CLIMATE RISK COUNTRY PROFILE

ZIMBABWE

WORLD BANK GROUP

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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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CONTENTS

FOREWORD 1

COUNTRY OVERVIEW 2

CLIMATOLOGY 3

- Historical Climate 3
  - Overview 3
  - Data Snapshots 5
  - Key Climate Trends. 5
- Projected Climate 6
  - Overview 6
  - Data Snapshots 7
  - Key Climate Trends. 8

CLIMATE CHANGE IMPACTS ON NATURAL HAZARDS 9

- Natural Hazards 9
- Climate Change Impacts 10
- Gender 10

CLIMATE CHANGE IMPACTS ON KEY SECTORS 11

  - Agriculture 11
  - Water. 13
  - Energy 16
  - Forestry. 17

ADAPTATION 20

- Institutional Framework for Adaptation. 20
- Key Adaptation Policies and Reports 21
- Adaptation Options for Key Sectors 21
  - Agriculture 21
  - Water. 22
  - Energy 23
  - Forestry. 23
  - Disaster Risk Management 24

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

Located between latitudes 15°–23°S and longitudes 25°–34°E, Zimbabwe is a landlocked country neighboring Botswana, Zambia, Mozambique, and South Africa. It is endowed with abundant natural resources with total land area of 390,757 square kilometers,[1] and a population of over 14.6 million in 2019.[2] According to the World Bank estimations, the Gross Domestic Product (GDP) of the country reached $21.4 billion in 2019. The annual GDP growth peaked at 11.9% in 2011 and has been decreasing since: in 2019 the annual GDP growth rate was at –8.1%, well below the average annual GDP growth of low-income countries (4.4%). Zimbabwe is subject to a complex physical and climatic structure.[3] According to Köppen-Geiger Climate Classification, northern Zimbabwe experiences subtropical climate with dry winter and hot summer; and southern area faces hot arid and steppe climate.[4]

The country's economy is largely dependent on services (61.3% of GDP, 2018), followed by industry (20.6% of GDP, 2018), agriculture (8.3% GDP, 2018), and manufacturing (10.6% of GDP, 2018).[2] As indicated in its first Nationally Determined Contribution (NDC), the key sectors to boosting Zimbabwe's economy – including agriculture, water, energy, forestry, tourism, and industry, among others – are also susceptible to abrupt climate variability.[5] Climate change is likely to adversely impact Zimbabwe's key economic sectors as well as its livelihoods. With climatic variability increasing, natural disasters will occur more frequently and have the potential to hit the most vulnerable parts of the population, the poor, in a disproportionate way[6] since poor people are often overexposed to these hazards. In other words, natural disasters can push people into poverty as a result of their impacts.[7]

The adaptation priorities identified in the first NDC consist of promoting climate resilient crop and livestock development and climate smart agricultural practices; building resilience in managing climate related disaster risks such as droughts and floods; strengthening management of water resources and irrigation in the face of climate change; promoting practices that reduce risk of losses in crops, livestock and agricultural incomes; and cross sectoral adaptation efforts such as capacity building through research and development, education and awareness, and training in climate change related issues and mainstreaming gender responsive climate policies.

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1 Zimbabwe's National Climate Change Response Strategy (NCCRS, 2015). URL: http://www4.unfccc.int/sites/nama/_layouts/UN/FCCC/NAMA/Download.aspx?ListName=NAMA&Id=165&FileName=Climate%20Change%20Response%20Strategy.pdf

2 World Bank Open Data. Data retrieved in May 2021. URL: https://data.worldbank.org/

3 D. Manatsa and G. Mukwada (2012): Rainfall Mechanisms for the Dominant Rainfall Mode over Zimbabwe Relative to ENSO and/or IODZM. The Scientific World Journal, vol. 2012, Article ID 926310. DOI:10.1100/2012/926310. URL: https://www.hindawi.com/journals/tswj/2012/926310/cta/

4 Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel (2006): World Map of the Köppen-Geiger climate classification updated. Meteorol. Z., 15, 259–263. DOI: 10.1127/0941-2948/2006/0130. URL: http://koeppen-geiger.vu-wien.ac.at/pics/1976-2000.gif

5 Zimbabwe's First Nationally Determined Contribution (NDC). URL: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Zimbabwe%20First/Zimbabwe%20First%20NDC.pdf

6 IPCC 5th Assesment Report (AR5, 2014): Chapter 22: Africa - Impacts, Adaptation, and Vulnerability, pp. 1199–1265. URL: https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap22_FINAL.pdf

7 Hallegatte et al. (2017): Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters. URL: https://openknowledge.worldbank.org/handle/10986/25335

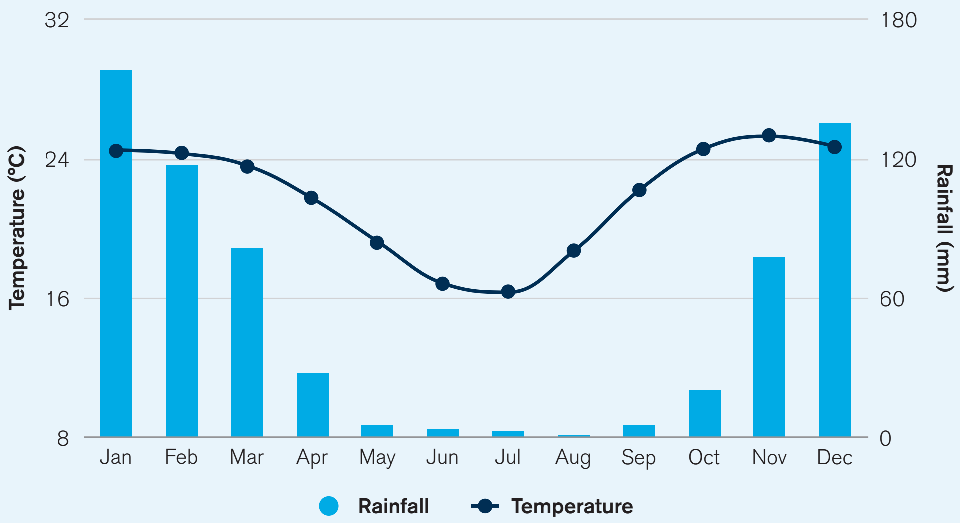
Historical Climate

Overview

The country experiences its rainy season along with relatively high temperatures from October to March; and it encounters dry seasons with low temperatures from June to August. After the dry and cold season, the average temperature peaks around October or November. As shown in **Figure 1**, the mean monthly temperature of the country ranges between 15 °C and 25 °C, for the latest climatology, 1991–2020.[8] During the same time period, the mean monthly precipitation of the country varies from 2 mm to 160 mm, which resulted in an annual average rainfall of roughly 670 mm.[9]

Figure 2 shows maps of average annual rainfall (left) and annual temperature (right) for Zimbabwe. Total annual rainfall varies at both temporal and spatial levels. Rainfall in the country decreases from north to south and from east to west. On average, southern Zimbabwe (300–500 mm) receives less rainfall than the northern

FIGURE 1. Average monthly temperature and rainfall of Zimbabwe for 1991–2020[10]



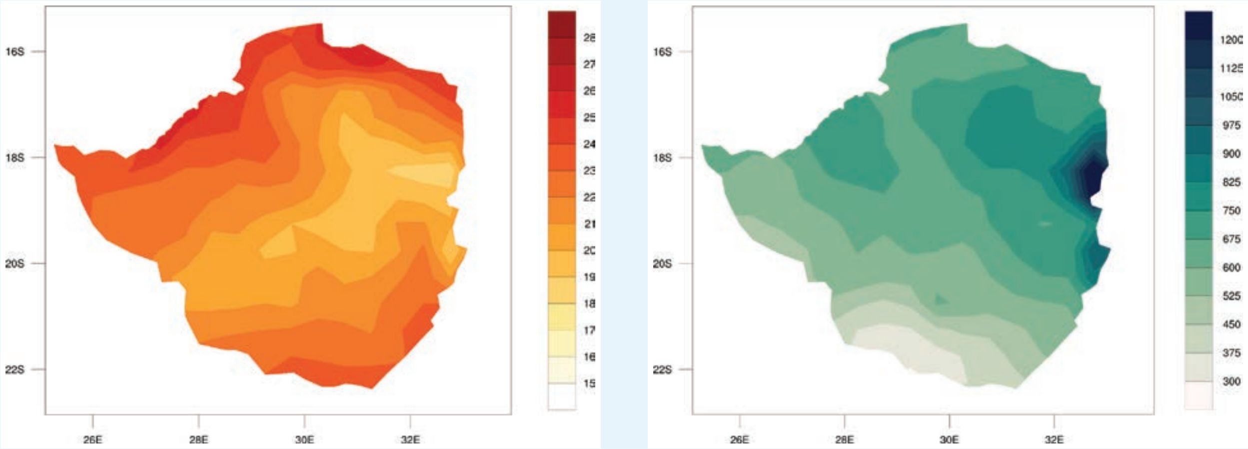
8 WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Historical. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe

9 WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Historical. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe

10 WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Historical. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe

(700–1000 mm) and eastern (above 1000 mm) parts of the country.[11] The high-elevation areas in the east and the highveld (the portion of the South African inland plateau which has an altitude above roughly 1500 m, but below 2100 m) are generally cooler than the lower areas.[12] Average annual temperature ranges between 18°C and 22°C for the higher areas (or central and eastern areas) and between 22°C and 25°C for the lower areas (southern and northern areas).[13] The ground frost, an important seasonal marker for agriculture, takes place during dry and cool season (June – August), which peaks around late June and mid/late July.[14]

