ggds-green-growth-dev-strategy-20171204.pdf

[11] Ministry of Water and Environment (2016). Uganda's Nationally Determined Contribution (NDC). URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Uganda%20First/INDC%20Uganda%20final%20%2014%20October%20%202015.pdf

[12] Uganda National Planning Authority (2018). The Uganda Green Growth Development Strategy, 2017/18–2030/31. URL: https://www.undp.org/content/dam/LECB/docs/pubs-reports/undp-ndc-sp-uganda-ggds-green-growth-dev-strategy-20171204.pdf

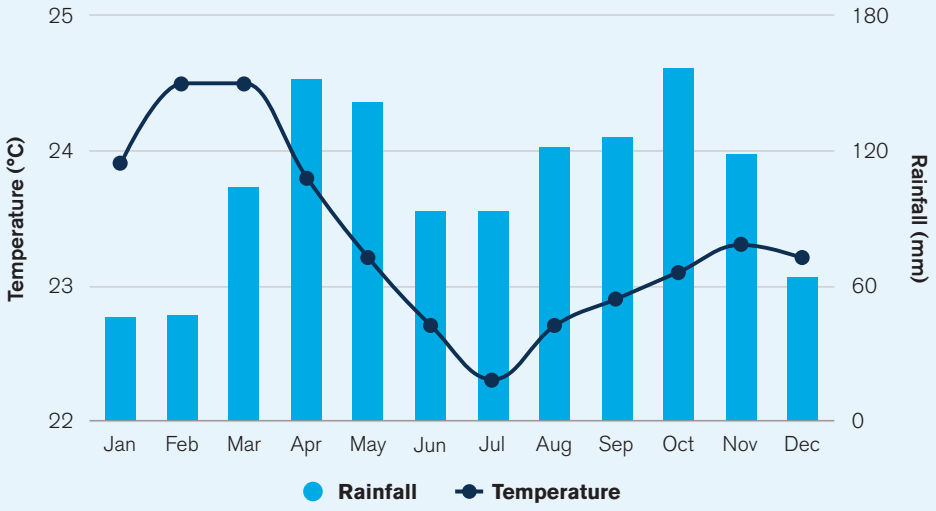
[13] USAID (2013). Uganda Climate Change Vulnerability Assessment Report. URL: https://www.climatelinks.org/sites/default/files/asset/document/ARCC-Uganda%2520VA-Report.pdf

(ITCZ) systems. Uganda also experiences the El Nino Southern Oscillation (ENSO) phenomena, which are principal driving forces of intra-annual to inter annual rainfall variability. Specifically, the most pronounced impacts for Uganda are during the rainy season, September to December, where the El Nino is often equated to floods rather than La Nina that is often equated to droughts.[14] Southern Uganda can receive between 600 to 2,200 mm of rainfall annually, while the northern part of the country receives between 400 and 1,600 mm per year. Precipitation patterns in Uganda indicate varied rainfall distribution with areas like Karamoja receiving the lowest amounts of rainfall of approximately 400 mm and areas around Lake Victoria and Elgon receiving the highest amounts of rainfall, up to 2,200 mm.

Overall, Uganda experiences moderate temperatures throughout the year. However, the country's diverse topography results in wide-ranging temperature, from 0°C in the ice-capped Rwenzori Mountain Range and Mt Elgon, to 30°C in the north-eastern areas of Gulu, Kitgum and Moroto. The Rwenzori Mountain Range has permanent ice caps, however due to rising temperatures, the area typically covered by ice reduced by 49% between 1987 to 2003 and is projected to disappear by the 2040s.[15] This has implications for the area's water resources, livelihood activities and is likely to change its epidemiological profile.

Analysis of data from the World Bank Group's Climate Change Knowledge Portal for the historical period 1901–2019 (**Table 1**) shows mean annual mean temperature for Uganda to be 22.8°C, with monthly temperatures ranging between 21.7°C (July) and 23.9°C (February). During this period, total annual average precipitation is 1,197 mm, and mean monthly precipitation of the country varies from 39.6 mm in January to 152.7 mm in April. **Figure 2** shows Uganda's most recent climatology, from 1991–2020 and **Figure 3** presents the observed spatial distribution of average annual precipitation and temperature.

FIGURE 2. Average monthly temperature and rainfall for Uganda for 1991–2020[16]



[14] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

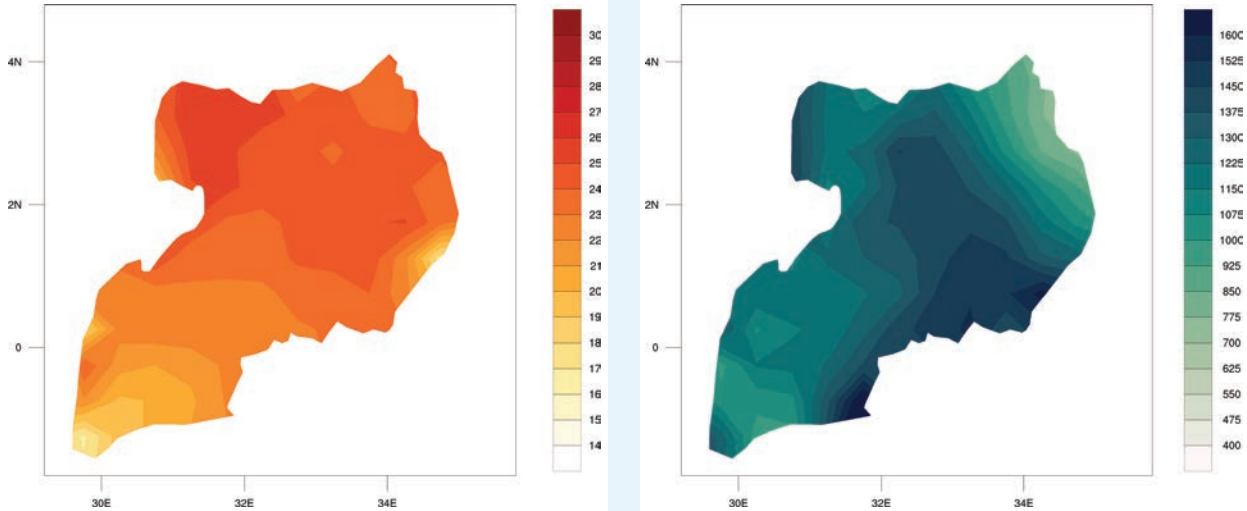
[15] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

[16] WBG Climate Change Knowledge Portal (CCKP, 2021).Uganda URL: https://climateknowledgeportal.worldbank.org/country/uganda/climate-data-historical

TABLE 1. Data snapshot: Summary statistics

Climate Variables	1901–2020
Mean Annual Temperature (°C)	**22.4°C**
Mean Annual Precipitation (mm)	**1,200.1 mm**
Mean Maximum Annual Temperature (°C)	**28.7°C**
Mean Minimum Annual Temperature (°C)	**16.2°C**

FIGURE 3. Map of average annual temperature (left); annual precipitation (right) of Uganda, 1991–2020[17]



Key Trends

Temperature

Average temperatures in Uganda have increased by 1.3°C since the 1960s. Notably, minimum temperatures have increased 0.5–1.2°C for this period with maximum temperatures increasing by 0.6–0.9°C.[18] Increased average temperatures have been observed at 0.28°C per decade since 1960. Daily temperature observations since 1960 show significantly increasing trends in the frequency of the number of hot days, and much larger increased trends in the frequency of hot nights.[19] Hot days and nights are defined as the number of days/nights in which the temperature exceeded on 10% of days/nights in the current climate of the region and season. Hot days in Uganda have increased by 74 days (an additional 20% of days) between 1960 and 2003. The most significant increase has been observed in June, July, August in which hot days increased by an average of 8.6 days per month. The average number of hot nights also increased by 136 nights since 1960 (an additional 37% of nights)

[17] WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda. URL: https://climateknowledgeportal.worldbank.org/country/uganda

[18] USAID (2012). Uganda Climate Vulnerability Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/uganda_climate_vulnerability_profile_jan2013.pdf

[19] Ministry of Water and Environment (2015). Uganda National Climate Change Policy. URL: https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf

between 1960 and 2003. The most significant increases have also been observed in June, July, August in which hot nights increased by 14 days per month. The number of cold days have decreased, by 20 days since 1960, with the rate of decrease most rapid in the September, October, November season.[20] Cold days and nights are defined as the number of days/nights in which the temperature below 10% of days/nights in the current climate of the region and season.

Precipitation

Precipitation for the country is highly variable, but overall, Uganda has experienced a statistically significant reduction in annual as well as seasonal rainfall. Seasonal rainfall for March, April, May has been most affected, with decreases of 6.0 mm per month, per decade.[21] Decline in rainfall has been observed in some Northern districts: Gulu, Kitgum, and Kotido. While trends in extreme rainfall conditions are more difficult to define due to the lack of data and seasonal variability, droughts have increased in Uganda over the past 60 years. Specifically, over the past 20 years, western, northern and north-eastern regions have experienced more frequent and longer-lasting drought conditions. In the highly arid, north-eastern district of Karamoja, seven droughts occurred between 1991–2000, with additional droughts occurring in 2001, 2002, 2005, 2008 and 2011.[22] The percentage of rainfall occurring from heavy precipitation events is anticipated to increase, which would also escalate the risk of disasters such as floods and landslides.[23]

Climate Future

Overview

The main data source for the World Bank Group's Climate Change Knowledge Portal (CCKP) is the CMIP5 (Coupled Inter-comparison Project No.5) data ensemble, which builds the database for the global climate change projections presented in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Four Representative Concentration Pathways (i.e. RCP2.6, RCP4.5, RCP6.0, and RCP8.5) were selected and defined by their total radiative forcing (cumulative measure of GHG emissions from all sources) pathway and level by 2100. The RCP2.6 for example represents a very strong mitigation scenario, whereas the RCP8.5 assumes business-as-usual scenario. For more information, please refer to the RCP Database. For simplification, these scenarios are referred to as a low (RCP2.6); a medium (RCP4.5) and a high (RCP8.5) emission scenario in this profile. **Table 2** provides CMIP5 projections for essential climate variables under high emission scenario (RCP8.5) over 4 different time horizons. **Figure 4** presents the multi-model (CMIP5) ensemble of 32 Global Circulation Models (GCMs) showing the projected changes in annual precipitation and temperature for the periods 2040–2059 and 2080–2099.

