Government of Zimbabwe

CLIMATE CHANGE MAINSTREAMING MODULE

For Development Planning

GOVERNMENT OF ZIMBABWE

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The Climate Change Mainstreaming Module for Development Planning has been developed pursuant to the need to enhance the capacity of stakeholders critical in the planning process to mainstream climate change in development planning process along the lines of devolution. It responds to the need to reduce vulnerability and build resilience to climate change related vagaries by factoring climate change considerations at the planning stage.

The national institution responsible for climate change mainstreaming is the Climate Change Management Department in the Ministry of Environment, Climate, Tourism and Hospitality Industry.

The module for the mainstreaming research programme was developed by the following experts:

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Structure of the Module

The Government of Zimbabwe initiated its Climate Change National Adaptation Planning process in 2015. The main objective of the National Adaptation Planning process is to mainstream climate change and reduce vulnerability of communities and climate sensitive sectors. As part of enhancing the climate change mainstreaming agenda, the Government is implementing a climate change mainstreaming research programme, to inform public and private sector adaptation investment priorities and subsequent long term adaptation options.

The programme which is targeted at stakeholders from subnational level critical in the planning and development process, comes at a time the Government's devolution process has gained momentum. The programme will thus be critical in enhancing the capacity of these stakeholders to integrate climate change in development planning, towards the country fulfilling its set targets on building resilience and developing in a low carbon trajectory.

The module programme contains six chapters namely:

1. Introduction to Climate Change
2. Climate Change Vulnerability and Adaptation Assessments
3. Introduction to Climate Change Mitigation
4. Introduction to Planning for Climate Change
5. Climate Change Budgeting, Finance and Monitoring and Evaluation
6. Research for Mainstreaming Climate Change into Development Planning

Chapter one is an introductory chapter providing the basic elements of climate change including aspects of the climate system and aspects of the climate of Zimbabwe. The chapter also introduces the learners to the anthropogenic activities that are some of the key drivers of climate change through the production of greenhouse gasses (GHGs). It concludes by giving an overview of the international and national climate change policy architecture.

Chapter two focusses on climate change and its complex linkages to development by introducing the concept of conducting vulnerability and adaptation assessments. This chapter further presents examples of climate change impacts and programmes to address them in Zimbabwe. It provides guidance of systematic identification of specific vulnerabilities and adaptation options and the implementation of programmes to ensure sustainable development.

Chapter three provides key definitions and concepts related to climate change mitigation and low emission development. The section gives insights into strategic frameworks and policy approaches for climate change mitigation and transition to a low emission development economy. It further gives an overview of greenhouse gases (GHGs), historical global emission levels and trends, national emission levels per sector and global warming potential values for greenhouse gases not controlled by the Montreal Protocol on substances that deplete the ozone layer. Significant activities contributing to emission of greenhouse gases in energy, transport, industry, forest, agriculture and waste sectors are described. For each of the above-mentioned economic sectors described above, some selected mitigation options are suggested. The section also provides an outline of environmental, social and economic co-benefits of mitigation actions and shifting towards a low emission development pathway. Given also in the mitigation section is a snapshot of cooperative approaches available for countries under the United Nations Framework Convention on Climate Change to facilitate collaborations to achieve their emission reduction and limitation obligations.

Chapter four focuses on identifying the important elements to consider in integrating climate change in development planning processes. After identifying these entry points it is imperative to then develop a robust monitoring and evaluation framework with set indicators to monitor the implementation of climate change mainstreaming feeding into the National Development Strategy goals.

Chapter five defines climate finance and explains its importance as countries including Zimbabwe step up efforts on climate action. The need for domestic climate financing is elaborated to support climate change initiatives and leverage international climate finances. For monitoring purposes, the chapter presents the concepts of budget tracking and coding to track climate relevant expenditure in the national budget. As Parties to the UNFCCC implement the Paris Agreement, the need to monitor and evaluate climate finance is an important requirement for transparency and accountability.

Chapter six on Research for Mainstreaming Climate Change in Development covers the steps undertaken in identifying researchable issues, formulation of research objectives, problem definition and how to formulate climate research. The chapter thus includes methods and materials needed to be considered when planning to carry out a research study. Furthermore, the chapter outlines the processes involved in designing data collection tools, how to collect and analyse data to meet specific research questions and how to present the research findings in the form of a report or oral presentation. Finally, the chapter guides on the formulation of a research work plan as well as the budgetary considerations necessary for a successful research programme.

Acronyms

CH_4	Methane
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFCs	Chlorofluorocarbons
CMIP5	Climate Model Intercomparison Project fifth phase
CO	Carbon monoxide
CO_2	Carbon dioxide
CVA	Climate Vulnerability Assessment
GHGs	Greenhouse gases
GtC	Gigatonnes of carbon
GWPs	Global Warming Potentials
HFCs	Hydrofluorocarbons
IPCC	Inter-governmental Panel on Climate Change
ARC	Fifth Assessment Report (AR5) -of the IPCC
INDCs	Intended Nationally Determined Contributions
ITCZ	Inter-Tropical Convergence Zone
NAMA	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plan
NASA	National Aeronotic and Space Admin
NAZCA	the Non-State Actor Zone for Climate Action
NCAR	National Center for Atmospheric Research
NCLEI	National Centers for Environmental Information
NOAA	National Oceanic and Atmospheric Administration
NCCRS	National Climate Change Response Strategy
NDC	Nationally Determined Contributions
N_2O	Nitrous Oxide
PFCs	Perfluorocarbons
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SYR	Synthesis Report
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WMO	World Meteorological Organisation

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Chapter 1 Introduction to Climate Change

Learning Objectives

The chapter introduces participants to the basics of climate change science. At the end of the chapter participants will be able to:

- Explain the basic concepts of climate change science
- Identify the natural and anthropogenic drivers of climate change
- Explain observed and projected trends and impacts in the climate
- Appreciate the different climate change scenarios and their implications for climate change adaptation
- Appreciate national and international responses

Topics

Topics that will be covered include:

- Definition of key concepts such as climate, weather, climate variability and climate change
- The climate system
- The climate of Zimbabwe
- Sources , types and importance of greenhouse gases
- The greenhouse gas effect
- Natural and human contribution to climate change
- Main observed changes in the climate since the industrial revolution
- Projected future trends and impacts of climate change on surface temperature, precipitation, water resources, agriculture, health, biodiversity, extreme weather events
- Overview of Main Sources of Scientific Climate Information, relevant Programmes and Institutions
- Overview of the National Climate Policy Framework, Climate Change Convention, Kyoto Protocol, Paris Agreement and the Montreal Protocol.

1.1 Introduction

The atmosphere is the essential physical and chemical environment for life. Changes, anthropogenic or otherwise, to the physical and chemical properties of the atmosphere have the potential of affecting directly the quality of life and even the very existence of some forms of life. Human-induced climate change, in particular, as well as other global environmental issues such as land degradation, loss of biological diversity and stratospheric ozone depletion, threatens our ability to meet very basic human needs, such as adequate food, water and energy, safe shelter and a healthy environment. It has become more apparent that most people believe that human-induced climate change is inevitable. Further proof of the reality of climate change was made available through the various stages of research work of the Intergovernmental Panel on Climate Change (IPCC), which was established by the World Meteorological Organisation (WMO) and United Nations Environment Programme (UNEP) in 1988. The IPCC concludes that human activity is having a discernible effect on the environment, and that global temperatures are projected to increase at a rate unprecedented in the last thousand years.

A majority of experts believe that important reductions in net greenhouse gas emissions are technically feasible due to a wide range of technologies and policy measures in the energy supply, energy demand and agricultural and forestry sectors. Besides, the current and anticipated adverse effects of climate change on socio-economic and ecological systems can, to some degree, be reduced through proactive adaptation measures. Consequently, discussions are taking place at the international and national levels seeking how to best cope with this issue, particularly in developing mitigation and adaptation strategies to prevent future generations from excessively negative impacts and to reduce the world vulnerability to these changes.

The process of devolution has seen an increasing role of the local government structures (at Provincial and District levels) in the governance of the areas under their purview. The decision makers at these levels are now expected to implement inclusive planning adequately informed and guided, including on climate issues. It is then essential that the technical and professional staff of the Provincial and District Development Committees have the necessary background and knowledge of basic concepts and approaches of the issue of climate change in order to provide authoritative responses and focused mainstreaming towards climate resilience and low carbon development.

1.2 Climate, Weather, Climate Variability and Climate Change

Climate is generally defined as the average state of the atmosphere for a given time scale (hour, day, month, season, year, decade and so forth) and generally for a specified geographical region. The average-state statistics for a given time scale including all deviations from the mean/average are obtained from the ensemble of conditions recorded for many occurrences for the specified period of time.

Climate descriptors also include conditions at the Earth's surface such as ocean temperatures and snow cover. The average-state description involves a wide range of variables depending on what is of interest. Temperature and precipitation are the most commonly used; however the list may include wind, cloudiness and sunshine, pressure, visibility, humidity and elements with noteworthy human impacts such as severe storms, excessively high and low temperatures, fog, snow and hail. The method of description focuses on statistical parameters, the mean and measures of variability in time such as the range, standard deviation, and autocorrelations. It is important to identify the difference between weather and climate.

Weather describes the atmospheric condition at a single instant of time for a single occurrence. In general, climate may be thought of as an average of weather conditions over a period of time including the probability for distributions from this average.

Climate Change is defined as the change in climate attributed directly or indirectly to human activity which, in addition to natural climate variability, is observed over comparable time periods. The definition adopted by the United Nations Framework Convention on Climate Change (UNFCCC) focuses only on the human activity that alters the composition of the global atmosphere and excludes other human activity effects such as changes in the land surface. Sometimes the term 'climate change' is used to include all climate variability, which can lead to considerable confusion. Climate has variability on all time and space scales and will always be changng.

Climate Variability is defined as variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events. The term "Climate Variability" is often used to denote deviations of climatic statistics over a given period of time (e.g. a month, season or year) when compared to long-term statistics for the same calendar period. Climate variability is measured by these deviations, which are usually termed anomalies.

Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external factors (external variability).
The climate system is defined as the five components in the geophysical system, the atmosphere and four others which directly interact with the atmosphere and which jointly determine the climate of the atmosphere. The five components are listed below:

(a) Atmosphere;
(b) Ocean;
(c) Land surface;
(d) Ice and snow surfaces (both land and ocean areas); and,
(e) Biosphere (both terrestrial and marine).

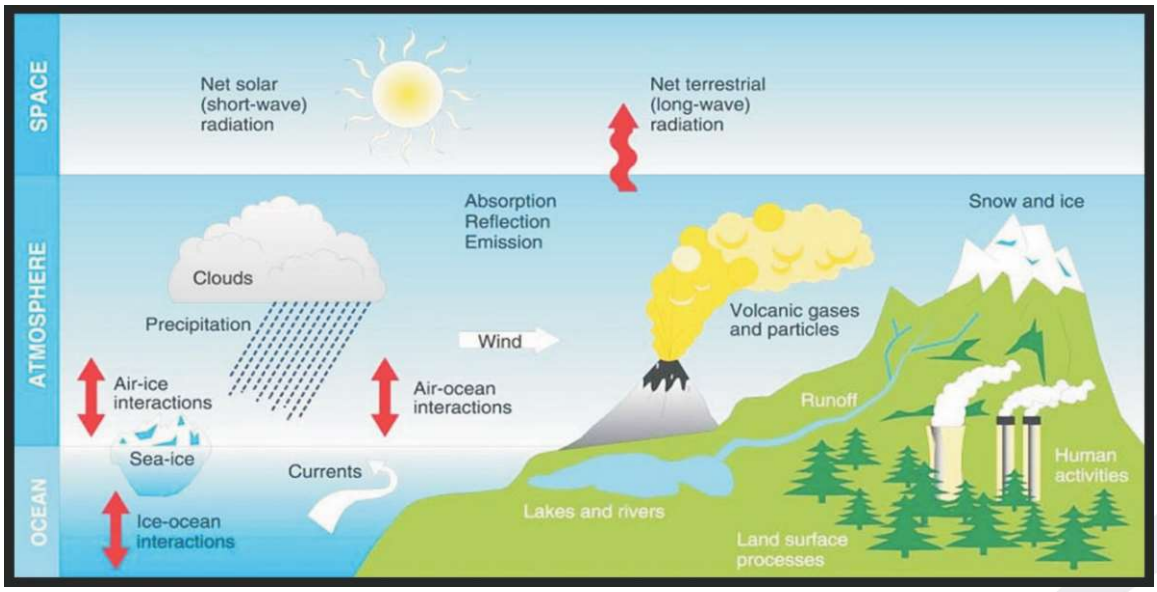


Fig 1.1: Schematic view of the components of the Global Climate System, their process and interactions and some aspects that may change.

Figure 1.1 shows the scope of the climate system. Note that the two-way arrows in the diagram identify explicit interactions between the atmosphere and other components. At this point it is appropriate to recognize that there are other factors, also variable in nature, which contribute to determining the climate. These are considered 'external' forcing factors and include the Sun, Earth orbital parameters, land-ocean distribution, Earth topography (land and ocean), and basic composition of the atmosphere and ocean. These are important determiners of the climate which, except for the basic composition of the atmosphere and oceans, are not affected in return by the climate conditions.

The definition for the climate system makes it clear that one has to have an appreciation of all of the system's components (atmosphere, ocean, land surface processes, cryosphere, and biosphere) in order to understand it. In reality one needs to know a limited amount, dependent on the time scales considered, about the non-atmospheric components to understand the interactions of those components with the atmosphere. In general, these interactions occur primarily at physical interfaces so that, for example, for ocean interactions, it is necessary to know only the conditions at the oceanic upper boundary and for cryosphere interactions only at the surface of the ice.
To know such conditions, of course, it is necessary to understand how they vary in relationship to conditions within the ocean and ice. Unlike the other interactive components, the ocean is an easily movable fluid, as is the atmosphere, so that understanding the ocean for climate system applications requires dealing with geophysical fluid dynamic and thermodynamic relationships as complex as those for the atmosphere.

1.3 The Climate of Zimbabwe

Zimbabwe is located in the sub-tropics, which makes rainfall the most important climate parameter. The climate is strongly influenced by the movement of the Inter-Tropical Convergence Zone (ITCZ), which brings rainfall through the collision of warm moist air masses from the north and cool air masses from the south. Zimbabwe has a hot rainy season with significant rainfall for about four months between October and March followed by a dry period of about six months. The summer rainy season lasts from November to March. The cold dry season lasts for about three months from mid-May to mid-August, during which both rainfall and temperatures decrease.

Finally, there is the warm, dry season, which lasts until the onset of the rains. In much of the country, annual rainfall ranges from 550 to 900 millimetres. The rains occur primarily in the form of showers and thunderstorms in the afternoon. The wettest regions are the north and the east where altitude rises up to about 2900 metres, while the driest region is the south, in the Limpopo Valley, on the border with South Africa, where rainfall drops below 400 mm per year.

In the latter region, the altitude drops to around 500 to 600 metres, while in the south-eastern strip, at the border with Mozambique, where the Gonarezhou National Park is found, it goes down to around 200 to 300 meters. Another area where the altitude drops to around 500 meters is found in the north, areas around Lake Kariba. It goes without saying that the areas where the altitude is lower are also the hottest, and in October and November, highs can even reach 40°C. The areas on the main watershed have comparably moderate temperatures and generally higher rainfall.

Rainfall

Zimbabwe has one of the most variable rainfall patterns in terms of distribution across time and space, and dry spells and droughts are part of a normal cycle. During an average rainy season, it is normal for the country to experience four to five dry spells of different lengths. Flash flooding and hailstorms are often experienced during the rainy season.

Figure 1.2 shows the variability in average seasonal rainfall since records began in 1901. As is shown by the strongly zigzagging line, Zimbabwe has experienced wide fluctuations in average seasonal rainfall over the last century. The red line on the graph indicates that average rainfall is gradually declining. The decline is attributed to natural and human-induced climate change.

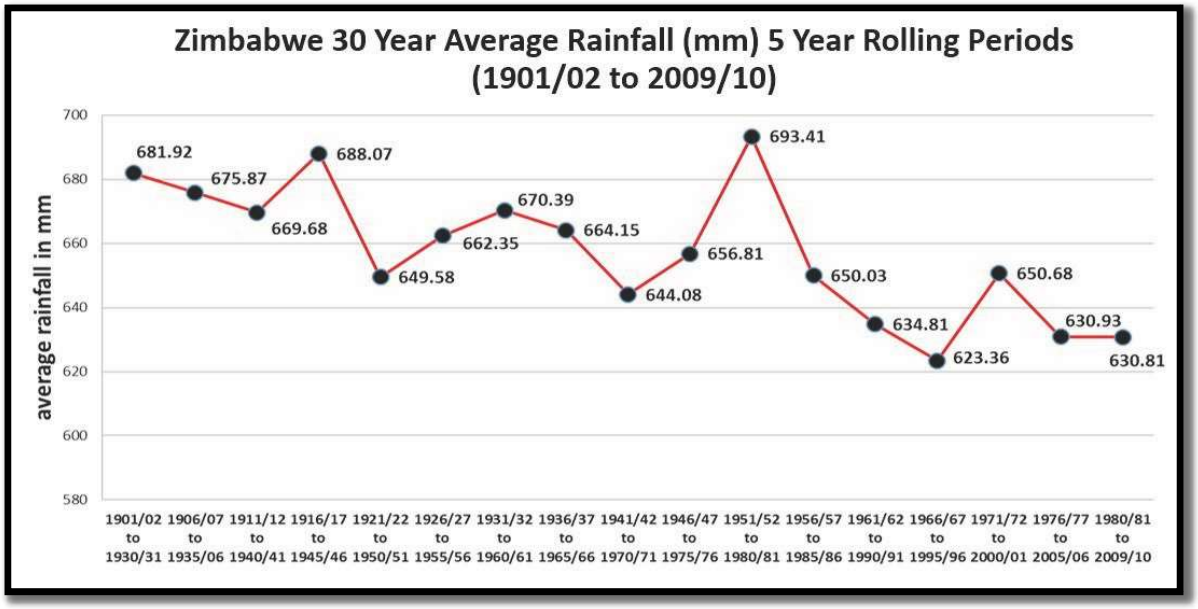


Fig 1.2: Zimbabwe 30 Year Average Rainfall (mm) 5 Year Rolling Periods (1901/02 to 2009/10)

Zimbabwe also experiences wide variations in the rainfall distribution across the country. The higher-altitude districts along the central watershed and the eastern highlands typically experience greater amounts of rain (above 1,000 mm per season) than low-lying areas and in the west (350-450 mm per season). The western parts usually receive the first rains of the season when cloud bands appear from the west before the main rain- bearing systems build up, producing the convectional rainfall which is the bulk of the type of rainfall received across the country during a normal rainy season.

The southern and south-eastern parts occasionally experience drizzle, or guti, and light rain brought by cool, moist south- easterly air masses from the Indian Ocean during both summer and winter. Relief rainfall is often experienced along the main watershed and in the eastern highlands.

Temperature

The average maximum and minimum temperatures vary across the country, with the lowest maximum temperatures being experienced in the eastern highlands and the hottest in the low-lying areas in the west and extreme south. The temperature variations are mainly due to differences in altitude. On average the elevated central watershed and eastern highlands experience lower temperatures than low-lying areas. All areas have a daily temperature range which is lowest just before sunrise, usually increasing by more than 10°C to reach the maximum around mid-afternoon. Figure 1.3 shows the inter-annual variations of temperatures in Zimbabwe, with a clear upward trend that implies a general rise in temperatures over time.

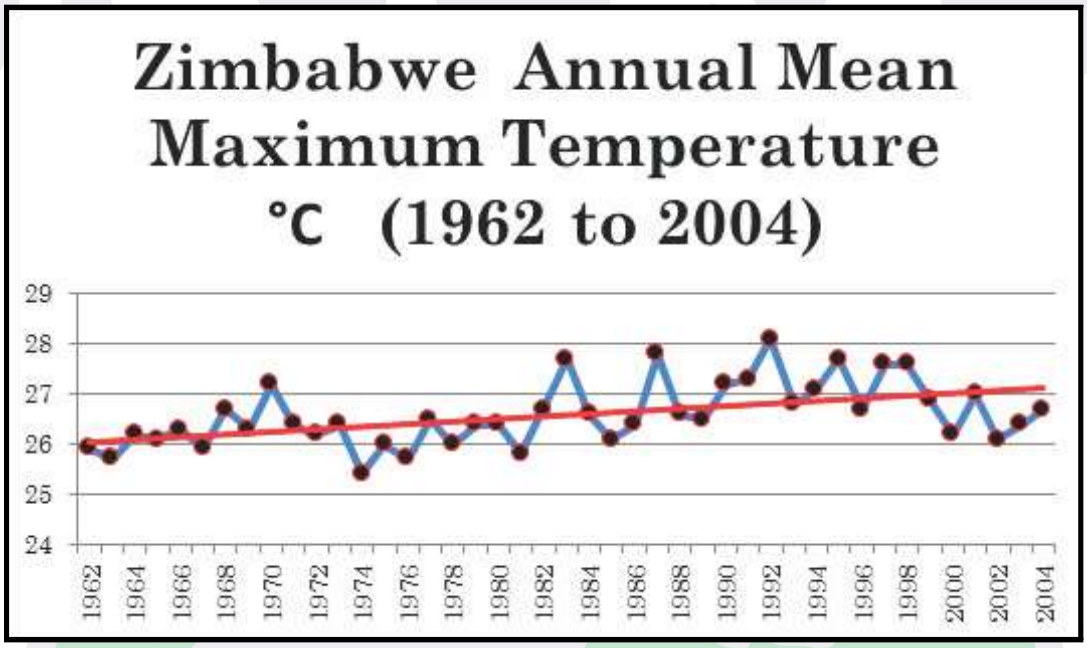


Fig 1.3: Annual Mean Temperature (1962 - 2004)

1.4 Greenhouse Gases: Sources, Types and Importance of Greenhouse Gases

In order to understand the importance of greenhouse gases, one needs to appreciate what these gases are, their sources and types as well as the electromagnetic wave energy transfer (radiation). Radiation accounts for nearly all energy transfer from the sun and is the primary source of energy for the atmosphere and the entire climate system. Such transfer is also the only way in which significant amounts of energy can leave the climate system.

The energy of the global climate system is nearly in balance with incoming and outgoing radiation transfers. A change in one component will produce a different balanced state. The primary human impact on the energy balance especially relating to emission of the greenhouse is to alter the radiative properties of the atmosphere with respect to these two energy streams. This effect far out-shadows other anthropogenic energy sources and sink effects such as the heating due to combustion and nuclear processes. Understanding the impacts of human action on radiation transfer processes in the atmosphere and on the Earth's surface is crucial to understanding climate change.

