



## Zimbabwe



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### General Climate

Zimbabwe lies within the Tropics, just to the north of the Tropic of Capricorn. Its climate varies according to the relief; with higher areas in the east experiencing cooler and wetter conditions compared with the warmer and drier regions of the west and southwest.

Rainfall in Zimbabwe is unimodal (i.e. one wet season per year), which occurs over Zimbabwean summer, with rains usually beginning around mid-November and ending in March; the majority of rain falls between December and February (Unganai & Mason, 2002). The rainfall can be heavy when it arrives, with 45 percent of total annual rainfall falling on 10 percent of the heaviest rain days (ibid). The rainy season is driven by the movement of the Inter-Tropical Convergence Zone (ITCZ). The ITCZ is the point of convergence of easterly trade winds from the northern hemisphere (north-east trades) and the southern hemisphere (south-east trades) in a belt of low pressure (Godwin, 2005), bringing consistent rainfall. During the course of a year, the ITCZ migrates between the northern and southern tropics, bringing rain to the countries over which it passes (Marchant *et al.*, 2007). Zimbabwe is at the southern extent of the ITCZ's passage over Africa, so the end of the movement south and beginning of the return north occurs over the country, resulting in a single rainy season.

Annual rainfall totals vary across the country, from over 800mm in the Highlands in the north to less than 400mm in the lowlands to the south. Seasonal totals (see Table 1) reflect the unimodal rainfall pattern, with warmer temperatures associated with the wet season, and cooler temperatures in the dry season.

Period	Mean Temperature (°C)	Mean Total Rainfall (mm)	Mean number of rain days
Annual	21.0	692	74
March-April-May (MAM)	20.8	123	15
June-July-August (JJA)	16.5	9	3
September-October-November (SON)	23.1	111	15
December-January-February (DJF)	23.6	450	40

Table 1 – Observed seasonal and annual climate for Zimbabwe (1961-90 average) (Mitchell *et al.*, 2004)

The ITCZ is predominantly an oceanic feature and its position changes with the warmest sea surface temperatures (SSTs) (Marchant *et al.*, 2007). It is thus affected by variations in both the Pacific and Indian Oceans, which in turn are affected by the ocean-atmosphere phenomena of the El Niño-Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) respectively (Tierney *et al.*, 2008). The warm phase of ENSO, known as El Niño, is associated with periods of low rainfall and the risk of drought in Zimbabwe, while ENSO’s cold phase, La Niña, brings periods of high rainfall and increased risk of flooding. Positive IOD events are associated with lower summer rainfall in Zimbabwe (Manatsa *et al.*, 2008).

**Key climate vulnerabilities:** Drought; flooding; food security; infectious disease epidemics

## Observed Climate Changes

- Observed records show that the average temperature of Zimbabwe has increased by 0.4°C, with the 1990s the warmest decade of the century (Hulme & Sheard, 1999).
- Observed records show that average rainfall across Zimbabwe has decreased by around 5 percent during the 20<sup>th</sup> century, with the 1990s as the driest decade of the century (ibid).