[20] McSweeney, C., New, N. and Lizcane, G. (2010). Uganda, UNDP Climate Change Country Profiles. URL: https://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Uganda/Uganda.hires.report.pdf

[21] McSweeney, C., New, N. and Lizcane, G. (2010). Uganda, UNDP Climate Change Country Profiles. URL: https://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Uganda/Uganda.hires.report.pdf

[22] Future Climate for Africa (2016). Africa's Climate- Helping Decision-Makers Make Sense of Climate Information. Uganda Country Fact Sheet. URL: http://2016report.futureclimateafrica.org/wp-content/uploads/2016/10/CDKNJ4897_FCFA_Print_WEB_15.pdf

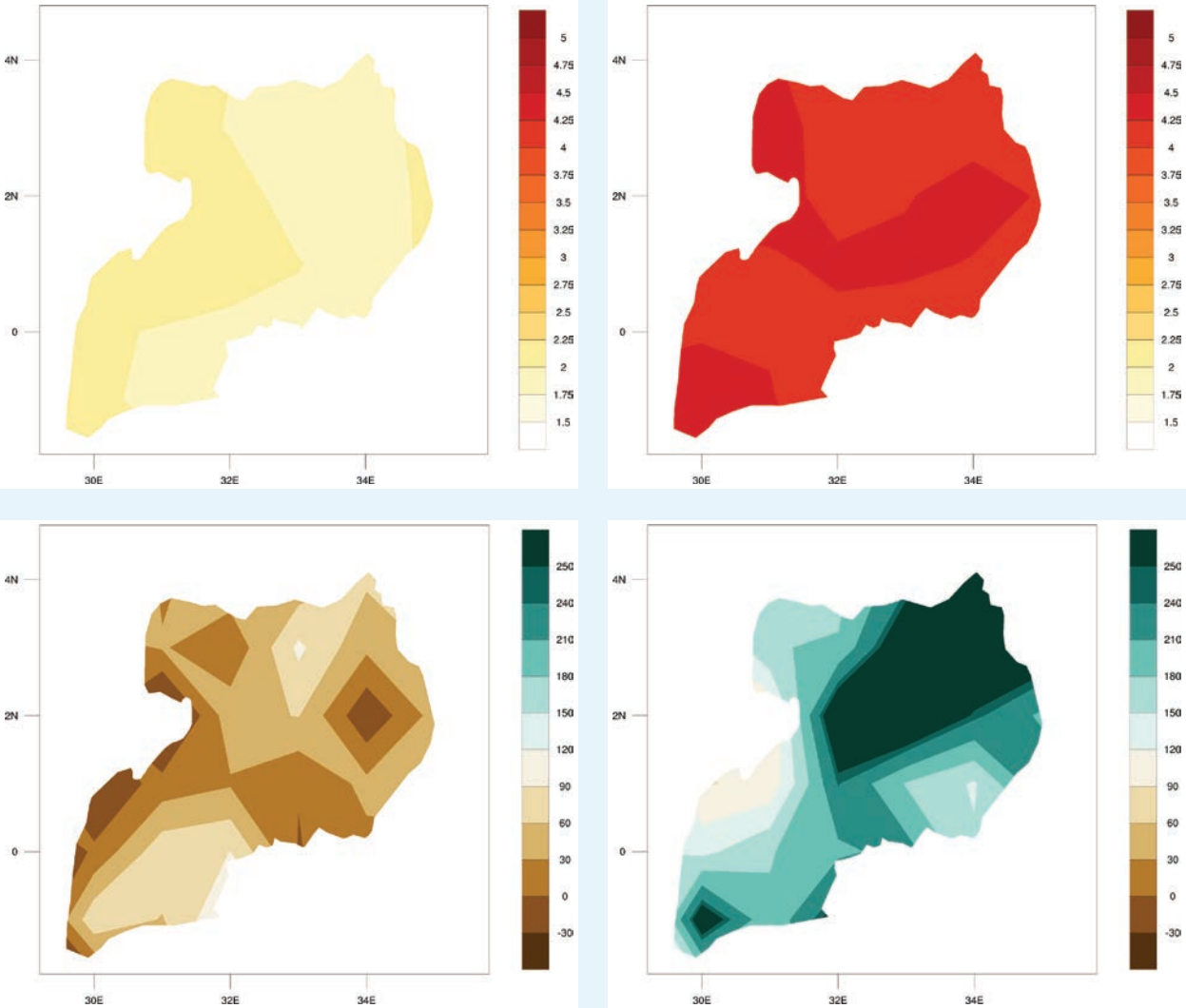
[23] USAID (2012). Uganda Climate Vulnerability Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/uganda_climate_vulnerability_profile_jan2013.pdf

TABLE 2. Data snapshot: CMIP5 ensemble projection

CMIP5 Ensemble Projection	2020–2039	2040–2059	2060–2079	2080–2099
Annual Temperature Anomaly (°C)	**+0.6 to +1.5** (+1.0°C)	**+1.2 to +2.5** (+1.8°C)	**+1.9 to +3.9** (+2.8°C)	**+2.6 to +5.2** (+3.7°C)
Annual Precipitation Anomaly (mm)	**–23.5 to +25.9** (+1.4 mm)	**–25.9 to +32.5** (+2.9 mm)	**–26.5 to +45.1** (+7.37 mm)	**–26.0 to +63.1** (+13.6 mm)

Note: The table shows CMIP5 ensemble projection under RCP8.5. Bold value is the range (10th-90th Percentile) and values in parentheses show the median (or 50th Percentile).

FIGURE 4. CMIP5 ensemble projected change (32 GCMs) in annual temperature (top) and precipitation (bottom) by 2040–2059 (left) and by 2080–2099 (right), relative to 1986–2005 baseline under RCP8.5[24]



[24] WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda Projected Future Climate. URL: https://climateknowledgeportal.worldbank.org/country/uganda/climate-data-projections

Key Trends

Temperature

Increased temperatures are expected for East Africa and specifically for Uganda. Under a high-emission scenario, monthly temperature change is expected to increase by 1.8°C for the 2050s and by 3.7°C by the 2090s. Increased temperatures will also impact increased aridity and the length and severity of the dry season (December to March). Projected rates of warming are greatest in Uganda's coolest season: June to September, with temperatures expected to increase by 1.5 to 5.4°C by the end of the century. Hot days are expected to occur on 15–43% of days by the 2050s and by 18–73% of days by end of century. Nights that are considered 'hot' (>26°C) are expected to increase more quickly than hot days.[25] Temperature rise is projected to increase across all emission scenarios throughout the end of the century. As seen in **Figure 5**, under a high-emission scenario, average temperatures will increase rapidly by mid-century. Across the seasonal cycle (**Figure 6**), temperature increases will be felt from September to January. These high heat days will result in significant implications for human and animal health, agriculture, ecosystems as well as energy generation.

FIGURE 5. Historical and projected average temperature for Uganda from 1986 to 2099[26]

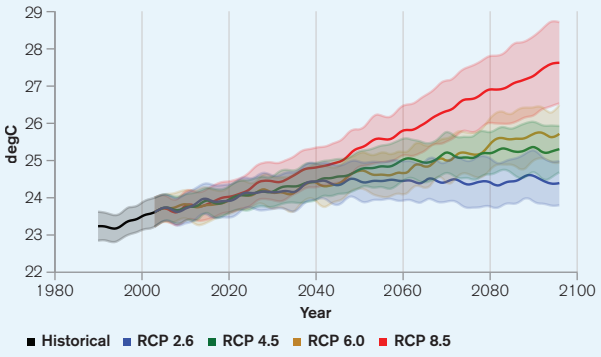
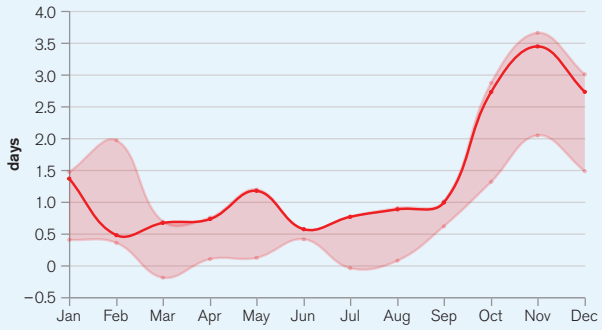


FIGURE 6. Projected change in Summer Days (Tmax> 25°C)[27]



Precipitation

Under a high-emission scenario, monthly annual precipitation is expected to increase in some areas of the country, with deceases in others, notably the northern and north-eastern areas. Rainfall is predicted to increase significantly and consistently for the western shores of Lake Victoria and the central western region; the Mount Elgon region; and the region extending from Mount Rwenzori to the southern parts of Lake Kioga. The greatest change in the intensity and frequency of extreme rainfall events is likely to take place between the current and the mid-century period in this region, which is likely to impact major agriculture and livestock zones and transportation

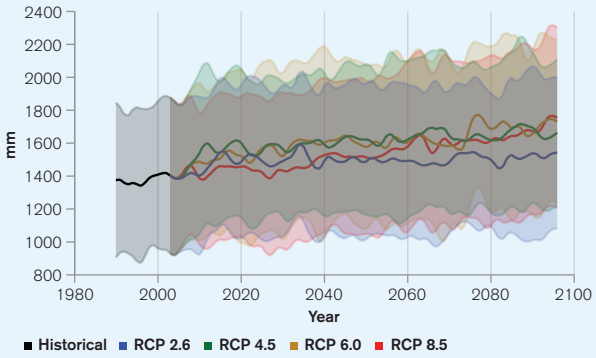
[25] McSweeney, C., New, N. and Lizcane, G. (2010). Uganda, UNDP Climate Change Country Profiles. URL: https://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Uganda/Uganda.hires.report.pdf

[26] WBG Climate Change Knowledge Portal (CCKP, 2021). Interactive Climate Indicator Dashboard - Agriculture. Uganda. URL https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=UGA&period=2080-2099

[27] WBG Climate Change Knowledge Portal (CCKP, 2021). Interactive Climate Indicator Dashboard - Agriculture. Uganda. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=UGA&period=2080-2099

routes. Overall, there is a likely increase for the number of consecutive wet days (daily accumulation of rainfall ≧ 1mm per day) throughout the year. Additionally, the number of days with precipitation greater than 20mm will increase in each of the two rainy seasons in Uganda. **Figure 7**, shows the change in the projected annual average precipitation for Uganda.[28] For the annual national-scale aggregate, average precipitation is likely to increase slightly by the of the century under a high emissions scenario of RCP8.5, with much of the increase expected for certain areas and occurring through an increase in intense precipitation events.