Greenhouse gases are gases in Earth's atmosphere that trap heat. They let sunlight pass through the atmosphere, but they prevent the heat that the sunlight brings from leaving the atmosphere reradiating it back to Earth's surface, thus contributing to the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases. To a lesser extent, surface-level ozone, nitrous oxides, and fluorinated gases also trap infrared radiation.

Greenhouse gases have a profound effect on the energy budget of the Earth system despite making up only a fraction of all atmospheric gases. Concentrations of greenhouse gases have varied substantially during Earth's history, and these variations have driven substantial climate changes at a wide range of timescales. In general, greenhouse gas concentrations have been particularly high during warm periods and low during cold periods.

There's a whole family of greenhouse gases (GHGs). But an important thing to remember is that they are not all "created equally." A particularly important distinction among them is their varying Global Warming Potentials (GWPs). Some are much more "efficient" - and that is decidedly not a compliment in this context - at retaining heat energy in the atmosphere, not allowing it to escape. Some are short-lived, while others can easily last decades or longer in the atmosphere. Some GHGs are emitted in vast quantities but, quite fortunately, may not be so voracious or "efficient" as those emitted in far smaller quantities; others have just the opposite qualities - emitted in only trace amounts, but extremely efficient in blanketing the planet's atmosphere and keeping heat from escaping beyond it.

To bring some understandable reason to the family of GHGs, scientists speak in terms of carbon dioxide equivalent - CO_2e. That approach in effect makes carbon dioxide (CO_2), the prevailing "currency" of greenhouse gases and global warming. Below is a summary of the major greenhouse gases.

Water Vapour

Water vapour is water in the gaseous state. As the temperature of the atmosphere rises, more water is evaporated from ground storage (rivers, oceans, reservoirs, soil). Because the air is warmer, the absolute humidity can be higher (in essence, the air is able to 'hold' more water when it's warmer), leading to more water vapour in the atmosphere. As a greenhouse gas, the higher concentration of water vapour is then able to absorb more thermal infrared energy radiated from the Earth, thus further warming the atmosphere.

Carbon Dioxide (CO_2)

Let's now consider what the climate community considers to be the "most important greenhouse gas".

Carbon dioxide (not to be confused with carbon monoxide (CO), associated with vehicle tail pipe emissions or with home CO alerts from burning coal or charcoal) occurs both naturally and as a result of human activities. It is an inevitable by-product of the incomplete combustion of fossil fuels, and in particular coal. While CO_2 emissions come from a variety of natural sources, human-related emissions are responsible for the increase that has occurred in the atmosphere since the industrial revolution. Concentrations of CO_2 in the atmosphere have increased by more than one-third since the beginning of the Industrial Age. Projections over coming years see that trend continuing.

Methane (CH_4)

Methane, a hydrocarbon gas resulting from both natural causes and as a result of human activities such as agriculture and farming, is an especially potent (read "efficient," but not as a compliment) GHG and absorber of radiation. Methane is far less abundant than CO_2 in the atmosphere and it has a considerably shorter lifespan of 12 years. Valued for energy production, methane, like CO_2, is odorless and colorless - and it has both beneficial and harmful qualities. It is estimated that human activities account for over 60% of total methane emissions, primarily from industry, agriculture and waste management activities. Wetlands are a natural source of methane, emitting it from bacteria that decompose organic materials in the absence of oxygen. Smaller sources include termites, oceans, sediments, volcanoes and wildfires.

Nitrous Oxide (N_2O)

Nitrous oxide occurs naturally in Earth's atmosphere as part of the nitrogen cycle. While it is the product of a wide variety of natural sources, human activities - agriculture, fossil fuel combustion,

wastewater management and industrial processess - are increasing the atmospheric concentrations.In addition, nitrous oxide molecules in the atmosphere have long life spans - about 120 years before they are removed in a "sink" or destroyed as a result of chemical reactions. A pound of N_2O gas has the equivalent warming effect of 300 times that of one pound of carbon dioxide.

Fluorinated Gases (HFCS, PFCS, SF6)

Fluorinated gases are emitted in smaller quantities than the other greenhouse gases, but what they lack in volume they can make up in potency and long lifespans in the atmosphere, ranging from 1-270 years for hydrofluorocarbons (HFCs) to 800-50,000 years for perfluorocarbons (PFCs) and about 3,200 years for sulfur hexafluoride (SF6). Once emitted into the atmosphere, they disperse widely around the globe; they are removed from the atmosphere only by sunlight in the highest levels of the atmosphere. Being the most potent of the GHGs and having the longest lifespans, these gases often are described as the "high global warming potential (GWP) gases." Aluminum and semiconductor manufacturing processes are among the principal emitters of the fluorinated gases

The Greenhouse Gas Effect

Generally referred to as the 'Greenhouse Effect', this is a process that occurs when gases in the Earth's atmosphere trap the Sun's heat. This process makes the Earth much warmer than it would be without an atmosphere. The greenhouse effect is one of the things that makes the Earth a comfortable place to live.

How does the Greenhouse Effect work?

As you might expect from the name, the greenhouse effect works like a greenhouse! A greenhouse is a building with glass walls and a glass roof. Greenhouses are used to grow plants such as tomatoes and tropical flowers.

A greenhouse stays warm inside, even during the winter. In the daytime, sunlight shines into the greenhouse and warms the plants and air inside. At night time, it is colder outside, but the greenhouse stays pretty warm inside. That's because the glass walls of the greenhouse trap the Sun's heat.

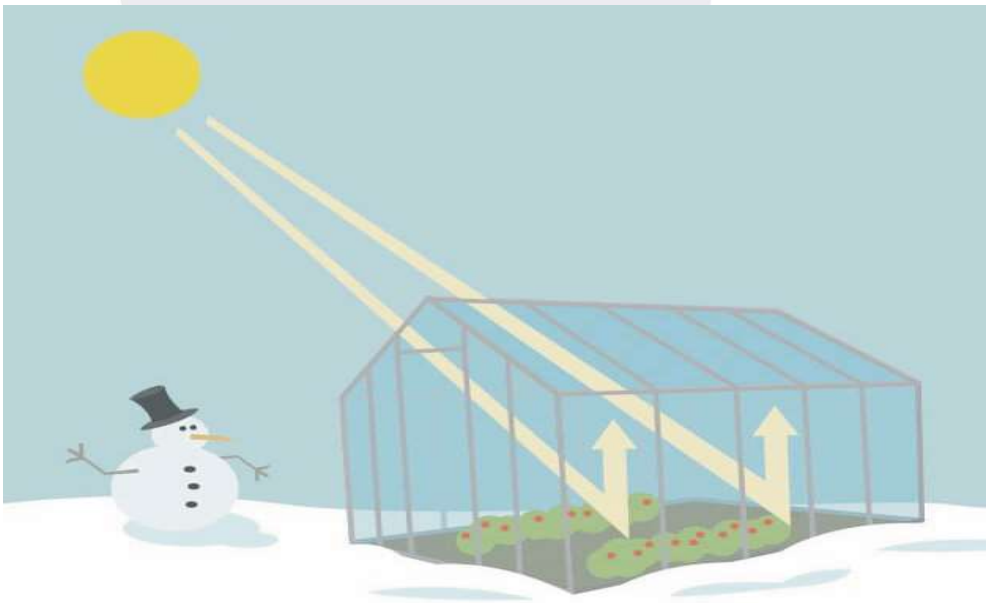


Fig 1.4: A Greenhouse captures heat from the Sun during the day. It's glass walls trap the Sun's heat, which keeps plants inside the Greenhouse warm - even on cold nights.

The greenhouse effect works much the same way on Earth. Gases in the atmosphere, such as carbon dioxide,trap heat just like the glass roof of a greenhouse. These heat-trapping gases are called greenhouse gases.

During the day, the Sun shines through the atmosphere. Earth's surface warms up in the sunlight. At night, Earth's surface cools, releasing heat back into the air. But some of the heat is trapped by the greenhouse gases in the atmosphere. That's what keeps our Earth warm at an average temperature of 15˚C.

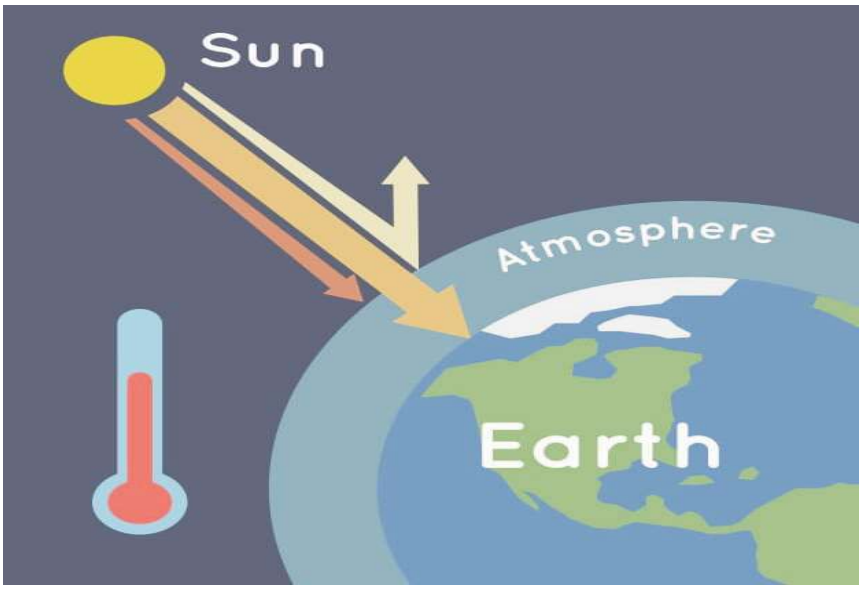


Fig 1.5: Earth's Atmosphere traps some of the Sun's heat, preventing it from escaping back into Space at night

1.5 Natural and Human Contribution to Climate Change

Human Contribution

Human activities contribute to climate change by causing changes in Earth's atmosphere in the amounts of greenhouse gases, aerosols (small particles), and cloudiness. The largest known contribution comes from the burning of fossil fuels like coal and oil, which releases carbon dioxide gas to the atmosphere. The amount of carbon dioxide in the atmosphere has been observed to be increasing as well as some other greenhouse gases indicated in the sections above.

Coal-based electrical energy, land use and land use change in some cases due to deforestation and land clearing for agricultural purposes and creation of settlements or otherwise, veld fires, inefficient transport systems (poor road/city designs), petroleum based vehicles, poor waste management and use of energy inefficient appliances (household and industrial) have also been blamed for fuelling the increase of greenhouse gases into the atmosphere. When trees are cut down and burned or allowed to rot, their stored carbon is released into the air as carbon dioxide. And this is how deforestation and forest degradation contribute to global warming.

Fig 1.6: Some examples of Sources of Greenhouse Gases

It is important to note that deforestation is a primary contributor to climate change. Land use changes, especially in the form of deforestation, are the second largest anthropogenic source of atmospheric carbon dioxide emissions, after fossil fuel combustion.

Greenhouse gases and aerosols affect climate by altering incoming solar radiation and out-going infrared (thermal) radiation that are part of Earth's energy balance. Changing the atmospheric abundance or properties of these gases and particles can lead to a warming or cooling of the climate system.

As a result of human activity, a global warming trend has been observed which has been attributed to human impact on the climate system since the beginning of the Industrial Revolution.

Natural Contribution

As we may all be aware, the earth has gone through warm and cool phases in the past, and long before humans were around. Forces that contribute to climate change include the sun's intensity, volcanic eruptions, and changes in naturally occurring greenhouse gas concentrations. But records indicate that today's climatic warming-particularly the warming since the mid-20th century-is occurring much faster than ever before and cannot be explained by natural causes alone. According to research these natural causes are still in play today, but their influence is too small or they occur too slowly to explain the rapid warming seen in recent decades. Below is a summary of some natural contributors to the causes of climate change.

Oceans

Oceans constitute a huge carbon reservoir. The carbon content of the oceans is 50 times that of the atmosphere and 20 times that of the biosphere. Since global oceans serve simultaneously as a carbon source and carbon sink, they play an extremely important role in regulating Greenhouse Gas (GHG) concentrations in the atmosphere. Unfortunately, the increased carbon dioxide in the ocean changes the water, making it more acidic. This is called ocean acidification.

More acidic water can be harmful to many ocean creatures, such as certain shellfish and coral. Warming oceans - from too many greenhouse gases in the atmosphere - can also be harmful to these organisms. Warmer waters are a main cause of coral bleaching.

Wetlands

Wetlands are vital ecosystems that include marshes, peat lands, and lakes. They are also one of the most important carbon pools on land, with carbon stocks that account for approximately 15% of the total land surface carbon. Wetlands are a major source of natural Methane (CH_4) emissions. As changing temperatures and hydrological conditions can affect the intensity of the CH_4 emissions, the global annual CH_4 emissions from natural freshwater wetlands vary greatly. It is important to preserve the wetlands.

Volcanic Eruptions

Volcanic eruptions can release a large number of volcanic gases into the atmosphere, including CH_4 and Carbon Dioxide (CO_2). Volcanic eruptions can be rapid and have high fluxes. Intermittent volcanoes release gas much more slowly but they last longer, so the total amount of GHGs released by intermittent volcanoes could be greater than those from eruptions.

Mud Volcanoes

Mud volcanoes are "volcanoes" characterized by the eruption of mud. During their formation and subsequent activity, they can also produce large amounts of hydrocarbon gas. The main GHG emitted by mud volcanoes is CH_4, which accounts for 95% of the total hydrocarbon gas, along with small amounts of CO_2.

Earthquakes

Earthquakes are another important source of GHGs, including the direct release of CO_2 from the Earth and that from the decay of plants and animals buried after earthquake events. However, researchers have rarely approximated earthquake GHG emissions. Despite the above causes of emissions, just like a glass greenhouse, the Earth's greenhouse is also full of plants! Plants can help to balance the greenhouse effect on Earth. All plants - from giant trees to tiny phytoplankton in the ocean - take in carbon dioxide and give off oxygen.

1.6 Main Observed Changes in the Climate Since the Industrial Revolution

Since the start of the industrial era (about 1750), the overall effect of human activities on climate has been a warming influence. The human impact on climate during this era greatly exceeds that due to known changes in natural processes, such as solar changes and volcanic eruptions. An overview of the main observed changes in the climate are outlined in the following sections.

Global Temperature Rise

The planet's average surface temperature has risen about 0.9°C since the late 19th century, a change driven largely by increased carbon dioxide and other human-made emissions into the atmosphere. Most of the warming occurred in the past 50 years, with the six warmest years on record taking place since 2014. Not only was 2016 the warmest year on record, but eight of the 12 months that make up the year - from January through September, with the exception of June - were the warmest on record for those respective months. The Earth's warming trend continued in 2019, making it the second-hottest year in over 140-year climate records, just behind 2016.

Warming Oceans

Climate change is taking a toll on forests, farms, freshwater sources and the economy - but ocean ecosystems are said to remain the epicenter of global warming.

Even with their vast capacity to absorb heat and carbon dioxide, oceans were 0.17°C warmer in 2017 than in 2000, and the warming trend appears to be accelerating. More than 90 percent of Earth's warming since 1950 occurred in oceans, a concern to the scientific world.

Climate change weakens the ability of the ocean and coasts to provide critical ecosystem services such as food, carbon storage, oxygen generation, as well as to support nature-based solutions to climate change adaptation.

Shrinking Ice Sheets

The Greenland and Antarctic ice sheets have decreased in mass. Data from National Oceanic and Atmospheric Administration (NASA) - Gravity Recovery and Climate Experiment show Greenland lost an average of 286 billion tons of ice per year between 1993 and 2016, while Antarctica lost about 127 billion tons of ice per year during the same time period. The rate of Antarctica ice mass loss has tripled in the last decade.

Glacial Retreat

Glaciers are retreating almost everywhere around the world - including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa *(for example the disappearing snowcap of Mount Kilimanjaro, as viewed from space in the picture below)*

Fig 1.7: Image showing the disappearing Snowcap of Mount Kilimanjaro

Sea Level Rise

Global sea level rose about 25 cm in the last century and is projected to rise by up to a metre by the year 2100. This will impact coastal and low lying areas as well as disrupt the atmospheric and themohaline (ocean) circulation which influence the weather.

Extreme Events

One of the most visible consequences of a warming world and changing climate is an increase in the intensity and frequency of extreme weather events. The National Communications of Zimbabwe to the United Nations Framework Convention on Climate Change (UNFCCC) finds that the number of heat waves, heavy downpours, and major tropical cyclones has increased in the south eastern African region, and the strength of these events has also increased.

A measure of the economic impact of extreme weather is the increasing number of million-dollar disasters in Zimbabwe. The number of record high temperature events in the world has been increasing, while the number of record low temperature events has been decreasing, since 1950.

Climate change is expected to worsen the frequency, intensity, and impacts of some types of extreme weather events. For example, sea level rise increases the impacts of coastal storms and warming can place more stress on water supplies during droughts. Displacement of some low-lying rural and urban settlements will be a future challenge.

This is the reason why many cities, states, and businesses around the world are taking steps to prepare for more extreme weather.

Activity 1.1:

Learn more about the links between Climate Change and: Drought, Extreme Heat, Extreme Precipitation , Cyclones, Windstorms and Wildfires.

1.7 Projected Future Trends and Impacts of Climate Change

Projected changes in temperature for the 21st century

The latest climate model, Climate Model Intercomparison Project fifth phase(CMIP5) project global temperature increases of the range from 1.8°C (1.1 - 2.9°C) to 4°C (2.4 - 6.4°C) from the 1980s to the end of the 21st century according to the Intergovernmental Panel on Climate Change (IPCC) scenarios.

The global average temperature is expected to increase by about 0.2°C per decade over the next two decades. Continuing greenhouse gas emissions at or above current rates would cause a further increase in global temperatures and many other climatic changes during the 21st century.

Other projected changes for the 21st century

Global average sea level is expected to rise by 18 to 59 cm by the end of the 21st century. Warming is expected to be greatest over land and at high northern latitudes and smallest over the Southern Ocean and parts of the North Atlantic Ocean. Other projected changes include acidification of the oceans, reduced snow cover and sea ice, more frequent heat waves and heavy precipitation, more intense tropical cyclones, and slower oceanic currents.

Projected changes on the longer term

Warming and sea level rise caused by human activities will continue for centuries, even if greenhouse gas concentrations were to be stabilized. If warming persists over many centuries, it could lead to a complete melting of the Greenland Ice sheet, increasing global sea levels by about 7m. Coastal lands will be threatened.

1.8 Overview of Main Sources of Scientific Climate Information, Relevant Programmes and Instituions

There are several sources of scientific climate information, **relevant programmes and institutions** that you can access to provide you with a better understanding of climate and climate change. Some of these major sources, programmes and institutions include but not limited to the following:

1. Inter-Governmental Panel on Climate Change (IPCC)
The IPCC is the most referenced and most widely used source of climate change information. It periodically synthesizes published material into special IPCC and Synthesis Report (SYR). The latest being the IPCC Fifth Assessment Report (AR5), which provides an overview of the state of knowledge concerning the science of climate change, emphasizing new results in research on climate change.

2. United Nations Climate Change Portal
The Global Climate Action portal - previously known as NAZCA (the Non-State Actor Zone for Climate Action) - was launched with an interactive map and country profile pages. As the portal's landing page, this map makes it easy for users to navigate cross-sector climate commitments from around the world.

The portal plays an important role in showcasing the climate commitments that are taking place around the world and across all sectors of society and, by celebrating the progress in climate action, it encourages more ambition and engagement from a wide range of actors.

3. World Meteorological Organisation (WMO)
WMO is the international standardization organization and custodian of information in the fields of meteorology, hydrology, climatology and related environmental disciplines.

4.National Centers for Environmental Information (NCEI)
NCEI publishes the most recent national and international reports on the state of the climate as well as various other peer-reviewed papers and articles.

5. National Oceanic and Atmospheric Administration (NOAA)
The relevant information from NOAA, a USA government institution, provides a comparison of atmospheric samples contained in ice cores and more recent direct measurements, also provides evidence that atmospheric carbon dioxide (CO_2) has increased since the Industrial Revolution.

6.National Center for Atmospheric Research (NCAR)
NCAR, a USA government institution, provides the atmospheric and related Earth system science community with state-of-the-art resources, including supercomputers, research aircraft, sophisticated computer models, and extensive data sets.

7.Australian Academy of Science
The Australian Academy of Science is also a source of useful climate information.

8. Smithsonian: Making Sense of Climate Change website
It has reference articles and multimedia as well as a six-part video series that walks through the vastness of climate change starting with 'what climate is', to 'how humans interact with climate', to 'how climate has changed over time', and' what humans can do to be part of the solution to current climate disruption'.

9.Real Climate website
This website has been continually updated since 2007 with the latest climate research and climate communication materials. It is laid out in sections starting for "Complete Beginners", "Those with

Some Knowledge", "Informed, but in Need of More Detail", and "Informed, but seeking serious discussion of common contrarian talking points". It provides both links to other reliable websites as well as a discussion forum where you can interact with other site users.

10.Global Weirding on YouTube

Finally, Global Weirding is a YouTube channel featuring Dr. Katharine Hayhoe. In this space, she talks about climate issues through various lenses from the Arctic to developing countries and geoengineering to natural cycles. Dr. Hayhoe uses solid science communication techniques (including metaphors like the Heat-trapping Blanket) to make climate issues accessible to multiple audiences.

1.9 Overview of Climate Change Policy and Governance Frameworks

The Climate Policy Framework

The core elements defining Zimbabwe's climate policy framework are the 2017 National Climate Policy, the 2015 Nationally Determined Contributions to the UNFCCC and the 2014 National Climate Change Response Strategy. This is the framework from which the countries green growth and low carbon development strategies will get guidance and orientation.

National Climate Policy

The Government of Zimbabwe promulgated the National Climate Policy in 2017. The vision of the policy is a climate resilient and low carbon Zimbabwe. The National Climate Policy seeks to provide a framework to give the country basic principles and guidance under which the National Climate Change Response Strategy (NCCRS) and other climate related strategies and plans will be implemented. This policy is expected to assist the country to meet its NDCs to the UNFCCC, create resilient communities and drive the country towards a low carbon economy that is largely decoupled from climatic variations. It calls for the climate proofing of other policies and socio-economic infrastructure; strengthening of climate change governance; increased education and awareness; improved early warning and climate services; research to inform planning and future policy orientation; as well as a robust sustainable climate finance framework.

In terms of low emission development, the policy notes the current low energy consumption per capita, low energy access, especially in rural areas and high-energy intensity in industrial and commercial processes. It then recognises that as Zimbabwe makes strides towards socio-economic development, energy consumption is set to rise, putting pressure on already depleting wood resources, increasing energy demand as well as increasing fossil fuel consumption. The policy notes that other than being a disadvantage, this is an opportunity for Zimbabwe to follow a low carbon development pathway by taking advantage of innovations, technological developments and sustainable business models that will help it efficiently utilise its natural resource potential.