FIGURE 2. Map of average annual temperature (left) and annual precipitation (right) of Zimbabwe for 1991–2020[15]



Research shows that the El Niño Southern Oscillation (ENSO) has significant implications on rainfall across the country. Specifically, the country tends to receive less than average rainfall during the warm phase of ENSO (or El Niño) during the rainy season from October to March;[16] and it often experiences more than average rainfall during the cool phase of ENSO (or La Nina) also during the rainy season.[17] For example, during the 1987–88 El Niño year, seasonal precipitation decreased and the rainy season shortened in comparison to neutral or La Nina phases. Drought conditions in the year 2015/2016 also align with an El Niño phase.[18]

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[11] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf

[12] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf

[13] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Historical. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe

[14] Zimbabwe's National Climate Change Response Strategy (NCCRS, 2015). URL: http://www4.unfccc.int/sites/nama/_layouts/UN/FCCC/NAMA/Download.aspx?ListName=NAMA&Id=165&FileName=Climate%20Change%20Response%20Strategy.pdf

[15] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Historical. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe

[16] Zimbabwe Resilience Building Fund, 2016: El Niño-Southern Oscillation (ENSO) cycle events and their impacts in Zimbabwe. URL: http://www.zrbf.co.zw/download/library/5F00B100B2002900/enso-analysis--a5/

[17] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf

[18] Zimbabwe Resilience Building Fund, 2016: El Niño-Southern Oscillation (ENSO) cycle events and their impacts in Zimbabwe. URL: http://www.zrbf.co.zw/download/library/5F00B100B2002900/enso-analysis--a5/

In addition, the Inter-Tropical Convergence Zone (ITCZ) plays a vital role in driving rainfall seasonality and inter-annual variability. The country receives more rainfall when ITCZ moves further south, and vice versa. Furthermore, a scientific study has revealed that positive Indian Ocean Dipole/Zonal Mode (IODZM), also known as the anomalous positive Indian Ocean SST gradient, is strongly associated with rainfall deficits (or droughts) in the country.[19]

Data Snapshots

TABLE 1. Historical climate data for Zimbabwe from 1901 to 2020[20]

Climate Variables	1901–2020
Annual Temperature (°C)	**21.3** (20.4 – 22.9)
Annual Min-Temperature (°C)	**14.5** (13.4 – 15.8)
Annual Max-Temperature (°C)	**28.2** (26.7 – 30.1)
Annual Precipitation (mm)	**669.9** (390.6 – 1017.8)

Note: The medians (50th percentile) are highlighted in bold font, while the 10th and 90th percentiles are presented in parentheses.

Key Climate Trends

Mean annual precipitation exhibits a decreasing trend in the past decades (**Figure 3**). Late onset and early season cessation of the rainy or growing season has been observed for all the agro-ecological regions.[21]

On the other hand, mean annual temperature has increased by roughly 0.03°C/year from 1970 to 2016. The impact of the warming trend on the intensification of the droughts was more prominent during the Jan–March period.[22] Zimbabwe's Meteorological Services Department has also recognized that the warming trends from the 1970s has put stress on agricultural and water sectors, which are keys to economic growth.[23]

[19] Manatsa, D., Chingombe, W. and Matarira, C. H. (2008). The impact of the positive Indian Ocean dipole on Zimbabwe droughts. International Journal of Climate, 28: 2011–2029. http://onlinelibrary.wiley.com/doi/10.1002/joc.1695/full

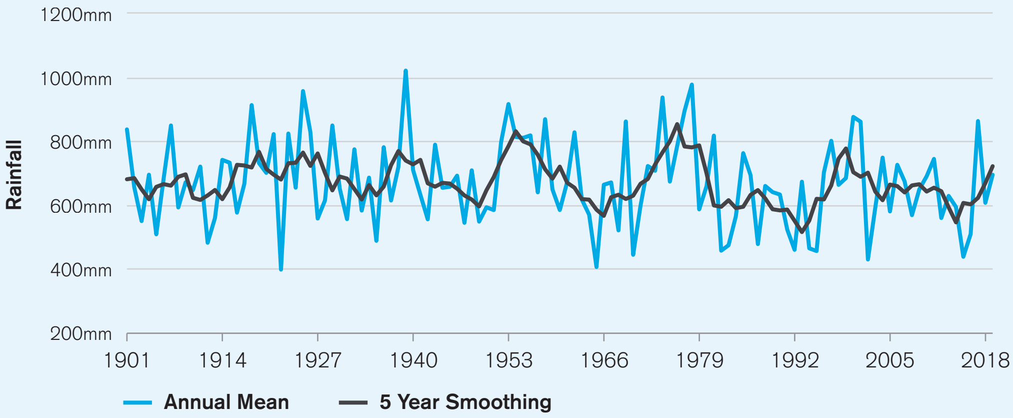
[20] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Historical. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe

[21] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf

[22] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf

[23] The National Climate Policy of Zimbabwe (2016).

FIGURE 3. Mean annual rainfall of Zimbabwe from 1901–2020[24]

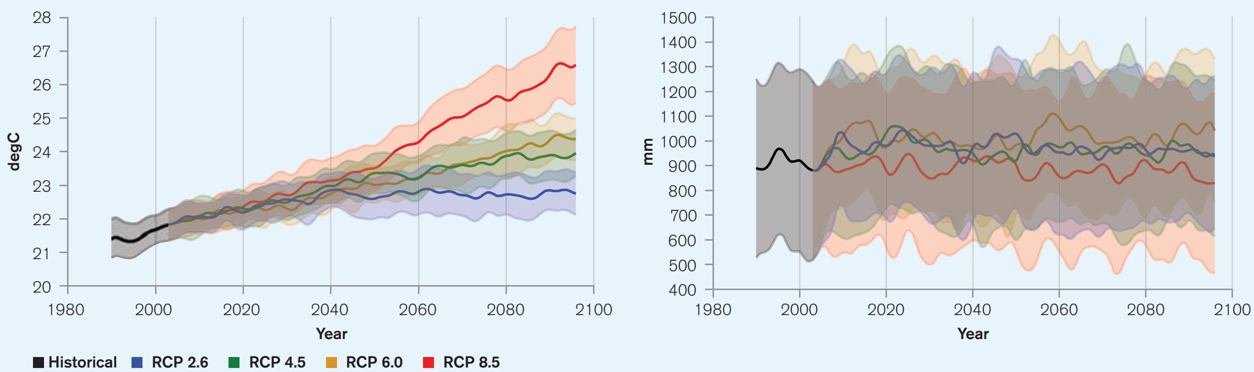


Projected Climate

Overview

Coupled Model Inter-comparison Project Phase 5 (CMIP5) models utilized within the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) provide projections of future temperature and precipitation. These models project consistent warming that varies by emissions scenario; meanwhile projected trends in rainfall are less certain, varying widely across both scenarios and models,[25] as shown in **Figure 4**. Projected changes in temperature and precipitation are shown in **Table 2**.

FIGURE 4. Projected changes in Zimbabwe's annual temperature (left) and precipitation (right)[26]



[24] WBG Climate Change Knowledge Portal (CCKP, 2019). Climate Data: Historical. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe

[25] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf

[26] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Projections. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe/climate-data-projections