FIGURE 7. Annual average precipitation in Uganda for 1986 to 2099[29]



CLIMATE RELATED NATURAL HAZARDS

Overview

Uganda is at risk to natural disasters. The country experiences extreme weather events which lead to mudslides, landslides and flooding, particularly for the country's mountain regions and related districts such as Mbale in the Mt Elgon region.[30] Extreme events leading to disasters such as floods, droughts, and landslides have increased over the last 30 years. Flooding has become more frequent, largely due to more intense rainfall.[31] Over the past two decades, an average of 200,000 Ugandans are affected each year by disasters. Increased intensity of heavy rainfall has led to greater impact of floods and are causing more damage due to expanded infrastructure, human settlement and general development of the country.[32]

Uganda's vulnerability is exacerbated due to its high level of poverty and its high dependence on 'climate sensitive' sectors: agriculture, water, fisheries, tourism, and forestry. The country is at high-risk to natural disasters such as flooding, drought, and landslides, however, its topographic diversity and highly marginalized segments of the

[28] WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda Water Dashboard. Data Description. URL: https://climateknowledgeportal.worldbank.org/country/uganda/climate-sector-water

[29] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data-Projections. Uganda. URL: https://climateknowledgeportal.worldbank.org/country/uganda/climate-sector-water

[30] Ministry of Agriculture, Animal Industry and Fisheries (2018). Guidelines for Mainstreaming Climate Change Adaptation and Mitigation in Agricultural Sector Policies and Plans. URL: https://www.agriculture.go.ug/wp-content/uploads/2019/09/Guidelines-for-Mainstreaming-Climate-Change-Adaptation-and-Mitigation-in-the-Agricultural-Sector-Policies-Plans-1.pdf

[31] Ministry of Water and Environment (2014). Guidelines for the Integration of Climate Change in Sector Plans and Budgets. URL: http://ccd.go.ug/wp-content/uploads/2018/04/National-Climate-Change-Mainstreaming-Guidelines-.pdf

[32] Department of Disaster Preparedness and Management (2011). The National Policy for Disaster Preparedness and Management. URL: https://reliefweb.int/sites/reliefweb.int/files/resources/1.%20National%20Policy%20for%20Disaster%20Preparedness%20%26%20Management.pdf

population, make it additionally vulnerable. Additional, non-climate stressors such as inadequate infrastructure to handle the increasing population are also impacting the vulnerability to natural disaster sensitivity and climate change vulnerability. With an urbanization rate of 5.4%, increasing amounts of the population are living in urban areas, putting pressure on existing infrastructure as well as scarce available land; a diminishing natural resource. As of 2017, 9.9 million people lived in urban areas of Uganda. This is projected to increase to 19.9 million by 2030 and 31.5 million by 2040,[33] causing increased pressure on urban infrastructure with increased likelihood of vulnerability for poorer and less-resilient communities.[34] Economic efforts and the development of industry has put additional pressure on the exploitation of forests, lake-fisheries, inner-city development, and agriculture lands, which has contributed to deforestation, overfishing, degradation of agriculture areas and forest environments, as well as the pollution and unsustainable use of water resources.[35]

Poverty, land degradation, rapid and unplanned urbanization since the 1960s, and weak enforcement of building codes and zoning regulations, and a lack of coordinated disaster response strategies present additional challenges to the country's adaption and resilience efforts. The country's debt limits available resources and thus ability to recover from disasters or provide necessary social protection.[36] Environmental degradation, underdeveloped irrigation systems, and near-absence of disaster preparedness at the community level are contributing factors to increasing drought risk in Uganda.[37]

Data from the Emergency Event Database: EM-Dat database, presented in **Table 3**, shows the country has endured various natural hazards, including floods, landslides, epidemic diseases, and storms.

TABLE 3. Natural disasters in Uganda, 1900–2020[38]

Natural Hazard 1900–2020	Subtype	Events Count	Total Deaths	Total Affected	Total Damage ('000 USD)
Drought	Drought	9	194	4,975,000	1,800
Earthquake	Ground Movement	5	115	58,100	71,500
Epidemic	Bacterial Disease	28	3,204	237,665	0
	Viral Disease	10	466	108,036	0
Flood	Flash Flood	4	76	8,614	0
	Riverine Flood	15	267	1,051,945	6,871
Storm	Convective Storm	1	23	47	0
Landslide	Landslide	8	540	151,546	0
	Mudslide	1	51	0	0

[33] World Bank DataBank (2021). Health Nutrition and Population Statistics: Population estimates and projections – Uganda. URL: https://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics:-population-estimates-and-projections

[34] World Bank (2015). Press Release. Managing Rapid Urbanization Can help Uganda Achieve sustainable and Inclusive Growth. March 3, 2015. URL: http://www.worldbank.org/en/news/press-release/2015/03/03/managing-rapid-urbanization-can-help-uganda-achieve-sustainable-and-inclusive-growth

[35] Department of Disaster Preparedness and Management (2011). The National Policy for Disaster Preparedness and Management. URL: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1732.pdf

[36] Department of Disaster Preparedness and Management (2011). The National Policy for Disaster Preparedness and Management. URL: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1732.pdf

[37] Office of the Prime Minister of Uganda (2016). District Hazard, Risk and Vulnerability Profiles. URL: http://www.necoc-opm.go.ug/hazard.html

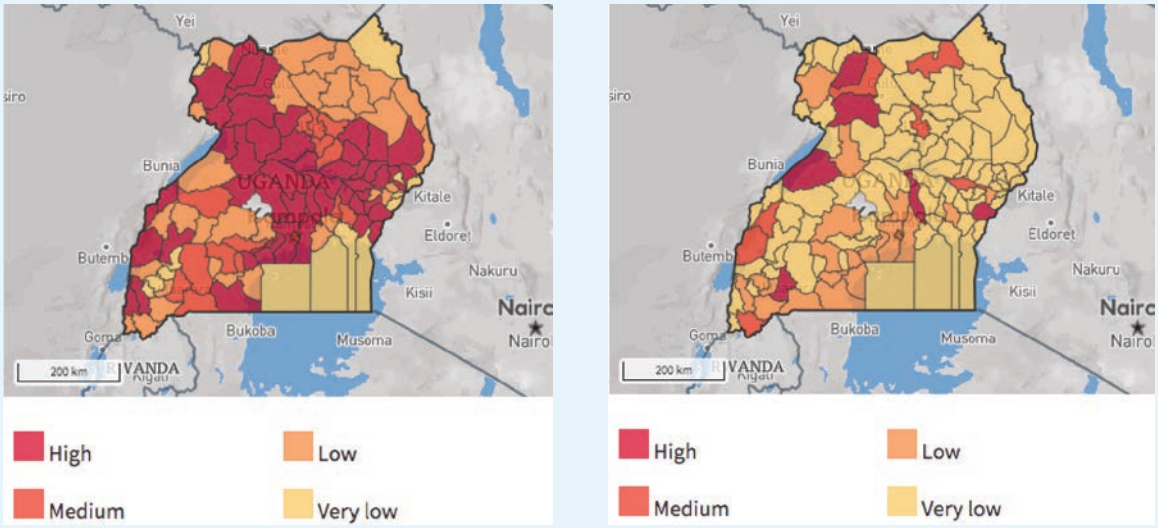
[38] EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium. http://emdat.be/emdat_db/

Key Trends

Flooding, particularly in low-lying areas of the country, presents the largest risk. Each year, floods impact nearly 50,000 people and costs over $62 million.[39] Uganda experiences both flash floods and slow-onset floods, which are common in urban areas, low-lying areas, areas along river banks and swamplands. Areas most prone to floods are the capital city, Kampala, as well as the northern and eastern areas of the country.[40] Heavy rainfall in arid areas has led to flash flooding causing infrastructure damage. Areas such as Gulu District, face large challenges in the rainy seasons as large areas of the district become impassable, often resulting in food shortages and inaccessibility to health facilities and schools due to the destruction of roads and bridges from flooding.[41]

Droughts affected close to 2.4 million people between 2004 and 2013, and drought conditions in 2010 and 2011 caused an estimated loss and damage value of $1.2 billion, equivalent to 7.5% of Uganda's 2010 gross domestic product.[42] Increasing heat conditions for the country are further exacerbating this problem. Severe drought in Uganda can result in human and livestock deaths and impacted areas are also experiencing reduced water tables, diminished water levels in major lakes as well as crop failures. Rapid population growth is also putting additional strain on depleted water resources. The most drought-prone areas in Uganda are the districts in the 'Cattle Corridor'. Extreme drought has been most prevalent in the Karamoja regions, which has resulted in frequent agricultural losses and significant food insecurity concerns.[43] Increasing heat risks are expected to occur in areas with decreased water availability, with the likelihood to increase impacts of drought. **Figure 8** presents the risk of river flood and urban flood risk for Uganda.

FIGURE 8. Uganda river flood risk (left)[44] and urban flood risk (right)[45]

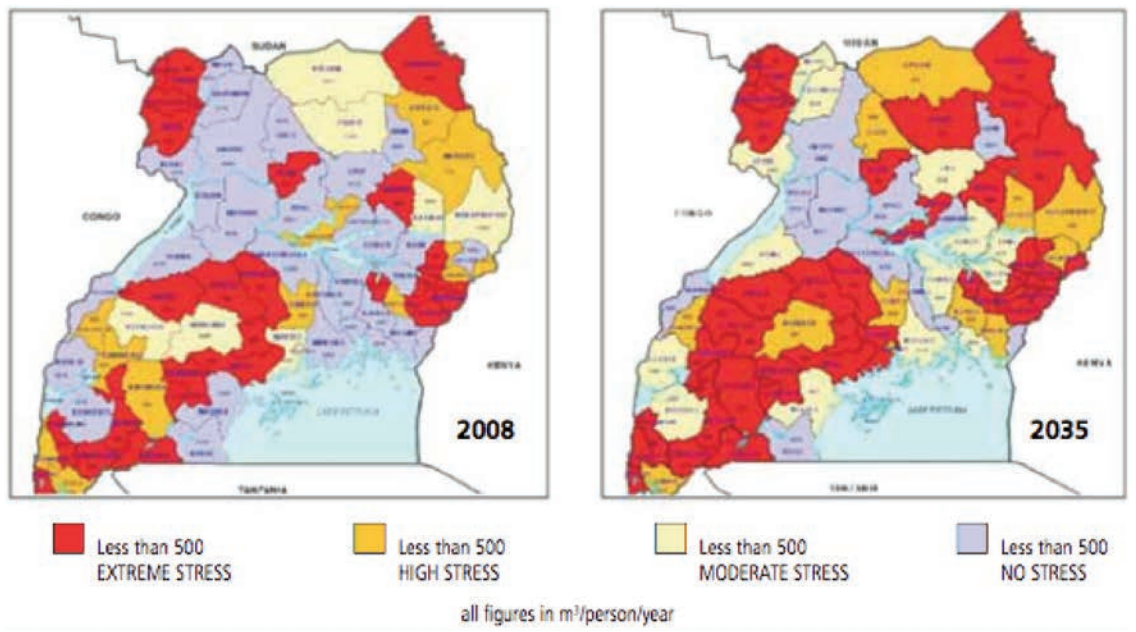


[39] The World Bank (2020). GFDRR – Uganda Country Profile. URL: https://www.gfdrr.org/en/uganda
[40] Department of Disaster Preparedness and Management (2011). The National Policy for Disaster Preparedness and Management. URL: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1732.pdf
[41] Ministry of Water and Environment (2014). Guidelines for the Integration of Climate Change in Sector Plans and Budgets. URL: http://ccd.go.ug/wp-content/uploads/2018/04/National-Climate-Change-Mainstreaming-Guidelines-.pdf
[42] The World Bank (2020). GFDRR – Uganda Country Profile. URL: https://www.gfdrr.org/en/uganda
[43] Department of Disaster Preparedness and Management (2011). The National Policy for Disaster Preparedness and Management. URL: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1732.pdf
[44] ThinkHazard! (2020). Uganda River Flood. URL: http://thinkhazard.org/en/report/253-uganda/FL
[45] ThinkHazard! (2020). Uganda Urban Flood. URL: http://thinkhazard.org/en/report/253-uganda/UF

Climate change is expected to increase the risk and intensity of flooding as well as increase likelihood for water scarcity for certain areas of the country. Increased intense rainfall events, with the possibility of higher rainfall for some areas will lead to the heightened risk of flooding, loss of life, and damage to property and infrastructure. Intense rainfall and flooding may also result in soil erosion and water logging of crops, decreasing yields and increasing food insecurity. Additionally, the likelihood of increased aridity and drought stress is expected to lead to water scarcity in some areas, resulting in increased demand for water, raising and the potential for conflict and biodiversity loss. Higher temperatures with increased aridity may also lead to livestock stress and reduced crop yields.[46]

This is likely to result in further, significant economic losses, damage to agricultural lands and infrastructure as well as human casualties. Furthermore, land degradation and soil erosion, exacerbated by recurrent flood and drought, adversely impact agricultural production, further affecting the livelihoods of the rural poor. In addition, the relative lack of risk-informed territorial planning and a weak enforcement of building codes has resulted in unsafe construction in many high-risk areas, particularly on slopes and degraded land, increasing risk of landslides. Small rural farmers, are more sensitive to impacts of disasters (floods, dry periods, landslides) because they have limited resources with which to influence and increase adaptive capacity.[47] **Figure 9** shows the distribution of water stress in Uganda for 2008 and the projected areas of water stress in the country for 2035.

