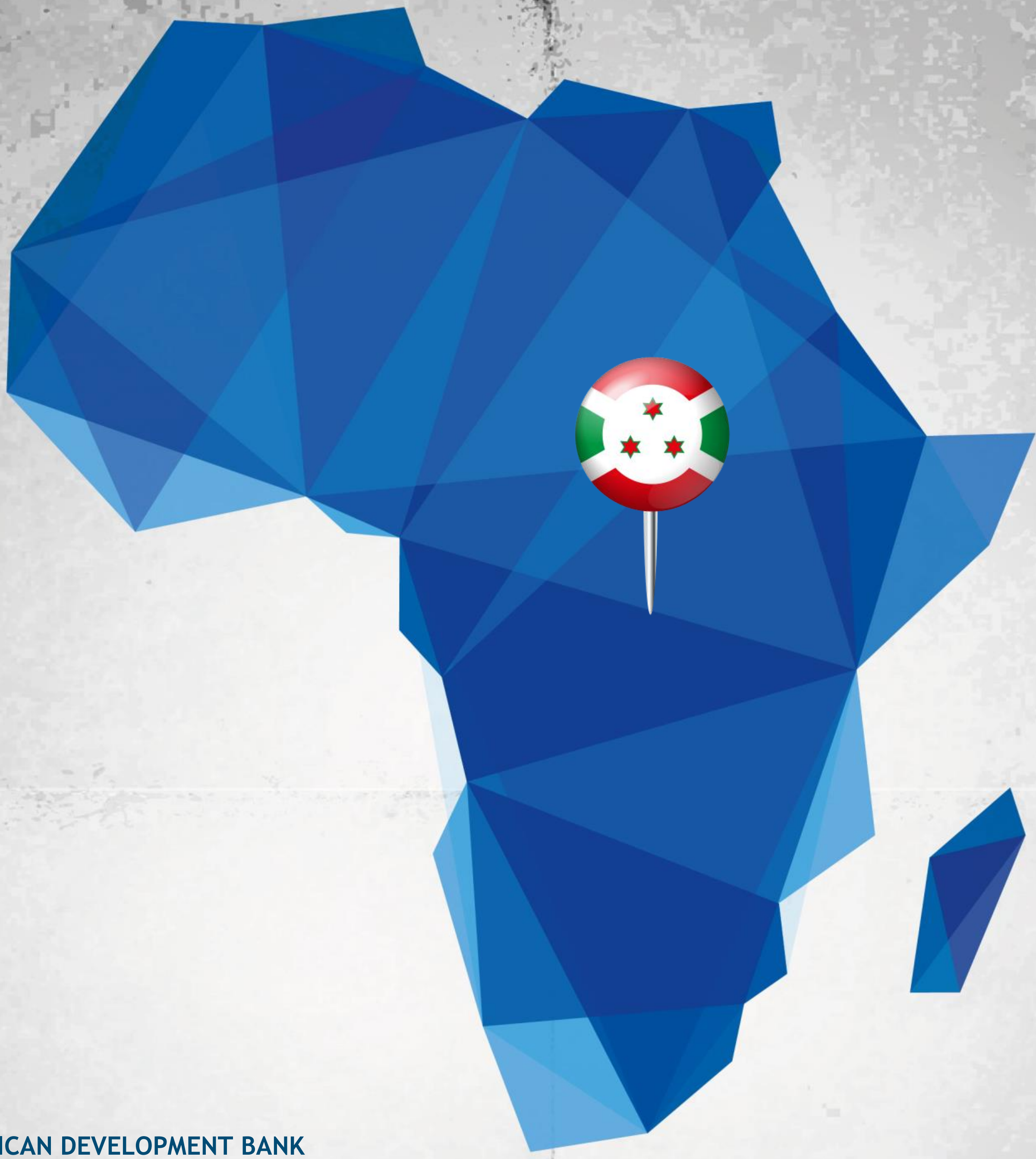
BURUNDI



AFRICAN DEVELOPMENT BANK

# NATIONAL CLIMATE CHANGE PROFILE

**PRODUCED IN COLLABORATION WITH:**
African Climate & Development Initiative, University of Cape Town;
Climate Systems Analysis Group, University of Cape Town;
Energy Research Centre, University of Cape Town; Cirrus Group.

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***ACKNOWLEDGEMENT***

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BURUNDI

# 1. BACKGROUND

## 1.1 Geographic and socio-economic context

The Republic of Burundi (henceforth, 'Burundi', shown below in Figure 1-1) is a landlocked country in the Great Lakes region of Africa and is one of the smallest countries on the continent. Burundi has the smallest urban population in Africa (~11%) but has the third highest urbanisation rate (~5.6%) on the continent. Burundi is one of the poorest and least-developed countries in Africa, with the second highest proportion (~78%) of people living below the poverty line, ~92% of the workforce in agriculture and only 7% of the population has access to electricity. As a result, Burundi has a Human Development Index of 0.40, one of the lowest in Africa. However, inequality in Burundi is lower than the majority of African countries (GINI co-efficient of 33.4). In addition to the socio-economic challenges that undermine the development of Burundi, the country's population is also vulnerable to the impacts of climate change and natural disasters. During the period 1996-2016, ~3,062,500 people in Burundi were affected by drought, in addition to which floods affected a further ~94,800 people. The ND-GAIN index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. Burundi's ND-GAIN index is 0.40, the 6th lowest in Africa, as a result of a low readiness score and a high vulnerability score. Key socio-economic and demographic indicators are further presented and summarised in Table 1-1, below.

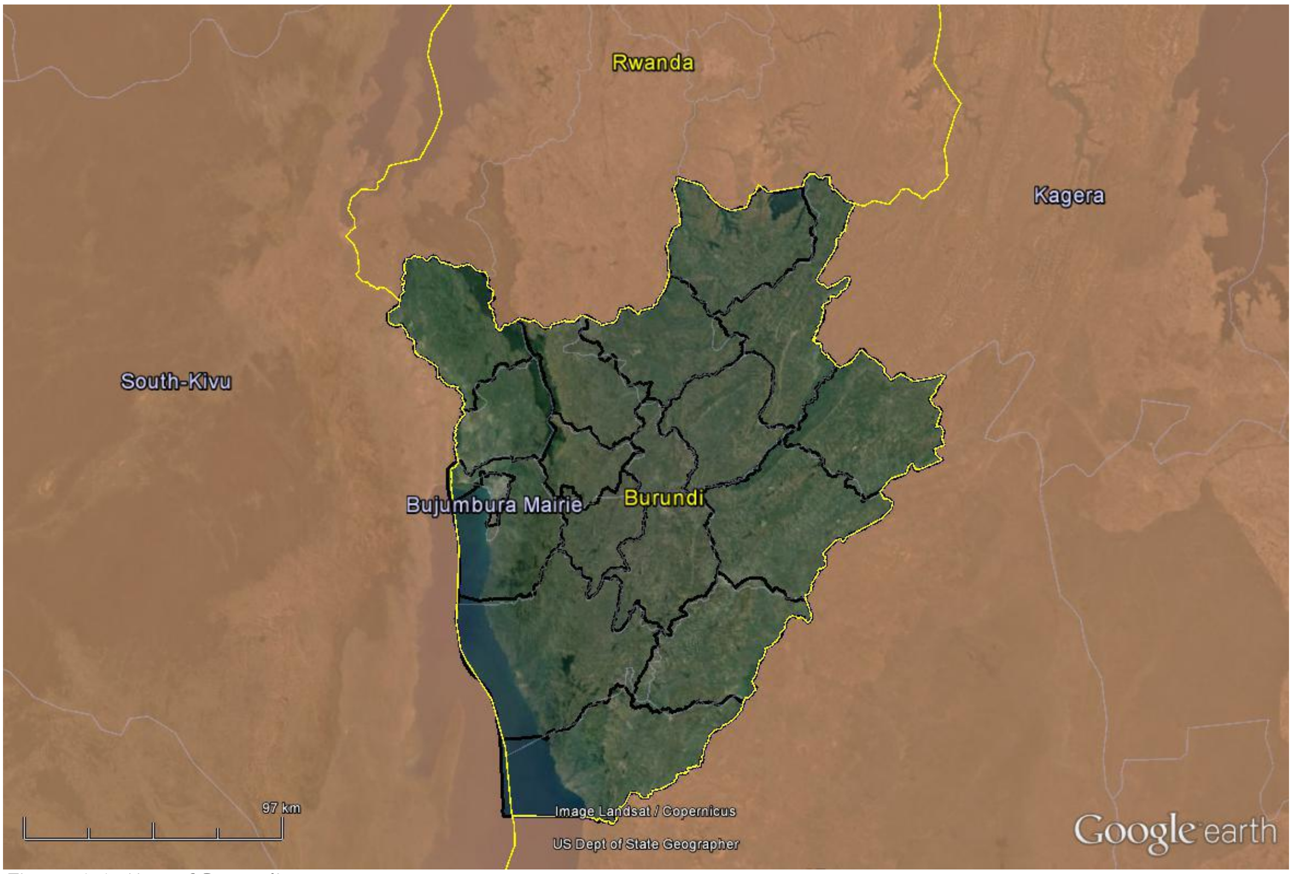



*Figure 1-1: Map of Burundi*

*Table 1-1: Socio-Economic Context of Burundi (reference year ranges from 2014 - 2017)*