The National Climate Policy sets to accelerate mitigation measures by adopting and developing low carbon development pathways in the Industrial; Energy; Waste; Agriculture; Land Use, Land Use Change and Forestry sectors. This is in line with meeting the global goal set in the Paris Agreement of limiting global temperature increase to well below 2℃ above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5℃ above pre-industrial levels. To enable measurement of progress towards a low carbon economy, the policy calls for the development of a national monitoring, reporting and verification system for GHG emissions and actions.

Success and sustainability of climate change mitigation in various sectors partly depends on the economic viability of interventions. The policy calls for enhancement of national capacity in bankable low emission project design and the provision of financial and economic incentives for use of cleaner technologies and practices as well as removal of trade barriers. The policy specifically calls for the development and implementation of a Green Growth/ Low Emission Development Strategy.

National Climate Change Response Strategy

The National Climate Change Response Strategy (NCCRS) aims to mainstream climate change adaptation and mitigation strategies in economic and social development at national and sectoral levels through multi-stakeholder engagement. The strategy looks at sector specific challenges, risks and impacts as well as adaptation and mitigation opportunities. It outlines green growth strategies related to:

i. Promotion of renewable energy, energy efficiency and cleaner technologies;
ii. Capacitation of local authorities to deliver proper, effective and efficient waste management services in order to reduce GHG emissions from waste management;
iii. Afforestation programmes to increase the countries carbon sink;
iv. Implementation of pilot mitigation projects.

The strategy points out key policy, institutional and regulatory matters needed to pursue a low carbon development pathway as follows:

i. Policy and regulatory frameworks that restrict release of short-lived climate pollutants;
ii. Policy, institutional and legal frameworks required to take advantage of the financial incentives from REDD+ while maintaining social safeguards;
iii. A transport policy framework that encourages use of transport with low carbon emissions;
iv. Creation of an enabling policy environment which encourages investment into alternative energy production using waste;
v. Mainstreaming climate change in policies for vulnerable groups with their active participation at every level.

The strategy identifies capacity building and education, training and awareness as strategy enablers.It calls for the implementation of adaptation and mitigation initiatives by all socio-economic sectors, institutions and all levels of government. The monitoring and evaluation of the strategy's implementation will be done by the Climate Change Management Department. It further highlights key actions that the country should take to be able to tap into international carbon financing mechanisms.

Since the strategy was developed before the National Climate Policy and the landmark Paris Agreement there might be need for minor revisions of the document to take on board key issues that were not envisaged in 2014 such as the NDCs.

United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC was adopted in 1992 at the Rio Earth Summit. The Government of Zimbabwe

became a party to the Convention in November of the same year. Since then, the country has complied with all the reporting requirements of the Convention through its National Communications and National Greenhouse Gas Inventory Reports. These reports document the levels of emissions from the country's key economic sectors, identify vulnerabilities, analyse capacity gaps and look at financial needs.

Article 2 of the UNFCCC states that the ultimate objective of the Convention and any related legal instruments that the Conference of the Parties may adopt is 'to achieve stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner'.

Alluding to low carbon development, the Convention further states under Article 4 that 'all Parties shall promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors'. In its quest to reduce GHGs, it promotes sustainable management, conservation and enhancement of sinks and reservoirs of GHGs including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems.

Kyoto Protocol

The Kyoto Protocol is an international agreement under the UNFCCC, which commits its Parties by setting internationally binding emission reduction targets. Recognizing that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the Protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities". During the first commitment period of the Kyoto Protocol which ran from 2008 to 2012, 37 industrialized countries and the European Union committed to reduce GHG emissions to an average of five percent against 1990 levels. During the second commitment period, Parties committed to reduce GHG emissions by at least 18 percent below 1990 levels in the eight-year period from 2013 to 2020. Under the Protocol, a country's actual emissions have to be monitored and precise records have to be kept of the GHG reductions.

For developing countries, the main method by which they are expected to reduce emissions is through the Clean Development Mechanism (CDM), which allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in a developing country. Such a project can earn saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO_2, which can be counted towards meeting Kyoto its targets.

Paris Agreement

To complement the global efforts to address climate change as guided by the UNFCCC and the shortcomings of the Kyoto Protocol, an agreement on climate change that is applicable to all parties called the Paris Agreement was negotiated and adopted in December 2015. The Agreement

presents the most ambitious global step towards fighting climate change and reorienting the international economy towards low carbon development. Zimbabwe signed the Paris Agreement in 2016 and ratified the agreement in 2017. The Paris Agreement provides a point of departure from the Kyoto Protocol in that it requires all parties to the Agreement to contribute towards the reduction of GHG emissions whilst building resilience.

Of note in the Paris Agreement are Article 2 and Article 4. Article 2 articulates on the need 'to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by amongst other things holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change'. In order to comprehensively address climate change mitigation, Parties are expected to develop long-term low greenhouse gas emission development strategies as elaborated in Article 4. Article 4 specifies that "all Parties shall strive to formulate and communicate long-term low greenhouse gas emission development strategies, mindful of Article 2 taking into account their common but differentiated responsibilities and respective capabilities, in light of different national circumstances".

Nationally Determined Contributions to the UNFCCC

In 2015, the UNFCCC requested all parties to submit their then Intended Nationally Determined Contributions (INDCs) towards reducing global emissions. Article 4 of the Paris Agreement states that "Each Party shall prepare, communicate and maintain successive Nationally Determined Contributions (NDCs) that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions". NDCs detail and quantify intended actions by countries in reducing GHG emissions and form the cornerstone of the Paris Agreement.

Article 6 of the Paris Agreement establishes a mechanism to contribute to the mitigation of GHG emissions and support sustainable development for use by Parties on a voluntary basis. The mechanism aims to:

i. promote the mitigation of greenhouse gas emissions while fostering sustainable development;
ii. incentivize and facilitate participation in the mitigation of greenhouse gas emissions by public and private entities authorized by a Party;
iii. contribute to the reduction of emission levels in the host Party, which will benefit from mitigation activities resulting in emission reductions that can also be used by another Party to fulfil its nationally determined contribution; and
iv. deliver an overall mitigation in global emissions.

During the 2015 Paris Climate Conference, the UNFCCC Secretariat reported that the implementation of the communicated NDCs is estimated to result in aggregate global emission levels of 55.2 (52.0 to 56.9) Gt CO_2 eq in 2025 and 56.7 (53.1 to 58.6) Gt CO_2 eq in 2030. The relative rate of growth in emissions in the 2010 to 2030 period is expected to be 10 to 57% lower than that over the period 1990 to 2010, reflecting the impact of the INDCs. The Conference of Parties to the UNFCCC in Decision 1/CP.21 (2015) notes with concern that the estimated aggregate greenhouse gas emission levels in 2025 and 2030 resulting from the intended nationally determined contributions do not fall within least-cost 2℃ scenarios and that much greater emission reduction efforts will be required than those associated with the intended nationally determined contributions in order to hold the increase in the global average temperature to below 2℃ or to 1.5℃ above pre-industrial levels.

The Montreal Protocol on Substances that Deplete the Ozone Layer

The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted on 16 September 1987 and entered into force on 1 January 1989. Its objective is to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer by phasing out man-made chemicals that deplete the stratospheric ozone layer.

Most of the ozone depleting substances in use today are in refrigeration and air conditioning sectors. These include Hydrofluorocarbons (HFCs) which have a high global warming potential and contribute to climate change. HFCs are Greenhouse Gases (GHGs) that are also controlled under the Kyoto Protocol but were introduced to replace Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs) in Refrigeration and Air Conditioning. There has been a sharp increase in use of HFCs in Refrigeration and Air Conditioning, which has resulted in increased emissions of these GHGs into the atmosphere exacerbating impacts of climate change globally. Zimbabwe is party to the Montreal Protocol.

The Kigali Amendment is the current amendment to the Montreal Protocol and requires parties to gradually reduce the use of Hydrofluorocarbons (HFCs) by between 80 to 85% by 2045 and 2047, respectively, for developing countries and by 2036 for developed countries. The base line level for HFCs reduction is calculated as the average of the consumption figures for the years 2020 to 2022. This will be followed by a freeze in the consumption of these gases by the 2024 for African States and other developing countries. Globally, the reduction of HFCs under the Kigali Amendment is expected to avoid up to 0.4℃ warming by the end of the century, while continuing to protect the ozone layer.

Chapter 2 Climate Change Vulnerability and Adaptation Assessments

The chapter will introduce participants to:

- Key definitions and concepts of climate change vulnerability, adaptation and resilience.
- Framework for vulnerability assessment; examples of adaptation options that can be implemented for various vulnerable sectors.
- Linkages between climate change adaptation and development.

Important international and local adaptation initiatives and programmes.

Learning Objectives

At the end of the chapter, participants will be able to:

- Explain the importance of adaptation in preparing for and coping with climate change.
- Outline key elements of a vulnerability assessment.
- Identify adaptation options.

Analyse linkages between climate change adaptation development planning and gender considerations.

Topics

The following topics will be covered include:

- Introduction to climate change adaptation and resilience.
- Steps in doing a vulnerability assessment.
- Identifying and selecting adaptation options.
- Linking adaptation and development planning.
- International and local initiatives to support climate change adaptation.

2.1 Introduction

Zimbabwe and other developing countries are vulnerable to climate change due to factors such as exposure to climate induced extremes and risks, level of economic development, among others. As a result of this vulnerability, the country is in the process of strengthening the enabling environment for climate change adaptation guided by national and international climate policy architecture such as the National Climate Change Response Strategy, Paris Agreement, Sendai Framework for Disaster Risk Reduction and the 2030 Agenda for Sustainable Development. The Paris Agreement emphasis the need for countries to increase their ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production.

Tangible steps need to be taken to empower planning structures at all levels, different socio-economic sectors and communities to build their resilience to the threats that climate change brings. Left unchecked, these threats will erode long-term opportunities for human development, undermining human productivity and capabilities. This chapter introduces you to the key matters related to climate change adaptation and its links with development planning. It aims to build a basic understanding of vulnerability to climate change and how it feeds into the adaptation process, the selection of adaptation options and the building of long-term resilience to climate change impacts.

2.2 Defining Key Concepts

For the purposes of this climate change module, we shall define the key concepts of vulnerability, adaptation and resilience as follows:

- Vulnerability to climate change is the propensity or predisposition to be adversely affected by climate related hazards. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. It is important to note that 'vulnerability' has no universally accepted definition and that it is important to clarify the conceptual framework at the start of any vulnerability aligned task.
- Adaptation is the adjustment of a system to moderate the effects of climate change and to take advantage of new opportunities. It is the process of adjustment to actual or expected climate and its effects. In human systems adaptation seeks to avoid harm or exploit beneficial opportunities and in some natural systems, human intervention may facilitate adjustment to expected climate and its effects.
- Resilience is the capacity of social, economic, and environmental systems to cope with a hazardous event, trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation. Resilience can be assessed through functions that determine, in the context of specific configurations and disturbances, the ability of a system to a) absorb shocks and retain its basic function, b) self-organize, and c) innovate and learn in the face of disturbances.

Figure 2.1 illustrates the main factors considered when determining the level of vulnerability of an individual, organisation or society. Closely related to vulnerability is climate risk. Generally, the greater the exposure to a climate hazard and sensitivity, the greater the vulnerability and climate risk. Greater adaptive capacity tends to lessen the effects of exposure and sensitivity thereby reducing vulnerability and climate risk.

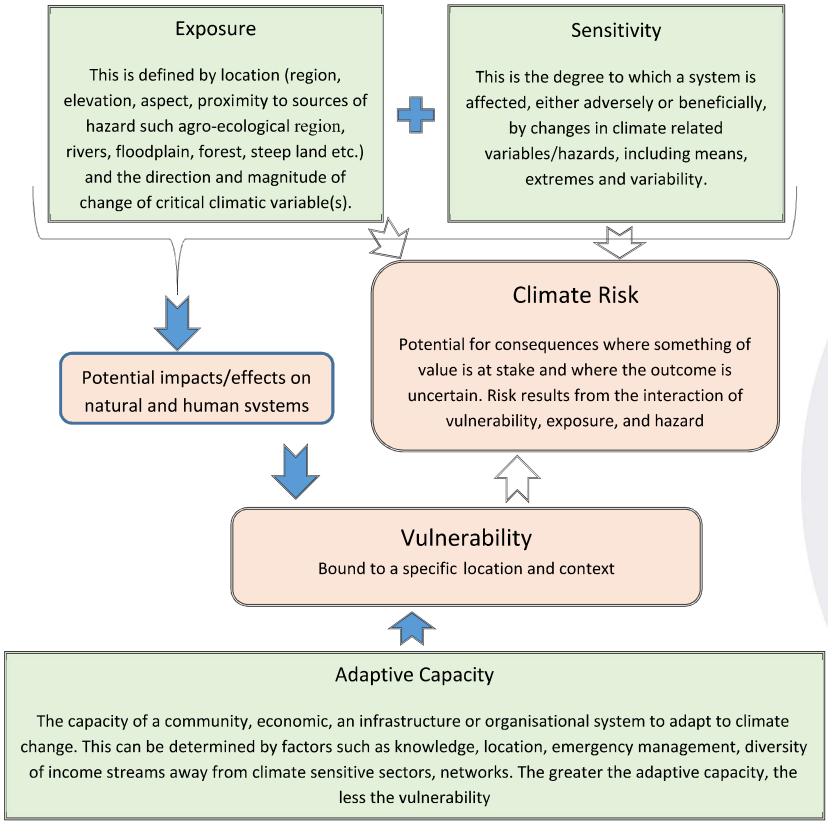


Fig 2.1: Exposure to Hazards and Sensitivity to Climate Change against the level of Adaptive Capacity define the Vulnerability and level of Climate Risk of a society.

Activity 2.1

What are some of the areas in your districts that are exposed to climate change due to their location? Elaborate on the weather related extremes that they are exposed to.

Are there any measures being taken to reduce the sensitivity of your province or district to climate change?

2.3 Linkages between Climate Change Adaptation and Development

Responding to the impacts of climate change is critical. Ensuring that climate change risks and impacts are considered systematically in national development policies and programmes is critical and this should be done with the view to making social and economic development resilient to a changing climate. 'Development as usual', without consideration of climate risks and opportunities, will not allow national development strategies to confront climate challenges.

Climate change has an impact on the development of all socio-economic sectors and if not addressed it creates a vicious cycle of poverty especially for rural communities. For example, the increased incidences of droughts and prolonged mid-season dry spells has had an impact on agricultural productivity and related incomes which in turn impact children's education and health resulting in school dropouts. The 2017 poverty survey by the Zimbabwe National Statistical Agency notes that for all Zimbabwe, children who left school and had not completed Grade 7 were poor (90.4%), while 52.4% were extremely poor. Children who left school having completed Form 4, were less likely to be poor (61.2%) compared to children who left school without completing Form 4. The high prevalence of poverty in turn reduces the populations adaptive capacity as savings are non-existent, knowledge limited and the community asset-base is low.

The United Nations (2019) notes that an agricultural drought affected many parts of Zimbabwe over the 2018/2019 rainfall season affecting 5.3 million people and requiring US$234 million in humanitarian assistance in order to avert hunger and starvation. With climate change, droughts are expected to become more frequent and intense. Nhemachena (2007) conducted studies which revealed that for Zimbabwe by 2050 a 2.5°C increase in temperature would result in a decrease in net farm revenues by US$0.4 billion for all farms and increase net revenue from farms with irrigation by US$0.3 billion. The study also examined the impact of a 5°C increase in temperature and the results showed that net revenues would decrease across, dryland farms and farms with irrigation by US$0.5 billion and US$0.003 billion respectively. A 14% decrease in precipitation would result in a decrease in net farm revenue by US$0.3 billion for all farms. These losses in revenue would have a direct impact on the purchasing power of farmers and would have a ripple effect on the rest the economy and revenue collected by the government.

The close relationship between climate change and development is aptly demonstrated by various extreme weather events that have affected the country in the past. Droughts, heavy rains and associated flooding, hailstorms and destructive winds disrupt socio-economic wellbeing and trigger humanitarian response measures that divert resources from developmental activities. The following pictures illustrate some disruptions caused by extreme weather events in Zimbabwe.Examples of impacts of climate change in Zimbabwe in recent years:

Figure 2.2: Picture extract from The Herald, 25 January 2010. A month-long dry spell wiped off the rain-fed maize crop in various parts of the country. This resulted in compromised food security and nutrition for many rural households, loss of income and limited local availability of raw materials for agro-processing industries. UNICEF (2014) links poor harvests to early child marriages.

Figure 2.3 A collapsed bridge in Chimanimani pictured on 18 March 2019 in the immediate aftermath of extreme heavy rains brought about by Tropical Cyclone Idai. According to the 2019 UN Flash Appeal for Zimbabwe about 5,000 meters of the water distribution network was washed away in Chimanimani town, over 250 boreholes, 18 water supply systems were damaged and more than 50 schools lost sanitation infrastructure in Chipinge and Chimanimani districts.

Figure 2.4 Picture extract from The Herald, 5 February 2010 showing a tobacco crop severely damaged by a hailstorm. Such events often result in financial setbacks on the part the farmer and overall losses of foreign currency exchange that the country would have generated from the export of the cash crop. Serious psychological impacts have been noted with some farmers reportedly committing suicide after failing to pay back bank loans.

Figure 2.5 Sizane High School in Bulawayo in the immediate aftermath of a storm that destroyed its roof, windows and learning materials in October 2016. Severe damage to education, health and other social infrastructure critical for human development is becoming increasingly common compromising the quality of service delivery.

The links between climate change and poverty are clearly disenable as extreme weather events tend to erode development gains as well as the capacity of communities and individuals to attain their full potential. The impacts of climate change are multifaceted and involve various interconnections as illustrated in Figure 2.6.

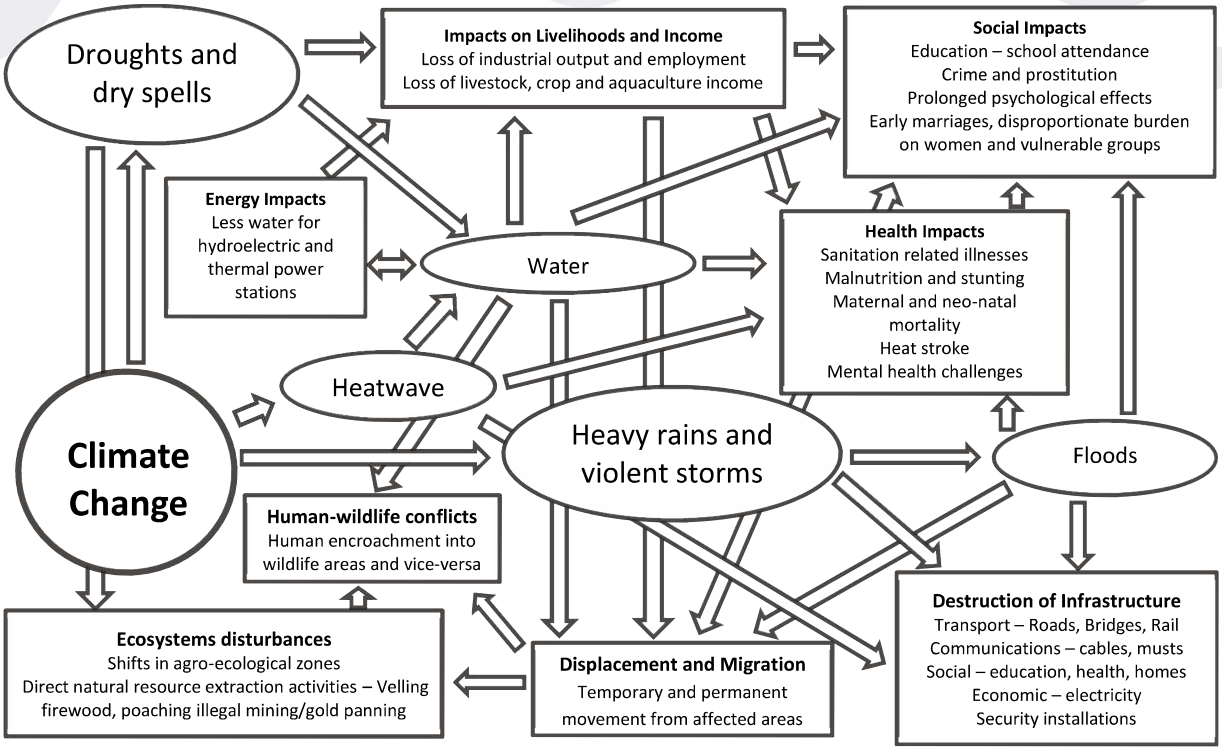


Fig 2.6 An Illustration of the Complex Inter-Relationships between Climate Change and Various Environmental , Social And Economic Element

The climate change adaptation process aims to support decision-making of communities, organisations and governments (including local governments) so that they are able to anticipate weather variability and in response to this and on the basis of experience, adjust plans and investment strategies accordingly. The high vulnerability levels of developing countries call for countries to develop adaptation strategies in order to increase resilience. UNDP (2018) identifies four levels that should be considered as components of an adaptation strategy as summarised in Table 2.1.

Table 2.1: Components of an Adaptation Strategy (Modified from UNDP, 2018)

Adaptation strategy component	Types of adaptation response	Brief Description	Aspects of vulnerability addressed
i. Improving baseline resilience to current climate variability	• Asset accumulation • Capacity development • Adaptive capacity development • Risk transfer	These are the actions or investments in established livelihood systems in response to expected or known patterns of climate variability. These investments should result in the community exhibiting the ability to self-organise, diversify livelihoods to deal with economic and social shocks and their anticipation and reaction to variability and extremes.	Sensitivity
ii. Adaptation to climate change hazards	• Asset accumulation (protection)	Involves system changes to prepare for climate change through managing uncertainty by improving adaptive capacity and giving people economic options with which they can rebound and recover from climate shocks.	Exposure
iii. The adjustment of policies and budgets	• Capacity development • Adaptive capacity development	Policy and institutional mainstreaming necessary for the scaling-up and replication of successful adaptation approaches as well as the promotion of innovation. This involves capacity development that encompasses actions to improve the effectiveness and efficiency of government institutions their capacity for planning for climate change.	Sensitivity and Exposure
iv. Addressing the residual risk	• Risk transfer, safety nets, insurance	Losses are inevitable, as it is impossible to reduce risk to zero due to climate variability. Risk transfer spreads the risks of extreme weather to a large pool of individuals through private-secto insurance schemes, family and community networks, as well as country-level or regional loss-sharing mechanisms.	Sensitivity
	• Relocation	The movement of settlements , infrastructure and livelihood zones to areas with less hazards.	Exposure

2.4 Framework for Climate Vulnerability Assessment

UNDP (2018) notes that adaptation is difficult without addressing baseline vulnerabilities. For countries with high levels of inequality and poverty, low levels of basic service delivery and limited livelihood options, vulnerability to climate change is high; addressing basic needs is the foundation for adaptation. Unless baseline stresses are addressed, unhelpful feedback loops can become activated through interventions intended to combat climate change, increasing vulnerability that magnifies negative effects or lead to maladaptation. For these climate baseline stresses to be accurately identified a climate vulnerability assessment (CVA) needs to be carried out before a climate change adaptation programme is initiated. USAID (2014) describes a CVA as an evidence-based analysis conducted to identify the extent to which a human, social and/or ecological system has been or will likely be affected by climate variability and change, and strategies to address these impacts.