FIGURE 9. Distribution of water stress in Uganda for 2008 and projected for 2035[48]



[46] Future Climate for Africa (2016). Africa's Climate- Helping Decision-Makers Make Sense of Climate Information. Uganda Country Fact Sheet. URL: http://2016report.futureclimateafrica.org/wp-content/uploads/2016/10/CDKNJ4897_FCFA_Print_WEB_15.pdf

[47] Department of Disaster Preparedness and Management (2011). The National Policy for Disaster Preparedness and Management. URL: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1732.pdf

[48] Department of Disaster Preparedness and Management (2012). The 2010–2011 Integrated Rainfall Variability Impacts, Needs Assessment and Drought Risk Management Strategy. Page 59. URL: http://gfdrr.org/sites/gfdrr/files/UGANDA_PDNA_Report_2012.pdf

Implications for DRM

The Ugandan Government has taken significant steps to advance its Disaster Risk Management (DRM) and climate resilience. Uganda's economic development framework and its 2010 Poverty Reduction Strategy Paper identified disaster management as one of the enabling sectors to achieve sustainable development. The Ministry of Disaster Preparedness and Refugees, part of the Office of the Prime Minister, facilitates collaboration among ministries, local governments, and communities for disaster preparedness and management.[49] The country's Disaster Management Policy was adopted in 2011 and outlines DRM priorities, which include strengthening institutions and financing for climate change adaptation; developing multi-sectoral adaptation plans; implementing programs to reduce the socio-economic impact of climate change and natural disasters; and increasing community-level resilience to climate change.[50]

The strategic DRM support provided to provinces and municipalities is enabling leaders to establish their own Disaster Prevention, Mitigation, and Response Committees and to develop and implement their own emergency and DRM plans. Capacity building support for disaster preparedness and management and post-disaster recovery is also being provided by bi-lateral partners. The integration of DRM criteria into building codes, regulations, and zoning laws is also underway to increase the resilience of education and health infrastructure.[51]

CLIMATE CHANGE IMPACTS TO KEY SECTORS

Climate change is projected to increase temperatures and impact water availability across Uganda, with some areas expected to experience flooding due to increased intensity of rainfall (central and southern regions), as well as the continued aridity and increased frequency of droughts for others (north, northeastern, west and southwestern regions). Key sectors such as, agriculture, health, water resources, wetlands, and forests are vulnerable to these climate change impacts in Uganda.[52] Temperature rise as well as the increase in the frequency and intensity of extreme droughts and floods are likely to reduce crop yields and cause a loss in livestock, which will have important implications for food security. Additionally, water resources are also likely to be increasingly strained in Uganda's climate future. While it is projected that precipitation will increase in some parts of East Africa, warmer temperatures will accelerate the rate of evapotranspiration, thus reducing the benefits of increased rainfall. With more frequent

[49] The World Bank (2020). GFDRR – Uganda Country Profile. URL: https://www.gfdrr.org/en/uganda
[50] Department of Disaster Preparedness and Management (2011). The National Policy for Disaster Preparedness and Management. URL: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1732.pdf
[51] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf
[52] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

and severe droughts, the region will likely experience negative impacts on water supply, biodiversity, and hydropower generation. A potential simultaneous increase in floods poses a serious water pollution threat, affecting health of wetland and forest ecosystems, which provide critical ecosystem services for communities in Uganda.[53]

Heavy rains, flooding, and soil erosion puts both urban and rural infrastructure at risk, particularly for poor and vulnerable groups. Flooding along Lake Victoria is likely to damage property and agricultural areas from flooding, landslides and soil erosion. Furthermore, increased occurrences of drought conditions and reduced rainfall across much of the country will impact agriculture, livestock and human health. This will specifically be impactful for the northern and central zones and traditional 'cattle corridor' already at risk from increasing aridity. Environmental degradation, impacted water resources, and loss of biodiversity and ecosystem services constitute serious obstacles to the country's continued development and poverty reduction efforts, increasing vulnerability to risks and hazards, increasing the importance for sustainable adaptation and resilience measures.[54]

Gender

An increasing body of research has shown that climate-related disasters have impacted human populations in many areas including agricultural production, food security, water management and public health. The level of impacts and coping strategies of populations depends heavily on their socio-economic status, socio-cultural norms, access to resources, poverty as well as gender. Research has also provided more evidence that the effects are not gender neutral, as women and children are among the highest risk groups. Key factors that account for the differences between women's and men's vulnerability to climate change risks include: gender-based differences in time use; access to assets and credit, treatment by formal institutions, which can constrain women's opportunities, limited access to policy discussions and decision making, and a lack of sex-disaggregated data for policy change.[55]

Agriculture

Overview

Uganda depends significantly on rain-fed agriculture and the agricultural sector plays a critical role in Uganda's food security and economic prosperity. The agricultural sector employs 70% (2014) of the working population and contributes over 1/4 of GDP.[56] Climate change could see a reduction in the national production of food crops such as cassava, maize, millet and groundnuts by the 2050s. Overall losses of food crops by the 2050s could reach up to US$1.5 billion. Fishing is a key livelihood source for up to 1.2 million people, and employs about 8% of the

[53] USAID (2012). Uganda Climate Vulnerability Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/uganda_climate_vulnerability_profile_jan2013.pdf

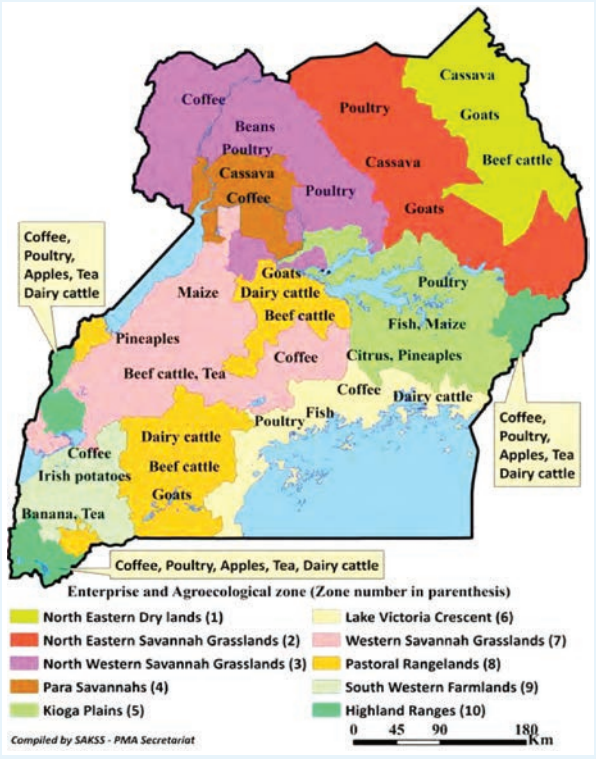
[54] Uganda National Planning Authority (2018): The Uganda Green Growth Development Strategy, 2017/18–2030/31. URL: https://www.undp.org/content/dam/LECB/docs/pubs-reports/undp-ndc-sp-uganda-ggds-green-growth-dev-strategy-20171204.pdf

[55] World Bank Group (2016). Gender Equality, Poverty Reduction, and Inclusive Growth. URL: http://documents1.worldbank.org/curated/en/820851467992505410/pdf/102114-REVISED-PUBLIC-WBG-Gender-Strategy.pdf

[56] Ministry of Agriculture, Animal Industry and Fisheries (2015). Uganda Climate Smart Agriculture Country Program 2015–2025. URL: https://canafrica.com/wp-content/uploads/2015/08/3-UGANDA-CLIMATE-SMART-AGRICULTURE-PROGRAMME.Final_.pdf

total labor force. Climate change trends in Uganda such as reduced water availability and watershed re-charge is likely to stress fisheries, resulting in disrupted livelihoods and significant economic losses.[57] **Figure 10** shows the country's agro-ecological zones, which experience varying degrees of vulnerability to climate-related hazards, mainly drought, floods, storms, and pests and diseases.

FIGURE 10. Uganda's agro-ecological zones[58]



Climate Change Impacts

Rising temperatures and shifting rainfall patterns may increase soil erosion and increase growing difficulties for many crops as well as shorten growing seasons. These scenarios are also likely to alter the occurrence and distribution of pests. Rising temperatures are expected to increase suitable conditions for crop diseases and pest infestations such as blast and bacterial leaf blight in rice, aflatoxin in maize, fungal and viral diseases in banana and beans, and coffee rust in coffee trees.[59] Erratic rainfall may increase post-harvest storage risks as well as impact crops needing to be dried in the sun (maize, beans, coffee, rice).[60] Districts such a Biukwe, Gulu and Mbale are particularly at risk due to high levels of consumption and cash crops grown in these districts, coupled with specific climate outlooks of increased temperature and variable rainfall. Increased dry periods and continued soil degradation, associated with unsustainable agricultural practices, contributes to a reduction in reservoirs and undermines food security. Major export crops like coffee and tea could also see a reduction in yields leading to combined economic losses of about US$1.4 billion in mid-century. **Figure 11** shows the predicted suitability for Arabica coffee production in Uganda through mid-century. Climate-induced losses are expected to range from 10–50% yield losses, with the potential to reduce foreign exchange earnings by $15–$80 million per year.[61]

[57] Future Climate for Africa (2016). Africa's Climate-Helping Decision-Makers Make Sense of Climate Information. Uganda Country Fact Sheet. URL: http://2016report.futureclimateafrica.org/wp-content/uploads/2016/10/CDKNJ4897_FCFA_Print_WEB_15.pdf