| VARIABLE | | SCORE/TOTAL | UNIT | RANK (OUT OF 54) |
|---|---|---|---|---|
| **Geography, socio-economy and demographics** | | | | |
| Population[1] | | 11,936,481 | people | 29 |
| Population growth rate[1] | | 3.3 | % population .$yr^{-1}$ | 2 |
| Population density[1] | | 465 | People/$km^2$ | 3 |
| Land area; total area[1] | | 25,681; 27,834 | $km^2$ | 46 |
| % Urban population[1] | | 11.5 | % population | 54 |
| % Urbanisation rate[2] | | 5.6 | % population .$yr^{-1}$ | 3 |
| Economy: total GDP[2] | | 3.0 | USD billions .$yr^{-1}$ | 42 |
| Economy: GDP by PPP[2] | | 8 | billion international dollars .$yr^{-1}$ | 41 |
| Economy: GDP/capita[2] | | 286 | USD per capita/yr | 51 |
| Population below the poverty line[3] | | 77.7 | % below USD 1.90 per day | 2 |
| Gender Inequality Index[4] | | 49.2 | | 32 |
| GINI co-efficient[3] | | 33.4 | | 44 |
| HDI[5] | | 0.40 | | 49 |
| Access to electricity[6] | | 7.0 | % population | 53 |
| **Summary indicators of climate change vulnerability** | | | | |
| Workforce in agriculture[7] | | 92.2 | % workforce | 1 |
| Number of people affected by drought[8] | | 3,062,500 | people | 17 |
| Number of people affected by flood events[8] | | 94,817 | people | 37 |
| Population living in informal settlements[6] | | 57.9 | % urban population | 22 |
| Incidence of malaria[9] | | 126 | cases per 1000 population at risk | 27 |
| ND-Gain Vulnerability Index[10] | Total | 30.1 | | 49 |
| | Readiness | 0.29 | | 40 |
| | Vulnerability | 0.69 | | 2 |

## 2. CLIMATE AND WEATHER

Burundi has a tropical highlands climate due to its altitude and its location just south of the equator. Strong temperature and rainfall variations are found across the country due to the mountainous landscape. Rainfall is highest over the central parts of the country and lowest over the north east and the lower elevation of the south west. That being said, the seasonality of rainfall is relatively consistent over the country with a dry season from June – August and a wet season from October – May peaking during March – May and November.

Burundi's water region extends beyond the country border primarily to the north. Climate variation within that region is however minor and no sub-regions are distinguished here. The Burundi region is illustrated in **Figures 2-1** and **2-2**, below, and summary descriptions can be found in **Table 2-1** below.

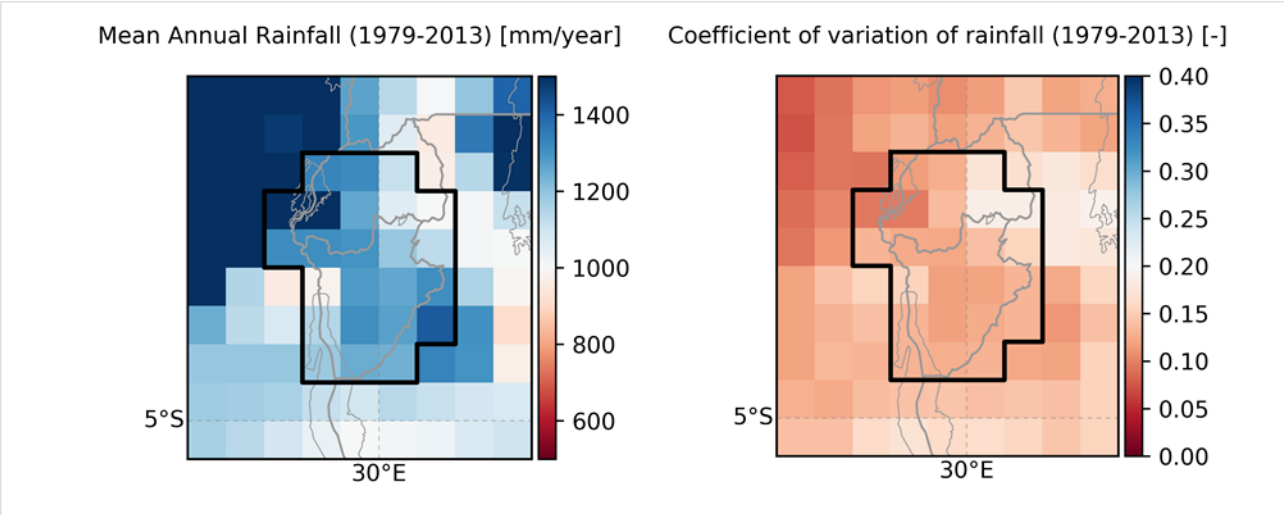
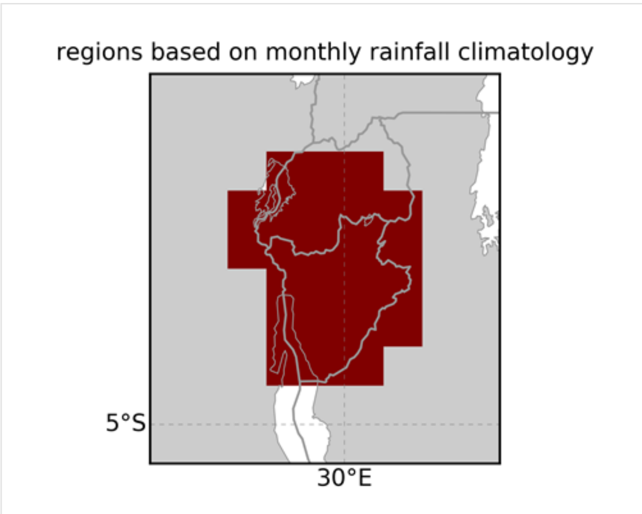



*Figure 2-1: Main characteristics (magnitude and variability) of rainfall in Burundi and its region*




*Coloured regions on the map (above) correspond to the colours used in rainfall and temperature graphs (below)*