2.4.1 Determining the Scope and Methods for CVA

The scope and methods used for conducting CVAs vary widely in the following aspects:

i. Complexity, from desk-based studies using existing resources to extensive modelling exercises;
ii. Consideration of space and time, covering very localized sites, entire countries, regions or the globe, or current, near-term or long-term future time periods;
iii. Purpose, from identifying climate change impacts to monitoring progress; and
iv. Level of expertise required to carry out the assessment.

The CVA provides a robust information base from which to design interventions aimed at reducing climate risks and/or taking advantage of the opportunities brought about by climate variability and change, both now and in the future. Specifically, CVAs can help one understand the following:

i. What climate stressors (e.g., rainfall changes, temperature change) contribute to vulnerability.
ii. Who or what is vulnerable to climate variability and/or change (e.g., fishing communities, rain-fed agriculture, wildlife tourism, and infrastructure) and what they are vulnerable to.
iii. Where vulnerable people, ecosystems, infrastructure and resources are located (e.g., near mudslide prone mountains or in a floodplain).
iv. When people or resources are or are likely to be vulnerable (e.g., dry season or cyclone season).
v. What internal and external factors make specific groups of people (e.g., children, elderly individuals) and resources vulnerable (e.g., poor community cohesion).
vi. What people and communities are doing to reduce their own vulnerabilities.
vii. How well people's and communities' actions are working to reduce their own vulnerabilities.
viii. The extent to which climate stressors (e.g., droughts) become barriers to development relative to non-climate stressors (e.g., population growth).
ix. What options are available to help people and communities adapt to the effects of climate variability and change.

2.4.2 The Role of Climate Change Scenarios in CVAs

Robust climate change scenarios are at the heart of successful climate vulnerability assessments. This is largely because of the usefulness of the scenarios themselves in shaping and guiding present and future assessments and actions. Figures 2.7 to 2.10 illustrate maps of Zimbabwe indicating some of the elements (poverty prevalence, proneness to meteorological droughts, proneness to mid-season dry spells and proneness to flooding) that define the climate vulnerability of different parts of the country that should be included in the initial stages of any vulnerability assessment to define the current state.

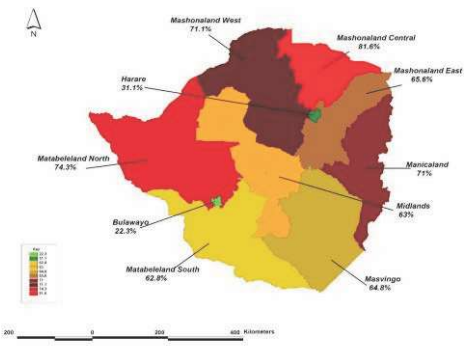


Fig 2.7: Poverty prevalence map by province 2017

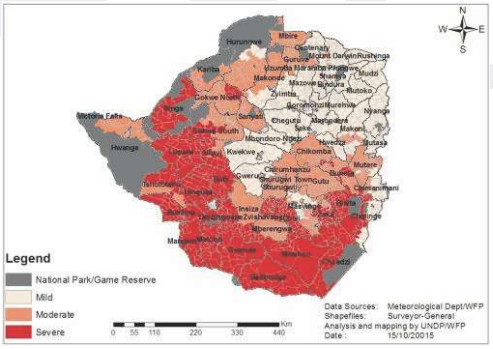


Fig 2.8: Proneness to meteorological droughts

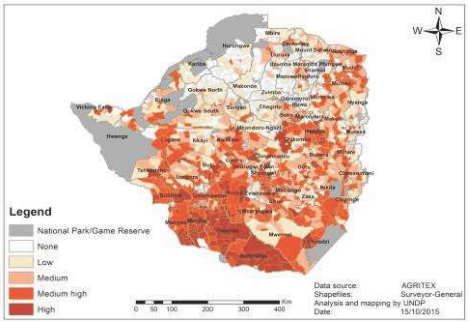


Fig 2.9: Proneness to mid-season dry spells

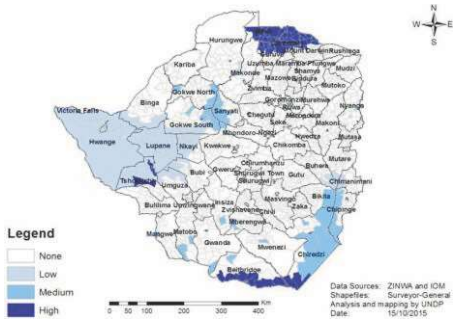


Fig 2.10: Areas prone to flooding

Whilst the information in figures 2.8 to 2.10 is of paramount importance in providing a broad understanding of the country's vulnerability to climate related hazards, climate change projections into the future are required to inform present-day planning. Climate change entails that the weather extremes are bound to get worse as we go into the future. The 2019 UNEP Emissions Gap Report notes that we will face increasingly severe climate impacts worldwide due to the fact that current global commitments for decarbonisation are way below what is required to stop catastrophic extreme weather events. This makes future climate projections critical in informing development planning and associated activities.

Figures 2.11 and 2.12 show the annual precipitation anomalies over Zimbabwe assuming that global changes will be in line with lowering of greenhouse gas concentrations in the near future or GHG emissions will reach their highest level respectively from 2020 to 2040. Figures 2.13 and 2.14 provide projections for the years 2041 to 2060. It should be noted that these are projections into future and highly dependent on the trajectory of the global economy which in turn is guided by politics and other factors therefore, there are uncertainties. None the less, they provide a scientific basis for planning.

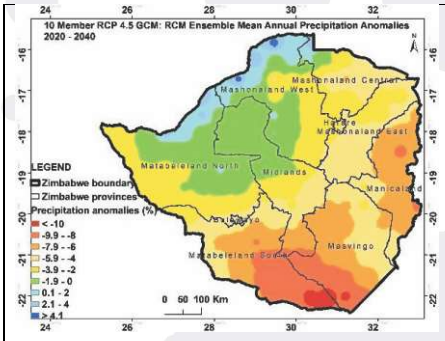


Fig 2.11: 10 Member RCP 4.5 GCM: RCM Ensemble Mean Annual Precipitation Anomalies 2020-2040

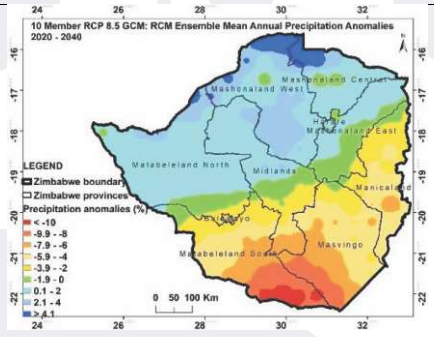


Fig 2.12 : 10 Member RCP 8.5 GCM: RCM Ensemble Mean Annual Precipitation Anomalies 2020-2040

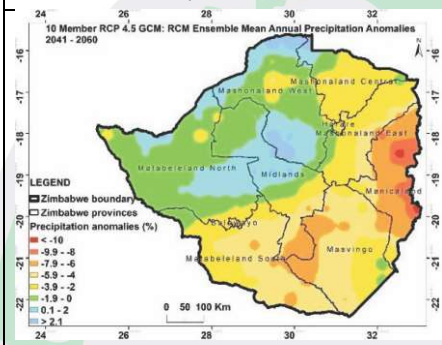


Fig 2.13: 10 Member RCP 4.5 GCM: RCM Ensemble Mean Annual Precipitation Anomalies 2041-2060

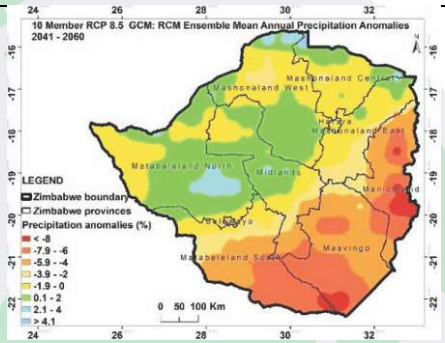


Fig 2.14 : 10 Member RCP 8.5 GCM: RCM Ensemble Mean Annual Precipitation Anomalies 2041-2060

In addition to the use of climate models, UNFCCC (2008) acknowledges that there are other approaches to developing climate change scenarios to support climate vulnerability assessments. These alternative approaches include:

i. Past climate analogues (using observed historical climate changes as an indicator of potential future changes);
ii. Spatial analogues (using maps to show how a location could change in the future); and
iii. Using incremental arbitrary changes (to assume simple increments of changes in climate variables).

The IPCC provides a synthesis of most of the conceptual frameworks used in vulnerability assessments through its Working Group II Synthesis Reports.

2.4.3 Climate Vulnerability Assessments at the Local Level

At the local activity level, CVAs can help focus adaptation or resilience efforts and inform the identification and incorporation of specific responses to climate stressors into activity implementation. This generally requires in-depth, field-based primary data collection to understand the factors that contribute to climate vulnerabilities in greater detail than is needed for strategy or project design. Table 2.2 provides a simplified approach to climate vulnerability assessment as adopted from USAID (2014). A successful assessment should be able to:

- Identify the critical climate risks to development activities
- Identify climate risk hotspots within the activities/zones
- Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable
- Analyse the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure.

Table 2.2 provides a framework through which a climate vulnerability assessment can be nested. It can be used as simplified checklist by development practitioners.

Table 2.2: Suggested Questions, Methods and Outputs for a Comprehensive Climate Vulnerability Assessment

Objectives and Questions	Methods	Illustrative Outputs
Identify the critical climate risks to the activity - Which climate risks are likely to have significant consequences for specific tasks or interventions and what effects will they have?	*Desktop review* to: • Identify the climate stressors most likely to affect activity site(s) • Determine how these climate stressors may interact with relevant non-climate stressors • Understand historical and projected climate risks for the activities • Understand past climate vulnerabilities and impacts of tasks and interventions *Stakeholder consultations* to: • Ground truth desktop review findings on risks to activity sites, sectors, communities or ecosystems • Identify or confirm vulnerable communities, ecosystems and resources – targeted participation of sector/area/community/ ecosystem experts and practitioners, community leaders, decision makers	• Charts of historical climate trends and future projections for a region, country or specific area • Country-, region- or location-specific narrative summarizing historical climate trends and future projections
Identify climate risk hotspots within the activity - Which regions, communities, ecosystems or natural resources are likely to experience the greatest vulnerabilities and/or impacts?	*Desktop review* to: • Identify the activity groups, ecosystems or natural resources that have been or are most vulnerable to climate risks • Understand the factors that contribute to their vulnerabilities, including the role of both climate and non-climate stressors *Stakeholder consultations* to: • Ground truth desktop review findings on vulnerable activity groups, ecosystems or natural resources – targeted participation of group/ecosystem/resource experts and practitioners, group or community leaders and representatives	• Maps and narrative describing identified hotspots, the associated vulnerabilities and the factors that contribute to them • Vulnerability index based on exposure, sensitivity and adaptive capacity indicators • Narrative summarizing sectoral climate risks, vulnerabilities and/or impacts • Qualitative

Objectives and Questions	Methods	Illustrative Outputs
	• Identify or confirm most vulnerable groups, ecosystems, natural resources – targeted participation of group/ecosystem/resource experts and practitioners, group or community leaders and representatives, decision makers *Additional analysis to:* • Conduct hazard, vulnerability or risk mapping; impact modeling; institutional assessment; and economic impact analysis • Conduct geospatial mapping of climate risks and impacts	ranking of sectoral climate risks, vulnerabilities and/or impacts to inform bounding of sector programming or project design, based on experts' and/or other stakeholders' inputs • Qualitative ranking of climate risks for strategy, project or activity goals based on experts' and/or other stakeholders' inputs • Risk matrix comparing probability and severity of different impacts
Understand what makes certain groups, ecosystems, species, natural resources or infrastructure vulnerable - What factors contribute to the exposure and sensitivity of communities, ecosystems, species, natural resources or infrastructure to climate variability and change?	*Desktop review* to: • Identify which activity communities, ecosystems and resources are exposed and sensitive to climate risks • Determine which factors contribute to exposure and sensitivity and how they may change • Understand how climate stressors may exacerbate non-climate stressors and which are greater contributors to sensitivity *Stakeholder consultations* to: • Gather local perceptions about exposure and sensitivity and fill gaps in understanding – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders • Ground truth desktop review findings about exposure and sensitivity factors, and the relationships between climate and non-climate stressors • Obtain local (traditional and other) knowledge about the exposure and sensitivity of target communities, ecosystems and resources; examples of other methods that may be relevant are participatory mapping and participatory rural appraisal	• Narrative describing groups', ecosystems', or resources' exposure and sensitivity and the factors that contribute to them • Vulnerability index based on group, ecosystem and/or resource exposure, sensitivity and adaptive capacity indicators • Maps of vulnerable groups, ecosystems or resources

Objectives and Questions	Methods	Illustrative Outputs
	• Understand which factors are most important contributors to exposure and sensitivity – targeted participation of community/ecosystem/resource experts and practitioners, community representatives and leaders	
Analyse the adaptive capacity of groups, ecosystems, species, natural resources or infrastructure - What physical, social, institutional, human and financial capacity to adapt to climate change exists and where are the gaps?	*Desktop review* of available information to: • Understand the capacities that communities, ecosystems and resources have leveraged in the past or currently leverage to respond to climate risks *Stakeholder consultations* to: • Gather local perceptions about the adaptive capacity of the communities, ecosystems and species that are the focus of the activity and fill gaps in understanding. • Obtain local (traditional and other) knowledge about adaptive capacity; examples of other relevant methods are participatory mapping and participatory rural appraisal • Ground truth desktop review findings about activity-level adaptive capacity – targeted participation of community/ecosystem/resource experts and practitioners, community/group representatives and leaders • Determine gaps in adaptive capacity and opportunities to strengthen it, including local (traditional and other) knowledge about exposure, sensitivity and adaptive capacity	• Narrative describing physical, informational, social and institutional, human, and financial adaptive capacity • Index based on indicators of physical, informational, social and institutional, human and financial adaptive capacity

2.5 Adaptation Options for Different Sectors

The impacts of Climate Change on agriculture in Zimbabwe through droughts, prolonged dry spells and hailstorms is well documented and the Government of Zimbabwe in the Baseline Report on Economic Development and Climate Change (2012), National Climate Change Response Strategy (2014) and National Climate Policy (2017) prioritises climate change adaptation in the agricultural sector. Table 2.3 outlines the climate risks associated with agriculture in Zimbabwe and the related adaptation options whilst table 2.4 briefly outlines options in the water, transport, settlements and energy sectors. More adaptation detailed options in the agriculture sector in the 2017 Climate Smart Agriculture Manual for Agricultural Education in Zimbabwe.

Table 2.3: Adaptation Options in the Agricultural Sector

Climatic risk	Effects on agriculture	Adaptation options
Decline in precipitation	Decrease in optimal farming conditions for some areas	· Livelihood diversification · Strengthen local farming capacity to reduce sensitivity to climate change · Changing cultivation practices · Increased irrigation of key crops
Increase in temperature	Crop area changes and decreased crop productivity	· Changes in crops and cropping patterns · Increased input of agro-chemicals to maintain yields · Advisory services for farmers on adapted farming practices and on new crops · Crop planting diversification · Agricultural insurance
	Loss of soil water retention capacity	· Irrigation · Create/restore wetlands · Water retention technologies
	Land abandonment	· Design regional adaptation plans · Livelihood diversification
	Increased erosion	· Better and new agricultural practices that reduce erosion · Change fallow and mulching practices to retain moisture and organic matter
Increase in extreme weather events	Droughts and floods	· Increase rainfall interception capacity · Reduce grazing pressures to protect against soil erosion from flash flooding · Contour ploughing and increase drainage · Insurance for crop damage and farm infrastructure
Frequent droughts	Reduced water availability	· Invest in irrigation development · Improvements in irrigation technology – drip irrigation, · New irrigation practices, eg. irrigating during the night · Installation of small-scale reservoirs on farms · Improve field drainage and soil absorption capacity · Improved water management, eg. water audits, water charging to promote efficient water use; recreate wetlands
	Deteriorating conditions for livestock	· Livestock breeding and introduction of heat tolerant breeds · Supplemental feeding · Match stocking densities to forage production

Table 2.4: Adaptation Options for Other Key Socio-Economic Sectors

KEY SECTOR			
Transport	Water	Settlements and Social Infrastructure	Energy
• Physical changes transport network, for example , ensuring that surface materials used for tarred roads can withstand high temperatures. • Construction of drains along roads, and bridges at appropriate heights can reduce the risk of flooding and flood damage. • Procedural changes, including mandatory drainage inspection beforethe rainy season commences. • Organisational changes, such as changes in policy, standards, contracts, decision making and investment. • The transport sector plays an important role in disaster preparedness and response e.g. Through collection of rainfall data along railway lines helps determine the safe use of particular sections of the track.	• Limit groundwater extraction by issuing of permits and fees for groundwater extraction Increase storage capacity by building reservoirs and dams • Work on the maintenance, rehabilitation and re-engineering of existing systems, canals, pumps, rivers and wetlands; and, • Develop and implement rainwater harvesting and storage techniques Improve the efficiency of irrigation technology to deliver more crops per drop; introduce drip irrigation technology to deliver more crops per drop; introduce drip irrigation, wastewater reuse and water recycling • Promote indigenous practices for sustainable water use (e.g. dambo cultivation); and , • Expand the use economic incentives,including metering and pricing, to encourage water conversation	• Make use of flood prone area maps provided by the Department of Civil Protection in settlement planning. • Review building codes and associated by-laws. • Climate proof existing social infrastructure such as school and clinics e.g. By adopting roof designs that are blown away by strong winds or destroyed by hail.	• Promote use of non-climate sensitive sources such as solarin tandem with grid electricity or mini-hydro power plants **Health** • Ensure the use of early warning systems in the design of local health programmes and activities • Raise community awareness on the linkages between climate change and increase in certain ailments within their locality

Activity 2.2

Identify climate change impacts the health sector in your province or district. Provide a list of adaptation options that ca be adopted to tackle these impacts

List the challenges that you would likely face in conducting a climate vulnerability assessment in your province or district. Suggest how these can be overcome.

2.6 Important Points to Note in Climate Change Adaptation Planning

Mainstreaming climate change adaptation into development planning requires practitioners to note the following important key points:

- It is vital to know the purpose of mainstreaming climate change as we implement adaptation planning. Mainstreaming aims to increase the effectiveness, efficiency and longevity of initiatives directed at reducing climate-related risks while at the same time contributing to sustainable development and improved quality of life.

- As adaptation measures are designed and undertaken, unintended impacts should be noted and addressed. Effective conflict management demands that responses that are effective in reducing climate risk are sustainable. An adaptation measure may be effective for one community but may undermine the ability of others to adapt through spatial spill overs and negative externalities. For example, stream bank cultivation due to failing irrigation systems in Zimbabwe further reduces the amount of river flow due to siltation affecting the remaining irrigation systems.

- In most cases climate change impacts are linked to gender issues and women's vulnerability. Decreasing availability of clean water, decreasing agricultural production, decreasing access to crop residues and biomass for energy, and increasing risk of famine are all areas where women take primary responsibility. These negative impacts of climate change are expected to increase in line with changes in extreme weather events. In light of this, there is a need to capture the positive effects of choosing adaptive investments which take the different needs of men and women into account. Women should be considered as agents of change who require an equitable footing in the adaptation process.

- The real challenge to mainstreaming adaptation is not planning but implementation.The implementation phase requires budgets, human resource capacity development and procurement to be climate sensitive and aligned towards low emission climate resilient development pathways. Public awareness, education and community participation are key enablers to ensure success of the mainstreaming process.

2.7 Climate Change Adaptation Initiatives

Since the acknowledgement by the international community in the 1990s that anthropogenic climate change is happening, various programmes and projects have been initiated and undertaken with the aim of aiding adaptation and resilience building efforts. The adaptation measures to address climate change vulnerability include both structural and non-structural measures. Structural measures are physical changes to infrastructure to achieve or facilitate adaptation and non-structural are other measures such as changes to contracts or implementing an emergency management plan.

All climate change adaptation programmes and projects aim to achieve transformation, that is, a change in the fundamental attributes of natural and human systems to reflect strengthened, altered or aligned paradigms, goals, or values towards promoting adaptation for sustainable development, including poverty reduction. The types of initiatives being implemented to address climate change vary widely and range from United Nations funded programmes to those sorely supported by the government or its agencies. Since climate change is a cross-cutting matter, the range of activities that can be undertaken to enhance adaptation and resilience is limitless.

Figure 2.15: A small dam constructed by the community in Mwenezi with the assistance of the Zimbabwe Resilience Building Fund. Climate change adaptation through water harvesting and redirecting its use for agriculture, household and other uses requires hard engineering to be done.

Figure 2.16: Teachers and Pupils at Machakata Secondary School in Gokwe South pose for a picture after that installation of a weather station by the Supporting Enhanced Climate Action Project in 2018. Education and awareness are regarded as enablers in climate change adaptation and most initiatives include a component relevant to the objectives of the project or programme. An understanding of one's local climate is a prerequisite when crafting adaptation interventions.

Figure 2.17: A newly build climate proofed rural homestead constructed by the government for one of the victims of the flooding that occurred in Tsholotsho as a result of cyclone Dineo of 2017. Climate change adaptation initiatives are closely aligned with concept of building back better which is being promoted under disaster risk management. Extreme climate events can trigger adaptation action.

Figure 2.18: Members of the Zimbabwe Defence Forces assist a wounded victim in the immediate aftermath of Tropical Cyclone Idai in March 2019. Ongoing government programmes aim to enhance the capabilities of all members of the Civil Protection Organisation including in climate change awareness, adaptation planning and climate related disaster preparedness and responsiveness.

Figure 2.19: The active participation women and girls in climate change adaptation planning is crucial. The picture shows part of an adaptation and disaster risk management training exercise conducted in Natane Ward 3 Bulilima 2019 under the Supporting Enhanced Climate Action Project

Figure 2.20: Drip irrigation at Tshongonkwe Irrigation scheme in Lupane. Some Adaptation projects in the agriculture sector have focused on such technologies which improve water use efficiency given that most climate models are pointing towards greater aridity in the future. The benefits also include the growth of private sector entities that manufacture and repair such technologies thereby aiding the economy at large.