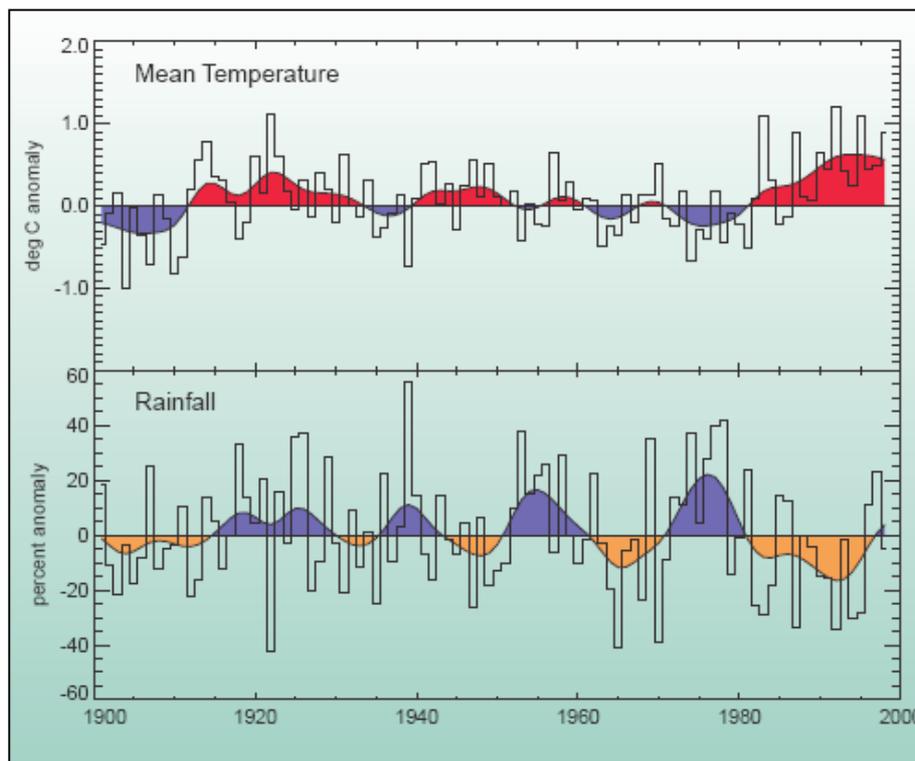


Figure 1: Changes in annual mean temperature, 1901-1998 (top), and annual rainfall, 1901-1998 (bottom), across Zimbabwe, respect to the average 1961-90 climate values of 21.3°C and 662mm respectively (Hulme & Sheard, 1999).

## Current Climate Vulnerability

Table 2 shows the top ten natural disasters that have affected Zimbabwe in the past 20 years. As can be seen, the dominant problems are related to water (drought and flooding) and disease epidemics. Many of the serious droughts that Zimbabwe has experienced throughout the 20<sup>th</sup> century have coincided with an El Niño event (for example, 1982-83 and 1991-92), reducing total rainfall to as little as 30 percent of the annual average (Orlove & Tosteson, 1999). In contrast, Zimbabwe often experiences extreme heavy rainfall during La Niña events, with many areas of the country experiencing flooding as a result. In December 2007, for example, the government announced a state of emergency after extensive flooding in the north and southeast (allAfrica, 2007).

Zimbabwe suffers heavily from a number of infectious diseases, such as cholera, malaria, rift valley fever, yellow fever, and African trypanosomiasis (sleeping sickness). Over 4 million of Zimbabwe's 12 million inhabitants, for example, live within in malarious areas. Between 1989 and 1996, 9,696 deaths and 6.4 million cases of malaria were reported – even with widespread underreporting and self-treatment (Makono and Sibanda, 1999). It was estimated in 1998 that approximately 8 percent of all deaths in Zimbabwe and 12 percent of all outpatient cases were attributed to malaria (Ebi *et al.*, 2005). Zimbabwe also struggles with cholera epidemics, which are affected indirectly by climate as outbreaks are often related to lack of water for drinking, washing and proper sewerage. A cholera outbreak that began in August 2008, for example, continued into June 2009, resulting in approximately 100,000 cases and over 4,000 deaths (WHO, 2009).

Hazard	Number of Events	Deaths	Total of Population Affected
Drought	4	-	13,155,000
<i>Average per event</i>		-	3,288,750
Epidemic (unspecified)	2	71	10,102
<i>Average per event</i>		36	5,051
Epidemic (bacterial)	14	4,852	110,078
<i>Average per event</i>		347	7,863
Epidemic (parasitic)	1	1,311	500,000
<i>Average per event</i>		1,311	500,000
Epidemic (viral)	1	50	1,200
<i>Average per event</i>		50	1,200
Flood (unspecified)	1	13	30,000
<i>Average per event</i>		13	30,000
Flood (general)	6	135	302,775
<i>Average per event</i>		23	50,463
Tropical Cyclone	2	8	-
<i>Average per event</i>		4	-

Table 2 – Natural Hazards in Zimbabwe (1991-2010) (CRED, 2010)

## Climate Change Projections<sup>1</sup>

### Temperature

Annual temperatures are predicted to increase more rapidly than the global average. Seasonally, the warming is projected to be greatest in the dry season, and the least in the wet season (Hulme & Sheard, 1999). Projected changes in temperature for three future periods in the 21<sup>st</sup> century are as follows:

- 2020s: +1.6°C (0.9 to 2.2°C)
- 2050s: +2.8°C (1.4 to 4.1°C)
- 2080s: +3.5°C (1.9 to 6.2°C)

<sup>1</sup> Projections are taken from Hulme & Sheard (1999) and show a Medium emissions scenario ('A1') with Low ('B1') and High ('A2') emission scenarios in brackets to give the range. For more detail on the emissions scenarios see Nakićenović & Swart (2000).