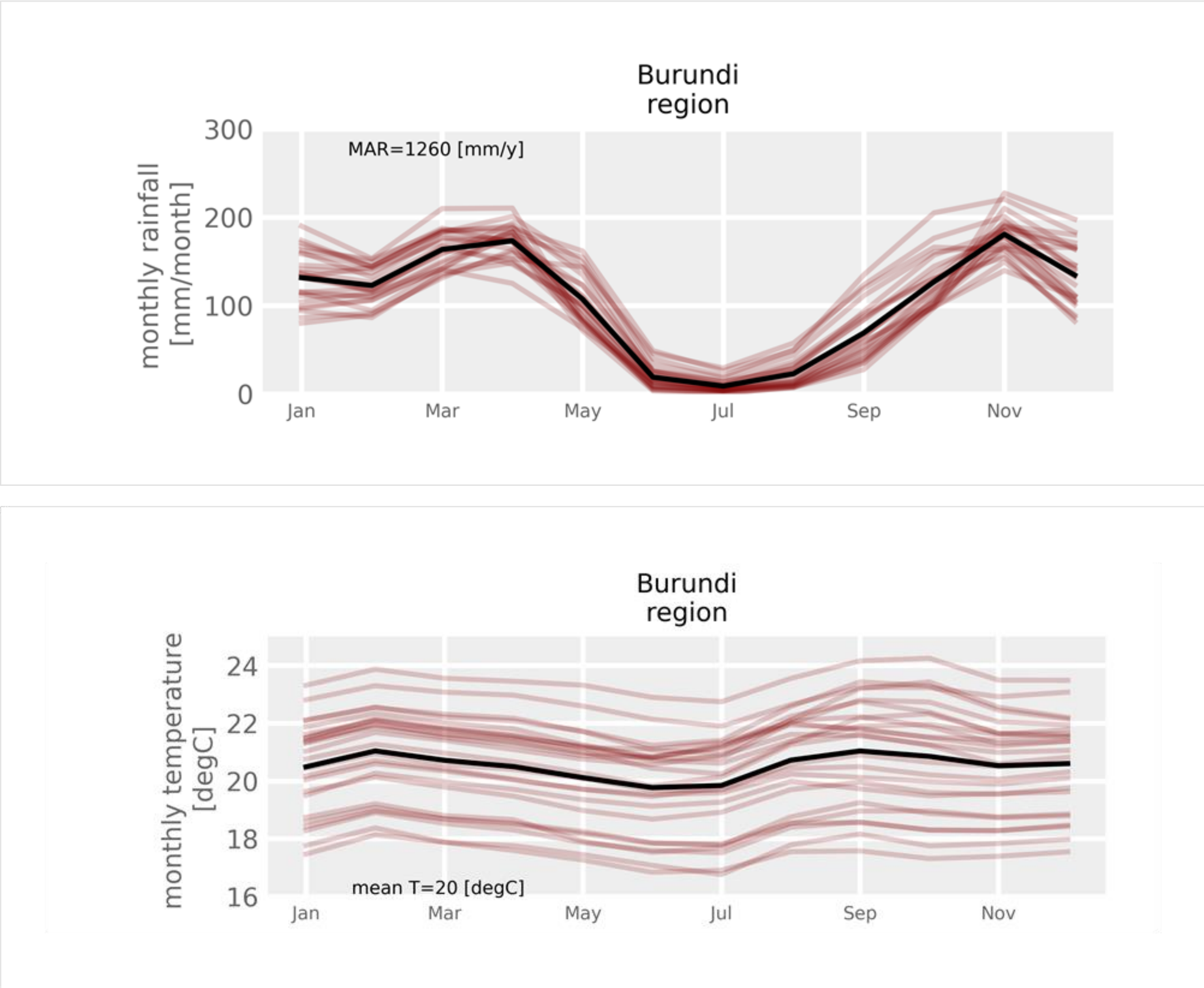



*Figure 2-2: Rainfall region of Burundi and its rainfall climatology*

*Table 2-1: Main characteristics of rainfall of Burundi region*

| | |
|---|---|
| Burundi region | A region with annual rainfall reaching 1260mm/year and daily mean temperature of 20° C. Interannual variation in rainfall is low to moderate. Rainfall primarily occurs from October to May peaking with 180 mm/month during March – April and again in November. A clear dry season occurs during the austral winter (June – August). Clear spatial variations are evident in temperature primarily due to altitude. Seasonal differences in daily mean temperature are very small. |

## 2.1 Observed historical climate variations and climate change trends

The majority of Burundi experiences **moderate rainfall variability** on an inter-annual basis. On **decadal time scales** Burundi also experiences **clear variability** with some periods being relatively drier or wetter than others. This variability can be seen in the supporting evidence plots provided in the supplementary Appendix **(Figures A-1 to A-4).**

**Long term trends** across the region show **increasing temperatures** over the period 1979 – 2015, although that trend appears to be weaker in the last decade of that period. The long term trend in total annual rainfall is slightly positive and is associated with the increase in extreme rainfall events, but a decrease in general rainfall frequency. None of these trends are statistically significant. Long term trends and variability in the Burundi region are summarized in **Table 2-2** below and illustrated further in the supplementary Appendix **(Figures A-1 to A-4).**

*Table 2-2: Summary of trends in rainfall and temperature attributes in Burundi (1979 - 2015)*

| REGION | MEAN T [DEG C/DECADE] | TOTAL RAINFALL [MM/DECADE] | HEAVY RAINFALL [DAYS/DECADE] | RAINY DAYS [DAYS/DECADE] |
|---|---|---|---|---|
| Burundi | +0.37 | slight upward | +1.4 | downward |

## 2.2 Projected (future) climate change trends, including temperature, precipitation and seasonality

Projected changes in main attributes of climate for the Burundi region are summarized in Table 2-3, below, and described in Sections 2.2.1 and 2.2.1. Additional analysis and visualisation of projections can be found in **Figures A-5 to A-8** in the supplementary Appendix.

### 2.2.1 Projected changes in precipitation from present to 2100

Rainfall projections for Burundi show a pattern of **potential increased rainfall** emerging from about the 2050s. That pattern appears to be consistent across the majority of CMIP5 models. Relative magnitudes of potential increased rainfall reach about 200mm/year wetter by 2100 which equates to 15% of the baseline normal. **The increase in rainfall** seems to be strongly associated with **increase in the high intensity rainfall events rather than in the frequency of rainy days**. It must be noted that these results are derived from GCM projections which may not accurately represent changes in extreme rainfall dynamics. They are, however, consistent with the increased convective rainfall intensity (e.g. thunderstorm-related rainfall) expected in a warmer climate.

### 2.2.2 Projected changes in temperature from present to 2100

**Air temperature** is projected to be between 1.5 and 2.5°C warmer in the Burundi region by the 2050s. By 2100 the range of projected temperatures is greater with the coastal regions showing projected increases of 3°C to 5.5°C.

*Table 2-3: Summary of projected climate changes across regions of Burundi for key climate variables by 2050*

| REGION | AVERAGE TEMPERATURE [°C] | TOTAL ANNUAL RAINFALL [MM/YEAR] | EXTREME RAINY DAYS [DAYS/YEAR] | RAINY DAYS [DAYS/YEAR] |
|---|---|---|---|---|
| Burundi region | **Increasing** +1.5°C to +2.5°C by 2050s but changes evident in next decades | **Normal to increasing,** ranging from no change to an increase of up to 15% by 2100. Change could become evident after 2050s | **Increasing,** ranging from small increase to an increase of up to 90% by 2100. Change could become evident from the 2060s | No consistent signal in projections |

## 2.3 Expected climate vulnerabilities

NOTE: Determining vulnerability of different sectors to climate variations or change is extremely challenging as there are many factors involved in vulnerability and different approaches can yield different results. The vulnerabilities presented here are based on UNFCCC reporting documents, such as national communications or national adaptation plans of action where available, and other literature where UNFCCC documents are not available.

The largely rural, landlocked country of Burundi is essentially an agricultural country. With crop production and animal husbandry contributing about half of the GDP, and export of products such as coffee, tea and cotton comprising around three quarters of export revenues, increasing temperatures and more extreme rainfall is a concern for both households and for the economy at large. While projections indicate an increase in annual rainfall, increased evaporation due to increasing temperatures and water quality implications following more extreme rainfall events may negatively affect access to safe water sources as well as hydropower production. The large proportion of the people living below the poverty line means that the majority of the population have very limited capacity to adapt to increasing temperatures and more extreme rainfall. While the population is still largely rural, high urbanisation rates combined with high poverty levels means that the growing urban settlements could be a concern, both in terms of the impacts of disasters and the provision of safe water, sanitation and health services.

*Table 2-4: Broad scale sectoral vulnerabilities and potential climate change impacts in Burundi*

| SECTOR | IMPACTS |
|---|---|
| **Agriculture** | Increased soil erosion during and loss of agricultural land and pastures<br>Shifting growing season<br>Declined agricultural yields including key export crops (coffee, tea, cotton)<br>Increased incidence of pests and diseases, affecting food crops and livestock<br>Increased death and heatstroke in livestock owing to increased temperatures and lack of water<br>Desertification impacting livelihoods and infrastructure |
| **Fisheries** | Reduced productivity and fish yields in lakes and river systems |
| **Water resources** | Declining lake levels, especially Lakes Cohoha, Rweru, Rwihinda and Kanzigiri in the Bugesera Depression<br>Increased salinization of groundwater resources around lakes<br>Decreased water quality of river and lake systems<br>Increased sedimentation of lakes and dams<br>Increased demand on water resources, leading to depletion of groundwater resources<br>Decreased productivity of pelagic fisheries |
| **Built infrastructure and human settlements** | Damage to or destruction of infrastructure, including roads, electricity networks, houses, schools, hospitals and businesses, owing to flooding<br>Increased potential for migration from rural to urban areas, owing to more people searching for viable livelihoods<br>Declined productivity of hydroelectric power plants, in particular the Marangara, Buhiga and Kayenzi plants<br>Increased scarcity of firewood and wood charcoal owing to combined pressure from human activities, rising temperatures and changes to biomass growth rates |
| **Human health** | Increased malnutrition and food insecurity as animal protein supply is reduced owing to decrease in productivity of pelagic fisheries and livestock farming<br>Increased prevalence of vector-borne diseases such as malaria<br>Increased number of people at risk of heat-related medical conditions, especially the elderly, children, and the chronically ill<br>Increased prevalence of diarroeal disease |

# 3. CLIMATE CHANGE MITIGATION, GREENHOUSE GAS EMISSIONS AND ENERGY USE

The major carriers of Burundi's energy mix, and the energy demands of major economic sectors, are summarised in Section 3.1, below. The major sources of GHG emissions, described by fuel source and sector, are described in Section 3.2. The latter section also includes summarised statistics on Burundi's agriculture sector, historical land use change and vegetation cover.