2.8 Summary

Improving the quality of public-sector decision making for the efficient and effective use of scarce public resources requires that decisions consider all risks and drivers, including climate change, which is becoming increasingly important. All programmes and projects should mainstream climate change in order to protect development gains and ensure that new initiatives are resilient to climate related challenges. Climate change mainstreaming should be guided by in-depth vulnerability assessments which provide enhanced understanding of the challenge at hand and the options available to tackle it. Despite all the efforts towards addressing the impacts of climate change, reducing or eliminating anthropogenic emissions into the atmosphere still remains the best may limit runaway climate change. The next chapter will introduce you to climate change mitigation.

Chapter 3 Introduction to Climate Change Mitigation and Low Carbon Development

The chapter introduces participants to:

- Key definitions of mitigation
- Introduction to greenhouse gas emissions, sources and sinks.
- Emission reduction strategies at global and national level
- Overview of national emission levels
- Country Mitigation targets
- Mitigation in the PA
- Potential mitigation options
- Integration of mitigation into development planning through low emission development strategies.

Learning Objectives

After completing the chapter, participants will be able to:

- Explain the importance of climate change mitigation and low carbon development.
- Describe relevant policy approaches and strategic frameworks.
- Identify key sectors for low carbon development and outline relevant mitigation options.
- Identify the main international mechanisms to support climate change mitigation and low carbon development.

Topics

The following topics will be covered:

- Introduction to climate change mitigation and low carbon development.
- Strategic frameworks and policy approaches for mitigation and low carbon development.
- Sectors with high mitigation potential.
- International and local initiatives to support climate change mitigation.

3.1 Introduction

This section provides a definition of climate change mitigation and related concepts. It further gives an overview of greenhouse gases (GHGs), current emission levels, as well as pledges of different countries to reduce GHG emissions in the future. The section concludes with some examples of co-benefits of climate change mitigation. Recognizing the centrality of reducing greenhouse gas emissions as the ultimate solution to addressing the vulnerability of systems and communities to climate change, this section describes the importance of mitigation and its benefits to socio-economic development.

What is Climate Change Mitigation?

Mitigation refers to efforts to reduce or prevent emission of greenhouse gases (GHGs) or to enhance their removal from the atmosphere by sinks. A sinks is any reservoir natural or otherwise that absorbs more carbon than it releases thereby lowering the concertation of carbon dioxide in the atmosphere

In order to prevent dangerous anthropogenic interferences with the climate system, it is imperative that action be taken to stabilize GHG concentrations in the atmosphere, hence, such actions are referred to as "climate change mitigation". Elements of mitigation includes:

- Reducing GHG emissions (e.g. by increasing efficiency)
- Preventing new GHG emissions to be released in the atmosphere (e.g. by avoiding the construction of new emission-intensive factories and
- Preserving and enhancing sinks and reservoirs of GHGs (e.g. by protecting natural carbon sinks like forests and oceans, or creating new sinks i.e. "carbon sequestration.

3.1.1 Concepts Related to Climate Change Mitigation

- Mitigation options can be classified in three way namely: a technology, practice or policy that reduces or limits emissions of GHGs or increases their sequestration. In order to reduce or limit GHG emissions and or increase their sequestration, a plethora or variety of mitigation options can be taken. They can be as complex as low-emission plan for the energy or agricultural sectors or as simple as improvements to daily appliances such as cook stove design. Mitigation options can vary greatly from one country to the other and need to be adapted to specific national circumstances·
- Low carbon/ emission development: low carbon development refers to economic development with minimal output of GHG emissions i.e. using less carbon for growth.
- Green Economy: this refers to an economy that results in 'improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities' (UNEP 2010). Green Economy encompasses the reduction of GHG emissions and also covers other environmental issues which are not directly related to climate change.

In order to make informed mitigation decisions, it is important to consider different GHGs, their sources and contribution to climate change through their Global Warming Potential (GWP). In terms of quantitative emissions, the most important gas is carbon dioxide as it accounts for approximately 76% of total GHG emissions. Other important attributes include the capacities of different gases to trap heat in the atmosphere or their so-called GWP, as well as the time a certain gas remains in the atmosphere.(IPCC 2007- 4th assessment report, UNEP 2012- the emissions gap report)

Table 3.1: Global GHGs contributing to Climate Change in percentages

GHG	Human Source	% of total GHG Emissions
Carbon dioxide	Fossil fuel combustion, land use changes, cement production	76%
Methane	Fossil fuel mining/distribution, livestock, rice agriculture, landfills	16%
Nitrous oxide	Agriculture (fertilizers) and associated land uses	6%
Hydrofluorocarbons	Liquid coolants	<2%
Perfluorocarbons	Refrigerant, electronics industry and aluminum industry	<2%
Sulphur hexafluoride	Insulator in electronics and magnesium industry	<2%
Nitrogen trifluoride	Electronics and photovoltaic industries	<2%

Table 3.2: Global Warming Potential (GWPs) of some GHGs and their Key Sources

Greenhouse Gas (GHG)	Atmospheric Lifetime (yrs)	Globa Warming Potential (GWP)	Primary Current Sources	
Carbon Dioxide (CO_2)	50-200	1	Fossil fuel use, land use, cement	
Methane (CH_4)	12±3	21	Fossil fuel use, agriculture	
Nitrous Oxide (N_2O)	120	310	Mostly agriculture, ~1/3 are anthropogenic	
Hydrofluorocarbons (HFC_s)	1.5 to 209	150 to 11,700	Alternative to ozone depleting substances	High GWP Gases
Perfluorocarbons (PFC_s)	2,600 to 50,000	6,500 to 9,200	Primary aluminium production, semiconductor manufacturing	
Sulfur Hexafluoride (SF_6)	3,200	23,900	Used in electric power transmission, magnesium and semiconductor idustries	

3.2 Strategic Frameworks and Policy Approaches for Mitigation and Low Emission Development

3.2.1 Low Emission Development Strategy (LEDS)

A Low Emission Development Strategy is a national, high-level, comprehensive, long-term strategy, which aims at decoupling economic growth and social development from greenhouse-gas (GHG) emissions. It provides long-term guidance for policy decisions. Low Emission Development Strategies outline overall economic and sector specific emissions trajectory for a country, set clear mitigation targets, and identify and prioritize policy interventions to achieve the set targets. To be effective and relevant, a LEDS should build upon and influence existing national strategies and processes, such as national development plans and sectorial strategies. In general, a low emission development strategy comprise most or all of the following elements:

- A long-term strategic vision based on national development priorities, global agreements and scientificprojections
- Baseline GHG emissions analysis and projections under a "business as usual" scenario
- Prioritization of key mitigation sectors and measures (according to , for example, abatement potential, costs, co-benefits, feasibility, timeframe of implementation, socio-economic and environmental impacts, synergies with existing national strategies and policies, etc)
- Identification of policies, measures and definition of targets.

3.2.2 Policy Instruments for Low Emission Development (LEDs)

An essential element of a LEDs is the identification of concrete policy measures. Policy-makers have the choice between various instruments to promote mitigation and low carbon development. Market based mechanisms, such as emissions trading schemes, establish an overall level of emissions allowed, and then let the open market determine the price. Financial incentives to promote mitigation include, for example, subsidies for renewable energies or access to capital for clean technology start-ups. Fiscal instruments, such as carbon taxes, follow the "polluter pays" principle. Other instruments include support for research and development of low carbon development technologies or the establishment of environmental standards. Investing in appropriate skills development, can also support the implementation of a low emission development strategy.

Market based instruments

- Emission trading schemes
- Payment for ecosystem services

Financial incentives

- Subsidies
- Access to capital

Fiscal instruments

- Taxes and tariffs
- Sector specific fiscal stimulus packages

Other Instruments

- Research, development and demonstration activities
- Environmental and social standards
- Capacity building, skills development and awareness raising

3.3 Co-Benefits Resulting from Mitigation and Low Emission Development

There are various environmental, economic, and social co-benefits that arise as a result of implementing mitigation actions and shifting economies towards low emission development. For example, forest conservation limits GHG emissions while at the same time protecting biodiversity and ecosystems. The promotion of renewable energies can lead to increased local employment due to decentralized energy production. Reducing GHG emissions has health benefits e.g. through lower urban air pollution concentrations. Successful mitigation measures can also lead to potential cost savings due to a reduced need for adaptation actions. Below is an outline of some of the major co-benefits of mitigation interventions.

Environmental Benefits

- Conservation of biodiversity and ecosystems
- Improved water and air quality
- Restoration of degraded land

Economic Benefits

- Employment creation
- Energy security
- New economic opportunities
- Potential cost savings

Social Benefits

- Access to better services
- Health benefits
- Lifestyle benefits

3.4 Sectors with High Mitigation Potential

This section presents the global emission trend and also sectors which have a particularly high mitigation potential (including energy, transport, buildings, industry, agriculture, forestry, and waste management). For each of these sectors, examples of specific mitigation measures that can be undertaken are provided. In order to plan for mitigation interventions, it is of paramount importance to understand the greenhouse gas contributions of each sector to the overall global emissions profile. Figure 3.1 presents the global greenhouse gas percentage contribution by economic sector.

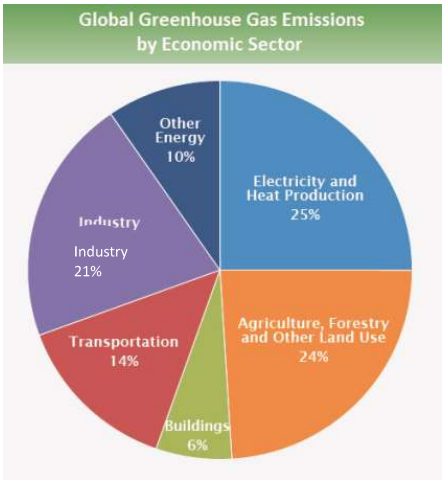


Figure 3.1: Global Percentage Emissions by Economic Sector, (Source: IPCC (2014))

From the pie chart (Figure 3.1), it is evident that the highest contributor of GHGs into the atmosphere is the energy sector, followed by the agriculture sector with the other sectors contributing lower GHGs.

Global carbon emissions from fossil fuels have significantly increased since the 1800s (See Fig 3.2 below). Since 1880, CO_2 emissions have increased by about 90%, with emissions from fossil fuel combustion and industrial processes contributing about 78% of the total greenhouse gas emissions increase from 1970 to 2019. Agriculture, deforestation, and other land-use changes have been the second-largest contributors. Emissions of non-CO_2 greenhouse gases have also increased significantly since 1900.

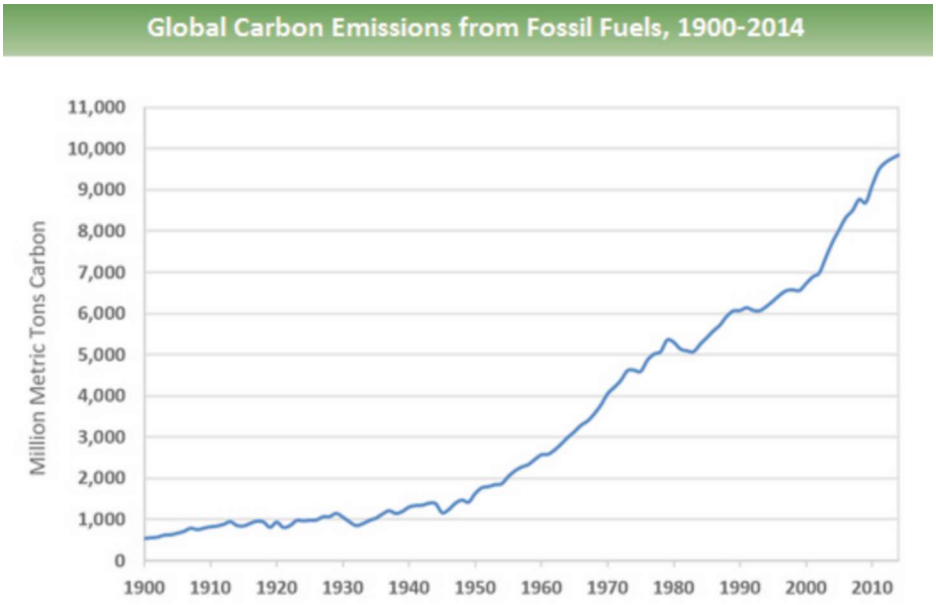


Figure 3.2: Trends in Global Emissions

In the case of Zimbabwe the highest emitters are also the energy and agriculture sectors contributing 48 percent and 44 percent, respectively. Figure 3.3 presents the summary of GHG emissions profile for Zimbabwe.

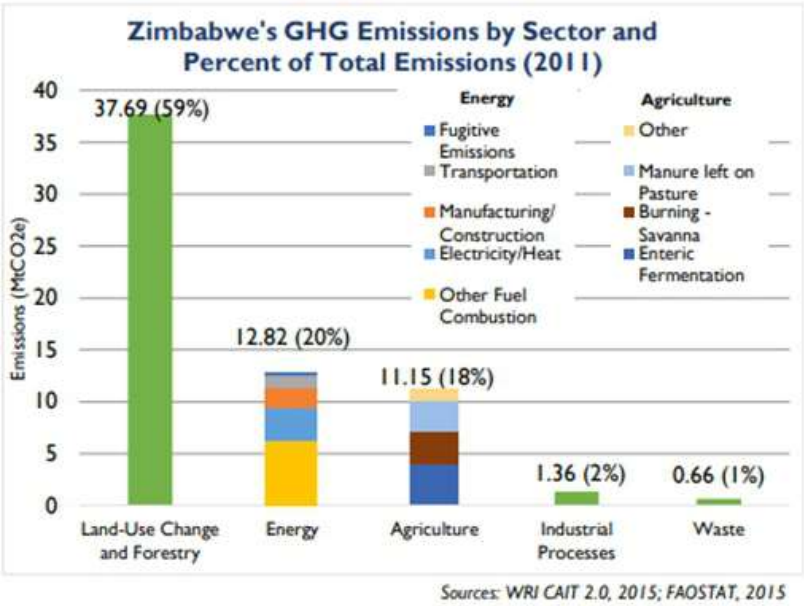


Figure 3.3: Zimbabwe's GHG Emissions Chart by sector

3.4.1 Selected Mitigaton Options by Sector

3.4.1.1 Transport Sector

Greenhouse gas emissions from this sector primarily involve fossil fuels burned for road, rail, air, and marine transportation. Almost all (95%) of the world's transportation energy comes from petroleum-based fuels, largely gasoline and diesel. The main challenges for the transport sector include high consumption of liquid fossil fuels, growing emissions, as well as chronic traffic congestion in many of the world's urban areas.

Key mitigation technologies developed in the transport sector focus on the design of more fuel efficient vehicles and the use of alternative energy sources such as biofuels. Policy interventions such as more affordable urban public transport and more bicycle lanes can also contribute to mitigating the impacts of the transport sector. In addition, consumer behavior plays an important role, for example in terms of purchasing smaller vehicles, or taking the bus, bike or train instead of a personal car. Mitigation options in this sector include:

- Fuel efficient vehicles (such as hybrid cars)
- Use of alternative energy sources (biofuels, fuel blending)
- Integrated land-use and transport planning
- Shift from individual transport to mass transport systems
- More efficient driving practices
- Non-motorized transport (cycling, walking)

3.4.1.2 Energy

Emissions from electricity and heat production are derived mostly from the burning of coal, natural gas and oil, which constitute the largest single source of global greenhouse gas emissions.

Other energy sources of greenhouse gas emissions refer to all emissions from the energy sector which are not directly associated with electricity or heat production, such as fuel extraction, refining, processing, and transportation.

The energy sector poses particular challenges in the context of low carbon development due to its size and its central role in driving global economy. In the case of Zimbabwe which is endowed with vast coal resources, coal-fired thermal power stations contribute close to 50 percent of the country's electricity. Transforming to other energy sources requires a lot of financial investments.

A wide variety of mitigation options can be applied in the energy sector. Renewable energies can make a major contribution to reducing emission levels. Changes in energy production patterns need to be supplemented with improvements in energy distribution systems (e.g. improved power grids) to avoid inefficient use of energy resources. Combined heat and power (CHP) allows the use of a heat engine or power station to simultaneously generate electricity and useful heat. Mitigation options in this sector include:

- Use of renewable heat and power (hydropower, solar, wind, geothermal and bioenergy)
- Improved supply and distribution efficiency
- Combined heat and power

3.4.1.3 Buildings

Greenhouse gas emissions from this sector arise from onsite energy generation and burning fuels for heat in buildings or cooking in homes. The design of homes, offices, commercial and industrial buildings can make a big contribution to reducing carbon emissions. In developed countries, opportunities for reducing emissions from the building sector are found mainly in retrofitting existing buildings (e.g. improved insulation, more efficient light bulbs, etc). For the majority of developing countries, which have a significant housing deficit, the greatest potential to reduce energy demand comes from a new generation of green buildings with more efficient design, less energy intensive materials, and higher performance standards. Mitigation options in this sector include:

- Efficient lighting and natural lighting
- More efficient electrical appliances, heating and cooling devices
- Improved insulation of buildings and appliances
- Integrated design of buildings including technologies such as intelligent meters that provide feedback and control
- Solar photovoltaic systems integrated in buildings

3.4.1.4 Industry

Greenhouse gas emissions from industry primarily involve fossil fuels burned on site at facilities for energy. This sector also includes emissions from chemical, metallurgical, and mineral transformation processes not associated with energy consumption and emissions from waste management activities. (Note: Emissions from industrial electricity use are excluded and are instead covered in the Electricity and Heat Production sector). Industry thus then consists of a vast range of activities involving thousands of different processes that are often site-specific in design. Whereas the buildings and transportation sectors can utilize a limited number of energy conservation measures that may be widely applied, the industrial sector requires more of a focus on options in specific industries. Generic technologies that cut across industries represent only part of the full range of opportunities, and even these generic technologies are typically customized for particular applications. Generally, low-carbon measures in the industrial sector include more efficient use of energy and better use of materials and recycling. Thereby, the greatest increases in the efficiency of energy and materials use often do not come from direct efforts to reduce consumption, but rather from pursuing other goals such as improved product quality and lower production costs. Mitigation options in this sector include:

- Process-specific technologies that improve efficiency and reduce emissions
- Material recycling and substitution
- Heat and power recovery/ cogeneration

3.4.1.5 Agriculture, Forestry and other land-use

Agriculture

Greenhouse gas emissions from this sector come mostly from agriculture (cultivation of crops and livestock) and deforestation. Mitigation of GHG emissions in the agriculture sector can be achieved through reducing and avoiding emissions by enhancing carbon sinks. To reduce emissions from farming systems, several means are available. For example, in crop and feed production, the use of inorganic fertilizer can be optimized, or in some cases, replaced by organic fertilizers.

To enhance carbon sinks different approaches exist, such as increasing biomass (and carbon) by incorporating trees and bushes to farming systems. Great potential also lies in increasing the carbon content of soils. Soil carbon sequestration rate is improved through the restoration of degraded soils, especially in vast grassland and pasture areas, by regulating animal numbers and pasture improvement. Mitigation options in this sector include:

- Manure and livestock management to reduce methane emissions
- Improved fertilizer application techniques to reduce Nitrous oxide emissions
- Improved crop and grazing land management to increase soil carbon storage
- Restoration of cultivated peaty soils and degraded lands
- Agro-forestry practices

Forestry

Forests are an important sink for carbon dioxide, one of the major greenhouse gases in the atmosphere. Reducing deforestation, establishing a forest where there was no forest (afforestation) or restocking depleted forests (reforestation) are some of the prime mitigation options that can be applied in the forestry sector. Forest management plays an important role in reducing deforestation and eliminating illegal logging. At policy level the promotion of voluntary certification schemes for sustainable forest management can contribute to ensuring that trees, an important carbon sink, are managed in a sustainable manner. Mitigation options in this sector include:

- Reduced deforestation
- Afforestation/ reforestation
- Sustainable Forest management including REDD+
- Tree species improvement to increase biomass productivity and carbon sequestration

3.4.1.6 Waste

Waste generates methane emissions from both liquid and solid streams coming from domestic and industrial processes. A number of mitigation options are available for reducing emissions in this sector. Mitigation options in this sector include:

- Landfill methane recovery
- Waste incineration with energy recovery
- Composting of organic waste
- Controlled wastewater treatment
- Recycling and waste minimization
- Bio-covers and bio-filters to optimize methane oxidation
- Construction of Biogas Digesters

3.5 International Initiatives to Support Climate Change Mitigation

Various international instruments and mechanisms are available under the United Nations Framework Convention of Climate Change (UNFCCC) to provide support to countries to achieve their emission reduction efforts. The Kyoto Protocol was one of the first protocols to enforce emission reductions by developed countries. Implementation of the protocol was guided by three flexible market mechanisms which include the Clean Development Mechanism (CDM), Joint Implementation (JI) and Emission Trading, of which CDM was applicable to developing country Parties. Under the Clean Development Mechanism, developed country Parties invest in projects that reduce emissions in any developing country and claim the emission reduction credits (carbon credits) to offset their domestic emission reduction obligations. The developing countries benefit through the sale of these carbon credits.

The Paris Agreement on Climate Change stablishes a new market mechanism to enhance cooperation by countries in meeting their respective nationally determined contributions targets. The new mechanism referred to as the Sustainable Development Mechanism (SDM) moves away from the concept of offsetting and incentivizes mitigation activities through results based climate finance and while promoting sustainable development.

The mechanisms outlined above are guided and controlled by the UNFCCC. However, some countries and regions have established their own carbon offset and trading schemes, such as the European Union Emissions Trading System (EU - ETS) , the New Zealand Emissions Trading Scheme (NZ ETS), Regional Greenhouse Gas Initiative (RGGI) in the US and the Tokyo Metropolitan Emissions Trading Scheme.

While in Zimbabwe there is no national emission trading system, there is potential to develop environmentally friendly, emission reduction projects and participate in other emission trading systems in other countries or regions.

For Zimbabwe with an emission reduction target of 33 % per capita, the thrust towards meeting this obligation and generally becoming a low carbon country by 2030 will be guided by the low emission development strategy. It is imperative to mainstream low carbon development in development plan to ensure compliance of the country with the obligations the Paris Agreement on Climate Change

Activity 3.6

1) *Identify high potential mitigation options in your area (Province/District/Sector)*
2) *How can the identified options (in 1) be integrated into your development plans and programmes/strategy?*
3) *Identify enablers for the options and benefits of the interventions.*

Chapter 4 Introduction to Climate Change Planning

The chapter addresses key aspects of climate change planning by:

- Providing an overview of different dimensions and entry points for climate change planning.
- Examining the roles of national sub-national and sectoral institutions in climate change planning.
- Explaining a five-step methodology for preparing a low-emission climate-resilient development strategy.
- Citing some of the main international initiatives to support climate change planning.

Learning Objectives

The chapter provides an overview of planning processes for climate change. After completing the chapter, participants will be able to:

- Explain why it is important to integrate climate change into planning processes.
- Explain the roles of national and sub-national institutions in planning for climate change.
- Analyse the main elements of a recognised climate change planning methodology.
- Monitor and evaluate prioritised climate change programmes and actions at national and subnational level.