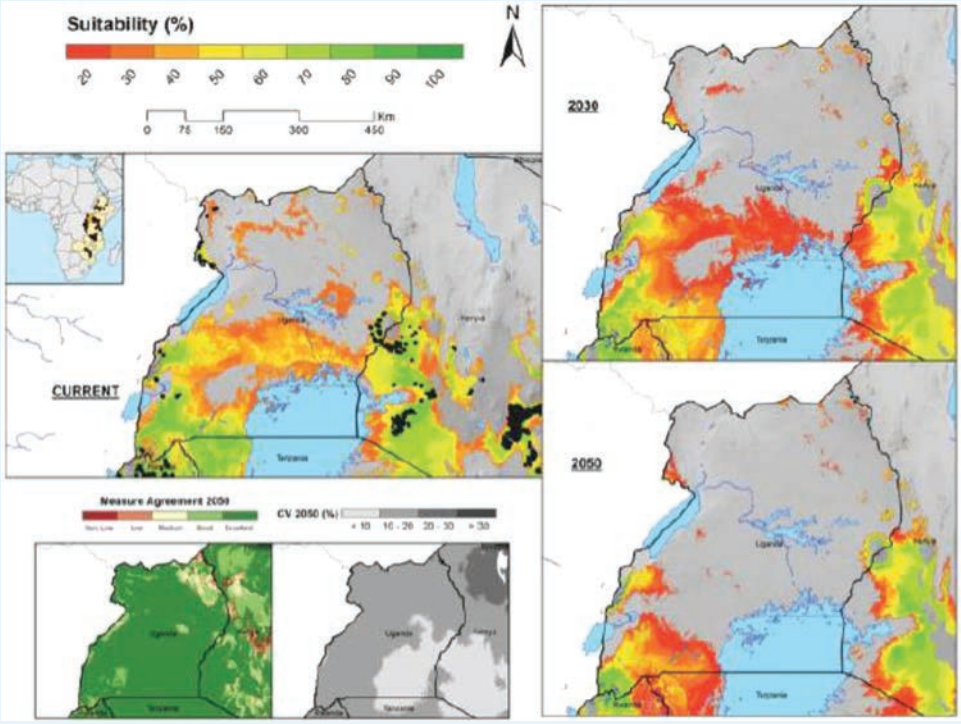
[58] Ministry of Agriculture, Animal Industry and Fisheries (2018). National Adaptation Plan for the Agricultural Sector. Page 18. URL: https://www.agriculture.go.ug/wp-content/uploads/2019/09/National-Adaptation-Plan-for-the-Agriculture-Sector.pdf

[59] Ministry of Water and Environment (2015). Economic Assessment of the Impacts of Climate Change in Uganda – National Level Assessment: Agricultural Sector Report. URL: https://cdkn.org/wp-content/uploads/2015/12/Uganda_Agricultural_Sector.pdf

[60] Ministry of Water and Environment (2015). Uganda National Climate Change Policy. URL: https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf

[61] Ministry of Water and Environment (2015). Economic Assessment of the Impacts of Climate Change in Uganda – National Level Assessment: Agricultural Sector Report. URL: https://cdkn.org/wp-content/uploads/2015/12/Uganda_Agricultural_Sector.pdf

FIGURE 11. Predicted suitability for Arabica coffee production in coffee-producing zones in Uganda for current, 2030, and 2050[62]



The agriculture sector relies heavily on ground and surface water supply, which are sensitive to localized land use and likely to experience decreasing recharge and quality due to reduced precipitation in some areas, and increased evaporation. An expected trend of reduction in rainfall in the peak of the rainy season can have consequences for agriculture and water quality, especially in more arid areas. Increased temperatures and the threat of waterlogging of fields may also result in an increased presence of pests and diseases harmful to yield production and quality. Changes in seasonality of precipitation will lead to further soil erosion and loss of soil fertility. Increased drought, as expected in the northwestern agricultural areas, is likely to reduce crop yields.[63]

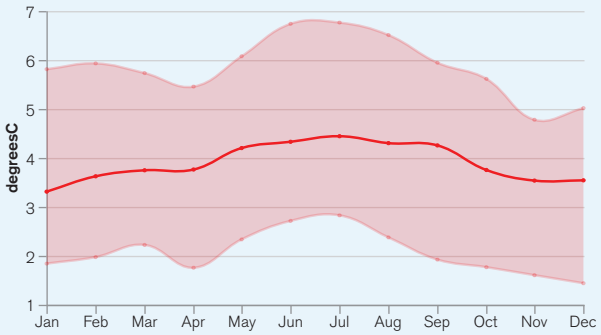
The direct impacts of climate change on livestock can also be related to heat. Under present climate conditions, heat stress makes it difficult for animals to keep up with heat dissipation, rendering them vulnerable to heat stress during, at least, part of the year. Heat stress has a variety of detrimental effects on livestock, but can include reductions on milk production and reproduction, particularly for dairy cows. Extreme events, such as heat waves, may particularly affect beef and dairy cattle, as well as crop yields and crop production quality.

[62] Ministry of Water and Environment (2015). Economic Assessment of the Impacts of Climate Change in Uganda – National Level Assessment: Agricultural Sector Report. Page 20. URL: https://cdkn.org/wp-content/uploads/2015/12/Uganda_Agricultural_Sector.pdf

[63] USAID (2012). Uganda Climate Vulnerability Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/uganda_climate_vulnerability_profile_jan2013.pdf

The projected increased heat will increase stress on crops and is also likely to alter the length of the growing seasons. Decreased water availability is likely to reduce yields and the reduction in soil moisture may alter suitable areas for agriculture or the production of specific crops. Increased heat and water scarcity conditions are likely to increase evapotranspiration, expected to contribute to crop failure and overall yield reductions.[64] **Figure 12** shows the average daily max-temperature across the seasonal cycle. These higher temperatures have implications for impacts to soil moisture and crop growth and will increase throughout the year.

FIGURE 12. Average daily max temperature for Uganda[65]



Adaptation Options

Both the sensitivity of the agricultural sector to the climate and the high reliance of this sector on rain-fed agriculture and irrigation have important implications for Uganda. Improvements should be made concerning water capture and storage as well as investments in more efficient irrigation structures throughout the country, particularly in more arid agricultural areas. The introduction and adoption of drought-prone and flood-prone crop varieties may increase short to medium-term resilience.[66] The adoption of sustainable rangeland and pasture management including no-burn agricultural practices for both small and large producers can improve ecosystems and sustainable forest management. Additionally, semi-stabled cattle systems will help to contribute to resilience of the country's upland agricultural areas.[67]

Diversification of income away from reliance on farming operations can also be an effective strategy for making farmers more resilient to climate change risks and more food secure for the future. Financing options for farmers should also be more accessible, including the development of insurance schemes for farmers to protect against climate change. The promotion of climate resilient cropping systems and improved integrated fisheries resource management can strengthen the resilience of key livelihood sectors.[68] Improvements should be made to the weather monitoring network and associated weather information systems, including the publication and distribution of agriculture-specific weather forecasts on a frequent basis (e.g. short-term and seasonal forecasts, monitoring of heavy rainfall, etc.).[69]

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[64] Ministry of Agriculture, Animal Industry and Fisheries (2015). Uganda Climate Smart Agriculture Country Program 2015–2025. URL: https://canafrica.com/wp-content/uploads/2015/08/3-UGANDA-CLIMATE-SMART-AGRICULTURE-PROGRAMME.Final_.pdf

[65] WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda Agriculture. Dashboard URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=UGA&period=2080-2099

[66] Ministry of Water and Environment (2015). Uganda National Climate Change Policy. URL: https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf

[67] Ministry of Agriculture, Animal Industry and Fisheries (2015). Uganda Climate Smart Agriculture Country Program 2015–2025. URL: https://canafrica.com/wp-content/uploads/2015/08/3-UGANDA-CLIMATE-SMART-AGRICULTURE-PROGRAMME.Final_.pdf

[68] Ministry of Agriculture, Animal Industry and Fisheries (2018). National Adaptation Plan for the Agricultural Sector. URL: https://www.agriculture.go.ug/wp-content/uploads/2019/09/National-Adaptation-Plan-for-the-Agriculture-Sector.pdf

[69] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

Water

Overview

Uganda is endowed with water resources in both surface and ground water. Projected climate change and variability are already affecting the availability of water in Uganda, with this trend expected to not only continue but increase, affecting primary sectors such as agriculture and livestock, fisheries, aquaculture, forestry and tourism.[70] Surface water resources are found in the form of streams, rivers, lakes and wetlands divided into eight water catchment basins.[71] However, the projected precipitation and temperature trends in conjunction with existing infrastructure and population growth indicate that water stress is considered highly likely for much of Uganda's population. Projections suggest reductions in surface water and groundwater supplies as well as decreased groundwater recharge from reduced precipitation. A substantial section of Uganda households utilize groundwater as their source of domestic water. Conservative estimates suggest that the cost of unmet water demand by 2050 could reach $5.5 billion, with the largest losses expected in the Lake Victoria, Albert Nile, and Lake Kyoga Watersheds. In the past, annual economic losses from droughts have been up to $237 million. Similarly, future droughts will likely have significant negative effects on water supply in Uganda.[72]

Climate Change Impacts

The country's largest lake, Lake Victoria, gets its recharge water mainly through precipitation (82%) with the balance coming from the two main seasons of rain water (March to May and September to December) that give it about 2,100 mm annually. However, the lake water level has shown a significant downward trend over the last 10 years. In 2006, Lake Victoria had reached an 80-year low; thereby affecting the water levels for Lakes Kyoga and Albert. Furthermore, over the last 10 years, Lake Kyoga levels have also shown a significant downward trend.[73]

Uganda's wetlands provide a large array of ecosystem services in urban and rural areas. They are used for farming, fishing, and livestock grazing, and are primary supplies for water for many rural households. Wetlands also play a crucial role at a regional level by filtering pollutants and regulating water flow. Wetland coverage across the country is in decline, at 15.6% in 1994 and 10.9% in 2008. These changes have been attributed to massive wetland degradation for rice cultivation and dairy farming, flower farming along the shores of Lake Victoria; especially in Buikwe, Mukono, Wakiso and Kampala districts, with occasional conversion for human settlement. The Lake Victoria catchment also includes wetlands from Bushenyi, Mbala, Mbarara, Ntungamo, Lyantonde, Rakai and Isingiro, which have been adversely impacted by the establishment of dairy cattle keeping in the wetlands along the river Rwizi-Rufuha. This has led to a large loss of wetlands across this major catchment.[74]

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[70] Ministry of Water and Environment (2015). Economic Assessment of the Impacts of Climate Change in Uganda – Final Study Report. URL: https://cdkn.org/wp-content/uploads/2015/12/Uganda_CC-economics_Final-Report2.pdf

[71] USAID (2013). Uganda Climate Change Vulnerability Assessment Report. URL: https://www.climatelinks.org/sites/default/files/asset/document/ARCC-Uganda%2520VA-Report.pdf

[72] Future Climate for Africa (2016). Africa's Climate- Helping Decision-Makers Make Sense of Climate Information. Uganda Country Fact Sheet. URL: http://2016report.futureclimateafrica.org/wp-content/uploads/2016/10/CDKNJ4897_FCFA_Print_WEB_15.pdf

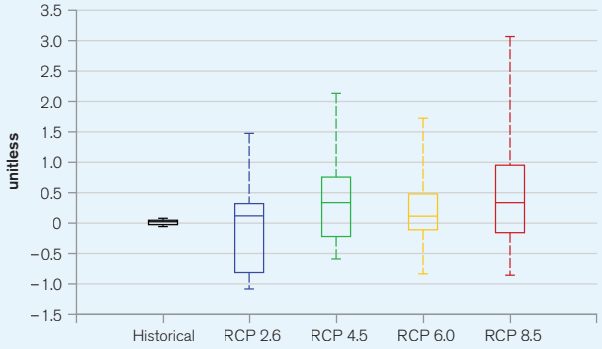
[73] USAID (2013). Uganda Climate Change Vulnerability Assessment Report. URL: https://www.climatelinks.org/sites/default/files/asset/document/ARCC-Uganda%2520VA-Report.pdf

[74] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

Uganda has made significant progress in its safe water coverage, which has improved from 61% to 65%, with sanitation coverage improved from 51% to 70% from 2005–2014, however improvements can still be made throughout the country. Piped sewerage is estimated at 6% nationally. Decreased availability and/or compromised quality of surface water supply will heighten the vulnerability of populations depending on these sources for daily activities; more intense and frequent storms and flooding may cause storm water flows, which increase the likelihood of water contamination of both surface sources and shallow wells.[75] This is a particularly serious potential adverse impact as people rely heavily on surface water when wells dry up. Increased temperatures and intense rainfall are putting greater pressure on the water and sanitation sector, with potential to further impact development gains.