## 3.1 National energy production and consumption

Burundi suffers from major deficits in energy production and electricity access. Over 80% of national energy supply and over 70% of energy consumption is accounted for by domestic use of biomass fuels. All oil and petroleum resources are imported and contribute less than 1% to Burundi's energy sector while hydroelectric energy contributes an additional ~0.7%. A small amount of coal is produced and contributes ~0.1% to national energy production. The access to electricity is extremely low in Burundi (7%) due to a lack of infrastructure and high costs (World Bank, 2012). Electricity is generated by hydroelectric and thermal power plants (~99%) and fossil fuels (~1%). The residential (~88.6%) and transport (~9%) sectors are the largest consumers of energy, followed by industry (~%1.5) and non-energy use (~0.7%). The total annual GHGs emitted by the abovementioned s sectors and fuel carriers are described further in Section 3.2.

Unless stated otherwise, all energy figures are derived from UN Stats (2014) [10]; World Energy Council (2016); [11]; and the World Resources Institute (2013) [12]. Agriculture & forestry-related emissions are also reported from Food and Agriculture Organisation (2014-2017) [14] and Global Forest Watch. (2015-2017) [15].

### 3.1.1 National energy production, primary energy supply and national energy consumption

The tables and figures below describe Burundi's energy sector, including national electricity production, primary energy supply and national energy consumption by fuel carrier.

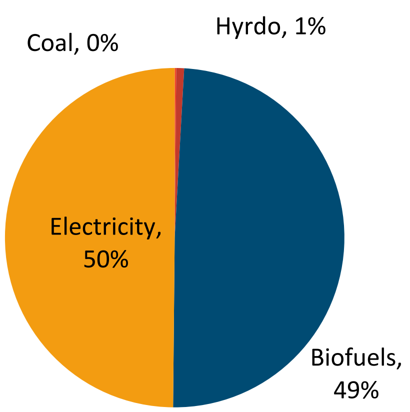



*Figure 3-1: Distribution of Burundi's national energy production between major energy carriers (2014-2016)*

*Table 3-1: National energy and electricity production in Burundi (2014-2016)*

| NATIONAL ENERGY PRODUCTION | | |
|---|---|---|
| **Source** | **Total (MTOE)[1]** | **% of total energy production** |
| Coal[11] | <0.01 | 0.1 |
| Hydro[12] | 0.02 | 0.7 |
| Biofuels[11] | 1.32 | 49.3 |
| Electricity[11] | 1.34 | 49.9 |
| Total national energy production | 2.7 | 100.0 |

[1] *Energy is expressed in 'Megatonnes of Oil Equivalent', where 1 Tonne Oil Equivalent = 11,630 KiloWatt hours (KWh)*

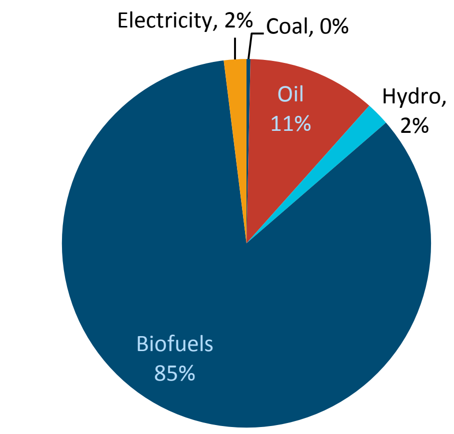



*Figure 3-2: Distribution of Burundi's national energy consumption by major energy carriers*

*Table 3-2: Burundi's national energy consumption by energy source*

| CONSUMPTION BY ENERGY SOURCE[11] | |
|---|---|
| **Source** | **Total (MTOE)** |
| Coal | <0.01 |
| Oil | 0.1 |
| Biofuels | 1.0 |
| Electricity | 0.02 |
| Total national energy consumption by source | 1.3 |

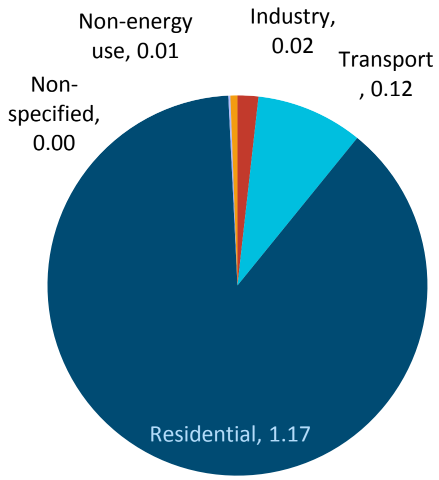



*Figure 3-3: Distribution of Burundi's national energy consumption by sector (2014-2016)*

*Table 3-3: Burundi's national energy consumption by sector (2014-2016)*

| CONSUMPTION BY SECTOR[11] | |
|---|---|
| **Sector** | **Total (MTOE)** |
| Industry | 0.02 |
| Transport | 0.12 |
| Residential | 1.17 |
| Non-specified | <0.01 |
| Non-energy use | 0.01 |
| Total national energy consumption by sector | 1.32 |

*Table 3-4: Burundi's national total primary energy supply (estimated for 2014-2016)*

| TOTAL PRIMARY ENERGY SUPPLY[11] | |
|---|---|
| **Source** | **Total (MTOE)** |
| Coal | <0.01 |
| Oil | 0.14 |
| Biofuels | 1.32 |
| Electricity | 0.02 |
| Total primary energy supply | 1.49 |

## 3.2 National greenhouse gas emissions by source and sector

Section 3.2.1, below, describes GHG emissions from all sectors of national energy consumption, which therefore includes emissions from fuel combustion, industrial/manufacturing processes, household-level energy consumption and AFOLU (Agriculture, Forestry and Other Land Use). These figures are compiled by the World Resources Institute's Climate Access Indicator Tools (CAIT). Section 3.2.2 provides additional details on Algeria's Land Use and Land Use Change sector, including detailed summaries of emissions from the agriculture sector and historical land use changes.

### 3.2.1 GHG emissions from primary energy consumption, by source and sector

*Table 3-5: Burundi's national greenhouse gas emissions from primary energy consumption (estimated for 2014-2016)*

| NATIONAL GHG EMISSIONS FROM PRIMARY ENERGY CONSUMPTION BY SOURCE AND SECTOR[13] | | |
|---|---|---|
| **Source / Sector** | | **Total emissions (MT $CO_2e$)** |
| Energy | Other fuel combustion | 0.22 |
| | Energy sub-total | 0.22 |
| Industrial processes | | 0.09 |
| Agriculture | | 2.13 |
| Waste | | 0.37 |
| Land use change and forestry (LUCF) | | 2.53 |
| Total emissions (including LUCF) | | 5.34 |

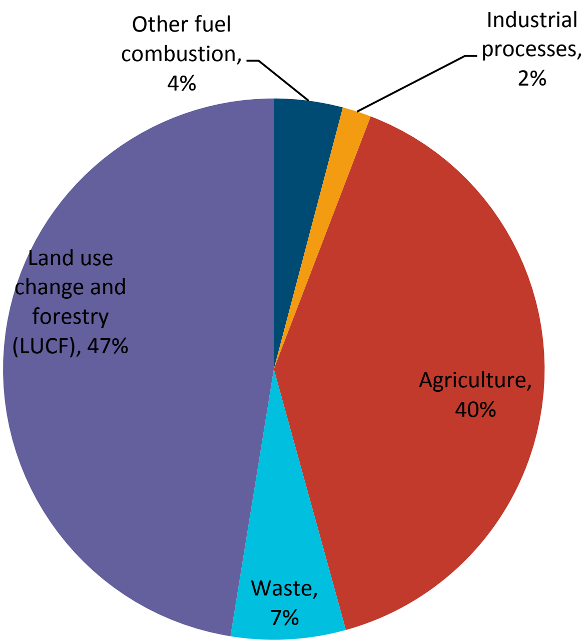



*Figure 3-4: Distribution of Burundi's GHG emissions by major sectors*

### 3.2.2 GHG emissions from agricultural practices

Table 3-6, below, summarises GHG emissions from Burundi's agriculture sector (derived from Food and Agriculture Organisation statistics). Although there are multiple agricultural practices and land use changes which contribute to GHG emissions, in the case of Burundi the land use change sector is by far the largest contributor to agricultural GHG emissions (~5.5 MT $CO_2e$). In particular, cropland and forest land use change contributes over 60% of total agricultural GHG emissions.