Topics

The following topics will be covered:

- Introduction to climate change planning.
- Methodologies for climate change planning
- The role of national and sectoral institutions in climate change planning.
- The role of sub-national institutions in climate change planning.
- Monitoring and evaluation of climate change programmes and actions.

4.1 Introduction to Climate Change Planning

Climate change poses a threat to socio-economic development affecting livelihoods options. In order for the country to build resilience and developing in a low carbon trajectory there is need to enhance the planning process particularly by mainstreaming climate change. Planning for mainstreaming climate change requires a cross sectoral approach and should be done at all level of government (national, provincial, district and ward). According to the former UN Secretary General Ban Ki-Moon, there is need to take concerted action by national and local governments which must work more closely together in tackling climate change if the world is going to mount an effective response to the problem (UN, 2009).

4.1.1 What is Planning for Climate Change?

Planning is the process of setting goals, developing strategies, outlining the implementation arrangements and allocating resources to achieve the goals. Planning for climate change entails development of plans specifically for climate change adaptation and mitigation as well as integration of climate change adaptation and mitigation into existing planning processes.

4.1.2 Hierarchy of Institutions Critical in Planning Process

In order to effectively plan for climate change there is need to recognise critical and relevant stakeholders at each planning stage i.e national, sectoral and subnational. There is an interconnectivity of the planning process making it a system in that planning efforts made at each level or tier influence the next level and vice versa. It is thus critical that as the Government of

Zimbabwe initiates the devolution process the three levels integrate climate change holistically towards building resilience in a low carbon economic development pathway.

Figure 4.1 Multi level and Sectoral Institutions Critical in the National Adaptation Planning Process

4.1.3 Entry Points for Integrating Climate Change in Existing Planning Processes

There are several entry points at national, sectoral and subnational levels that climate change may be integrated through. Table 1 demonstrates with examples levels of entry points for climate change mainstreaming. The National Development Strategies prioritise climate change mainstreaming across all the fourteen thematic areas which makes it easier for lower levels to develop indicators for climate change programming.

Table 4.1: Entry points for Climate Change Mainstreaming

Planning Institutions	**Entry Points**
National Government and cross sector ministries	• National Development Strategy • National development plan • National budget allocation process or review (expenditure frameworks and reviews)
Sector ministries	• Sector strategies, plans and policies (e.g. agriculture and water sector plans • Preparation of sector budgets • Public expenditure reviews
Sub-national authorities	• Decentralisation policies • District plans • Preparation of subnational budgets

4.1.4 Stakeholders Engagement in the Climate Change Planning Process

The process of mainstreaming climate change is a multi-stakeholder process given the crosscutting nature of climate change. Thus, after establishing the planning levels, it is important to identify the key players necessary to champion the process forward at each level and what their potential roles and influence to the process would be.

Figure 4.2 Potential Stakeholders to include in the Planning Process

4.1.5 The Basics for Effective Climate Change Planning

In order to successfully integrate climate change in relevant development planning process there is need for good governance and a good governance structure in place. Good governance will allow for an enabling environment for climate change mainstreaming bringing on board all the critical players necessary to champion the climate change agenda forward in a coherent consistent and coordinated manner. Figure 4.1.3 illustrates the important pillars of good governance to the mainstreaming agenda.

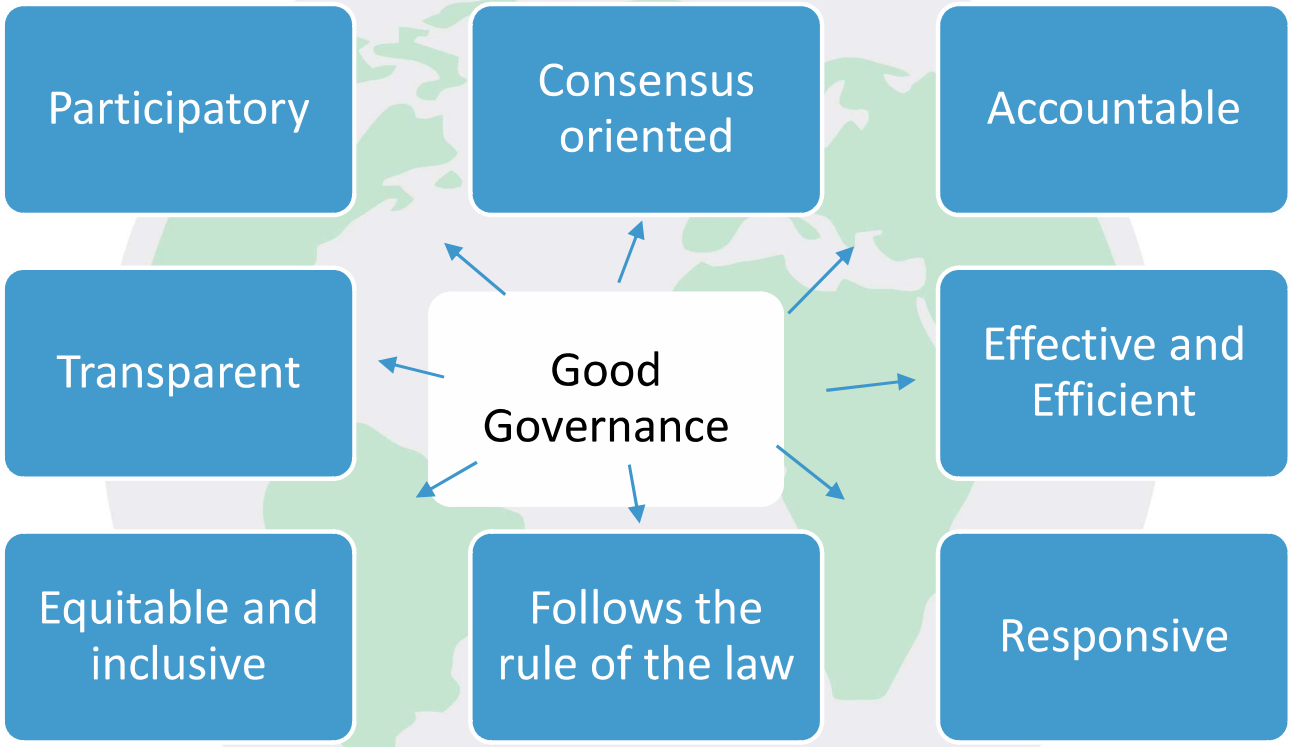


Fig 4.3: The Basics for Effective Climate Change Planning: Good Governance

4.1.6 Challenges for Climate Change Planning

Given the cross-cutting nature of climate change cutting across sectors there is need to take note of potential challenges that may derail the process. The challenges may be classified into five categories namely lack of coordination; scientific complexity and uncertainty; limited monitoring and evaluation process; lack of leadership and political support and economic costs and benefits of climate policy.

4.1.6.1 Planning for Climate Change under Scientific Uncertainties

There are basically two approaches that may be employed namely:

- No regret options: actions that generate net social and economic benefits irrespective of whether or not the climate change occurs e.g. green growth, adoption of renewable energy, resilient infrastructure, clean air etc.

- Precautionary principles: allows some risks to be deemed unacceptable not because there is high probability of occurring, but because the consequences if they occur maybe severe or irreversible. It calls for preventative action in the face of uncertainty mitigation pathways).

4.2 Key Stages in Climate Change Planning

Climate change responses should drive development choices that a country undertakes. Zimbabwe is initiating a low carbon and climate resilient trajectory which relies on a participatory approach to realise its set targets. This is being supported by a long-term low emission development strategy which seeks to propel the country towards a green economy and a National Adaptation Plan whose objective is to mainstream climate change into relevant development frameworks towards building resilience. Climate change mainstreaming is an effective tool for achieving a climate informed development pathway. This is because by working in an integrated way more innovative and diverse policy options can be identified aimed at propelling the country towards a green economy with resilience co benefits. This is beneficial as a low emission development strategy may attract public, private and multilateral funding opportunities such as from international climate financing windows.

In order to arrive at a point were climate change is effectively integrated the five steps under "Key stages in climate change panning are a useful guide to employ.

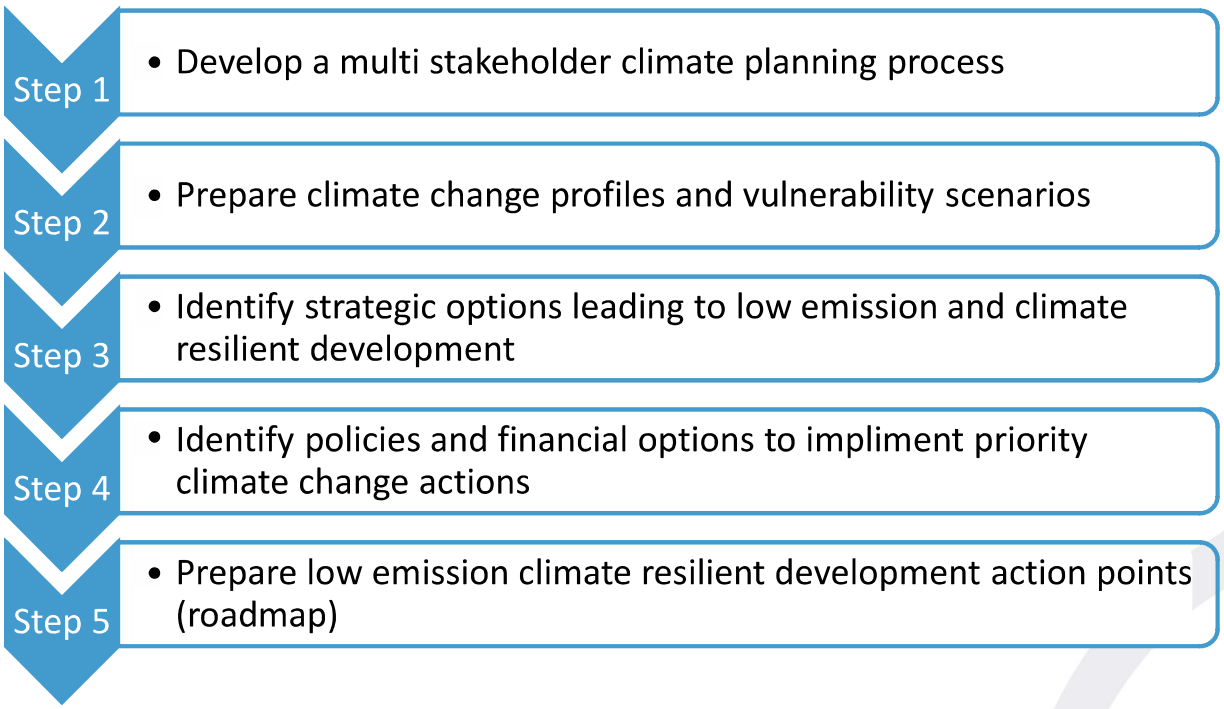


Figure 4.4 Key Steps in Climate Change Planning

Step 1 Develop a Multi stakeholder Climate Planning Process

Regardless of the level at which the planning is being initiated from, the following steps are necessary:

- Establish a core team to implement the mainstreaming agenda (at subnational level the Provincial Development Committees structures as they are replicated downwards are mandated to mainstream climate change along the line of devolution.
- Review and compile existing climate change information: plans assessments and policies.
- Address capacity needs for climate change mainstreaming.
- Raise awareness (Implement the National Adaptation planning process communication strategy).

Step 2 Prepare Climate Change Profiles and Vulnerability Scenarios

At the core of the planning process is establishing the vulnerability of a geographic area or sector to climate change. An appreciation of this vulnerability is necessary to inform which policy options to make towards building resilience. The following steps should undertaken:

- Develop climate change scenarios for your area
- Establish business as usual scenarios for GHG emissions and inventories
- Assess current and future vulnerabilities
- Produce current and future vulnerability maps.

Step 3 Identify Strategic Options

After an assessment of the various scenarios there is need to establish strategic adaptation options that are viable for a given geographic area or sector. These need to be aligned with national development goals.

- Review climate profiles and vulnerability scenarios
- Establish emission reduction targets and identify options to achieve them
- Develop different low emission climate resilient development scenarios for key socio economic sectors such as energy and agriculture
- Assess the impact of the different scenarios on predicted vulnerability of a given region/ province
- Based on future emission scenarios and vulnerability define low emission climate resilient development objectives and identify priority adaptation and mitigation options.

Step 4 Identifying Policies and Financing Options to Implement Priority Actions

- Perform technical social feasibility and cost benefit analysis of priority options
- Analyse barriers to implementation and identify those that can be addressed
- Evaluate existing policies and financing opportunities for the options at national and local level
- Identify required investment and financial flows and make recommendations by sector both in the mid and long term
- Identify and secure financing for the low emission climate resilient development options.

Step 5 Prepare a Low Emission Climate Resilient Development Action Points (Roadmap)

- Compile and synthesize results of previous steps and prepare a roadmap
- The action points should feed into the national development strategy objectives
- Provincial Development Coordinator in charge of devolution should endorse the plan
- Disseminate the strategy widely to key stakeholders and potential investors.

4.3 The Role of National and Sectoral Institutions in Climate Change Planning.

4.3.1 Why Is Climate Change Important for National Planning?

- Responding to climate change is closely linked with national planning process
- The effects of climate change can alter the effectiveness of existing plans
- International obligations under the UNFCCC need to be taken into account in national planning
- National Institutions provide principal interface with donor countries.

4.3.2 The Role of National Institutions in Managing Climate Change

- Set legislation and regulations that create incentives or disincentives for adaptation and mitigation
- Set priorities and provide overall policy framework within which other institutions (sectoral, sub-national, and local) operate
- Make budget allocations for adaptation and mitigation actions
- Facilitate coordination between sectors and different government levels
- Manage international relations with other countries/donors and ensure implementation of international treaties.

Table 4.2 : Climate Change Mainstreaming Stakeholders' Profile and their Potential Responsibilities

Stakeholders	Potential Responsibilities
Parliament of Zimbabwe	• Regulation and standards • National policies • Public finances oversight • Fiscal policy
National Government and Agencies	• National policies • Public finances • Fiscal policy • Institutional governance framework • Operational capacity of government • Management of government assets • Disaster preparedness and response
Development Partners	• Technical and financial support
Research Community and academia	• Research and Development
Traditional leaderships	• Awareness- building and lobbying
Civil society	• Awareness- building and lobbying
Private sector	• Service provision
Zimbabwe Institute for Rural and Urban Planning	• Information dissemination of climate change mainstreaming

Activity 4.1

Identify other national institutions that are critical in the mainstreaming of climate change planning process.

4.3.3 Why is Climate Change Important for Sectoral Planning?

- Climate change can impact effectiveness of existing sectoral plans and policies (adaptation)
- Sectors need to contribute to national emission reduction targets (mitigation)
- Climate change may affect national priorities and thus sectoral budget allocations (e.g. the
- Climate change induced cyclone idai influenced budget revisions towards infrastructure, health and food security as part of recovery plan.

4.3.4 The Role of Sectoral Institutions in Managing Climate Change

- Operationalise national/cross-sectoral climate change priorities through sectoral policies, plans, budgets and projects ("top-down")
- Inform national climate change policy frameworks ("bottom-up")
- Plan, implement, and monitor sector-specific adaptation and mitigation actions.

4.3.5 Sectoral Stakeholders

- Line ministries
- Sector-specific commissions
- Parliamentary committees focused on sectoral issues
- Research institutions and civil society organizations with a sectoral focus
- Private sector associations and labour unions

4.4 The Role of Sub-National Institutions in Climate Change Planning.

4.4.1 Why is Climate Change Important for Subnational Planning?

Understanding the influence climate change has on development planning and implementation will result in the effective intergration of climate issues in development planning as:

- The effects of climate change are felt locally.
- Planning investment decisions are often taken at the subnational level where concrete interventions are initiated.
- Increasing urbanisation as more and more people are relocating to cities.
- Climate change impacts the services local institutions provide.

4.4.2 The Role of Sub-National Institutions in Managing Climate Change

There are three main instruments that are available for subnational authorities to respond to climate change namely: planning and regulation; service delivery and revenue collection. The Subnational stakeholders include:

- Local government agencies;
- Urban and rural local authorities, municipality utilities, cooperative;
- Community based organisations;
- Businesses and associations;
- Communities;
- Vulnerable groups and
- Members of the public.

4.4.3 Mainstreaming Opportunities

Mainstreaming focuses on how climate change options can be integrated into pre-existing or emerging plans, programmes and policies. The following are mainstreaming reflection points:

- Are there clear opportunities to link options to existing plans, policies and programmes?
- Have any new opportunities emerged to mainstream specific options into other plans, programmes or policy development initiatives?
- New funding programmes (local government,state/provincial, national, international).
- New city planning initiatives (e.g. transport plan,local economic development strategy, public health plan, disaster risk reduction plan).

- New legislation or policy directives (e.g. greenhouse gas emissions reductions targets/ policies, disaster risk reduction policies).
- Do any of the actions identified to date require coordination with other initiatives or departments in order to maximize the potential for benefit, or minimize the potential for working at cross-purposes?

Activity 4.2

Pick two options such as climate proofing an irrigation scheme and analyse opportunities , planning constraints, political realities, capacities and other factors.

4.5 Key Points to Note in Climate Change Mainstreaming

The following key points are important to note in the process of mainstreaming climate change:

- Understanding the climate change risk and vulnerability.
- Finding synergies between adaptation and mitigation efforts can help facilitate action on climate change.
- Climate Change Action Plans and policies, programmes and projects are more effective and achievable if they are implemented or "mainstreamed" through existing national and subnational plans, strategies and processes.
- A robust monitoring and evaluation framework with set indicators for mitigation and adaptation is essential for successful climate change mainstreaming. This is further elaborated in Chapter 5.
- Important areas were planners may support and lead adaptation and mitigation activities in their planning capacities include:
    - Land use
    - Environmental planning
    - Storm water management
    - Building and site designs
    - Disaster preparedness
    - Local development strategies
    - Waste management
    - Water supply management
    - Transport plans
    - Community health programmes etc

Activity 4.3

With reference to adaptation and mitigation options identified in chapter two and chapter three, establish their mainstreaming potential within your sector, province or district:

How best can the identified options be integrated within existing local government planning and policy development.

Chapter 5 Climate Change Finance, Budgeting , Monitoring and Evaluation

The chapter will discuss the different meanings of climate finance. It will present climate change mainstreaming into national and subnational budget frameworks It will also cover other sources of finance including private sector and major streams of international climate finance.

Learning Objectives

The chapter provides participants with an understanding of existing financing flows and future needs, as well as a basic typology of financial sources. After completing the chapter, participants will be able to:

- Introduction to climate change in budgeting
- Identification and prioritisation of main programmes and initiatives for climate financing
- Define key elements of the international and international climate change finance architecture.
- Climate finance tracking

Topics

The following topics will be covered:

- Introduction to climate change finance and budgeting.
- Identification and prioritisation of main programmes and initiatives for climate financing
- National climate change finance.
- International climate change finance.
- Climate finance tracking

5.1 Introduction

Climate finance is a crucial climate change mitigation and adaptation element that Zimbabwe needs in order to achieve its development agenda and meet its obligations under the UNFCCC. The 2015 Paris Agreement of the UNFCCC acknowledges that responding to climate change and its impacts will involve new expenditure in all countries, including public spending in developing countries. The Paris Agreement among other objectives aims to, 'Make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development". With the expectation of additional public spending comes an interest to monitor and track such finance so as to ensure the transparency and accountability of public spending systems and decision making. It also provides an important opportunity to increase awareness of climate change among sector planners and budget officers.

Addressing climate change requires investments delivered by government programmes across a range of ministries and departments. Departmental spending by the leading ministry responsible for national climate change policies is an insufficient measure of all relevant climate change public spending, as adaptation and mitigation measures involve many sectors such as water, energy, infrastructure and agriculture. Efforts to monitor public climate change spending face several significant challenges including;

- The definitional ambiguity of climate change actions and hence financing, especially for adaptation finance

- A varying proportion of public funds do not pass through the national budget and therefore lie outside its reporting systems
- Insufficient detail to allow the climate change relevant component to be identified, and
- Actual expenditures (as opposed to the budget estimates) are often not readily available

As a result, climate change relevant finance within public expenditures has not been institutionalized in most countries.

5.1.1 What is Climate Finance?

A definition of "climate finance" is yet to be agreed internationally. However, according to the UNFCCC, Climate finance refers to local, national or transnational financing drawn from public, private and alternative sources of financing that seek to support mitigation and adaptation actions that will address climate change. The Convention, the Kyoto Protocol and the Paris Agreement call for financial assistance from Parties with more financial resources, developed countries, to those that are less endowed and more vulnerable, developing countries. This recognizes that the contribution of countries to climate change and their capacity to prevent it and cope with its consequences vary enormously. Climate finance is needed for mitigation, because large-scale investments are required to significantly reduce emissions. Climate finance is equally important for adaptation, as significant financial resources are needed to adapt to the adverse effects and reduce the impacts of a changing climate.

In accordance with the principle of "common but differentiated responsibility and respective capabilities" set out in the Convention, developed country Parties are to provide financial resources to assist developing country Parties in implementing the objectives of the UNFCCC. The Paris Agreement reaffirms the obligations of developed countries, while for the first time also encouraging voluntary contributions by other Parties.

Climate Finance is often understood as "new and additional" public financial assistance for developing countries outside the "normal" development assistance. Other financing sources, such as foreign direct investments and regular budgetary expenditures are also included.

Climate finance is critical in addressing climate change and support Zimbabwe's vision of a low-carbon and climate-resilient nation. This requires significant investments in sectors that emit large quantities of GHG to support mitigation efforts, and for adaptation and building resilience to climate change. Furthermore, climate finance is important to facilitate the capacity development, technology development and transfer needed to support and sustain implementation of climate actions.

5.1.2 Sources and Channels of Climate Finance

The sources and channels of climate finance can be categorized broadly as public or private. ***Public climate finance*** constitutes financial resources raised through taxes and other government revenue streams for climate change projects, whether international or domestic. ***Private finance*** typically refers to capital provided by the private sector; that is, the sector of the economy not controlled by the state. The private sector is made up of a wide range of actors, including individuals (consumers), small and medium enterprises, cooperatives, corporations, investors, financial institutions, and philanthropies.

The channels through which international climate finance flows into a country vary depending on the source and the recipient arrangements.