Rainfall and evaporation changes also impact rates of surface water infiltration and the recharge rates for groundwater. Low-water storage capacity increases the country's dependence on unreliable rainfall patterns. Changes in rainfall and evaporation translate directly to changes in surface water infiltration and groundwater re-charge. This has the potential for further decreased reliability of unimproved groundwater sources and surface water sources during droughts or prolonged dry seasons. Increased strain on pumping mechanisms leading to breakdowns if maintenance is neglected and the potential for falling water levels in the immediate vicinity of wells or boreholes, particularly in areas of high demand. Additionally, temperature increases have the potential to result in increased soil moisture deficits even under conditions of increasing rainfall. The figure below shows the projected annual Standardized Precipitation Evapotranspiration Index (SPEI) through the end of the century. The SPEI is an index which represents the measure of the given water deficit in a specific location, accounting for contributions of temperature-dependent evapotranspiration and providing insight into increasing or decreasing pressure on water resources. Negative values for SPEI represent dry conditions, with values below –2 indicating severe drought conditions, likewise positive values indicate increased wet conditions. This is an important understanding for the water sector in regards to quantity and quality of supply for human consumption and agriculture use as well as for the energy sector as reductions in water availability impacts river flow and the hydropower generating capabilities. As seen in **Figure 13**, at an aggregated national level, Uganda is projected to maintain its current level of wet conditions, however, while some areas of the country will experience heightened wetness, other areas will experience significant increases in aridity.

FIGURE 13. Annual SPEI drought index in Uganda for the period, 1986 to 2099[76]



[75] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16–2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf

[76] WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda Water Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/water/land-use-/-watershed-management?country=UGA&period=2080-2099

Adaptation Options

Uganda should address the challenges in its water resources arising from increasingly variable rainfall patterns. Specific attention is required in the most at-risk areas of the cattle corridor axis (which runs from the Karamoja region in the North East to Ankole in the South West). Minimal data on groundwater resources exists and further resources should be invested to support existing groundwater monitoring wells in Pallisa, Soroti, Rakai and Mbarara districts.[77] Increased investment can better support Uganda's water management infrastructure and support alignment with sanitation and quality drinking water requirements. Development planning for urban expansion should be coordinated through Uganda's climate change adaptation strategies. Planning and adaptation strategies for water resources should also be included within development strategies for agriculture, infrastructure, and energy sectors.[78] Improvements to the country's water infrastructure should be a priority. There is critical need to support the protection of lake and river catchments and other sources of freshwater (including aquifers) in order to secure a steady supply of freshwater across all sectors and communities. Climate change impacts in Uganda should be mainstreamed in all water resources management plans and programs to secure environmental safety and sustainable fresh water supply for the country in the immediate, near and long-term future.[79]

Energy

Overview

The energy sector in Uganda is comprised of petroleum, hydroelectric power, biomass, and renewable energy sources. Increased urbanization and high cost of electricity have continued to increase the demand for charcoal in urban areas. Uganda currently has 850 Megawatts (MW) of installed capacity (with effective generation of approximately 710 MW), of which approximately 645 MW is hydro and 101.5 MW is thermal generating capacity.[80] Uganda has an estimated overall electrical power potential of over 5,300 MW; comprising of 2,200MW of hydropower. The Government is investing in the construction of additional large hydropower facilities, such as the 600 MW Karuma hydro plant and the 183 MW Isimba Falls hydro project. Uganda has approximately 1,500 kilometers of transmission lines (over 33kV), which the government aims to double. Additional plans exist to upgrade existing transmission lines and develop an electrification 'ring' around Lake Victoria, in conjunction with Kenya and Tanzania.[81]

Climate Change Impacts

Uganda's power sector is heavily reliant on hydropower and is very sensitive to climate change from worsening droughts, more frequent floods and landslides. Furthermore, the country's energy infrastructure (dams, generation facilities, transmission and distribution facilities, energy crops) are highly vulnerable to climate variability and

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[77] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

[78] Irish Aid (2017). Uganda Climate Action Report for 2016. URL: https://www.irishaid.ie/media/irishaid/allwebsitemedia/30whatwedo/climatechange/Uganda-Country-Climate-Action-Reports-2016.pdf

[79] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16–2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf

[80] USAID (2016). Power Africa in Uganda. URL: https://www.usaid.gov/sites/default/files/documents/1860/UgandaCountryFactSheet.2016.09_FINAL.pdf

[81] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

climate change impacts. Already, adverse impacts from degraded catchment areas, reduced river flows, increased siltation, blown transmission and distribution systems continue to occur in Uganda.[82]

Electricity access in Uganda is approximately 15%, with only 24.2% of that used at the household level. Biomass is the traditional and predominate source of energy consumption at the household level. Projected trends of flooding, increased rainfall intensity and drought across the country is expected to adversely impact the country's biomass availability. Significant impacts are expected for the Masindi district at Bujawe central Forestry reserve in Buseruka Sub County, Kyamugongo central forestry reserve and the woodlands around Lake Kyoga.[83] Biomass depletion, either through woodland die-off or deforestation for agricultural lands or charcoal production is also having an adverse impact for the country's forests and biodiversity loss. Deforestation, coupled with intense rainfall also contributes to the country's landslide and flood challenges.[84]

A reduction in water availability and river flow threatens potential energy generation for Uganda. Projected trends are expected to increase costs of maintenance and repairing of power and energy infrastructure as well as disrupt power supply.[85] Increased heat is likely to threaten cooling capacity of power generating stations with potential to impact transmission. Cooling Degree Days (**Figure 14**) shows the relationship between daily heat and cooling demand, typically sourced through a form of active cooling or an evaporative process. The change in cooling degree days provides insight into the potential for extended seasons of power demand or periods in which cooling demand (power demands) might increase. As seen in the graph below, increases for cooling demands are expected to increase throughout the year. The Warm Spell Duration Index (**Figure 15**) represents the number of

FIGURE 14. Change in Cooling Degree Days (65°F) in Uganda for the period 2040–2059[86]

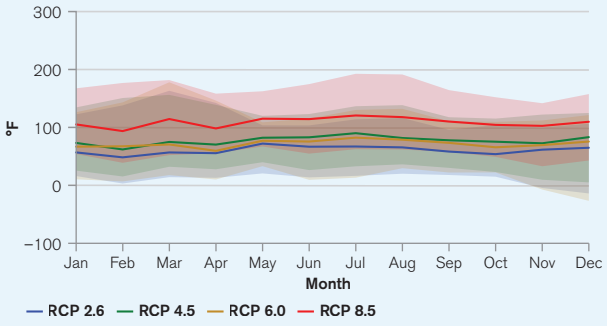
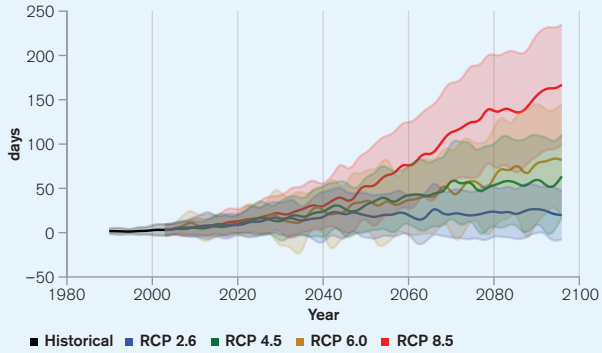


FIGURE 15. Warm Spell Duration Index in Uganda for the period 1986 to 2099[87]



[82] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16 – 2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf

[83] Ministry of Water and Environment (2015). Economic Assessment of the Impacts of Climate Change in Uganda. URL: https://cdkn.org/wp-content/uploads/2015/12/Uganda_CC-economics_Final-Report2.pdf

[84] Ministry of Water and Environment (2014.). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

[85] USAID (2016). Power Africa in Uganda. URL: https://www.usaid.gov/sites/default/files/documents/1860/UgandaCountryFactSheet.2016.09_FINAL.pdf

[86] WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda – Energy. URL: https://climateknowledgeportal.worldbank.org/country/uganda/climate-sector-energy

[87] WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda Energy Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/energy/oil-gas-and-coal-mining?country=UGA&period=2080-2099

days in a sequence of at least six days in which the daily maximum temperature is greater than the 90th percentile of daily maximum temperature. As shown in the figure below, warm spells are expected to sharply increase in the second half of the century.