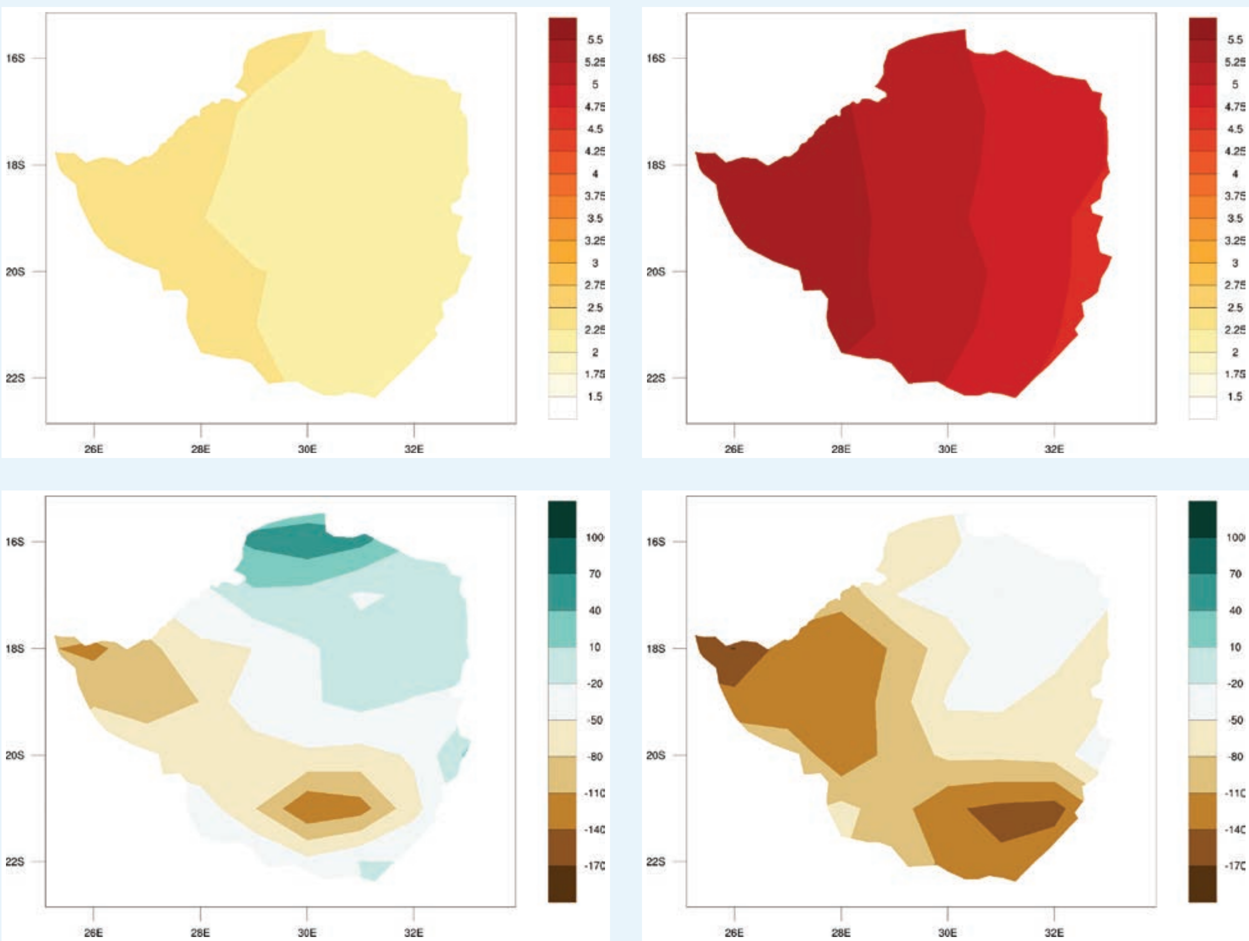
Data Snapshots

TABLE 2. CMIP5 ensemble projected change (32 GCMs) in Zimbabwe's annual temperature and precipitation compared to reference period 1986–2005 under RCP8.5[27]

CMIP5 Ensemble Projection	2020–2039	2040–2059	2060–2079	2080–2099
Annual Temperature Anomaly (°C)	**+1.2** (+1.1 to +1.5)	**+2.2** (+1.9 to +2.7)	**+3.4** (+3.2 to +4.0)	**+4.6** (+4.2 to +5.8)
Annual Precipitation Anomaly (mm)	**–3.3** (–12.5 to +1.0)	**–5.1** (–19.6 to +1.9)	**–7.4** (–27.8 to –1.3)	**–8.2** (–32.3 to –0.1)

Note: The medians (or 50th percentile) are shown in bold font and lower (10th percentile) and the higher (90th percentile) bonds are shown in parentheses.

FIGURE 5. CMIP5 ensemble projected change (32 GCMs) in annual temperature (top) and precipitation (bottom) by 2040–2059 (left) and by 2080–2090 (right) relative to 1986–2005 baseline under RCP8.5[28]



[27] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Projections. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe/climate-data-projections

[28] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Projections. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe/climate-data-projections

Key Climate Trends

As shown in **Table 3**, annual median precipitation is projected to decrease by roughly 1.2% (RCP 2.6) and 4.4% (RCP 8.5) in 2040–2059. By 2080–2099, annual median precipitation is projected to increase by 2.8% (RCP 2.6) and decrease by 10.7%. The rainfall reductions compared to the baseline period (1986–2005) are more pronounced during wet season, especially from October to March. As seen in **Figure 5**, northern and eastern parts of the country are projected to experience above normal precipitation while western and southern parts of the country will tend to receive less than historical levels of precipitation.

TABLE 3. CMIP5 ensemble projection of change in annual precipitation

Baseline and Projected Changes (mm)		Maximum	Upper Quartile	Median	Lower Quartile	Minimum
1986–2005	Mean	1619.84	1075.50	858.56	725.87	465.20
2040–2059	RCP 2.6	–5.3%	–2.4%	–1.2%	–2.9%	19.6%
	RCP 4.5	–7.2%	1.5%	1.2%	6.9%	3.2%
	RCP 6.0	–6.2%	0.8%	4.4%	4.6%	13.4%
	RCP 8.5	–5.4%	0.9%	–4.4%	–5.4%	3.9%
2080–2099	RCP 2.6	–12.6%	–1.4%	2.8%	–0.2%	19.2%
	RCP 4.5	–3.1%	–1.4%	4.1%	–1.3%	14.9%
	RCP 6.0	–4.2%	–0.3%	3.0%	4.0%	28.6%
	RCP 8.5	–7.7%	–5.9%	–10.7%	–13.1%	–6.7%

As shown in **Table 4**, annual temperature is projected to increase by 1.2°C (RCP 2.6) and 2.2°C (RCP 8.5) in 2040–2059. By 2080–2099, annual median temperature is projected to increase by 1.0°C (RCP 2.6) and 5.1°C (RCP 8.5). The rising temperatures compared to the baseline period are more noticeable during summer, from September to December. The spatial distribution of temperature increase is relatively homogeneous across the country, with a slightly higher warming trend projected in southern and western parts of the country.

TABLE 4. CMIP5 ensemble projection of change in annual temperature

Baseline and Projected Changes (°C)		Maximum	Upper Quartile	Median	Lower Quartile	Minimum
1986–2005	Mean	21.8	21.6	21.6	21.5	21.4
2040–2059	RCP 2.6	1.82	1.33	1.21	1.04	0.87
	RCP 4.5	2.14	1.90	1.62	1.40	1.34
	RCP 6.0	2.07	1.69	1.43	1.35	1.39
	RCP 8.5	2.72	2.51	2.18	1.86	1.42
2080–2099	RCP 2.6	1.81	1.32	1.04	0.90	0.69
	RCP 4.5	3.10	2.81	2.39	1.98	1.74
	RCP 6.0	3.71	3.30	2.99	2.40	2.12
	RCP 8.5	6.05	5.46	5.11	4.09	3.37

Natural Hazards

Data from the EM-Dat database (see **Table 5**) shows the country has endured various natural hazards, including droughts, epidemic diseases, floods, and storms over the past century. From 1900 to 2017, events captured in the database for Zimbabwe include 7 drought events, 22 epidemic episodes, 12 floods, and 5 storms, which resulted in total deaths of 7000 people, with more than 20 million people affected, and total damage estimates of 950 million USD. The country's GDP growth has been severely impacted by a series of major droughts. The number of people affected and economic loss caused by droughts have been observed to increase considerably. For instance, the drought episode in 2007 affected 6 million individuals; and the drought in 2013 caused economic damage of up to 500 million USD in addition to affecting over 4 million residents. Epidemic diseases, particularly bacterial and parasitic types, contribute to significant portion of total deaths and total affected people by natural hazards. Floods also generate large human and economic losses. As of 2017, the EM-DAT database includes a total of 9 riverine floods are accounted, affecting over 300 thousand people, killing over 270 people and leading to monetary loss of above 270 million USD. Moreover, analysis by Hallegatte et al. show Zimbabwe is one of the six countries where the poor are overexposed (or 50% more likely) to the impacts of floods than nonpoor people.[29]

TABLE 5. Natural hazards occurrence and damage in Zimbabwe from 1900–2017, extracted on Oct 25, 2017[30]

Natural Hazard	Subtype	Events Count	Total Deaths	Total Affected ('000)	Total Damage (Million USD)
Drought	Drought	7	–	19122.618	551
Epidemic	Bacterial disease	17	4,900	111.349	–
	Parasitic disease	1	1,311	500	–
	Viral disease	2	55	1.338	–
	Others	2	71	10.102	–
Flood	Flash flood	1	3	1.002	20
	Riverine flood	9	271	313.02	272.9
	Others	2	259	30.128	103.6
Storm	Convective storm	2	41	2.475	–
	Tropical cyclone	2	8	–	1.2
	Others	1	11	–	–

[29] Hallegatte et al. (2017): Unbreakable. Building the Resilience of the Poor in the Face of Natural Disasters. URL: https://openknowledge.worldbank.org/handle/10986/25335

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

Climate Change Impacts

According to analysis of the CMIP5 multi-model ensemble projection,[31] the annual likelihood of Zimbabwe encountering severe drought is projected to increase by 21% in 2040 to 2059 and by 47% in 2080 to 2099 compared to the baseline period of 1986 to 2005 under the RCP8.5 scenario. It is projected that western Zimbabwe is more likely to experience drought conditions. Extreme temperatures and precipitation events will be more prominent in the country. The number of days per year with a maximum temperature greater than 35°C is expected to increase by 39 days in the period from 2040 to 2059 and 108 days in 2080 to 2099 from the reference period under RCP8.5. The number of days of consecutive dry spell per year (or days without significant rainfall of at least 1mm) is projected to increase by 13 days in 2040 to 2059 and 25 days in 2080 to 2099. Climate change is expected to negatively impact the future occurrence, intensity and magnitude of floods, droughts, and epidemic episodes, which can consequentially lead to enormous social and monetary loss across multiple economic sectors.[32]

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.[33]

[31] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Projections. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe/climate-data-projections

[32] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf

[33] 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

Agriculture

In 2016, the total agricultural land area has reached 42% of the total land area. Meanwhile, employment in agriculture accounts for 67% of the total employment.[34] The majority of the agriculture is rain-fed, which makes the sector highly vulnerable to climate change impacts, especially precipitation variability and climate-induced natural hazards. Extreme weather events pose serious threats to the performance of the Zimbabwean agriculture sector and are likely to be accelerated by adverse impacts of climate change in the future. Therefore, the country has realized the importance of building climate resilience and facilitating low-carbon growth in this specific sector through national sectoral policies and development planning, as articulated in the NDC.