*Table 3-6: National annual greenhouse gas emissions from agricultural practice, forestry and other land use in Burundi (estimated for 2014-2017)*

| VARIABLE | | ANNUAL EMISSIONS (MT $CO_2E$) |
|---|---|---|
| Annual GHG emission from agricultural practices[14] | Burning - crop residues | 0.01 |
| | Burning - savanna | 0.01 |
| | Crop residues | 0.05 |
| | Cultivation of organic soils | 0.3 |
| | Enteric fermentation | 0.9 |
| | Manure management | 0.1 |
| | Manure applied to soils | 0.1 |
| | Manure left on pasture | 0.7 |
| | Rice cultivation | 0.04 |
| | Synthetic fertilizers | 0.04 |
| | Sub-total (Agricultural practices) | 2.2 |
| Annual GHG emission from land use change[14] | Grassland | 0.01 |
| | Cropland | 3.1 |
| | Forest land | -1.6 |
| | Burning biomass | 0.8 |
| | Sub-total (Land use change) | 2.3 |
| Total emissions | | 4.5 |

Table 3-7, below, summarises the recent historical changes in land use in Burundi through analysis of land use change. Statistics derived from the Global Forest Watch database were used to summarise the total area of wooded vegetation in various categories of canopy cover density (where 10-30% canopy cover can be considered as savanna, 30-50% cover can be considered woodland and 50-100% cover can be considered dense forest), as well as the historical rates of change in each vegetation category. Global Forest Watch reports the total aboveground carbon stock of Burundi's forest biomass as ~26.4 million tonnes.

*Table 3-7: Vegetation cover and land use change in Burundi (estimated for 2015)*

| VARIABLE | | | TOTAL (HECTARES) | TOTAL (% OF LAND AREA) | UNIT |
|---|---|---|---|---|---|
| Total tree cover[15] | 10-30% canopy cover | | 1,731,304.6 | 62.2 | % of total land area |
| | 30-50% canopy cover | | 386,913.5 | 13.9 | |
| | 50-100% canopy cover | | 130,625.9 | 4.7 | |
| | TOTAL | | 2,248,844 | 80.8 | |
| Land use change and agricultural expansion | Historical annual rate of deforestation[16] | 10-30% canopy cover | | 0.0 | % of previous year |
| | | 30-50% canopy cover | | 0.2 | |
| | | 50-100% canopy cover | | 0.4 | |
| | Area of agricultural land[17] | | 2,405,903.5 | 86.5 | % of total land area |
| | Historical annual area converted to agricultural land[17] | | -54,268.5 | -2.2 | % of previous year |

# 4. SUMMARISED NATIONAL PRIORITIES FOR CLIMATE CHANGE ADAPTATION AND MITIGATION

Burundi's main priority actions related to climate change are described in the country's submissions to the UNFCCC through the Intended Nationally Determined Contributions (NDC) document. The document includes detailed descriptions of Burundi's major commitments and priorities related to GHG mitigations (Table 4-2, below) as well as major priorities related to adaptation, derived from the draft National Adaptation Plan (NAP) (Table 4-3, further below).

Burundi's unconditional contribution is a reduction of greenhouse gas emissions by 3% compared to the business-as-usual (BAU) scenario for 2030. The conditional contribution is a reduction of greenhouse gas emissions by 20%, beginning in 2016, compared to the business-as-usual scenario for 2030.

Total estimated costs for implementation of the NDC are estimated to be USD 1.493 billion, including both adaptation and mitigation components.

Table 4-1, below, gives details on Burundi's GHG reduction targets outlined in the country's NDC, with information on target gases and sectors, the use of international markets in achieving targets (e.g. the use of carbon credits), and accounting methods used to quantify GHG emissions (e.g. inclusion of land use and land use change).

*Table 4-1: Summary of Burundi's NDC commitments for reduction of GHG emissions*

| GHG EMISSIONS REPORTED IN NDC (MT $CO_2E$/YR) | BASE LEVEL | REDUCTION TARGET | TARGET YEAR | SECTORS AND GASES | USE OF INTERNATIONAL MARKETS | LAND-USE INCLUSION / ACCOUNTING METHOD |
|---|---|---|---|---|---|---|
| 143.87 | BAU | 64 percent (conditional) | 2030 | $CO_2$, $CH_4$, $N_20$; Agriculture (livestock and soil), forestry, transport, electric power, industry (including mining) and buildings (including waste and green cities) | Yes, as a seller of international credits | Land-use included; accounting methodology not specified |

## 4.1 National priorities for climate change mitigation

Burundi's mitigation priorities are detailed for the energy, transport and AFOLU sectors. Proposed activities and investments within each sector are further categorised according to 'Technology Type', based on the categories of technologies listed by the Green Climate Fund's (GCF) impact indicators for mitigation projects (key for technology types provided below Table 4-2). In the energy sector, priorities reflect the need to increase the production and distribution of electricity. These include the research and development of renewable energies, specifically hydro-electricity, but also biogas, wind power and gasification, and the increase of energy efficiency and electrification. In the AFOLU sector, priorities include a move from mineral to organic fertilizer, a reforestation programme, drainage in rice cultivation, and a move towards waste recovery and composting. Burundi also prioritises the replacement of all traditional charcoal kilns and traditional home ovens. Burundi has one transport sector priority which is to ensure urban transport has low GHG emissions.

*Table 4-2: Mitigation priorities in Burundi's NDC*

| PRIORITY SECTOR | SECTOR-SPECIFIC ACTION | TECHNOLOGY TYPE* [2] | SECTION AND PAGE |
|---|---|---|---|
| **Energy** | Development of hydroelectricity | 1 | Mitigation, pg 12 |
| | Decentralized rural electrification through the use of photovoltaic systems | 1 | |
| | Development of small scale hydro-power (Pico hydro, water wheels, etc.) | 1 | Mitigation, pg 13 |
| | Resumption of research and development, distribution and extension of renewable energies (biogas, wind power and gasification) | 5 | |
| | Energy efficiency in production, transport, distribution and consumption (reduction of losses, low energy light bulbs and energy saving equipment) | 1, 2, 3 | |
| **Transport** | Urban transit with low GHG emissions | 2 | Mitigation, pg 8 |
| **AFOLU** | Gradual replacement of 100% of mineral fertilizers with organic fertilizer by 2030. | 4 | |
| | National Reforestation Programme to increase $CO_2$ well through 4,000 hectares of annual reforestation over the course of 15 years, beginning in 2016 | 9 | |
| | Replacement of 100% of traditional charcoal kilns and traditional home ovens by 2030 | 3 | |
| | Intermittent drainage in rice cultivation | 4 | Mitigation, pg 12 |
| | Recovery of the fermentable fraction of urban waste that can produce compost and biogas | 4 | |
| | Adaptation of agriculture to climate change | 4 | |
| | Waste recovery techniques for agriculture, forestry and livestock farming | 4 | |
| | Peat carbonization, and densification and carbonization of coffee husks, rice hulls and sawdust | 4 | |
| | Composting of waste from the defoliation of sugar cane plantations | 4 | |
| | REDD pilot programme | 4 | |

[2] **GCF Technology Type Key (derived from GCF's Results Framework for mitigation)*

*1. Reduced emissions through increased lower emission energy access and power generation.*

*2. Reduced emissions through increased access to low-emission transport.*

*3. Reduced emissions from buildings, cities, industries and appliances.*

*4. Reduced emissions from land use, deforestation, forest degradation, and through sustainable management of forests and conservation and enhancement of forest carbon stocks.*

*5. Strengthened institutional and regulatory systems for low-emission planning and development.*

*6. Increased number of small, medium and large low-emission power suppliers.*

*7. Lower energy intensity of buildings, cities, industries, and appliances.*

*8. Increased use of low-carbon transport.*

*9. Improved management of land or forest areas contributing to emissions reductions.*

## 4.2 National priorities for climate change adaptation

Table 4-3, below, shows Burundi's priorities for climate change adaptation. Burundi's proposed activities and investments related to adaptation are categorised according to 'Technology Type', based on the categories of technologies listed by the Green Climate Fund's (GCF) impact indicators for adaptation projects (key for technology types provided below Table 4-3). In terms of national priorities for climate change adaptation, Burundi's AFOLU sector is detailed. The only other sectors discussed in terms of adaptation priorities in Burundi's NDC included community-based priorities and the water sector. In terms of community-based adaptation activities, Burundi's priority is to coach the population to develop their climate change resilience. In the water sector, Burundi's main stated priority is to promote increased efficiency of irrigation. In the AFOLU sector priorities include intensifying and diversifying crop production, increasing access to agricultural equipment, promotion of sustainable fishing practices, improving agricultural and livestock production activities, improving information on vulnerable agricultural areas and promoting climate-smart agriculture, among others. General adaptation priority themes in the AFOLU sector are research around agricultural and other sectors, the management and sustainable use of resources, and the sustainable development and increase of production.