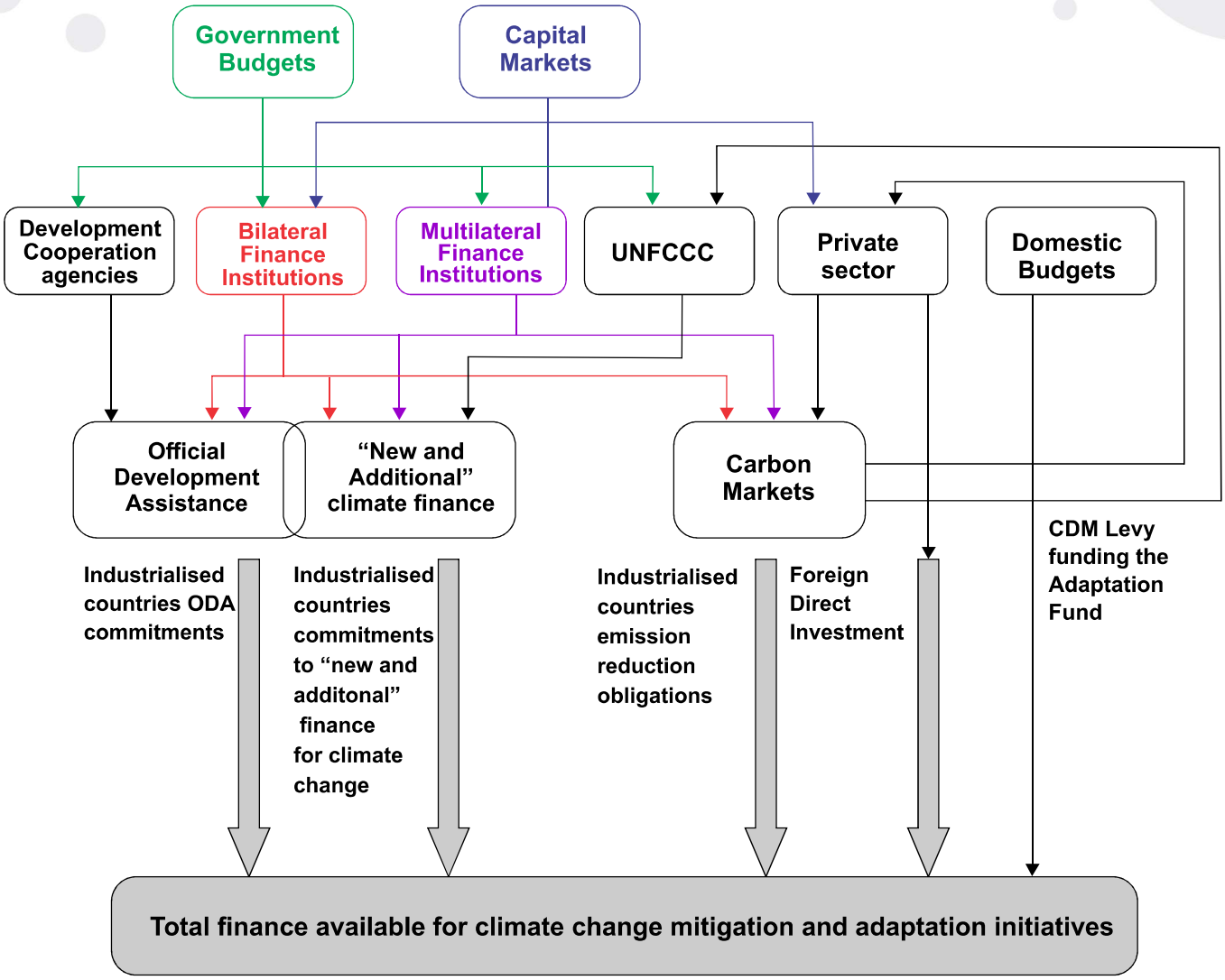


Figure 5.1 Financial Flows for Climate Change Mitigation & Adaptation In Developing Countries

There are other means of implementation which do not provide direct finance but facilitate climate action through provision of technical assistance and creating key enablers to climate action. These include the Climate Technology Centre and Network (CTCN), UN organisations, International agencies and philanthropic work among other sources.

5.2 International Climate Finance Flows

Public spending flowing through government systems that are captured in the national budget (the first and second of the channels Fig 5.2 are within a unitary system that uses standardised coding in many countries. However, expenditure passing through the third channel is not captured with the same level of consistency. This raises the danger of double counting of expenditures and makes the monitoring of such flows quite problematic. This has led to this channel of funding not being adequately captured in many climate change public expenditure analyses to-date, which represents an analytical gap as projects funded in this way may not necessarily respond to the spending priorities established through the national budget system. Three distinct finance flow channels exist as shown in Figure 5.2:

Figure 5.2: Channels of International Climate Finance Flow (GIZ,2016)

To facilitate the provision of climate finance, the UNFCCC established a financial mechanism to provide financial resources to developing country Parties. The financial mechanism also serves the Kyoto Protocol and the Paris Agreement. The Convention states that the operation of the financial mechanism can be entrusted to one or more existing international entities. These include the following:

5.2.1 Green Climate Fund (GCF)

The 16th Conference of Parties to the UNFCCC (COP 16) held in 2010, established the Green Climate Fund (GCF) and in 2011 the GCF was designated as an operating entity of the financial mechanism. The financial mechanism is accountable to the COP, which decides on its policies, programme priorities and eligibility criteria for funding.

The overall objective GCF is to promote a "paradigm shift towards low-emission and climate-resilient development pathways by providing support to developing countries to limit or reduce their GHG emissions and to adapt to the impacts of climate change". GCF supports projects and programmes in developing countries. It is governed by the GCF Board (GCF's Governing Instrument).

The Green Climate Fund is unique in its ability to engage directly with both the public and private sectors in transformational climate-sensitive investments. It works through a wide range of accredited entities to channel its resources to projects and programmes. Such entities may be international (e.g. UN Agencies), regional (e.g. COMESA), national (for example local banks and institutions) or subnational public or private institutions that meet the standards of the Fund. For country communications with the GCF, the GCF works through the GCF National Focal Point while in country GCF work coordination is led by the GCF Nationally Designated Authority (NDA). In the case of Zimbabwe the Ministry responsible for climate change serves as the NDA.

The GCF supports projects based on the following classifications:

Table 5.1: GCF Project Size Classification

Project Size	Funding allocation
Micro	less than USD 10 million
Small	USD 10 – 50 million
Medium	USD 50 – 250 million
Large	more than USD 250 million

5.2.1.1 GCF Access Modalities:

GCF resources are accessed through two modalities namely, Direct Access and International Access

a. Direct access refers to a situation whereby a country accesses funding through a National Implementing Entity (NIE) or through a regional accredited institution, which may apply directly for project funding. As of 2020, Zimbabwe did not have a National Institution accredited to the GCF for Direct Access;

b. International access whereby countries submit project proposals via multilateral organizations, such as an accredited UN institution or an accredited Multilateral Development Bank (MDB).

All applications for access to multi-lateral environmental funding mechanisms go through the National Designated Authority who in the case of Zimbabwe is the Climate Change Management Department.

The GCF website provides regular updates on the resources access facilities and the templates, and any other relevant news.

5.2.1.2 GCF Results and Focus Areas

To achieve a paradigm shift towards low-emission and climate-resilient pathways, the GCF aligns its investments with eight strategic mitigation (reduced emissions) and adaptation (increased resilience) impact results areas as represented in Figure 5.3:

Figure 5.3: GCF Result Areas

Furthermore, the GCF identifies six (6) clear investment criteria for funding. The GCF supports transformational projects that maximize impact, promote paradigm shift, enhance sustainable development benefits, respond to the needs of the beneficiary country, promote country ownership and demonstrate financial soundness.

5.2.2 Global Environment Facility (GEF)

The GEF is another operating entity of the UNFCCC's financial mechanism and has a long track record in environmental funding. Climate change is a focal area under the GEF. Resources are allocated based on the impacts of spending on environmental outcomes, while ensuring that all developing countries receive a share of the funding.

The GEF provides funding through four modalities: full-sized projects; medium-sized projects; enabling activities; and programmatic approaches. The selected modality should be the one that best supports the project objectives. Each modality requires completing different templates.

The GEF Operational Focal Point (OFP) coordinates all GEF-related activities within a country. The Ministry responsible for Environment is the GEF's OFP for Zimbabwe. The OFP reviews project ideas, checks against eligibility criteria and ensures that new project ideas will not duplicate an existing project. All projects to be submitted for approval require a Letter of Endorsement signed by the GEF OFP.

The GEF also administers the Special Climate Change Fund (SCCF) under the guidance of the UNFCCC Conference of Parties (COP). These funds support the development and implementation of national adaptation plans, although largely through smaller-scale projects with a country funding ceiling of USD 20 million.

5.2.3 Special Climate Change Fund (SCCF)

The Special Climate Change Fund (SCCF) was established under the Convention in 2001 to finance projects relating to: adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry and waste management; and economic diversification. This fund should complement other funding mechanisms for the implementation of the Convention.

5.2.4 Adaptation Fund

The Adaptation Fund (AF) was established in 2001 to finance concrete adaptation projects and programmes in developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change. Currently developing countries are accessing the Adaptation Fund resources up to a ceiling of US$10 million per country.

Resources from the Adaptation Fund can be accessed through a National Implementing Entity and multi-lateral institutions such as UNESCO and UNDP among others, which are accredited to the Adaptation Fund. In Zimbabwe the Environmental Management Agency (EMA) is the Adaptation Fund's National Implementing Entity (NIE).

5.3 National Climate Finance

Many countries are already spending considerable amounts on climate change through national budgets, even though the expenditures are not labelled as such. Countries are looking for more comprehensive approaches to managing climate finance taking into account all sources: domestic, external, public and private. In Zimbabwe, national climate finance is yet to be fully defined and appropriated through various means such as the national budget. The national development strategies recognize the threat of climate change and the need to mitigate and adapt to climate change. National climate finance is critical in leading national efforts to combat climate change and leverage international climate finance for example through co-financing multi-lateral climate finances like the GCF.

It is therefore critical to mainstream climate change in national planning and budgeting processes. For optimal outcomes, policy, planning and budgeting should be integrated. Given the time horizon of policies and strategies, it is useful to have a medium-term perspective for national and sectoral budgets.

The urgent need to combat climate change requires both domestic and external resources in-order for countries like Zimbabwe to meet their climate change obligations as well as achieve their own sustainable development targets. Climate change as an evolving phenomenon needs to be mainstreamed in development planning and budgeting process for a holistic and sustainable implementation of climate actions. The resource allocation stage invloves the transition of

operational action plans such as climate and climate related policies and strategies, NDCs, LEDs and NAPs into budgets. Climate change integration requires the reallocation of funding to more vulnerable sectors and regions such as agriculture, water resources, infrastructure, health and climate related disaster risk management. In the case of Zimbabwe, priority in resource allocation should be given to the highly vulnerable areas. The funds will be looking at supporting adaptation and/or mitigation specific plans and activities. The resource allocation stage also involves the translation of the sector action plan into a detailed set of investments, activities and projects and the sector action plan into a budget in line with the sector's budget allocation. Furthermore, the process should involve the identification of implementation arrangements, responsibilities, timelines and specific costs. This process typically involves a mix of top-down and bottom-up processes.

The National Climate Policy provides for establishment of a National Climate Fund to support climate action. This fund is meant to support local actions, and will be resourced from various sources including the Treasury, climate-related taxes, philanthropic contributions and international funding mechanisms such as the GCF and the Adaptation Fund.

5.4 Prioritisation of Adaptation Programmes and Initiatives for Climate Financing

There are various approaches in practice for adaptation and mitigation assessment where the most commonly used techniques are Cost Benefit Analysis (CBA), Cost Effectiveness Analysis (CEA) and Multi-Criteria Analysis (MCA).

5.4.1 Cost Benefit Analysis (CBA)

This is used when efficiency is the only criterion (UNFCCC, 2011). Hence it calculates the costs and benefits for all the options and compares them which assists identifying the most efficient option. The limitation of the Cost Benefit Analysis method is it relies only on one criterion and is applicable where the options are expressed in monetary terms.

5.4.2 Cost Effective Analysis (CEA)

CEA is used to identify the adaptation option which is least costly for meeting specific goals. It is primarily applied when it is difficult to express all the benefits of adaptation measures in monetary terms but where the cost can be quantified (UNFCCC, 2011). Thus, it allows one to identify the option which can achieve a defined goal in the most cost effective way. But the limitation of this approach is it cannot consider the other dimensions, e.g. co-benefits, equity, feasibility.

5.4.3 Multi-Criteria Analysis (MCA)

MCA involves assessment of adaptation options based on certain criteria. These criteria can be both quantitative and qualitative. Thus it can accommodate both types not being restricted like CBA or CEA. Moreover, it allows a participatory process for the assessment, i.e. all the stakeholders can participate at different stages of assessment. The above discussion suggests that MCA, as an approach for adaptation assessment, brings the most advantages.

Brooks et al., (2009) defines MCA as, *'any structured approach used to determine overall preferences among alternative options, where the options accomplish several objectives'*.
Desirable objectives and indicators which correspond to the options to be assessed must be identified for conducting this method. The indicators/criteria can be both qualitative and quantitative ; there can be indicators like costs expressed in monetary terms, at the same time, qualitative indicators like social indicators. Numerous assessments require both types of indicators to be considered at the same platform, i.e environment impact assessment and policy decisions. MCA can handle varied range of indicators/criteria for comparing different options, i.e social, environment , technical, economic and financial criteria. The key significance of this approach lies in its participatory aspect. It allows participatory aspect. It allows participation of stakeholders in the assessment process, i.e. identifying the assessment criteria and weighting of those criteria.

The steps to conducting a multi-criteria analysis for adaptation include:

- Step 1: Identify the decision-making body and a decision context
- Step 2: Identify adaptation options to prioritize
- Step 3: Identify Criteria for prioritization
- Step 4: Identify the outcome and performance of each option so that they can be ranked against identified criteria
- Step 5: Assign weights to each criteria to reflect its relative importance and aggregate
- Step 6: Examine Results
- Step 7: Conduct a sensitivity analysis with different weights if needed

The United Nations advocates MCA as the preferred method to assess adaptation options and policies. Moreover , environmental problems are characteristically complex in nature, uncertain and multiple scales are involved, and have their impacts on varied ranges of people and organisations. Therefore, the assessment of climate change adaptation measures should be participatory involving all the stakeholders in the decision making process.

5.5 Prioritisation of Mitigation Programmes and Initiatives for Climate Financing

A number of prioritization tools are available for mitigation projects. The criteria-based matrix (CBM) prioritization tool is one of the commonly used methods for prioritizing mitigation projects.

5.5.1 Criteria-Based Matrix Prioritization

The criteria-based matrix is used to determine which projects are most likely to yield successful improvements based on key factors or criteria. A critieria-based matrix can be an effective tool in prioritization climate change mitigation projects. The tool helps to sort a diverse set of projects into an order of importance through scoring and prioritizing based on an agreed criteria.

5.5.2 Strengths and Weaknesses of the Criteria Based Matrix

The Criteria Based Matrix Prioritization method although widely used, has a its own strengths and weakness as shown in Table 5.2.

Table 5.2: Strengths and Weaknesses of the Criteria Based Matrix

Strengths	Weaknesses
• It provides for complex projects analysis especially where multiple criteria for determining importance are involved • It provides a fairly consistent method for evaluating project • It helps reduce biases and individual perceptions in project selection • It makes it easy to convert qualitative assessments into numeric values for ease of ranking projects • It is adaptable for prioritization of different types of projects • It enables more detailed analysis of vital factors • When used by many experts , it facilitates easy consensus building	• The effectiveness of the criteria-based matrix depends on the expertise of the personnel involved in evaluating the project • It reduces project evaluation to quantitative assessments but some aspect of project evaluations require qualitative assessments

The Criteria based matrix prioritisation can be summarised in five (5) main steps as illustrated in figure 5.4

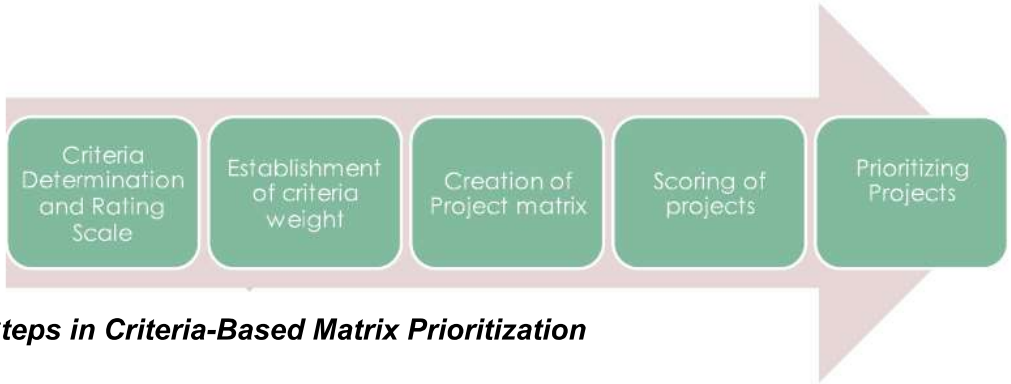


Figure 5.4:Steps in Criteria-Based Matrix Prioritization

5.6 Climate Finance Tracking

Climate Finance Tracking is a systematic way to trace and link budgetary allocations to their respective expenditures and outputs in climate-relevant activities.

Budget Coding refers to the process of tagging climate-change related activities within budget items and assigning specific codes to programmes and projects so that climate related expenditure can be tracked (OECD, 2012).

5.6.1 Why is Climate Finance Tracking Important?

The international community recognizes the need for a consistent flow of climate finance. This requires mobilizing financial resources from a wide range of sources, public and private, bilateral and multilateral sources. It is increasingly becoming important to track and report financial flows that support climate change mitigation and adaptation, to build trust and accountability with regard to climate finance commitments and monitor trends and progress in climate-related investment. The current status of climate finance reporting needs to enhance transparency, comparability and comprehensiveness. It is important to track climate finance for the following reasons;

- Support better project or programme design;
- Allow tracking and reporting climate finance flows internally and externally;
- Facilitate the assessment of results from climate investments vis-a-vis resources provided;
- Facilitate the mobilization of resources from national and international sources among others.

5.6.2 Context and Rationale for Climate Finance Coding and Tracking

Tracking and reporting climate finance flows has become a central concern for development and economic policy. Tracking helps to provide comprehensive data on climate change-relevant budgeting and spending, enabling the government to make informed climate policy decisions. Alongside other climate data, such as GHG inventories and vulnerability studies, climate finance data will serve as a cornerstone of data-driven decisions on climate investments in the country. Climate finance tracking is therefore essential to provide a standardized guide to identify climate-related projects and track the public climate finance that the country receives.

5.6.3 Key Pillars of Climate Finance Tracking and Reporting

- Evidence-based climate change policy formulation and the associated resource allocation across sectors
- Accountability and transparency of public spending
- Efficient and effective systems to track climate budgets and expenditures
- Climate finance reporting and verification

5.6.4 Tools for Climate Finance Tracking

At the national level, Climate Budget Tagging (CBT) is one of the tools in climate finance tracking. CBT is defined as a tool for monitoring and tracking of climate-related expenditures in the national budget system. It provides comprehensive data on climate change relevant spending, enabling government to make informed decisions and prioritize climate investments. CBT also encourages planning officers and policy managers to incorporate climate considerations in project design. By generating data on climate change investments which usual budget classification would not do, CBT enables public scrutiny on government's and donors' spending on tackling climate change issues strengthening accountability and transparency.

Countries wishing a robust national public climate finance tracking framework can learn from the Costa Rican experience, Figure 5.5, by beginning first with strong economy-wide analysis of current and projected GHG emissions and climate vulnerability, second with cross-sector policy objectives designed to meet that analysis, and finally, with budget management tools that identify whether fiscal priorities reflect the needs arising from those targeted objectives and outcomes.

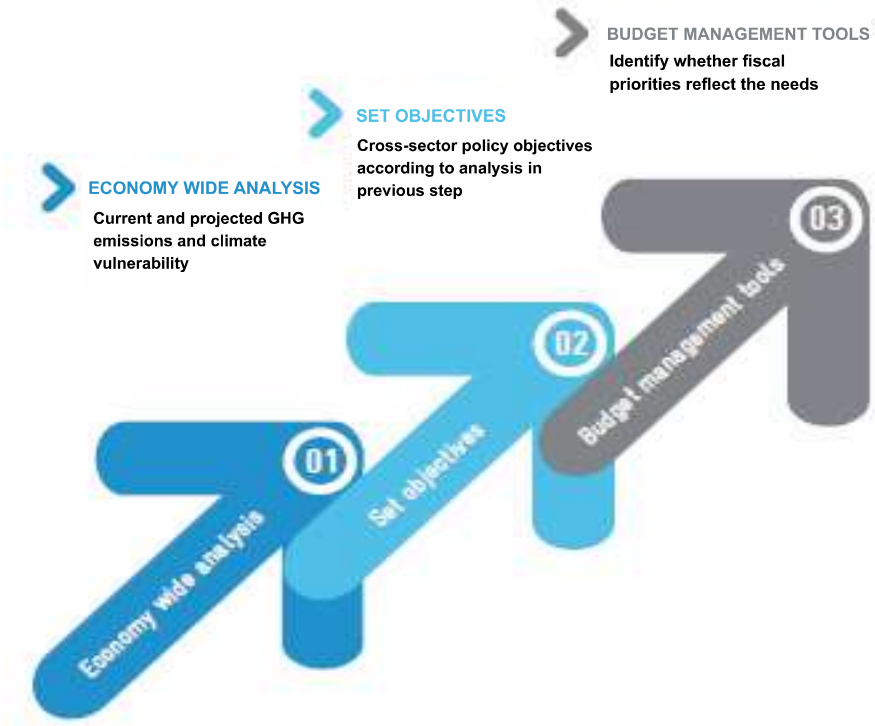


Figure 5.5: Main Steps for a Robust National Public Climate Finance Tracking Framework (GIZ,2018)

Using the model in Figure 5.5, National and sub-national stakeholders participate in all three levels, starting with the vulnerability assessments of their respective districts or province and setting adaptation and mitigation objectives in step 2 then lastly prioritize step 2 objectives in the planning and budgetary processes along the lines of devolution.

5.7 Monitoring and Evaluation for Climate Change

The role of monitoring and evaluation (M&E) in enhancing evidence-based management in development work is increasingly recognised, M&E remains under-utilized as a vital tool in informing climate change mitigation and adaptation interventions in many developing countries. Planners and implementers central to the devolution agenda need to employ M&E to enhance climate change mainstreaming. As Zimbabwe up scales climate action with both public and other sources of funding, M&E becomes critical to ensure transparency, accountability and attainment of set targets.

The Organisation for European Cooperation and Development (OECD) (2000a) defines monitoring and evaluation as follows:
Monitoring is a continuous function that uses systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing development intervention with indications of the extent of progress and achievement of objectives and progress in the use of allocated funds.

Evaluation is the systematic and objective assessment of an ongoing or completed project, program, or policy, including its design, implementation, and results. The aim is to determine the relevance and fulfilment of objectives, development efficiency, effectiveness, impact, and sustainability. An evaluation should provide information that is credible and useful, enabling the incorporation of lessons learned in the decision making process of both recipients and financiers.
Monitoring and evaluation are different but complementary processes. Monitoring involves checking progress on implementation and achievement of goals and Evaluation entails assessing or analysing the extent of implementation and achievement of goals. Monitoring gives information on where a policy, program, or project is at any given time (and over time) relative to respective targets and outcomes. It is descriptive in intent. Evaluation gives evidence of why targets and outcomes are or are not being achieved.