In Zimbabwe, approximately 80% of agricultural production is rain-fed, while the remaining 20% is irrigated. As one of the highest irrigation-dependent countries in the southern African region, Zimbabwe has deployed a relatively large portion of its irrigated potential, with a total irrigated area of 123,000 ha. An extra 80,000 ha can be irrigated from the estimated ground water available in the country.[35] Therefore, water availability is the crucial factor to agricultural development in the country. The country produces multiple grain crops which consists of maize, sorghum, mhunga, rapoko, oilseeds and industrial crops including tobacco, cotton, edible dry beans and paprika. With regards to market value, tobacco, cotton, and maize are the most important crops.[36]

Rain-fed agriculture is facing increasing threats with droughts and floods becoming more frequent and intense. The rain-fed crop production in Africa is projected to see a decline of 12% by 2080.[37] For Zimbabwe, maize is an important agricultural product as it is the staple food and gaining even more importance with cereal yield having decreased since the country's independence in 1965.[38] Over the past 15 years, maize yields have gradually declined while population has increased, resulting in higher than usual levels of food insecurity in most parts of the country.[39] Meanwhile, many different crops including major cash crops such as tobacco, cotton, tea, coffee, and horticultural crops are irrigated. Irrigated agriculture also encounters challenges as water demand increases and water availability declines.[40]

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[34] World Bank Open Data. Data retrieved in May 2021. URL: https://data.worldbank.org/

[35] NEPAD–CAADP Bankable Investment Project Profile (2004). "Zimbabwe Smallholder Irrigation Development". URL: http://www.fao.org/tempref/docrep/fao/007/ae567e/ae567e00.pdf

[36] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf

[37] K. Musiyiwa, W. Leal Filho, D. Harris, and J. Nyamangara (2014). Implications of Climate Variability and Change for Smallholder Crop Production in Different Areas of Zimbabwe. Res. J. Environ. Earth Sci., 6(8): 394–401, 2014. URL: http://maxwellsci.com/print/rjees/v6-394-401.pdf

[38] World Bank Open Data. Data retrieved in September 2018. URL: https://data.worldbank.org/

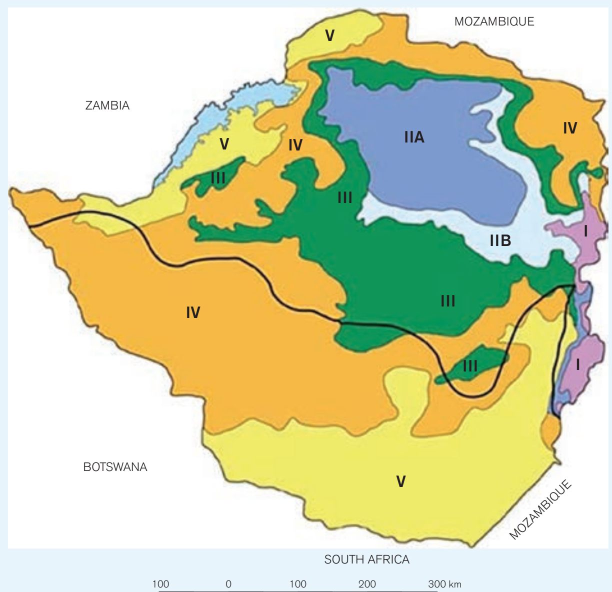
[39] Zimbabwe Resilience Building Fund, 2016: El Niño-Southern Oscillation (ENSO) cycle events and their impacts in Zimbabwe. URL: http://www.zrbf.co.zw/download/library/5F00B100B2002900/enso-analysis--a5/

[40] U. Adhikari et al. (2015). Climate change and eastern Africa: a review of impact on major crops. Food and Energy Security 2015; 4(2): 110–132 doi: 10.1002/fes3.61. URL: https://onlinelibrary.wiley.com/doi/epdf/10.1002/fes3.61

Similarly, limited precipitation and extreme heat induced by climate change are likely to contribute to diminished rangeland productivity, as well as decreased livestock production. A study shows that the majority of the country will experience reduced rangeland carrying capacity for livestock and wildlife, as Net Primary Production (NPP) drops from the current level of 8 tons/hectare per year to slightly above 5 tons/hectare per year by 2080.[41] The most intensive decline in rangeland productivity will appear in the Southwest and Northwest parts of the nation.[42]

Zimbabwe is divided into five agro-ecological regions (AERs), also known as natural regions (**Figure 6**), on the basis of the rainfall regime, soil quality and vegetation, among other factors. The quality of the land resource ranges from Natural Region (NR) I (most suitable) through V (least suitable). **Table 6** provides detailed descriptions of these natural regions and their farming systems.

FIGURE 6. Natural regions of Zimbabwe[43]



As a result of climate change, Zimbabwe's AERs have already witnessed drastic changes. A study carried out in 2012 shows that drought prone regions, NR IV and V, had become drier than previously experienced and increased in area by about 6% and 23%, respectively.[44] Major food producing regions, NR II and III, had shrunk remarkably by 49% and 14% respectively.[45] These changes indicate that Zimbabwe is trending towards more arid and non-arable climatic conditions, which could potentially lead to food insecurity, increase in unemployment and a reduction in economic growth.

[41] IIED Climate Change Working Paper No. 3 (December 2012). Climate change impacts, vulnerability and adaptation in Zimbabwe. URL: http://pubs.iied.org/pdfs/10034IIED.pdf
[42] T. Agrer (June 2017). Zimbabwe Climate Change Technical Assistance Program: Strategic Actions Supporting Livestock.
[43] Food and Agriculture Organization of the United Nations (FAO, 2006). Fertilizer use by crop in Zimbabwe, First Version. URL: http://www.fao.org/docrep/009/a0395e/a0395e00.htm#Contents
[44] C. Manyeruke, S. Hamauswa, L. Mhandara (2013). The Effects of Climate Change and Variability on Food Security in Zimbabwe: A Socio-Economic and Political Analysis. International Journal of Humanities and Social Science Vol. 3 No. 6 [Special Issue – March 2013]. URL: http://www.ijhssnet.com/journals/Vol_3_No_6_Special_Issue_March_2013/26.pdf
[45] C. Manyeruke, S. Hamauswa, L. Mhandara (2013). The Effects of Climate Change and Variability on Food Security in Zimbabwe: A Socio-Economic and Political Analysis. International Journal of Humanities and Social Science Vol. 3 No. 6 [Special Issue – March 2013]. URL: http://www.ijhssnet.com/journals/Vol_3_No_6_Special_Issue_March_2013/26.pdf

TABLE 6. Descriptions of the natural regions of Zimbabwe[46]

Natural Region	Area (000 ha)	% of total land area (%)	Annual rainfall (mm)	Farming Systems
I	613	1.56	> 1 000 Rain in all months of the year, relatively low temperatures	Suitable for dairy farming forestry, tea, coffee, fruit, beef and maize production
II	7 343	18.63	700–1 050. Rainfall confined to summer	Suitable for intensive farming, based on maize, tobacco, cotton and livestock
III	6 855	17.43	500–800. Relatively high temperatures and infrequent, heavy falls of rain, and subject to seasonal droughts and severe mid-season dry spells	Semi-intensive farming region Suitable for livestock production, together with production of fodder crops and cash crops under good farm management
IV	13 010 036	33.03	450–650. Rainfall subject to frequent seasonal droughts and severe dry spells during the rainy season	Semi-extensive region. Suitable for farm systems based on livestock and resistant fodder crops. Forestry, wildlife/tourism
V	10 283	26.2	< 450. Very erratic rainfall. Northern low veldt may have more rain but the topography and soils are poor	Extensive farming region. Suitable for extensive cattle ranching. Zambezi Valley is infested with tsetse fly. Forestry, wildlife/ tourism

Water

Total annual water generation in the country amounts to over 23 billion cubic meters, which is mainly replenished through rainfall and runoff into rivers, streams, lakes, aquifers, reservoirs, and wetlands. The country relies significantly on its surface water resources (about 90%) due to limited ground water resources (about 10%).[47] There are seven river catchments in Zimbabwe, namely Gwayi, Manyame, Mazowe, Mzingwane, Runde, Sanyati and Save.[48] **Table 7** below breaks down annual water generation by catchment. There are over 8000 dams in the country; however, only 149 large dams, which account for 80% of the allocated water to storage, are regularly tracked by ZINWA.[49] The implications of climate change on Zimbabwe's water resources management include limited runoff for hydropower plants, increased demand within the agriculture and energy generation sectors, and regional differences in water supply and shortages.[50] Specifically, warming temperatures can contribute to increased water loss through evapotranspiration;[51] and lower rainfall will negatively affect groundwater recharge and water runoff.[52]