*Table 4-3: Adaptation priorities in Burundi's NDC*

| PRIORITY SECTOR | SECTOR-SPECIFIC ACTION | TECHNOLOGY TYPE[3] |
|---|---|---|
| **AFOLU** | Develop, rehabilitate and manage hydro agricultural developments | 1, 2 |
| | Produce developments for rain-fed crops | 1, 2 |
| | Intensify and diversify agricultural production by simplifying access to inputs (fertilizer, subsistence crop seeds, drought-resistant fodder and crop protection products) and to agricultural equipment | 1, 2 |
| | Develop an agro-ecological approach (soil fertility management practices, use of manure and compost, development of agroforestry, and water and soil conservation) | 1, 2, 4 |
| | Develop the exploitation of fishing resources while conserving resources (stocking bodies of water with fish, development of rain-fed fish farming and application of zones closed to grazing) | 1, 2, 4 |
| | Improve agricultural and livestock production activities (drainage, conservation, drying and cold chain) including the use of renewable energy sources (hydraulic, solar and wind) | 1, 2, 4 |
| | Water control with a view to increasing agricultural and livestock production | 2, 4 |

[3] **GCF Technology Type Key (derived from GCF's Results Framework for adaptation)*

*1. Increased resilience and enhanced livelihoods of the most vulnerable people, communities, and regions.*

*2. Increased resilience of health and wellbeing, and food and water security*

*3. Increased resilience of infrastructure and the built environment to climate change threats*

*4. Improved resilience of ecosystems and ecosystem services*

*5. Strengthened institutional and regulatory systems for climate responsive planning and development*

*6. Increased generation and use of climate information in decision making*

*7. Strengthened adaptive capacity and reduced exposure to climate risks*

*8. Strengthened awareness of climate threats and risk reduction processes*

| PRIORITY SECTOR | SECTOR-SPECIFIC ACTION | TECHNOLOGY TYPE[4] |
|---|---|---|
| **AFOLU (cont)** | Use information networks to identify areas ravaged by disease and/or with major water and pastureland resources | 1, 2, 4 |
| | Development and rational management of forest resources: raising the forest cover rate to 20% by 2025 | 4 |
| | Promotion of forest resources | 4 |
| | Increase in agricultural production and productivity and development of sustainable production systems than can re-establish food self-sufficiency in the short and medium terms | 2, 4 |
| | Management and sustainability capacity-building in the agricultural sector in order to transform subsistence farming into profitable market agriculture managed by professionals | 2, 4 |
| | Promotion of climate-smart agriculture (agrometeorology) | 2, 4 |
| | Integrated water resources management by a small hydrological unit | 2, 4 |
| | Integrated management of climate risk and forecasts over time (by means of probabilities and forward-looking studies) so as to be able to take action in advance | 6 |
| | Protection of aquatic and land-based ecosystems | 2, 4 |
| | Research and extension of drought-resistant forest species | 4 |
| | Establishment of functional monitoring and evaluation mechanisms for climate change, as well as knowledge management and information mechanisms | 6 |
| **Community based** | Coaching of the population to develop their resilience to climate change | 1 |
| **Water** | Develop small and large-scale irrigation and improve its efficiency in order to reduce water consumption | 1, 2 |

[4] **GCF Technology Type Key (derived from GCF's Results Framework for adaptation)*

*1. Increased resilience and enhanced livelihoods of the most vulnerable people, communities, and regions.*

*2. Increased resilience of health and wellbeing, and food and water security*

*3. Increased resilience of infrastructure and the built environment to climate change threats*

*4. Improved resilience of ecosystems and ecosystem services*

*5. Strengthened institutional and regulatory systems for climate responsive planning and development*

*6. Increased generation and use of climate information in decision making*

*7. Strengthened adaptive capacity and reduced exposure to climate risks*

*8. Strengthened awareness of climate threats and risk reduction processes*

# 5. ASSUMPTIONS, GAPS IN INFORMATION AND DATA, DISCLAIMERS

The observed and projected climate trends described in Section 2 'Climate and Weather' are derived from a combination of publicly-available observational data and CMIP5 climate models. Detailed information is included in Section 6. Appendix 1, including '6.1.b. Historical Trends and Variability Analysis' and '6.1.c. Climate Projections Visualisations'.

Unless stated otherwise, all statistics reported in Section 1 ('Geographic and Socio-Economic Context' and Section 3 'Climate change mitigation, greenhouse gas emissions and energy use') are derived from databases of publicly available datasets managed by international or multilateral agencies including inter alia The World Bank Group, the United Nations, World Resources Institute and International Energy Agency.

Unless stated otherwise, all energy and greenhouse gas emission figures are derived from UN Stats (2014); World Energy Council (2016); the World Resources Institute (2013), and the International Energy Agency (2016). Agriculture & forestry-related emissions are also reported from Food and Agriculture Organisation (2014-2017) and Global Forest Watch. (2015-2017). Full references are provided as a supplementary appendix.

As a result of the use of standardised methodologies and data sources across the 25 countries included in this AfDB Climate Change Profile, statistics and estimates reported herein may differ from other publicly available datasets or national estimates. Readers are advised to always check for updated publications and newly released national datasets.

This AfDB Climate Change Profile series is intended to provide a brief touch-stone reference for climate change practitioners, project managers and researchers working in African countries. The figures and estimates provided herein are intended to inform the reader of the main climate-related challenges and priorities, however these should be used to inform a process of additional research and in-country consultations. The University of Cape Town, the African Development Bank and its Boards of Directors do not guarantee the accuracy of figures and statements included in this work and accept no responsibility for any consequences of its use.

# 6. APPENDIX 1

## 1.a Supporting evidence

The climate projections detailed in Chapter 2 (above) are supported by rigorous analysis of observed and model projections data. More details of this analysis and supporting figures can be found below.

## 1.b Historical trends and variability analysis

The analysis of historical trends and variability of key climate variables is presented below. This analysis uses the WATCH Climate Forcing dataset which has been selected as the most broadly representative of station observations across Burundi. Long term (1979 to 2013) trends as well as inter-annual variability (decade to decade) has been analysed for total annual rainfall, number of rainfall days, number of extreme rainfall days, and daily mean temperatures (1979-2014) for the climate region of Burundi. The plots below detail **inter-annual variability** (dotted lines), **decadal variability** (smooth bold solid curves) and **long term trends** (thin straight lines) for each region and statistic. This allows for comparison of different types of variability against the long term trend. It can be seen that for rainfall statistics, inter-annual and decadal variability are typically fairly large compared to long term trends. For example, for total annual rainfall, the region has very high inter-annual (1100mm in some years to 1600mm in other years) and moderate decadal variability (1150mm in some decades to 1300mm in other decades). Long term trends are not statistically significant but could be around 45mm over the 30 year period.