## Precipitation

Model experiments suggest that annual rainfall decreases across Zimbabwe in the future. This decrease occurs in all seasons, but is more conclusive for the early and late rains than for the main rainy season months of December to February (not shown). By the 2080s, annual rainfall averages between 5 per cent (B1-low scenario) and 18 per cent (A2-high scenario) less than the 1961-90 average (Hulme & Sheard, 1999). For comparison, the decade 1986-1995 in Zimbabwe was about 15 per cent drier than average.

- 2020s: -5 percent (-3 to -6 percent)
- 2050s: -8 percent (-4 to -12 percent)
- 2080s: -10 percent (-5 to -18 percent)

## Climate Change Impacts

### Flooding

Climate change projections show that, on average, there is a drying trend for Zimbabwean rainfall. Zimbabwe currently receives a substantial proportion of its rainfall in heavy events, and this variability is likely to increase with a greater number of irregular, heavy events and corresponding dry periods. The result of which would be an increased risk of flash flooding, especially where rainfall follows a dry period and rainfall run-off is high.

### Water Resources

As rainfall becomes more unreliable and temperatures increase, availability of fresh water will decrease. One of Zimbabwe's main water supply reservoirs, Umzingwane near Bulawayo for example, has been declining since 1977 (allAfrica, 2008). The majority of Zimbabwe's water is taken from dams, particularly for urban centres and large-scale irrigation schemes; the National Communication on Climate Change (MOMET, 1998) reports that yield from these dams could reduce by 30-40 percent under climate change. In rural areas, where water supply is less secure, there will be an increased risk of shortages for agriculture and domestic consumption.

### Agriculture & Food Security

The majority of Zimbabwe's farmland is situated in the south, in the savannah region, with average annual rainfall below 600mm (Orlove & Tosteson, 1999). Agriculture is predominantly rain-fed for both subsistence and commercial farming, and for subsistence farmers in particular, resilience to drought is low. The primary food crop for small-hold farmers is maize, which is preferred over more drought-resistant crops such as millet and sorghum (Phillips *et al.*, 1998). Increasingly unreliable rainfall as a result of climate change will result in higher vulnerability of agriculture to drought, increasing the risk of crop failures and famine.

### Public Health

Increases in rainfall extremes and average annual temperatures will affect the potential habitat of disease vectors such as mosquitoes, and hence their abundance. The city of Harare, for example, is at a sufficiently high altitude to keep it largely free from malaria; however, it is at risk if the mosquito habitat area expands (Hulme & Sheard, 1999). A study by Ebi *et al.* (2005) showed that under a high emissions scenario, Zimbabwe could have near-complete climate suitability for malaria by 2050. The study also showed that highland areas may become suitable for malaria transmission as average temperatures increase, thus putting an increasing part of the population at risk. There is also a risk in the lowland areas where increased heavy rainfall events may provide habitat for mosquito breeding and therefore increase the risk of disease incidence. With an increased risk of flooding, there is also likely to be an increased risk of the spread of water-borne diseases such as cholera and dysentery. In addition to a larger number at risk from infectious diseases, drought-induced malnutrition will increase susceptibility to infection (McMichael *et al.*, 2003).

### Housing & Communities

Zimbabwe's homes are often damaged or washed away during the rainy season when heavy downpours cause sharp rises in the levels of such river as the Zambezi and the Save. The 2007/08 rainy season, for example, saw flooding destroy homes, livestock and infrastructure in the low-lying areas of the country (BBC

(2008a); BBC (2008b)). With the projected increase in rainfall and heavy rainfall events, Zimbabwe's housing will be under increasing risk of damage and destruction.

## Biodiversity & Conservation

Climate change presents a serious threat to the biodiversity of Zimbabwe. The combination of increasing temperatures and decreasing rainfall could result in a decline in woodlands and grasslands and a corresponding expansion of scrub savannah (Hulme & Sheard, 1999). This would have a corresponding impact on bird and insect species for which the grasslands provide their habitat. The impact on Zimbabwe's forests could be to reduce the evergreen forests of the eastern highlands to seasonal forests, while the tall savannah woodlands could also be reduced to bushlands (allAfrica, 2008).

## Livelihoods

The economy of Zimbabwe, widely known for its hyper-inflation, depends on commercial agriculture for around 40-50 percent of its export revenues (CEEPA, 2006). Exports include agricultural products such as roses, tobacco and maize (in years of good rainfall). At around 30 percent of the working population, agriculture is the largest source of formal employment, but more importantly it is the basis of the livelihood of approximately 70 percent of the population (Orlove & Tosteson, 1999; CEEPA, 2006). Unreliable rainfall will affect crop productivity and poor harvests may affect the proportion of food available for export.