Adaptation Options

Effective energy generation, transmission and use is critical to the country's overall development agenda and Uganda is under pressure to scale its energy generating capabilities in order to become more resilient to climate change and meet development goals. This can be achieved through the implementation of research programs to inform priorities and implementation of renewable energy, as outlined in the 2007 National Renewable Energy Policy. There is high potential for clean energy generation, however, the country's legal framework and institutional capacities need to be improved. Strengthened institutions and individual capacity needs to be built in renewable energy technology and management and policies should be designed to promote private investment in renewable energies such as increased hydropower capacity and solar.[88]

Health

Overview

Uganda is expected to have significant health effects caused by climate change, mainly in relation to the expected increasing incidence of rising temperatures, heat waves, floods, landslides, and droughts.[89] The risk of vector-borne diseases such as malaria and dengue fever are likely to increase towards the 2070s. Under both high and low emissions scenarios, by 2070 the WHO estimates that approximately 108 million people are projected to be at risk of malaria annually in Uganda. Population growth will also increase at-risk populations where current malaria presence is static. Increased temperatures and chance of flooding around rivers and lakes, specifically Lake Victoria, is likely to also increase vector and water-borne diseases such as schistosomiasis, dengue as well as cholera.[90] Districts such as Buikwe, Masaka, Mpigi, Jinja and Mayuge are at risk. Socio-economic conditions and cross-border trade across Lake Victoria has increase transmission and spread of HIV/AIDS around Lake Victoria communities.[91]

Climate Change Impacts

Under a high emissions scenario, heat-related deaths in the elderly (65+ years) are projected to increase to about 81 deaths per 100,000 by the 2080s compared to the estimated baseline of under 2 deaths per 100,000 annually between 1961 and 1990.[92] Rising temperatures are of increasing concern. The annual distribution of days with a high heat index provides insight into the health hazard of heat. **Figure 16** shows the

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[88] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16–2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf

[89] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16–2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf

[90] Uganda One Health Platform (2018). Uganda One Health Strategic Plan 2018–2022. URL: https://health.go.ug/sites/default/files/Uganda%20OHSP%20Final%20Launched%2015-02-2018%20%281%29.pdf

[91] Future Climate for Africa (2016). Africa's Climate- Helping Decision-Makers Make Sense of Climate Information. Uganda Country Fact Sheet. URL: http://2016report.futureclimateafrica.org/wp-content/uploads/2016/10/CDKNJ4897_FCFA_Print_WEB_15.pdf

[92] World Health Organization (2015). Climate and Health Country Profile – 2015, Uganda. URL: http://apps.who.int/iris/bitstream/handle/10665/246136/WHO-FWC-PHE-EPE-15.30-eng.pdf;jsessionid=B4D0B3A49EAB3BAD447384EB27315385?sequence=1

FIGURE 16. Projected days with a Heat Index >35°C[93]

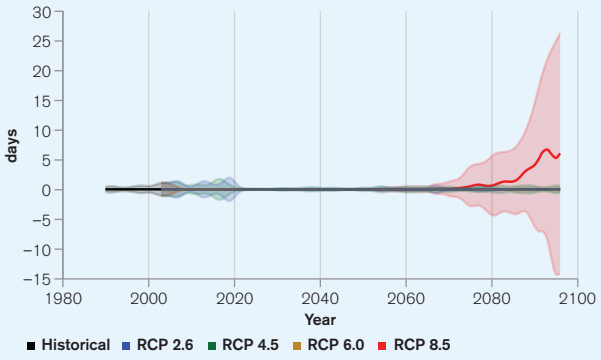
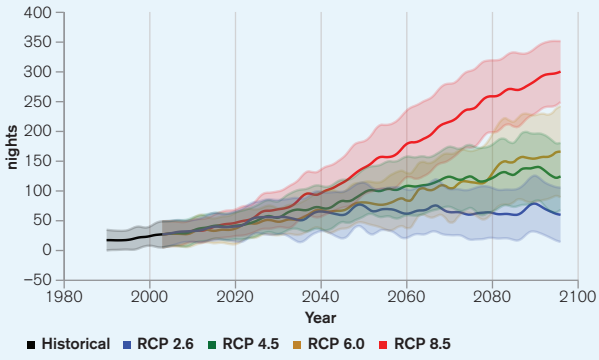


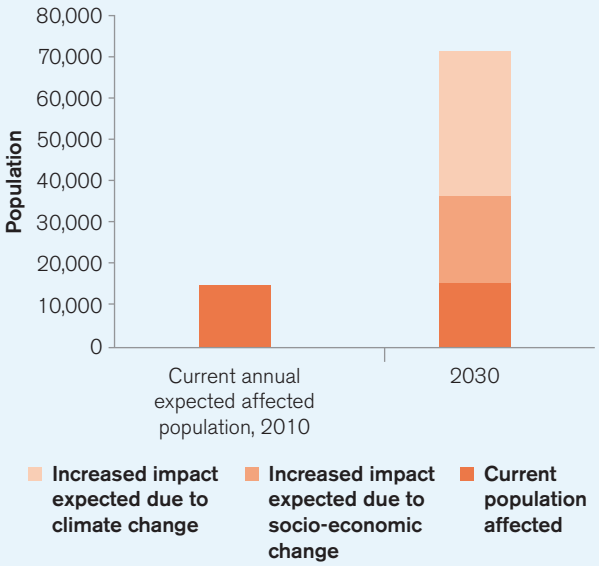
FIGURE 17. Number of Tropical Nights (Tmin >20°C)[94]



expected Number of Days with a Heat Index >35°C for the 2090s; showing an increase under a high emission scenario by the late century. Increased health threats can be projected and monitored through the frequency of tropical nights (>20°C). Tropical Nights (**Figure 17**) represents the projected increase in night temperatures for different emission scenarios.

Projected precipitation changes and heavy rainfall for the central and southern areas of the country result in an increased risk of river flooding. The WHO estimates that by 2030, an additional 34,600 people may be at risk of river floods annually, and 21,600 due to socio-economic change above the estimated 15,500 annually affected population in 2010 (**Figure 18**).

FIGURE 18. Population affected by inland river flood in 2030[95]



Extreme weather, increased heat and aridity will directly as well as indirectly impact the population. In this tropical climate, outdoor workers and the agricultural industry are at risk to heat stress, dehydration and prolonged exposure can lead to chronic kidney disease and cardiovascular diseases.[96] Additionally, higher temperatures, land and water scarcity, flooding,

[93] WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda Health Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/health/systems-and-service?country=UGA&period=2080-2099

[94] WBG Climate Change Knowledge Portal (CCKP, 2021). Uganda Health Sector. URL: https://climateknowledgeportal.worldbank.org/country/uganda/climate-sector-health

[95] World Health Organization (2015). Climate and Health Country Profile – 2015, Uganda. Page 3. URL: http://apps.who.int/iris/bitstream/handle/10665/246136/WHO-FWC-PHE-EPE-15.30-eng.pdf;jsessionid=B4D0B3A49EAB3BAD447384EB27315385?sequence=1

[96] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

drought and displacement, also negatively impacts agricultural production and causes breakdown in food systems. This will disproportionally affect vulnerable groups and lead to food insecurity, further exacerbating Uganda's malnutrition challenges, especially among children (stunting in children under 5 was 34.2% in 2012). The WHO estimates malnutrition impacts to increase by as much as 20% by 2050 due to reduced agricultural and livelihood opportunities in Uganda.[97]

The country's weak and/or at-risk infrastructure undermines income-earning opportunities, limits access to health and education facilities, and raises the price of goods and services; this is especially impacted by times of extreme storms. Areas with the poorest road networks are often the most food insecure, particularly in rural areas, contributing to reduced economic productivity and exacerbating food insecurity.[98] Intense precipitation and floods in some areas, the road network will be further stressed, impacting food distribution networks and as well as employment opportunities.[99]

Adaptation Options

Uganda's health-care infrastructure needs to be upgraded to support more systemic climate change resilience. Capacity needs to be built to support the adaptation to extreme weather events and support the necessary response capacities. Health care system personnel are not fully aware of the relationship between climate change and variability and health impacts. To date, there has been no specific training of the personnel in regard to adaptation to climate change and mitigating its negative health impacts. Increases in training and capacity can improve the level of knowledge and skills to prevent diseases connected with climatic factors, however this knowledge remains relatively limited among the general population. Additionally, improved monitoring and surveillance systems are not conducted at the right geographical and temporal scale that would allow observations of trends and make advance forecasts to direct interventions against climate sensitive diseases.[100] Increased investment, coupled with a targeted climate-health-adaptation research agenda can support the identification and analysis of trends and develop indicators to improve health sector capacity to react. The development of Health Early Warning Systems are needed, specifically for heat wave and flooding warnings.[101]

Fisheries

Overview

Uganda's fisheries resources are among its most significant natural endowments as expansive water resources support a large and varied fish population. It is one of the most important sub-sectors in Uganda's agricultural

[97] World Health Organization (2015). Climate and Health Country Profile – 2015, Uganda. URL: http://apps.who.int/iris/bitstream/handle/10665/246136/WHO-FWC-PHE-EPE-15.30-eng.pdf;jsessionid=B4D0B3A49EAB3BAD447384EB27315385?sequence=1

[98] Uganda One Health Platform (2018). Uganda One Health Strategic Plan 2018–2022. URL: https://health.go.ug/sites/default/files/Uganda%20OHSP%20Final%20Launched%2015-02-2018%20%281%29.pdf

[99] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16–2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf

[100] World Health Organization (2015). Climate and Health Country Profile – 2015, Uganda. URL: http://apps.who.int/iris/bitstream/handle/10665/246136/WHO-FWC-PHE-EPE-15.30-eng.pdf;jsessionid=B4D0B3A49EAB3BAD447384EB27315385?sequence=1

[101] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16–2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf

sector and a key livelihood for approximately 700,000–1.2 million people and is a major source of dietary protein. Fish export is also the second largest export earner for Uganda and has experienced substantial growth over recent years. Uganda's fishery resources are diverse in both aquatic ecosystems and fish species biodiversity. The Ugandan fisheries industry is largely artisanal, based on inland capture from lakes: Victoria, Kyoga, Albert Edward, George and Kazinga Channel, rivers, swamps and flood plains, all of which are critical habitats, breeding and nursery grounds for fish covering about 18% (42.000 km^2) of Uganda's total surface area. Lake Victoria currently supplies about 50% of the total national fish catch.[102]

Climate Change Impacts

Uganda's aquatic ecosystems are threatened by resource over-exploitation, transformation and degradation of habitat, pollution, and now, climate change. The sector is increasingly strained from increasing fishing efforts, which are exerting high pressure on capture fisheries, resulting in fish scarcity and prompting use of destructive fishing gears and technologies. This has led to increased investment and costs in fishing operations in order to chase and catch scarce fish. The sector is also highly vulnerable to implications from climate change due to the country's exposure and its dependence of national economy and diets on fisheries. Expected changes in seasonal rainfall in combination with overall reduction in rainfall for the country by end of the century is expected to result in the reduction in water levels and will lead to further decline in fish stocks and other aquatic resources. As rainy seasons are becoming increasingly erratic in both northern and southern areas of the country, with both wetter rainy seasons and drier dry seasons. Lake Victoria water levels are sensitive to climatic factors in the long-term and there has been a general decline in rainfall in the Lake Victoria basin from 2000–2005, contributing to a decline in lake level of 2.3 m. Additionally, increased aridity and drought, with increased temperatures has made fish breeding and re-stocking efforts more challenging and has further reduced available fish stock and increased pressures of food insecurity.[103]

Adaptation Options

Uganda can enhance sector resilience through improved water conservation practices, particularly concerning damns and usage of water resources from major lakes and rivers, also important to fish stock. Fish research entities need to include climate change impacts into research agendas and improve the implementation of climate change related activities within the fishery sector planning process.[104] Awareness needs to also be increased around the challenges and risks faced to the fishery sector and to fishing communities in support of more sustainable practices. Livelihood diversification may be an important option for many fishing communities that continue to be reliant on climate-sensitive fisheries resources. Finally, efforts can improve and strengthen transboundary cooperation regarding more sustainable fisheries ecosystems.[105]

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[102] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16–2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf

[103] World Fish Center (2012). Impacts of Climate change and Variability on fish Value Chains in Uganda. Project Report 2012–2018. URL: http://pubs.iclarm.net/resource_centre/WF_3139.pdf