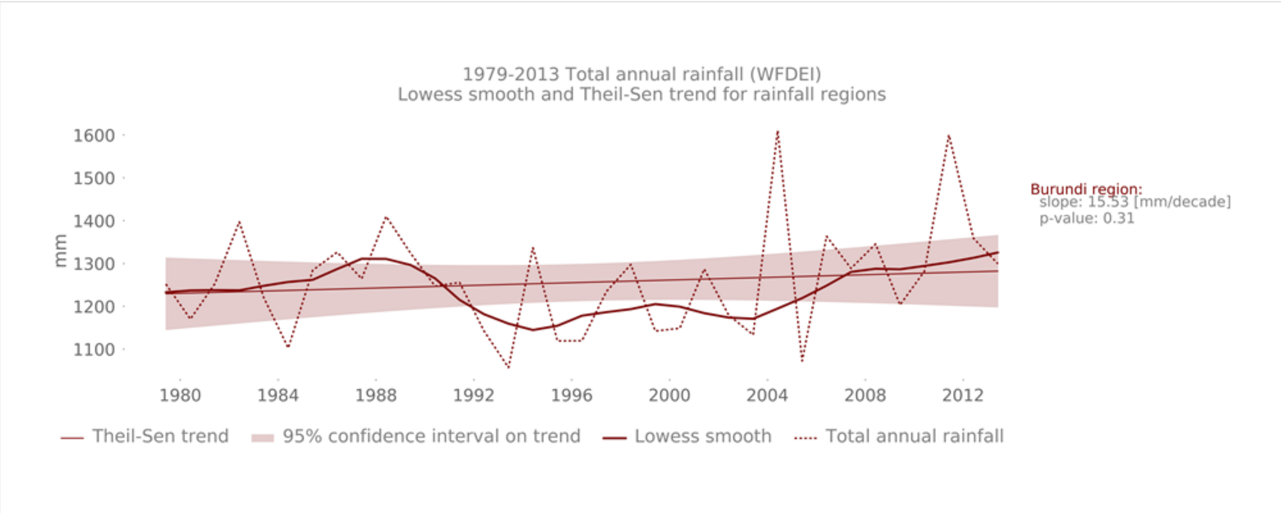



*Figure A-1: Long term trends and variability in total annual rainfall regions*

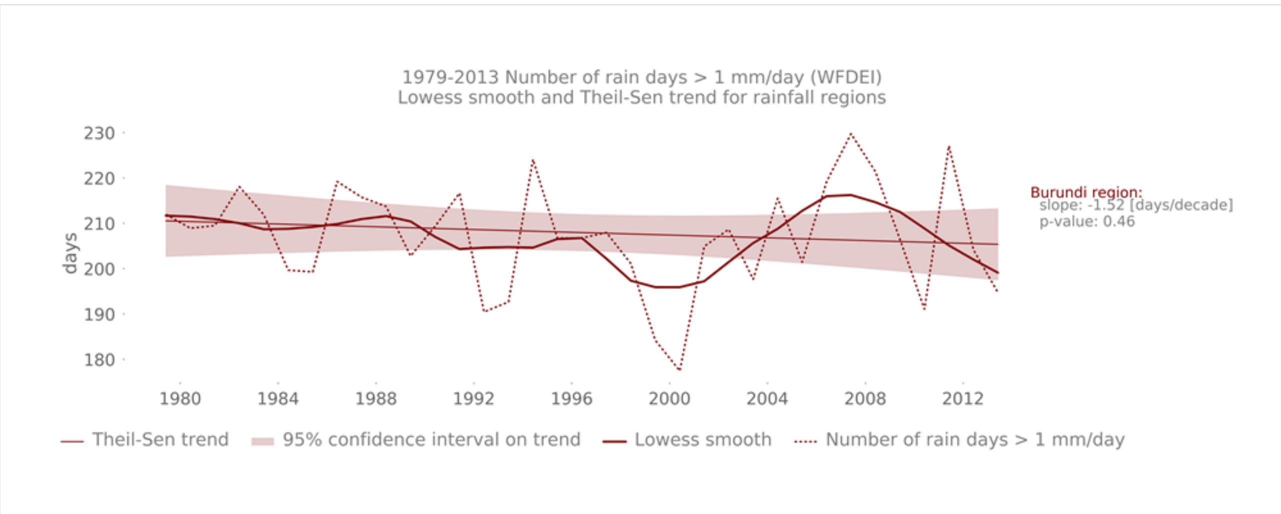



*Figure A-2: Long term trends and variability in frequency of rainfall events for rainfall regions*

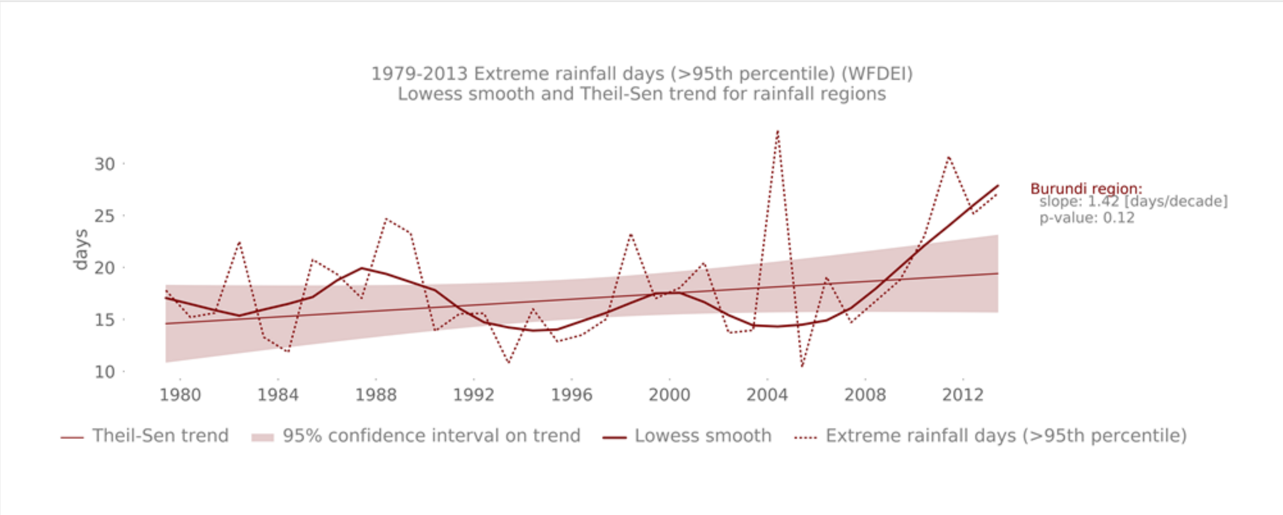



*Figure A-3: Long term trends and variability in extreme rainfall events for rainfall regions*

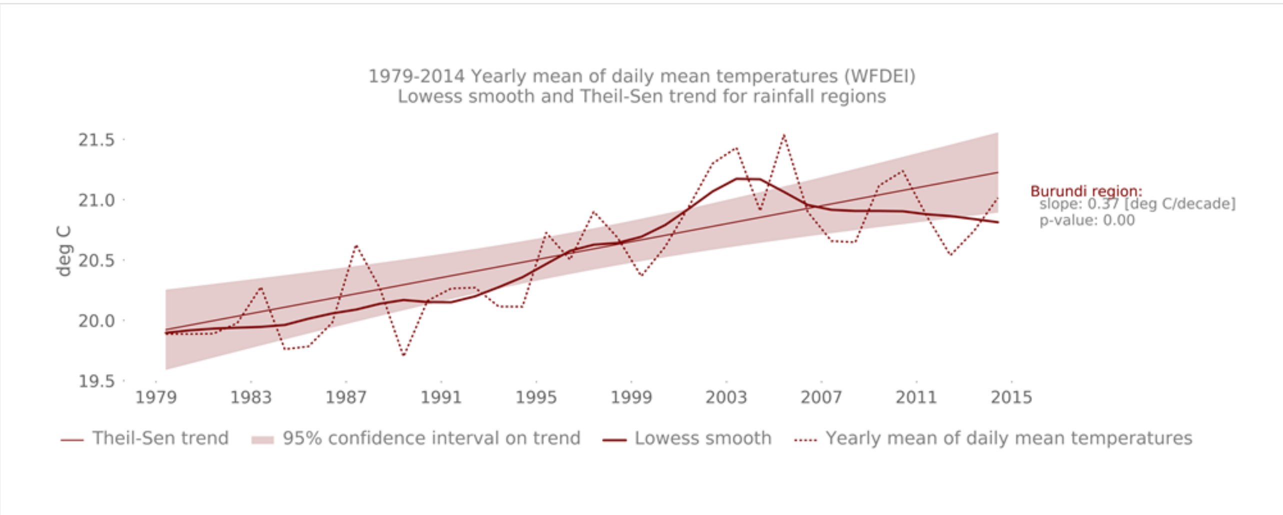



*Figure A-4: Long term trends and variability in daily mean air temperatures for rainfall regions*

## 1.c Climate projections visualizations

The plots below (Figures A-5 – A-8) are called plume plots and they are used to represent the different long term projections across the multiple climate models in the CMIP5 model archive used to inform the IPCC AR5 report. The plots show projected variations in different variables averaged over the climate regions. The blue colours indicate variations that would be considered within the range of natural variability, so in other words, not necessarily the result of climate change. The orange colours indicate projection time series where the changes would be considered outside of the range of natural variability and so likely a response to climate change. It is important to note that these are global climate model projections and so likely do not capture local scale features such as topography and land ocean boundary dynamics. They also may not capture small scale features such as severe thunderstorms that can have important societal impacts. Finally, these projections are averages over relatively large spatial areas and it is possible that different messages would be obtained at small spatial scales and if various forms of downscaling are performed.