[46] Food and Agriculture Organization of the United Nations (FAO, 2006). Fertilizer use by crop in Zimbabwe, First Version. URL: http://www.fao.org/docrep/009/a0395e/a0395e00.htm#Contents
[47] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf
[48] Zimbabwe's National Climate Change Response Strategy (NCCRS, 2015). URL: http://www4.unfccc.int/sites/nama/_layouts/UN/FCCC/NAMA/Download.aspx?ListName=NAMA&Id=165&FileName=Climate%20Change%20Response%20Strategy.pdf
[49] Preparation of A National Water Resources Master Plan, Interim Report-1, Volume 1 - Main Report (October 2017)
[50] Preparation of A National Water Resources Master Plan, Interim Report-1, Volume 1 - Main Report (October 2017)
[51] Zimbabwe's Third National Communication to the United Nations Framework Convention on Climate Change (TNC, 2016). URL: http://www.un-gsp.org/sites/default/files/documents/zwenc3.pdf
[52] Preparation of A National Water Resources Master Plan, Interim Report-1, Volume 1 - Main Report (October 2017)

TABLE 7. Runoff generation by catchment (Source: MRW/ZINWA, 2007)

Catchment	Area (km²)	Unit Mean Annual Runoff (mm)	Gross Mean Annual Runoff (× 10^6 m^3)
Gwayi	87,960	21	1,856
Manyame	40,497	82	3,306
Mazowe	34,944	131	4,582
Mzingwane	62,451	28	1,724
Runde	41,056	52	2,148
Sanyati	74,534	52	3,905
Save	48,448	126	6,094

Water availability could be tremendously affected by changes in annual precipitation. A small decline in mean annual precipitation could potentially lead to a significant drop in mean annual runoff and groundwater recharge. For instance, a 3 to 7% decrease in annual rainfall under a Business-as-usual emission scenario is projected to cause a 23% annual runoff decline in Sanyati catchment by 2050 and 35% by 2080 (see **Table 8**).[53]

TABLE 8. Estimated current, 2050, and 2080 mean annual runoff (Giga-Liter/Year) in Zimbabwean catchments under two emissions scenarios

Catchment	Current (World Climate Data)	2050 Business as usual scenario (A2a)	2050 Ecologically aware scenario (B2a)	2080 Business as usual scenario (A2a)	2080 Ecologically aware scenario (B2a)
Gwayi	2,088	–	1,047 (–50%)	–	1,432 (–31%)
Manyame	4,496	4,244 (–6%)	4,661 (4%)	4,046 (–10%)	4,736 (5%)
Mazowe	5,665	4,825 (–15%)	5,559 (–2%)	4,874 (–12%)	5,443 (–4%)
Mzingwane	1,082	–	379 (–65%)	–	356 (–67%)
Runde	3,530	1,967 (–44%)	2,343 (–33%)	1,311 (–63%)	2,271 (–26%)
Sanyati	6,905	5,314 (–23%)	6,248 (–10%)	4,483 (–35%)	6,471 (–6%)
Save	8,010	5,455(–32%)	6,558 (–18%)	4,970 (–38%)	6,414 (–20%)

Note: Percentage decreases in recharge are shown in brackets.

[53] R. Davis and R. Hirji (2014). Climate Change and Water Resources Planning, Development and Management in Zimbabwe. URL: http://documents.worldbank.org/curated/en/925611468329355687/pdf/937310WP0Box380babwe000Issues0Paper.pdf

TABLE 9. Estimated groundwater recharge (Giga-Liter/Year) for Zimbabwean catchments (Source: Davis and Hirji, 2014)

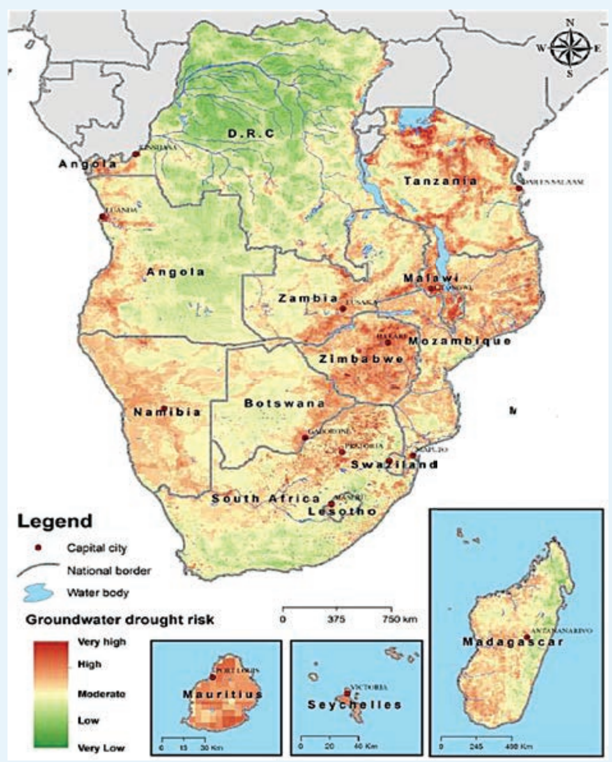
Catchment	Current (World Climate Data)	2050 Business as usual scenario (A2a)	2050 Ecologically aware scenario (B2a)	2080 Business as usual scenario (A2a)	2080 Ecologically aware scenario (B2a)
Gwayi	1,596	1,438 (–10%)	1,520 (–5%)	1,359 (–15%)	1,549 (–3%)
Manyame	1,907	1,868 (–2%)	1,932 (1%)	1,839 (–4%)	1,944 (2%)
Mazowe	1,918	1,791 (–7%)	1,901 (–1%)	1,811 (–6%)	1,844 (–2%)
Mzingwane	632	537 (–15%)	558 (–12%)	473 (–25%)	556 (–12%)
Runde	1,449	1,215 (–16%)	1,277 (–12%)	1,096 (–24%)	1,265 (–13%)
Sanyati	2,750	2,549 (–7%)	2,668 (–3%)	2,441 (–11%)	2,694 (–2%)
Save	2,660	2,279 (–14%)	2,439 (–8%)	2,197 (–17%)	2,418 (–9%)

Note: Percentage decreases in recharge are shown in brackets.

Some of the key findings of R. Davis and R. Hirji (2014) include: mean annual runoff in drier southern catchments (e.g. Mzingwane and Gwayi) could decline significantly due to climate change, while northern catchments (e.g. Manyame and Mazowe) will remain relatively unaffected; similarly, negative impacts on groundwater will be the strongest in southern drier catchments (e.g. Runde and Mzingwane)[54] compared to northern catchments.

The impacts of climate change on water resources could be diverse. For example, changes in runoff could limit hydropower generation, increasing temperatures may increase water demand for agriculture and energy generation, decreasing rainfall could increase the cost for water treatment and wastewater management, and climate change might lead to more frequent and intensified natural hazards including floods and droughts. In particular, groundwater recharge is highly dependent on rainfall, and therefore decreases in rainfall will negatively impact groundwater availability. The map shows the groundwater drought risk for southern Africa, which indicates that Zimbabwe is highly susceptible to groundwater drought risk. It was estimated that the percentage of population at very high risk of groundwater drought could rise from 32% to 86% without measures to adapt to the effects of climate change (see **Figure 7**).

FIGURE 7. Groundwater drought risk for Southern Africa (Source: R. Davis and R. Hirji , 2014)



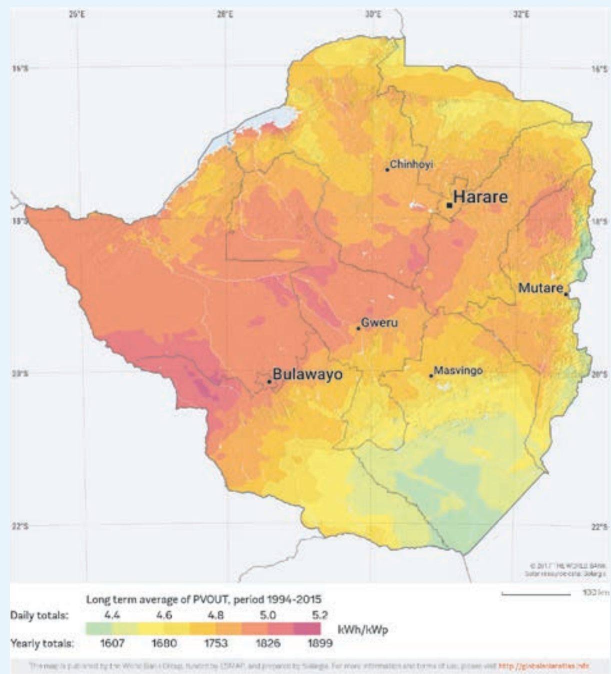
[54] R. Davis and R. Hirji (2014). Climate Change and Water Resources Planning, Development and Management in Zimbabwe. URL: http://documents.worldbank.org/curated/en/925611468329355687/pdf/937310WP0Box380babwe000Issues0Paper.pdf

A recent preliminary analysis on climate change impacts on Zimbabwe's mean annual river runoff and potential evapotranspiration (PET) using 121 climate scenarios (CMIP3 and CMIP5) reached a similar conclusion. Specifically, mean annual runoff is projected to decline in all seven basins under majority of scenarios for the 2041–2050 period compared to the 1961–1990 baseline, ranging between –60% and +40%.[55] Change in PET is projected to increase for all basins across all scenarios, ranging from +5% to 15%, with Gwayi showing the highest changes by the 2040s.[56]

Energy

The energy sector is the largest contributor, approximately 49%, to the country's total greenhouse gas (GHG) emissions.[57] In 2012, 59% of energy was generated from non-carbon resources in the form of hydropower from the Lake Kariba power station and 39% of energy was derived from coal power plants in Hwange, Munyati, Harare and Bulawayo (see **Table 10**). Electricity demand of the country is anticipated to double between 2012 and 2020,[58] which will require a tremendous increase in power generation capacity, possibly by taking advantage of the country's high potential in renewable energy (i.e. hydropower and solar). Currently, 750MW hydro power plants have been installed with additional 300MW planned for the Kariba hydro power plant.[59] There remains 1720MW hydropower potentials on the Zambezi River to be developed and over 20 mini hydro sites identified to be fully developed.[60] The country has an average solar radiation of 20 MJ/m²/day.[61] The spatial distribution of Zimbabwe's solar PV power generation potential is shown in **Figure 8**.[62]

FIGURE 8. Estimated solar PV power generation potential for Zimbabwe (1994–2015)[63]



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55 WBG (2015, draft). Background note C: Enhancing the Climate Resilience of Zimbabwe's Infrastructure: Selected Illustrations in the Water and Power Sectors.