[104] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16–2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf

[105] Ministry of Water and Environment (2015). Uganda National Climate Change Policy. URL: https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf

Transportation

Overview

Uganda's rapid development has also resulted in a significant increase of its transportation sector. This includes both individual movements either through owned vehicles (cars, motorcycles) or use of shared transport as well as the expansion of road infrastructure. This has improved the efficiency and opportunity for human and goods movement across the country, but has also resulted in increased emissions. Uganda's transport sector is heavily dominated by road transport and the government has invested heavily on road infrastructure.[106] However, despite the heavy investment in road infrastructure (Uganda has the highest percentage of road networks as compared to any of its regional neighbors), only 67% of households have access to a usable road all year round. Additionally, Uganda's motorization remains quite low: 9.3 vehicles per 1,000 Ugandans; of which 3.4 were motorcycles.[107]

Climate Change Impacts

The transportation sector remains one of the highest greenhouse gas emitting sectors and uncontrolled sustainable expansions and the country's transportation sector threatens Uganda's efforts towards pursuing a green economy and improving its resilience to climate change.[108] Projected climate change trends are expected to have negative impacts on Uganda's road infrastructure and transport sector. The transport sector is expected to be impacted by increasing temperatures, increased incidence of extreme events, flooding, landslides and drought. The increased frequency and duration of extreme rainfall events are likely to erode road and bridge support structures as well as washout roads entirely, leaving communities stranded from services and external aid. Increase in runoff and speed of river flows, siltation, and undercutting of infrastructure is likely to destabilize bridges and dams, as well as make roads impassable. This has a disproportionate impact on poor smallholder farmers, whose livelihoods may become threatened due to inaccessibility to market access or higher transaction costs.[109]

Adaptation Options

Uganda's Ministry of Works and Transport, in collaboration with the National Roads Authority, is developing a climate change strategy for the transport sector to ensure that new road projects include reviews of climate risks, such as flooding or bank erosion. Efforts towards 'climate proofing' should also support ongoing adaptation and mitigation strategies. Additional investments should also be made to existing transportation networks regarding maintenance and repairs as well as improvements to make infrastructure more resilient.[110] As of 2010, an estimated 27% of national bridges and roads were found to be properly maintained. Overall, Uganda's

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[106] Ministry of Water and Environment (2015). Uganda National Climate Change Policy. URL: https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf

[107] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

[108] Ministry of Water and Environment (2016). Uganda's Nationally Determined Contribution (NDC). URL: https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Uganda/1/INDC%20Uganda%20final%20%2014%20October%20%202015,%20minor%20correction,28.10.15.pdf

[109] USAID (2014). An overview of climate change and agriculture infrastructure in Uganda. URL: https://www.climatelinks.org/sites/default/files/asset/document/Uganda%2520CC%2520and%2520Infrastructure%2520Overview_CLEARED.pdf

[110] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

transportation sector would benefit from the shift to less vulnerable forms of infrastructure, which can reduce greenhouse gas emissions while still providing cost-effective service delivery. For example, Uganda urgently needs to shift long distance movement of agricultural products for export to more efficient rail service. Uganda's "Vision 2040" details extensive investment in new railways linking all parts of the country with its neighbors.[111]

Biodiversity

Overview

Uganda has a high degree, and unique combination of biological diversity in both its topography and wildlife. This is due to its location that endows it to both ecological communities that are characteristic of the drier, East African savannas and the wetter West African rain forests, combined with high altitude ranges. The majority of the country's biodiversity is found in natural forests and other natural ecosystems such as mountains, savannahs, wetlands, lakes and rivers. Uganda has approximately 18,783 species of which 7.5% are mammals, 10.2% of birds, 6.8% butterflies and 4.6% dragonflies. Uganda's forests are particularly rich in biodiversity in terms of species and genetic potential.[112]

Climate Change Impacts

Uganda has worked to preserve its biodiversity and its unique ecosystems by instituting conservation zones for specific areas; including 10 national parks, 12 wildlife reserves, 506 central forest reserves (1,173,753 ha), local forest reserves covering 4,957 ha. Importantly, Uganda has also established collaborative arrangements for management of trans-boundary protected area systems.[113] The country's biodiversity is also a key element for its thriving tourism sector.

Uganda's biodiversity is faced with many threats, many of which are directly tied to human activity, such as deforestation, growing population pressures leading to conversion of forest into agricultural and grazing land and over-harvesting for firewood, charcoal, timber and non-wood forest products. Uganda is experiencing natural resource degradation which is a direct threat to sustainable development. It is estimated that up to 97% of Uganda's land area suffers from some form of human induced land degradation. Such problems include soil erosion and declining soil fertility, deforestation, pollution of land, water and air resources, loss of biodiversity and over-harvesting of forests, fisheries and water resources. Threats to the country's biodiversity are also exacerbated by climate change trends such as changing seasonal patterns, increased temperatures and aridity, which puts additional pressures on fragile ecosystems.[114]

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[111] USAID (2014). An overview of climate change and agriculture infrastructure in Uganda. URL: https://www.climatelinks.org/sites/default/files/asset/document/Uganda%2520CC%2520and%2520Infrastructure%2520Overview_CLEARED.pdf

[112] Ministry of Water and Environment (2015). Uganda National Climate Change Policy. URL: https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf

[113] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

[114] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

Adaptation Options

Uganda is working hard to ensure the sustainable management of its biodiversity and conservation areas. This includes managing local community needs, with tourism opportunities and effective resource management.[115] Restrictive regulations (i.e. limited abilities to collect biomass or wood for cooking) is recognized to be very difficult for forest communities. However, improvements can be made towards the provision of biodiversity information through increased sensitization of these communities regarding the dangers relating to poor land-use and harmful agriculture and/or deforestation practices. Uganda's biodiversity sector can also benefit through ensuring environmental impact assessments are conducted when planning for and introducing an activity that may affect the biodiversity. It is crucial that these activities are included in the development of the mining, oil, and gas industry.[116]

ADAPTATION

Institutional Framework for Adaptation

Uganda's Ministry of Water and the Environment is the lead entity responsible for environmental and climate change issues for the country. The Ministry's Climate Change Directorate is the lead facilitator to regional and international actors on behalf of the government, including the development of National Communications and the 2015 National Climate Change Policy.[117] Uganda's disaster management is coordinated through the Department of Disaster Preparedness and Management, under the Office of the Prime Minister.[118]

Policy Framework for Adaptation

Uganda submitted its Nationally Determined Contributions to the UNFCCC in 2016, which provides the platform to integrate responsible environmental management with climate change adaptation strategies, that also account for the country's social and economic development targets,[119] as set out in its Second National Development Plan and National Climate Change Strategy. The country submitted its Second National Communication to the UNFCCC in 2014. These strategies focus on the preparation and strengthening of institutional frameworks for improved management of climate change effects and to make available the necessary resources to support strategic adaptation activities and to advance low emission and climate resilient development. This aims to integrate

[115] Ministry of Water and Environment (2015). Uganda National Climate Change Policy. URL: https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf

[116] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf

[117] Ministry of Water and Environment (2015). Uganda National Climate Change Policy. URL: https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf

[118] Department of Disaster Preparedness and Management (2011). The National Policy for Disaster Preparedness and Management. URL: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1732.pdf

[119] Ministry of Water and Environment (2016). Uganda's Nationally Determined Contribution(NDC). URL: https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Uganda/1/INDC%20Uganda%20final%20%2014%20October%20%202015,%20minor%20correction,28.10.15.pdf

climate change learning in key sectors to promote human and institutional capacity. Efforts are also focused on the research and development of National Adaptation Program of Action for key, prioritized sectors, water, agriculture and coastal zones.[120]

National Frameworks and Plans

- Uganda One Health Strategic Plan (2018)
- Guidelines for Mainstreaming Climate Change Adaptation and Mitigation in Agricultural Sector Policies and Plans (2018)
- National Adaptation Plan for the Agricultural Sector (2018)
- The Uganda Green Growth Development Strategy, 2017/18–2030/31 (2018)
- Nationally Determined Contribution (2015)
- Second National Development Plan (2015)
- National Climate Change Policy (2015)
- Climate Smart Agriculture Policy (2015)
- Guidelines for the Integration of Climate Change in Sector Plans and Budgets (2014)
- Second National Communication (2014)
- National Renewable Energy Policy (2007)
- Uganda Vision 2040 (2007)

Recommendations

Research Gaps

- Gain a better understanding of the timing and magnitude of incidence of several important indicators of climate change in the future, as well as the key vulnerabilities, development impact, and possible adaptation responses
- Widen the participation of the public, scientific institutions, women and local communities in planning and management, accounting for approaches and methods of gender equity[121]
- Strengthen environmental monitoring capabilities for strengthened and more effective environmental management
- Enhance Uganda's adaptive capacity through continuing investment in weather stations and expanding the country's national hydro-meteorological monitoring system and improved networking for the measurement of climate parameters[122]
- Strengthen technical capacity to integrate climate-smart agriculture and climate change risk management into farmer's and the wider agricultural sector[123]
- Implement a household survey to collect poverty data in the context of disaster and climate resilience for Uganda

[120] Republic of Uganda (2015). Second National Development Plan (NDPII) 2015/16–2019/20. URL: http://npa.ug/wp-content/uploads/NDPII-Final.pdf
[121] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf
[122] Ministry of Water and Environment (2015). Uganda National Climate Change Policy. URL: https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf
[123] Ministry of Agriculture, Animal Industry and Fisheries (2015). Uganda Climate Smart Agriculture Country Program 2015–2025. URL: https://canafrica.com/wp-content/uploads/2015/08/3-UGANDA-CLIMATE-SMART-AGRICULTURE-PROGRAMME.Final_.pdf

Data and Information Gaps

- Improve observational data through the additional of weather stations and hydro-meteorological instrumentation
- Improve technical capacity to analyze hydro-met data and project impacts across sectors
- Establish institutional capacity for providing timely early warning systems
- Develop early warning systems about dangerous hydrometeorological phenomena and climate risk management[124]
- Develop a tool to quantify economic losses from disasters in various infrastructure sectors

Institutional Gaps

- Ensure integration of National Environmental Strategy goals are developed within sectoral and regional plans
- Implement of cross-sectoral climate-smart solutions at national and subnational levels[125]
- Integrate climate change concerns into relevant policies and planning processes at the state and national levels[126]

[124] Ministry of Water and Environment (2014). Uganda Second National Communication to the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/resource/docs/natc/uganc2.pdf
[125] Ministry of Agriculture, Animal Industry and Fisheries (2015). Uganda Climate Smart Agriculture Country Program 2015-2025. URL: https://canafrica.com/wp-content/uploads/2015/08/3-UGANDA-CLIMATE-SMART-AGRICULTURE-PROGRAMME.Final_.pdf
[126] USAID (2013). Uganda Climate Change Vulnerability Assessment Report. URL: https://www.climatelinks.org/sites/default/files/asset/document/ARCC-Uganda%2520VA-Report.pdf

CLIMATE RISK COUNTRY PROFILE

UGANDA

WORLD BANK GROUP