## Energy

Reduction in annual rainfall under climate change will also affect the energy generation in Zimbabwe. Hydroelectric power generation at Kariba dam is dependent on a sufficiently high lake level to allow water to be drained; the drought in the 1980s, for example, resulted in a substantial reduction in lake levels and an associated reduction in energy generation (Hulme & Sheard, 1999).

## Transport

Much of the road and railway infrastructure is in much need of investment and repair, and will be in increasing danger of being damaged by flooding and land subsidence under climate change. For the majority of the population, forms of transport are limited to walking, head loading and use of pack animals, which would be largely unaffected by climate change.

## Government Response

Zimbabwe signed and ratified the United Nations Framework Convention on Climate Change (UNFCCC) and also prepared and published an initial National Communication on Climate Change. According to the Communication 'awareness-raising campaigns are used to involve the general public in issues concerning climate change', and 'workshops and seminars are being conducted throughout the country for a variety of stakeholders, including policy makers, industrialists, NGOs, academia, media and the public' (MOMET, 1998).

Zimbabwe has no basic climate change research programmes, primarily a result of issues of finance, and a lack of human expertise. However, research in climate change-related issues is carried out by Government institutions in the areas of agriculture, water resources, energy and forestry, among others (ibid). The Southern Centre for Energy and Environment (SCEE), a non-governmental organisation in Zimbabwe, carries out climate change research for possible mitigation options in industry, particularly in energy efficiency (ibid).

The Government has an investment programme to construct medium to large dams and increase capacity of existing ones (ibid). The focus of this programme is to improve accessibility to water for irrigation and encourage a shift from subsistence agriculture to cash crops (ibid).

As part of the Southern Africa Development Community (SADC), Zimbabwe is part of several early warning systems for food shortages. In 1987, the SADC initiated the Regional Early Warning System (REWS) to provide advance warning of food security issues, the head office of which is located in Harare (Orlove & Tosteson, 1999). However, such systems are not led or funded by central government, but instead are the benefactor of assistance agencies such as the Food and Agriculture Organization of the United Nations (FAO) (ibid). REWS provides regular information on likelihood of crop failure, food supply projections, demand assessments and identifies those areas at greatest risk from food shortages (ibid).

## Likely Adaptation Options

The following are a selection of options for adapting to climate change as identified in Zimbabwe's National Communication (MOMET, 1998):

- Changing land use practices: maintaining forest diversity and extensiveness, through altering land-use, harvest and planting practice; conserving large tracts of natural forest (for example, the demarcated forest reserves; nature reserves and national parks) and expanding as well as connecting protected areas with conservation corridors for wildlife.
- Improved forest management: managing and planning land uses around forested areas, to identify and manage areas of potential forest migration or decline, especially corridors or buffer zones along water bodies.
- Switching from monoculture to diversified agriculture: this is already being encouraged through various awareness raising campaigns. However, this depends on acceptability by local farmers, and the provision of capital and equipment.
- Water resource investigations: improvement in the knowledge of groundwater storage may indicate that groundwater is a feasible source of water that can be developed.
- Promotion on water-efficient irrigation techniques: it is estimated that agriculture currently uses about 80 percent of the surface water resources. Irrigation efficiencies vary from 40-60 percent; therefore, the improvement in water-use efficiency could be extremely beneficial.

## Useful Websites

- UNDP Climate Change Country Profiles: <http://country-profiles.geog.ox.ac.uk/>
- UNFCCC NAPAs from Non-Annex I Countries: [http://unfccc.int/national\\_reports/napa/items/2719.php](http://unfccc.int/national_reports/napa/items/2719.php)
- UNFCCC First Communications on Climate Change for Non-Annex I Countries: [http://unfccc.int/national\\_reports/non-annex\\_i\\_natcom/items/2979.php](http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php)
- Adaptation Learning Mechanism: <http://www.adaptationlearning.net/>
- IPCC Reports: [http://www.ipcc.ch/publications\\_and\\_data/publications\\_and\\_data\\_reports.htm](http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm)

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*Note: This profile is designed to give a brief, non-technical overview of the current and future climatic conditions of Zimbabwe. The key climate impacts are summarised by sector; however, this should not be taken as an exhaustive list, and the corresponding list of adaptation options are as a guide of likely or possible strategies.*



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