56 WBG (2015, draft). Background note C: Enhancing the Climate Resilience of Zimbabwe's Infrastructure: Selected Illustrations in the Water and Power Sectors.

57 Zimbabwe's First Nationally Determined Contribution (NDC). URL: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Zimbabwe%20First/Zimbabwe%20First%20NDC.pdf

58 Zimbabwe's National Climate Change Response Strategy (NCCRS, 2015). URL: http://www4.unfccc.int/sites/nama/_layouts/UN/FCCC/NAMA/Download.aspx?ListName=NAMA&Id=165&FileName=Climate%20Change%20Response%20Strategy.pdf

59 Renewable Energy Market Study Zimbabwe (2017). URL: https://www.rvo.nl/sites/default/files/2017/11/renewable-energy-market-study-zimbabwe-2017.pdf

60 Renewable Energy Market Study Zimbabwe (2017). URL: https://www.rvo.nl/sites/default/files/2017/11/renewable-energy-market-study-zimbabwe-2017.pdf

61 Renewable Energy Market Study Zimbabwe (2017). URL: https://www.rvo.nl/sites/default/files/2017/11/renewable-energy-market-study-zimbabwe-2017.pdf

62 WBG Global Solar Atlas (2018). URL: http://globalsolaratlas.info/downloads/zimbabwe

63 WBG Global Solar Atlas (2018). URL: http://globalsolaratlas.info/downloads/zimbabwe

TABLE 10. Production of electricity in Zimbabwe in GWh (Source: NCCRS, 2015)

Power Station	Generated Energy (GWh) 2010	2011	2012
Hydro generators (Kariba)	5,798.78	5,091.42	5,372.00
Coal generators (Hwange, Munyati, Bulawayo, Harare)	2,711.78	3,811.60	3,575.00
Other renewable generators (Border Timbers, Hippo Valley, Triangle)			167.23
Other generators (not included above)			2.60
Total Energy Generated	8,510.56	8,903.02	9,116.83

The impacts of climate change on the energy sector consist of changing energy demand for heating and cooling, affecting energy supply composition and technologies, and requiring adaptation measures to reduce climate-induced risks. Rising temperatures will likely reduce energy demand for heating while increasing energy demand for residential and commercial cooling.[64] The number of cooling degree days in the country is projected to increase by 1194°F/year in 2040 to 2059 and 2902°F/year in 2080 to 2099 from baseline period under RCP8.5.[65] This is translated into an additional of 3.3°F/day and 8.0°F/day cooling respectively. On the contrary, the number of heating degree days is expected to decrease by 225°F/year (or 0.6°F/day) by 2040 to 2059.[66] The majority of the energy supply in the country is derived from hydropower generation. The projected reduction in precipitation, increase in evaporation, and increase in water demand will reduce river runoff and thus negatively impact hydropower generation. Hence, there is urgent need for the country to seek alternative energy resources, such as natural gas, solar power, etc. In fact, most areas of the country are endowed with solar potential with insulation of up to 6 kW/m^2 per day.[67] In the NDC, the country communicated its intention to install $4.23 billion in solar lighting, solar water heaters and solar powered off-grids. Overall, climate change impacts encourage the energy industry to adopt technologies that enhance energy efficiency and performance. Lastly, more severe and/or frequent extreme weather conditions and natural disasters could damage energy infrastructures (e.g. dams, solar panels, rails, grids). Therefore, building climate-smart energy infrastructures and establishing effective post-disaster response and recovery measures become critical.

Forestry

The forestry sector also plays vital role in supporting socio-economic growth of the country. Specifically, forest rents make up 4.1% of the country's total GDP in 2016.[68] Unfortunately, in the past decades the country's forest cover has been declining dramatically due mainly to over-exploitation and degradation of the indigenous forest. The ratio of forest area over total land area has seen a drastic decrease from 57% in 1990 to 36% in 2015 in the country.[69] Between

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[64] Fifth Assessment Report of The Intergovernmental Panel on Climate Change (IPCC AR5). http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-IntegrationBrochure_FINAL.pdf

[65] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate by Sector-Energy. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe/climate-sector-energy

[66] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate by Sector-Energy. URL: https://climateknowledgeportal.worldbank.org/country/zimbabwe/climate-sector-energy

[67] Zimbabwe's National Climate Change Response Strategy (NCCRS, 2015). URL: http://www4.unfccc.int/sites/nama/_layouts/UN/FCCC/NAMA/Download.aspx?ListName=NAMA&Id=165&FileName=Climate%20Change%20Response%20Strategy.pdf

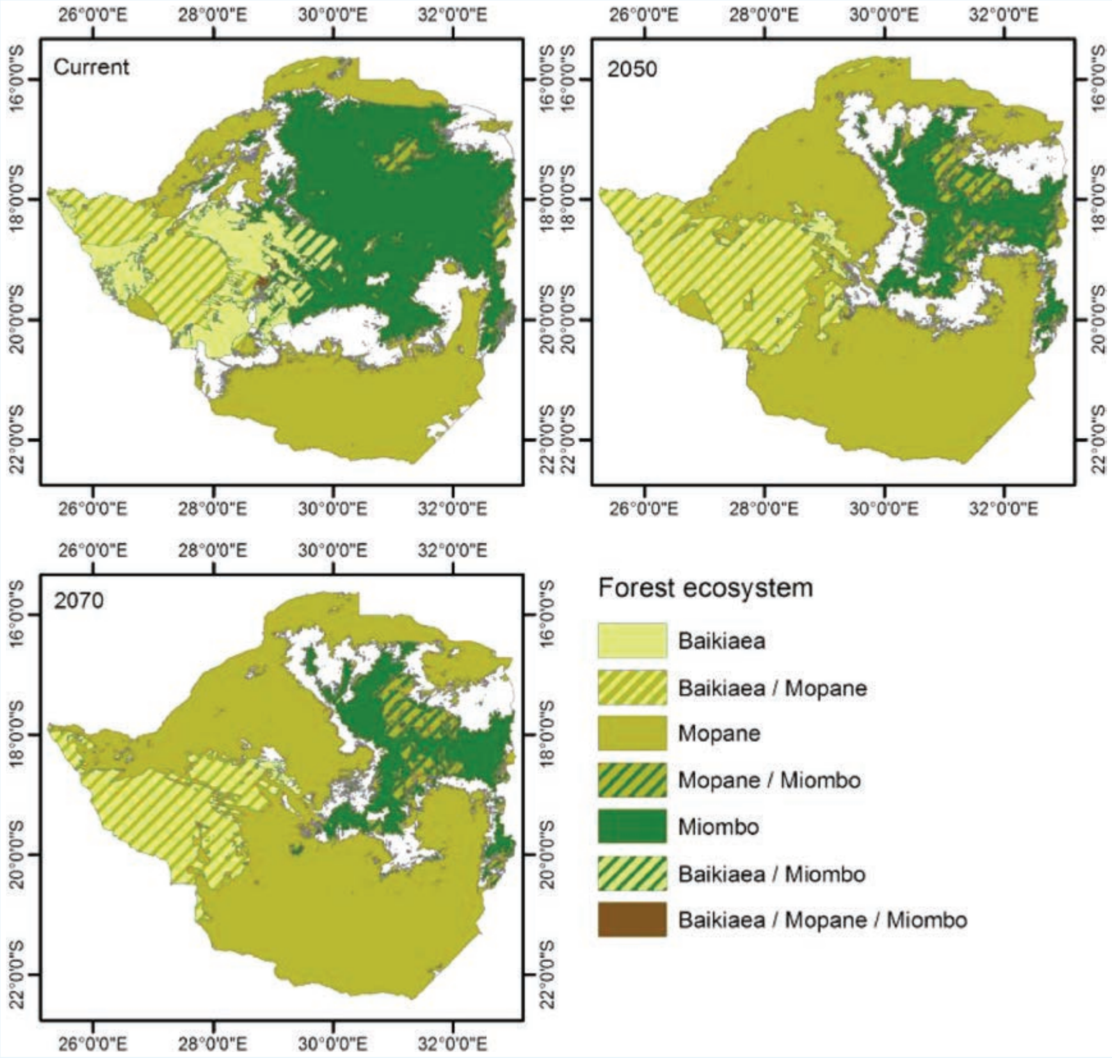
[68] World Bank Open Data (2018). Forest rents (% of GDP) from 1990 to 2016. Note: This indicator measures forest rents as a share of the gross domestic product (GDP) of a given country. Forest rents are round-wood harvest times the product of average prices and a region-specific rental rate. URL: https://data.worldbank.org/indicator/NY.GDP.FRST.RT.ZS?locations=ZW

[69] World Bank Open Data (2018). Forest area (% of land area) from 1990 to 2015. URL: https://data.worldbank.org/indicator/AG.LND.FRST.ZS?locations=ZW

1990 and 2010, Zimbabwe suffered loss of an average of 327,000 ha or 1.48% forest cover per year, totaling over 6.5 million ha.[70] A wide range of factors are responsible for deforestation and land degradation. These include expansion of agricultural land, overharvesting of fuel wood, encroachment of human and industrial settlements, lack of sustainable land-use and forest management system, and frequent wildfires (due to both anthropogenic and natural causes).