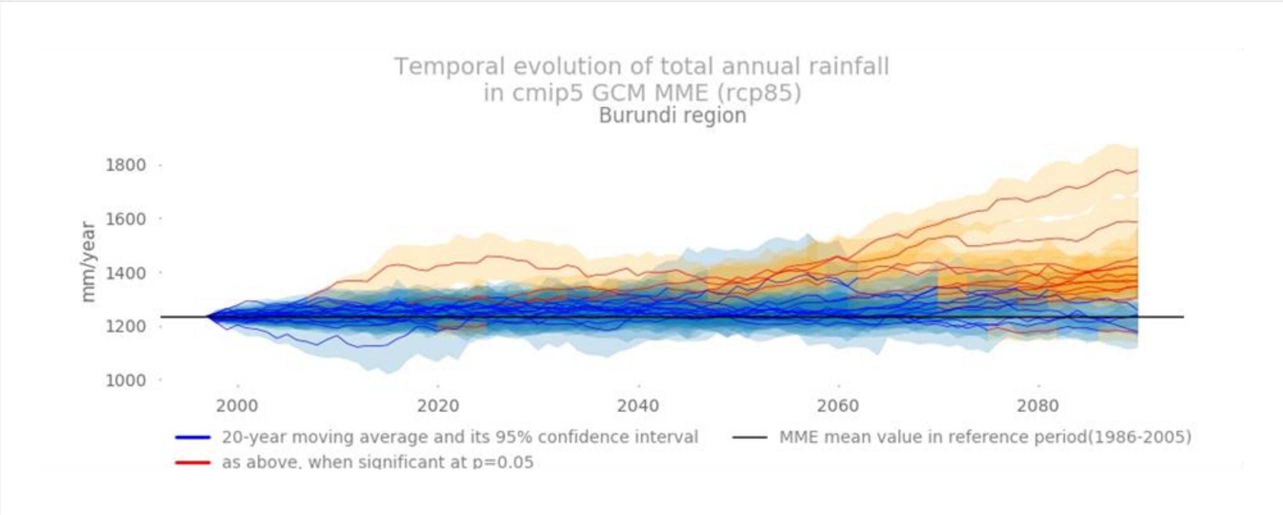



*Figure A-5: Projected changes and emergence of changes in total annual rainfall*

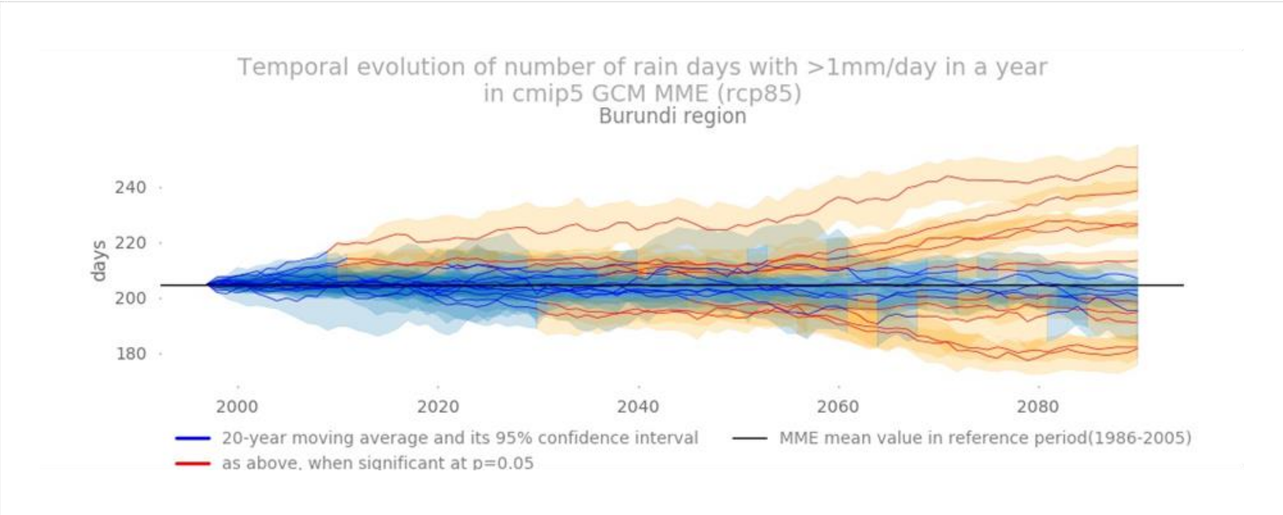



*Figure A-6: Projected changes and emergence of changes in number of rain days per year*

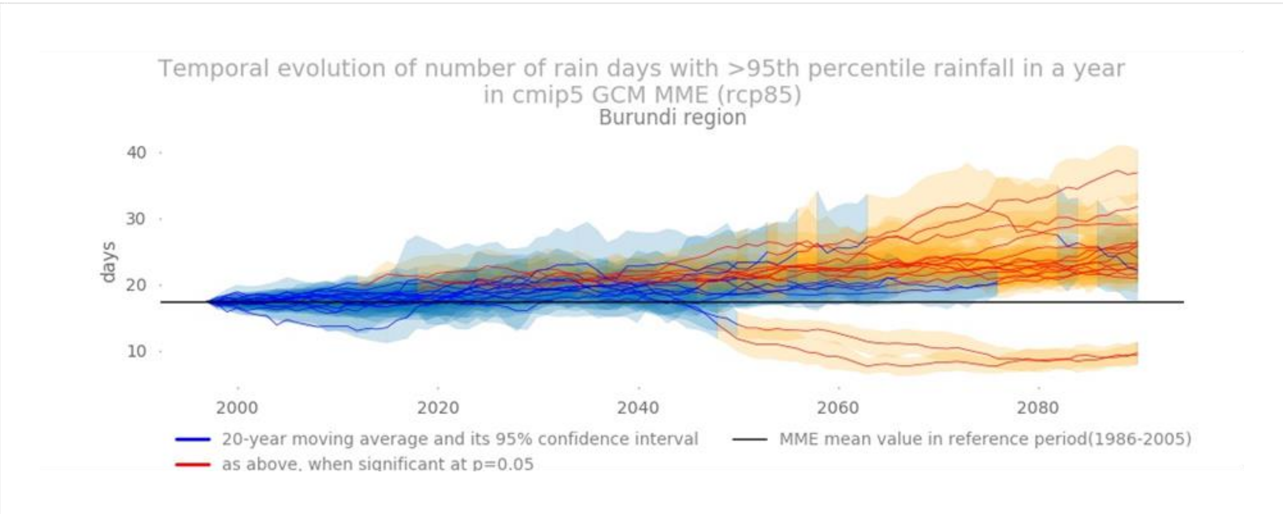



*Figure A-7: Projected changes and emergence of changes in number of very heavy rainfall days (greater than 95th percentile) per year*

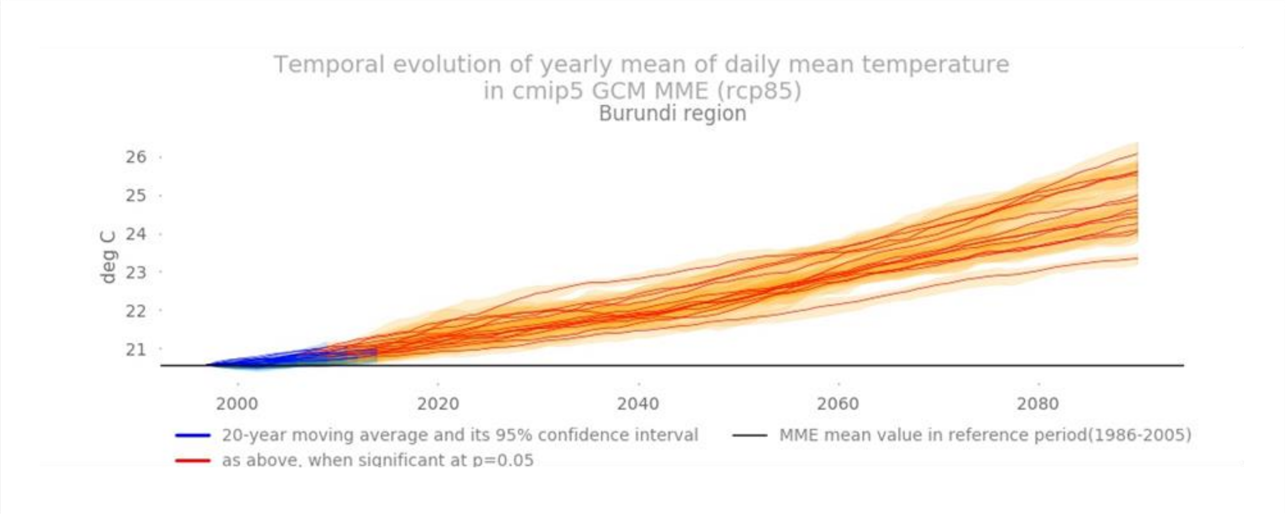



*Figure A-8: Projected changes and emergence of changes in annual mean daily mean temperatures*

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