Climate change will potentially influence the plantation species composition of the forest ecosystems, extents of forest ecosystems, species volume and density, biodiversity characteristics, frequency and intensity of forest fires. The three major forest ecosystems in the country are the Baikiaea (25% of total forest cover), Miombo (30% of total forest cover), and Mopane (45% of total forest cover). Baikiaea is mainly located in western region; and Miombo dominates northern and eastern regions of the country. **Figure 9** shows the current and projected forest

FIGURE 9. Current, 2050 and 2070 predictions of Baikiaea, Mopane and Miombo overlaid (Source: INDUFOR, 2017)

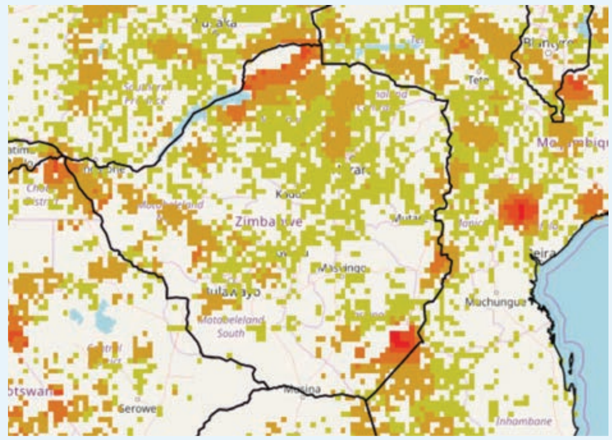


[70] Zimbabwe Forest Infomration and Data. URL: https://rainforests.mongabay.com/deforestation/2000/Zimbabwe.htm

cover by three forest ecosystems for 2050 and 2070. The forest cover of Baikiaea and Miombo ecosystems are both projected to decrease dramatically, to 18% and 10% by 2050 respectively. Meanwhile, Mopane forests are expected to expand to 70% by 2050.[71] The impacts of climate change on plantation species are not statistically significant for the major plantation species in Zimbabwe, namely *Pinus patula, Pinus taeda* and *Eucalyptus grandis*.

As shown in **Figure 10**, wildfire has historically been one of the most dangerous natural hazards in the country.[72] High fire density appears in northern and southeastern parts of the country. Statistically speaking, wildfire is associated with more than 1 million hectares of loss in rangelands and forests per year.[73] Wildfire hazard in the country has been classified as high by ThinkHazard, because available information indicates that the possibility of encountering weather conducive for wildfires that could lead to both social and economic loss in a given year surpasses 50%.[74] Climate induced heat stress, droughts, and reduced rainfall amount are both likely to increase the frequency and intensity of wildfires in the region. Sustained high temperatures and decreased precipitation both are contributors to droughts, which tend to be the drivers for wildfires. In other words, climate change is likely to increase the frequency and intensity of wildfires, creating challenges for sustainable forest management.

FIGURE 10. Wildfire density in Zimbabwe for 1997–2010 (Source: Global Risk Data Platform, 2018)



- Less than 30 (events/pixel)
- 30 - 100 (events/pixel)
- 100 - 300 (events/pixel)
- 300 - 1,000 (events/pixel)
- More than 1,000 (events/pixel)
- No data

[71] Indufor/AEMA, Ministry of Environment, Water and Climate (2017). Impacts of Climate Change on Forest Ecosystem and Plantation Distribution in Zimbabwe.

[72] Global Risk Data Platform (2018). This dataset includes an average of fires density over the period 1997–2010. It is based on the modified algorithm 1 product of World Fire atlas (WFA, ESA-ESRIN) dataset. URL: http://preview.grid.unep.ch/index.php?preview=data&events=fires&evcat=3&lang=eng

[73] Zimbabwe Human Development Report (2017). Climate Change and Human Development: Towards Building a Climate Resilient Nation. URL: http://www.zw.undp.org/content/dam/zimbabwe/docs/key%20documents/UNDP_ZW_2017ZHDR_Briefs%20-%20Climate%20Change%20and%20Health.pdf.

[74] Think Hazard (2018). URL: http://thinkhazard.org/en/report/271-zimbabwe/WF

Institutional Framework for Adaptation

Name	Area of Work
Governmental	
The Ministry of Environment, Water and Climate (MEWC)[75]	• The Ministry of Environment, Water and Climate as the National Focal Point on Climate Change, is mandated to guide the nation's compliance in all multi-lateral environmental agreements, including INDC. • The National Technical Committee, chaired by MEWC, is composed of line ministries, private sector, CSOs, research institutions, financiers, development partners, etc. It is responsible for implementation, financing, capacity building and Measurement, Reporting and Verification (MRV) system for NDC implementation as directed by the steering committee and in line with the Paris Agreement. • MEWC has initiated the National Adaptation Plan (NAP) development process which seeks to develop medium to long term approaches for reducing vulnerability to climate change impacts and facilitating the integration of climate adaptation into ongoing planning processes at national and sub- national levels.
High Level National Steering Committee	• The existing High Level National Steering Committee, which is chaired by the Office of the President and Cabinet and composed of heads of line ministries, is responsible for providing policy direction in the implementation of the NDC in line with National Development Objectives.
The Environmental Management Agency (EMA)[76]	• The Environmental Management Agency (EMA) is a statutory body responsible for ensuring the sustainable management of natural resources and protection of the environment, the prevention of pollution and environmental degradation, the preparation of Environmental Plans for the management, and protection of the environment. • The NAP development process is championed under the Scaling Up Adaptation in Zimbabwe through Strengthening Integrated Planning Systems Project, an initiative led by the Government of Zimbabwe supported by the United Nations Development Programme (UNDP) and implemented by the EMA.
International	
Zimbabwe Vulnerability Assessment Committee (ZimVAC)[77]	• ZimVAC is a consortium of Government, UN agencies, NGOs and other international organizations established in 2002, led and regulated by the government. It is chaired by Food and Nutrition Council (FNC), a department in the Office of the President and Cabinet whose mandate is to promote a multi-sectoral response to food insecurity and nutrition problems.
Regional/NGO	
Zero Regional Environment Organization (ZERO)	• ZERO is the lead agency in Zimbabwe for the implementation of the United Nations sponsored Millennium Development Goals (MDGs) and functions as the Regional Secretariat for the Community Organizations Regional Network (CORN), a SADC country member network. • The institution coordinates, catalyzes, facilitates and evaluates various types and levels of development projects and interventions in the region. Projects developed and administered by ZERO include agricultural productivity, land resources, renewable energy, and health studies.

[75] Zimbabwe's First Nationally Determined Contribution (NDC). URL: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Zimbabwe%20First/Zimbabwe%20First%20NDC.pdf

[76] The Environmental Management Agency of Zimbabwe. URL: https://www.ema.co.zw/index.php/2014-06-12-03-49-33/mission-vision-values.html

[77] Zimbabwe Vulnerability Assessment Committee (ZimVAC) 2017 Rural Livelihoods Assessment Report. https://docs.wfp.org/api/documents/WFP-0000019918/download/?_ga=2.17595833.181058783.1510028610-164740008.1510028610

Key Adaptation Policies and Reports

- National Adaptation Plan (2019)
- Third National Communication to the UNFCCC (2017)
- National Climate Policy (2016)
- Zimbabwe Agriculture Investment Plan (2013–2017)
- Nationally Determined Contribution (2016)
- National Climate Change Response Strategy (2015)

Adaptation Options for Key Sectors

Agriculture

Various policies are established or in the process of being prepared to enhance resilience building in agriculture sector, including the Comprehensive Agriculture Policy (under development since 2012), Livestock Policy (under development since 2014), Mechanization and Irrigation Policy (under development since 2015), and Food and Nutrition Security Policy (2013). As reported in the Zimbabwe's NDC, the total financial needs to build resilience for the agricultural sector amounts to 34.9 billion USD by 2030 under business as usual scenario, 75% of which requires international support while 25% comes from national budget.

The strategies for adaptation in agriculture and food security highlighted in the NCCRS (2015) and NDC (2016) include:

- *Develop frameworks for sustainable intensification and commercialization of agriculture at different scales across agro-ecological regions.*
- *Strengthen capacity to generate new forms of empirical knowledge, technologies and agricultural support services that meet emerging development challenges arising from increased climate change and variability.*
- *Strengthen early warning systems on cropping season quality, rangelands conditions, droughts, floods, disease/pest outbreaks and wildlife movement in order to enhance farmer preparedness.*
- *Develop frameworks for promoting science-based crop production and post-harvest technologies and management practices.*
- *Strengthen the capacity to identify and promote adoption of indigenous and improved livestock breeds that are tolerant to climate related stresses.*
- *Establish monitoring systems for greenhouse gas emissions in agricultural systems and support mechanisms for their reduction.*
- *Strengthen national research and extension capacity for development and integrated management of agricultural water resources.*

Key recommendations from the WB report[78] include:

- *Searching for integrated solutions to disease and pest control that are cost effective.*
- *Research into viable production systems for different farmers to produce more small stock.*
- *Application of biotechnology to promote better reproduction methods by exploring new techniques in artificial insemination and embryo transfer and more efficient production of fodder and silage.*
- *Incorporate resistance through biotechnology to reduce production costs and livestock mortality and combating new and re-emerging zoonotic diseases.*

Water

The water sector is mainly guided by the Water Act of 1998 and National Water Policy of 2013, which first highlights the need to include impact of climate change in all water related planning. A National Water Resources Master Plan for 2020–2040 (NWRMP) is in the process of being developed through close collaboration between MEWC, the Ministry of Lands, Agriculture and Rural Resettlement (MLARR), the Ministry of Energy and Power Development (MEPD) and the World Bank. It will serve as the blueprint for sustainable water resources development, utilization, and management in the country.

The key adaptation measures for the water sector communicated in NCCRS (2015) and NDC (2016) include:

- *Promote and support water harvesting as a climate change adaptation strategy.*
- *Develop, rehabilitate and maintain surface and groundwater resources.*
- *Strengthen and intensify monitoring systems for hydro-meteorological parameters.*
- *Promote efficient water use practices in the economy across all sectors.*
- *Strengthen institutional capacity, research and extension for integrated water resources management.*
- *Strengthen biodiversity conservation management and integrity of natural ecosystems to adapt to climate change.*
- *Strengthen water and moisture conservation initiatives.*
- *Conduct more frequent yield assessments of surface and groundwater resources.*

Key recommendations from the WB reports[79,80] include:

- *Incorporate climate change into water infrastructure planning and design.*
- *Rehabilitate water infrastructure (e.g. existing reservoir storage systems).*
- *Employ water demand management approaches.*
- *Put in place appropriate water allocation and water pricing mechanisms.*

[78] Manzungu, E., Moyo, S., Boehlert, B., and Cervigni, R. 2018. Potential Impacts of Climate Change and Adaptation Options in Zimbabwe's Agriculture Sector, Harare: Sam Moyo African Institute for Agrarian Studies.

[79] Enhancing the Climate Resilience of Zimbabwe's Infrastructure: selected illustrations in the Water and Power sectors (2015). Draft World Bank Background Note.

[80] Assessment of the Potential Impacts of Climate Variability and Shocks on Zimbabwe's Agricultural Sector (2018). World Bank Report.

Energy

Enhancing the inclusion of renewable energy in energy supply is one of the key strategies of the National Energy Policy (2012). A reliable, sufficient, and sustainable energy system is essential for boosting GDP growth. The National Climate Change Response Strategy (2015) strongly advocate the development of an Integrated Energy Resources Plan to fulfill the energy supply gap at the lowest cost by optimizing energy resources mix and increasing the share of renewable energy supply. The incorporation of adaptive capacity into energy sector leads to roughly 1.5 billion USD in financial needs as reported by the NDC, 80% of which requires international support while 20% comes from domestic contribution.

The key adaptation measures for the energy sector communicated in NCCRS (2015) and National Climate Policy (2016) include:

a) *Introduce policies and regulatory frameworks for renewable energy, energy conservation and energy efficiency.*
b) *Strengthen energy planning, research and development.*
c) *Promote renewable energy and adoption of energy efficient technologies and practices across all socio-economic sectors of the economy and the built environment.*
d) *Improve road and rail infrastructure for efficient transportation of goods and people.*
e) *Promote research, development, adoption and deployment of robust, gender-sensitive, sustainable green technologies.*
f) *Promote cleaner fossil fuel technologies and access to clean and affordable energy.*
g) *Enhance monitoring reporting and verification systems based on appropriate methodologies to account for GHG emissions in the energy sector.*

Forestry

The Forest Act (1999) deals with all issues related to the management and use of forest resources in the country, which also regulates the functions of the Forestry Commission. The Communal Lands Forest Produce Act (1987) deals explicitly with the rights and obligations of communities with respect to use of communal forest resources. A new National Forest Policy is under development "to manage, conserve and sustainably utilize forest resources, in order to enhance the contribution of the forest sector to development and social equity through active participation of all stakeholders for the benefit of present and future generations of the people of Zimbabwe."[81]

The key adaptation measures for the forestry sector communicated in NCCRS (2015) and NDC (2016) include:

- *Develop and enforce policies that regulate change from one land-use to another especially the clearance of forests and woodlands to other land-uses.*
- *Promote establishment of land-use plans at district, ward, village and farm management levels that clearly identify forestry as a recognized land-use.*
- *Strengthen research, planning and financial support to forestry and natural resources management, to develop cost effective adaptation options.*
- *Build capacity for forest management in a changing climate.*
- *Promote and strengthen biodiversity conservation management and the integrity of natural ecosystems by using an ecosystem-based approach to adapt to climate change.*

[81] MEWC, 2017. National Forest Policy. Draft. Ministry of Environment, Water and Climate. Government of Zimbabwe. Harare.

- *Promote appropriate climate smart land-use options for the drier natural regions where cattle production and wildlife ranching are the most suitable land-use options.*
- *Strengthen the effectiveness of Trans-Frontier Conservation Areas as a mechanism for sustainable biodiversity conservation and climate adaptation.*
- *Promoting non-timber forest products and sustainable agro-forestry practices to enhance forest-based adaptation.*

Key recommendations from the WB report[82] include:

- *Promote community-based forest management, including the avoidance of forest degradation and/or the rehabilitation of forest vegetation amongst other things trough assisted natural regeneration (including fencing techniques) as well as strengthening community governance systems for common-property forestry management, including a possible reform of tenure systems especially for plantation forestry.*
- *Promote risk management on pest, diseases, invasive species, and wildfire through the deployment of surveillance drones and early warning systems.*
- *Strengthening policy environment to create a better enabling environment for integrated landscape and watershed management, particularly through better implementation of the land tenure reform policy, community governance structures, and cross-sectoral, landscape level natural resource management.*

Disaster Risk Management

The frequency and intensity of natural disasters, especially droughts, floods and storms, have been observed to increase over the past decades, which are predicted to further increase as a consequence of climate change.[83] The Ministry of Local Government, Public Works and Urban Development has established a Disaster Risk Management Bill under the Civil Protection Act of 1989, which focuses exclusively on the reactive aspect of disaster risk management. Currently, a new policy along with a new act are both under development with emphasis on the preparation, response, and recovery components of disaster risk management.[84] The DRM Bill has been revised on three occasions, however it is still not endorsed according to a report from the Capacity for Disaster Reduction Initiative (CADRI) in 2017. The NCCRS (2015) emphasizes the need for strengthening adaptation and DRM under its 1st Pillar.

The options for disaster risk management outlined in the NCCRS (2015) and NDC (2016) include:

- *Develop an integrated and coordinated approach to reducing disaster risk and to address impacts of climate change through a multi-stakeholder approach.*
- *Enhance early warning systems and capacity of hydro-meteorological services to advise on weather related impacts on new infrastructure as well as mitigation of potential damage to existing infrastructure.*
- *Review and update policy and by-laws on building standards and codes to make them adaptive to climate change.*
- *Invest in climate resilient social infrastructure.*
- *Enhance community resilience to climate change.*
- *Strengthening early warning systems (EWS) on climate related agricultural risks.*
- *Developing and sustaining an integrated approach in all sectors of the economy to reduce impacts of climate extreme events.*
- *Promoting climate indexed insurance solutions and enabling market frameworks.*

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[82] Zimbabwe Climate Change Technical Assistance Program: Strategic Actions Supporting the Forest Sector (2018). Draft World Bank Report.
[83] National Climate Change Response Strategy (2015)
[84] Third National Communication (2016)

Key recommendations from the CADRI assessment[85] include:

- Establish a dedicated information management (IM) capability within Department of Civil Protection (DCP) through: (i) human resources (dedicated staff), (ii) technical capacities (training of the staff in IM), (iii) equipment (computers, internet connection).
- Scale up community-based DRM initiatives to build resilience of at-risk communities.
- The technical DRM staff at Provincial/District level should assist in coordinating DRM (prevention, mitigation, preparedness, response, and recovery), including at Ward and Village level to avoid fragmentation or duplication of efforts. Use the structures for DRM coordination for climate change adaptation planning and coordination as well.
- Conduct risk mapping of transboundary risks.
- Revise the draft DRM Bill to align it to the Sendai Frame work for Disaster Risk Reduction and to integrate provisions for the proposed institutional structure that is manageable within existing national resources.
- Endorse the revised DRM Bill and DRM Policy and commence implementation in support of an effective DRM system.
- Provide adequate funding for DRM at national level in line ministries, and at sub-national level.
- Guarantee availability of cash reserves that may be rapidly disbursed through fast-track mechanism in support of disaster response operations.

[85] Capacity Assessment of the Disaster Risk Management System in Zimbabwe (2017). Capacity for Disaster Reduction Initiative (CADRI). URL: https://www.cadri.net/sites/default/files/Zimbabwe-Report-May-2017.pdf

CLIMATE RISK COUNTRY PROFILE

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