Table 5.3: Complementary roles of Results-Based Monitoring and Evaluation

Monitoring	Evaluation
• Clarifies program objectives • Links activities and their resources to objectives • Translates objectives into perfomance indicators and sets targets • Routinely collects data on these indicators, compares actual results with targets • Reports progress to managers and alerts them to problems	• Analyses why intended results were or were not achieved • Assesses specific casual contributions of activities to results [so development and testing of theory is critical to M&E work] • Examines implementation process • Explores unintended results • Provides lessons, highlights significant accomplishment or program potential, and offers reommendations for improvement

5.7.1 Types of Monitoring and Evaluation

Monitoring and Evaluation is evolving as one of the key activities in projects and programmes implementation. As such it has also evolved from the traditional monitoring system to the contemporary or results based monitoring and evaluation.

Table 5.4: Approaches for Monitoring and Evaluation

Elements of Implementation Monitoring (traditionally used for projects)	Elements of Results-focused Monitoring (used for a range of interventions and strategies)
• Description of situation/problem before intervention- based on subjective source • Benchmarks for activities and immediate outputs- focus is on what is to be done and what are the immediate results • Data collection on inputs and immediate outputs- monitoring and evaluation is based on resource utilisation and immediate results • Systematic reporting on provision of inputs and production of outputs	• Baseline data to describe the problem or situation before intervention • Indicators for outcomes • Data collection on outputs and how and whether they contribute toward achievement of outcomes • More focus on perception of change among stakeholders • Systematic reporting with more qualitative and quantitative information on the progress towards outcomes • Done in conjunction with strategic partners • Captures information on success or failure of partnership strategy in achieving desired results

5.7.2 Monitoring and Evaluation System

The M&E system provides the environment through which M&E processes can conducively take place within a government or organization. The system offers managers and decision-makers an additional management tool that provides feedback on performance of an intervention to enable them to learn, act and improve policies, programmes and projects both routinely and periodically.

A functioning M&E system at any level provides a continuous flow of information that is useful internally and externally' providing 'information on progress, problems and performance to managers who are striving to achieve results'. Based on systems thinking, Gorgens and Kusek (2009:8) presented 12 components of a functional M&E system. The M&E system is made up of:

- Structure and organizational alignment for M&E systems;
- Human capacity for M&E systems;
- M&E partnerships;
- M&E plans;
- Costed M&E work plans;
- Advocacy, communication and culture for M&E systems;
- Routine monitoring;
- Periodical surveys;
- Databases useful to M&E systems;
- Supportive supervision and data auditing;
- Evaluation and research; and
- Using information to improve results.

5.7.3 Tools for Monitoring and Evaluation

To effectively implement a Results based Monitoring and Evaluation System two main tools are involved (i) Implementation Plan and (ii) the M&E Framework.

5.7.3.1 Implementation Plan

The Implementation plan basically uses a logical frame work/ log frame. A Logical Framework is an analytical process for structuring and systematizing the analysis of a project or programme idea.

Table 5.5: Logical Framework Matrix

	Indicators of Achievement	Means of Verification	Key Risks and Assumptions
Goal			
Outcome			
Outputs			
Activities			

Key to the Logframe

Goal-the long-term results that an intervention seeks to achieve, which may be contributed to by factors outside the intervention.

Outcomes-the primary result(s) that an intervention seeks to achieve, most commonly in terms of the knowledge, attitudes or practices of the target group.

Outputs-the tangible products, goods and services and other immediate results that lead to the achievement of purposes outcomes.

Activities- the collection of tasks to be carried out in order to achieve the outputs. Activities (e.g. activity schedule / GANTT chart) for practical purposes

Inputs- resources (financial, human, information, etc.) to be utilized to carry out the activities. Like activities, may often be included in separate document

Indicators-quantitative and/or qualitative criteria that provide a simple and reliable means to measure achievement or reflect changes connected to the goal. Once an indicator has been decided upon, it is important to establish benchmarks, that is, historical baseline information against which future monitoring information can be compared. This is critical to understanding how the intervention is supporting the achievement of the identified objectives.

Activity 5.1

In groups, develop a logical framework for an adaptation or mitigation initiative you are familiar with.

5.7.3.2 Monitoring and Evaluation (M&E) Framework

The M&E framework guides what gets monitored, how, when and by whom. It will also identify how this information is shared with stakeholders, including partner agencies and organizations assisting with implementing certain Climate Change Plans, programmes and actions, and the broader community.

To guide the Monitoring and Evaluation process an M&E Framework is used as shown in Table 5.6

Table 5.6: Monitoring and Evaluation Framework

Indicator	Data Collection Method/Source	Frequency and Schedule	Responsible Person	Information Use
Goal				
Outcmes				
Outputs				
Activities				
Inputs				

Key to M&E Plan

Indicators are typically taken directly from the log frame, but should be checked in the process to ensure they are SMART (specific, measurable, achievable, relevant, and time-bound).

Data Collection Method/Source column identifies sources of information and data collection methods and tools, such as the use of secondary data, regular monitoring or periodic evaluation, baseline or end line surveys , interviews , etc.

The Frequency/Schedules column states how often the data for each indicator will be collected, such as weekly, monthly, quarterly, annually, etc. It also states any key dates to schedule, such as start-up and end dates for collection or deadlines for tool development

The Person/s Responsible column lists the people responsible and accountable for the data collection and analysis, e.g., community volunteers, field staff, project/program managers, local partner/s, and external consultants

Activity 5.2

In groups, develop an M&E framework for the adaptation or mitigation initiative that identified in the previous activity (Activity 5.1)

Chapter 6 Research for Mainstreaming Climate Change in Development

The chapter will cover different elements of the project cycle, types of studies (longitudinal/panel, cross sectional), literature review, sampling frame, data triangulation, elements of report writing, PowerPoint presentation and oral presentation.

Learning Objectives

The chapter will equip participants with knowledge and skills of how to obtain and assess information for climate change and mainstreaming. At the end of the chapter, participants will be able to:

- Identify climate change issues and challenges (adaptation and mitigation) to be mainstreamed into development planning at provincial level.
- Prioritise identified mitigation and adaptation options at provincial level
- Planning for low carbon and resilient development at provincial level.
- Define the scope of climate change mainstreaming.
- Identify and analyse literature dealing with climate change mainstreaming
- Apply complementary research methods and techniques for climate change mainstreaming in terms of data collection and analysis.
- Make a logical write up of the findings.
- Present the findings to different audiences

Topics

The following topics will be covered:

- How to identify researchable problems
- Formulating objectives
- Methodology (Data collection instruments, actual data collection and data analysis)
- Work plan
- Budgeting
- How to write a good report
- How to prepare an oral presentation

6.1 Introduction

Scientific research involves a systematic way of performing a methodical study in order to prove a hypothesis or answer specific questions. Research protocols are broadly similar but may vary slightly between the different fields of study. The three major goals of research are establishing facts, analysing information, and reaching new conclusions. The three main aims of undertaking research are searching for, reviewing, and evaluating information. It is important to note that scientific research does not provide absolute answers to questions, but instead gives probable answers based on evidence gathered and current knowledge. New information can lead to the rejection of ideas previously believed to be true.

6.2 Components of Research

6.2.1 Introduction

The section introduces you to research on climate change issues in view of the prevailing national circumstances and local contexts.

It provides background information and the general research framework. The introduction lays the broad foundation for the subject area that in turn places the study within the larger context of the relevant scientific literature. As such the introduction must give a summary of the findings from extensive literature review so as to establish the need for the research. In addition to sharing the results of other studies that are closely related to the study topic, it sets a benchmark for comparing the results of the study with other findings after framing the problem.

6.2.2 How to Identify Researchable Problems (Problems Identification)

In order to identify researchable problems, the researchers are expected to read widely and review literature from authoritative sources and scholarly databases which collate information on such subjects such as journals. In the case of climate change, there is a need to review both published and authentic grey literature from Government ministries and agencies as well as other reports both official and media communications to pick up the issues before subjecting them to scholarly detailed analyses. This preliminary analysis assists in identifying researchable problems which are operational and can be mainstreamed into development.

The knowledge gaps constitute the researchable problems, which describes the context for the study within the scientific body of literature. A researchable problem is defined as a gap that exists in the literature, theory, or practice that leads to a need for the research study. A researchable problem needs to easily recognize it and answer the question: Why does this research need to be conducted? If a researcher is unable to answer this question clearly and succinctly, then the statement of the problem will come off as ambiguous and diffuse. Researchable problems should not ideally be societal problems whose answers are to the research problem/question is obvious, otherwise they become management issues that may be resolved without further research.

Zimbabwe Context: Some of the researchable gaps problems and gaps in literature in terms of climate change are identified in key climate change literature such as the IPCC Assessment reports at international level, Global Resource Outlook and at national level in key governance documents such as the National Communications, Gaps and constraints section, the National Climate Change Response Strategy, Gaps and areas identified from the Provincial and District Coordinators' offices and the community, background notes to the National Climate Policy and technical documents such as the World Bank. Other possible researchable issues are identified in research areas of consideration for future research in scholarly journals, recommendations in government reports and results of various consultative processes. There are various key Government documents which were born out comprehensive consultative processes and technical assessment of scientific data including stakeholder input such as the National Climate Policy which also provide possible options of researchable areas. Researching on climate change gaps and needs is important to facilitate climate change mainstreaming in support of devolution. Some researchable areas could be identified from the District and Provincial level stakeholders.

6.2.3 Formulating Research Objectives (and Hypotheses/Research Questions)

Research largely depends on sound research objectives, which therefore clearly state what the research project seeks to achieve. An objective is the realistic achievement or milestone or solution a candidate wishes to attain. Research objectives could may be classified into two levels: Main objective and Specific/Sub-objectives.

The main objective states what the research expects to achieve in general terms and it normally relates to the title of the research. Specific objectives are breakdowns of the general objectives into smaller, logically connected parts of the general objective. These specify what the study will do,

where it will be conducted and for what purposes. Each objective must signify a specific task to be accomplished in the research. They enable or help to develop the research methodology including even the research methods and also the equipment that will have to be used.
Elements of good objective

- Specific;
- Measurable
- Achievable
- Realistic and;
- Time-bound

In order for the objective statement to be measurable, verbs like to determine, to measure, to design, to formulate, to describe, to develop, to create, to establish, to calculate which resulting specific and measurable output are preferred as opposed to verbs such as to observe, to study, to evaluate, to find out, to appreciate, and to understand.

Research objectives are usually followed by or accompanied by respective hypotheses or research questions. A hypothesis being a testable statement central to scientific research. One or more hypotheses could be tested in a study. There are generally two classes of hypotheses:

(1) hypothesis for differences and, (2) hypothesis for relationships.

In the case of the former you may intend to test whether there is a difference in the maize yield between two or more areas receiving different rainfall amounts. In the case of the latter, you may intend to test whether there is a relationship between levels of wheat primary productivity and temperature rise. The practice of using hypotheses was derived from using the scientific method in science inquiry. They have philosophical advantages in statistical testing

Research questions on the other hand, are most often used in qualitative inquiry, although their use in quantitative inquiry is becoming more prominent. Whilst a research question poses a relationship between two or more variables but phrases the relationship as a question; a hypothesis represents a declarative statement of the relations or differences between two or more variables. Deciding whether to use questions or hypotheses depends on factors such as the purpose of the study, the nature of the design and methodology, and the audience of the research.

In the context of climate change research and the need for mainstreaming which is a multi-disciplinary study, the selection of objectives, hypotheses and/ research questions helps to contextualize and narrow down the research. Some of the priority researchable problems which could assist in formulating relevant research objectives are contained in the earlier chapters such as vulnerability assessments, adaptation, mitigation and finance chapters.

6.2.4 Methodology (Data Collection Instruments, Actual Data Collection and Data Analysis)

Since the research process has many steps which build upon the other with the methodology being the heart of the research proposal, it is critical to list and describe some of the critical stages of the research and method which are central in identifying, evaluating, presenting and using information through research (Porter et.al. 2004). Some of the key steps in research design include developing the data collections tools and instrument or experimental design, the actual data collection and

analysing the data to answer the pre-defined research questions or test the hypotheses in line with the research objectives. It indicates the methodological steps you will take to answer every question or to test every hypothesis illustrated in the Questions/Hypotheses section. Some of the methodologies include Climate Vulnerability Assessment (CVA) contained in Chapter 2 of this Module.

The specific aspects of each of these steps is given in the next sub sections:

6.2.4.1 Data Collection Techniques and Tools

There are several data collection techniques inclusive of: Using available (secondary) information, Observing, Interviewing Key Informants (KII), Administering written questionnaires such as Household Questionnaire (HHQ), Focus group discussions (FGD), Projective techniques and Ethnography. The next subsections detail some of the methods of data collection and sources of the data

Using available (secondary) information

In the climate sphere, there is usually a large amount of data that has already been collected by others especially the Meteorological and Hydrological Services which could be analysed to inform decision-making, policy or practice.

Key Informant Interview (KII)

The research may have to identify possible persons or institutions and deign key informant interviews (KII) in order to access this available information possibly through a carefully designed instrument such as a KII checklist or compilation sheet. The key informants could be persons of authority and experts or authoritative figureheads in the District or Province or area of interest.

Observing

Observation is a technique that involves systematically selecting, watching and recording behaviour and characteristics of living beings, objects or phenomena. In the climate change discourse, this methodology could be used to note changing characteristics of tree species or biomes in response to different climate characteristics such as rainfall, temperature and determination of changes in riparian modifications.

Interviewing

An interview is a data-collection technique that involves oral questioning of respondents, either individually or as a group. Answers to the questions posed during an interview can be recorded by writing them down (either during the interview itself or immediately after the interview) or by tape-recording the responses, or by a combination of both.

Administering written questionnaires

A written questionnaire (also referred to as self-administered questionnaire) is a data collection tool in which written questions are presented that are to be answered by the respondents in written form. A written questionnaire can be administered in different ways such as by: Sending questionnaires by mail with clear instructions on how to answer the questions and asking for mailed responses; Gathering all or part of the respondents in one place at one time, giving oral or written instructions, and letting the respondents fill out the questionnaires; or Hand-delivering questionnaires to respondents and collecting them later. With the advent of technology (ICT), questionnaires are now being easily developed and administered online through such systems as Survey Monkey.

The questions can be either open-ended or closed (with pre-categorised answers). Closed questionnaires are preferred where quantitative responses are required whereas open-ended questions are preferred where depth or case studies are involved to get further details/The methodology could be used to assess specific qualitative information from many respondents.

Focus Group Discussions (FGD)

A focus group discussion allows a group of 8 - 12 informants to freely discuss a certain subject with the guidance of a facilitator or reporter. This is usually desirable when triangulating quantified climate information from secondary sources and where there is need for some regulation and peer review of responses.

Projective Techniques

This approach involves use of projective techniques such as images to trigger an informant to react to some kind of visual or verbal stimulus.

Ethnography

Ethnography is a type of anthropology that involves studying people or systems in a particular society or culture by observing them in their natural setting. It is a participant approach best used when one wants to understand subtle and personal behaviours in practice.

Table 6.1 : Differentiation between Data Collection Techniques and Data Collection Tools

Data Collection Techniques	Data Collection Tools
Using available information	Checklist; data compilation forms
Observing	Eyes and other senses, pen/paper, watch, scales, microscope, etc.
Interviewing	Interview guide, checklist, questionnaire, tape recorder
Administering written questionnaires	Questionnaire

Source : Dilman et al., 2002.

6.2.4.2 Actual Data Collection

The actual data collection outlines the general plan for collecting the data. This may include survey administration procedures, interview or observation procedures. It involves key processes such as sampling and various methods of using collecting data using the tools developed for the same purpose such as administering questionnaires and carrying out the interviews.

Sampling

Empirical research almost always depends upon a sample which is assumed to accurately represent a population. Researchers rarely survey the entire population for two main reasons: the cost is too high, and the population is dynamic. Sampling thus becomes important for data collection. It is part of statistical practice concerned with the selection of a subset of individual observations within a population of individuals intended to yield some knowledge about the population of concern, especially for the purposes of making predictions or conclusions based on statistical inference. The techniques by which the sample was chosen are therefore vital to a discussion on the validity of the research findings. The key reason for being concerned with sampling is that of validity-the extent to which the interpretations of the results of the study follow from the study itself and the extent to which results may be generalized to other situations with other people. Sampling is critical to external validity-the extent to which findings of a study can be

generalized to people or situations other than those observed in the study. To generalize validly the findings from a sample to some defined population requires that the sample be drawn from that population according to one of several probability sampling plans. Another reason for being concerned with sampling is that of internal validity-the extent to which the outcomes of a study result from the variables that were manipulated, measured, or selected rather than from other variables not systematically treated. Perhaps the key word in sampling is representativeness. One must ask oneself, "How representative is the sample of the survey population (the group from which the sample is selected) and how representative is the survey population of the target population (the larger group to which we wish to generalize)?

Sampling Process

The sampling process comprises several stages: Defining the population of concern; Specifying a sampling frame, a set of items or events possible to measure; Specifying a sampling method for selecting items or events from the frame; Determining the sample size; Implementing the sampling plan; and Sampling and data collecting. Sampling Methods include: Simple random sampling, Systematic sampling, Stratified sampling, Cluster sampling, Quota sampling and Convenience sampling or Accidental Sampling.

6.2.4.3 Data Analysis

Analysis of data is a process of inspecting, cleaning, transforming, and modelling data with the goal of highlighting useful information, suggesting conclusions, and supporting decision making. It is critical in this process to specify and describe in detail the procedures and techniques of quantitative and qualitative data analysis you will use (e.g., ANOVA, MANCOVA, etc). Analyses are done during data collection as well as after all the data have been gathered. The goal of the analysis is to discover patterns, ideas, explanations and "understandings". A thorough analysis requires three steps: organization of the data, summarizing the data, and then interpreting the data. The researcher must therefore communicate his/her precise intentions and reasons for these intentions to the reader. This helps him/her and the reader evaluate the choices made and procedures followed. Indicate briefly any analytic tools you will have available and expect to use (e.g., SPSS, SYSTAT). Provide a well thought-out rationale for your decision to use the design, methodology, and analyses you have selected. Three types of analyses are common in qualitative research: Thematic Content Analysis, Indexing and Quantitative Descriptive Analysis as well as; Statistical Analysis

6.2.5 Limitations and Delimitations

A limitation identifies potential weaknesses of the study. Think about your analysis, the nature of self-report, your instruments, and the sample. Think about threats to internal validity that may have been impossible to avoid or minimize-explain. Delimitation addresses how a study will be narrowed in scope, that is, how it is bounded. This is the place to explain the things that you are not doing and why you have chosen not to do them-the literature you will not review (and why not), the population you are not studying (and why not), the methodological procedures you will not use (and why you will not use them). Limit your delimitations to the things that a reader might reasonably expect you to do but that you, for clearly explained reasons, have decided not to do.

6.3 Research Work Plan

A work plan is written to plan the activities for a given period of time as a guiding document for the activities to be carried out during that time period and also to convince decision makers for its

approval, then. It provides a general outline of the time schedule you expect to follow and thus demonstrates an awareness of the need for planning and the timescale of the research. Since most inexperienced researchers tend to underestimate the amount of time that the various stages of research will take, some of the recommended considerations when developing a work-plan is to "Be generous when working out time frames and check them with a more experienced researcher".

6.3.1 Why Prepare a Work Plan?

The main purpose of a work-plan is to work as a planning and management instrument (tool) which provides a framework for planning the work, and is a guide during the period in question for carrying out that work (Dillman et.al 2009). It is also used by funding agencies and executing agencies as a document for justifying the release of money. It is also a useful document contributing to transparent and for monitoring purposes by supervisors and progress-tracking.

6.3.2 The Structure and Content of a Work Plan

There are several layouts of work-plans and presentations differ. Life/Natural Sciences and Technology fields usually make use of a Gantt chart to show the work-plan whereas Social Sciences and Business fields use a word format such as: Abstract or Executive Summary, Introduction and Background (The Problems), Goals and Objectives (The Outputs), Resources and Constraints (The Inputs), Strategy and Actions (from Inputs to Outputs), Appendices (Budget, Schedule and Others). A well deigned work-plan facilitate timeous achievement of research results and presents a good basis for budgeting. A logical framework may be used in presenting the key components, activities, budgets and timelines for a research work.

6.4 Budgeting and Possible Sources of Funding

The budget section outlines the specific fundable activities and materials that will be needed for the research. Research budgeting is easier if the research process (especially objectives, methodology and work-plan) is carefully crafted such that there are clear quantified activities which are designed to meet each of the research objectives aimed at fulfilling the research aim. Budgets and budget justifications demonstrate feasibility, value for money and detail why you need an item for your project, as well as how you arrived at the costings.

According to Bryman. (2007) there are generally two categories of research costs: direct costs and indirect costs. Direct costs are costs integral to achieving the research objectives, directly address the research objectives and relate to the research plan. These include:

- Personnel, e.g. research assistants and staff costs.
- Equipment such computers, specialist software, databases, secure cloud storage
- Travel and subsistence e.g. for data collection
- Acquisition of specific skills such as Climate modelling training or data management
- Other (e.g. Consumables such as stationary and climate data mining cost).

Indirect costs are institution costs that benefit and support research activities at the institution. Although they are necessary for the conducting of the research and may be incurred during the project, they are costs that do not directly address the approved research objectives of the research. Indirect cost are:

- Operations and maintenance of buildings (e.g. libraries, labs, meeting venues)
- Insurance, legal and financial services
- Publishing costs
- Regulatory and research compliance and administration of research services

The last and key components of the budgeting is indicating what funds are available or potential funding sources.

6.5 How to Write a Good Report

Report-writing is a crucial factor which may impact the mainstreaming of research outputs in development, planning, decision-making and furthering research. It is equally critical for monitoring progress during the research and enabling continued funding of the research. Although there are various types of reports, most components are standard. These include:

i) *A title* which should explain what the research is about, succinctly.

ii) *Authors* plus their institutions so as to explain who did the work and all details must be correct. Only those who made a major contribution to the completed product should be included. Co-authors may add considerable strength, substance, and a fresh perspective.

iii) *Abstract/Summary* which must contain a synopsis of the problem, methods, results and conclusion of work described. This allows the reader to quickly grasp the essence of the work. When reviewing content one should look at if it explains why the work was done? Does it outline the whole of your work findings? It is one of the most critical components whose purpose must include capturing the reader to have interest in the whole research.

iv) *Table of Contents*- this shows the organisation of the text; all sections must be covered and page numbers must be correct.

v) *A list of all acronyms/abbreviations* used but not those of SI, chemical elements or standard bio-chemical terms must be given.

vi) *Definitions* segment may include all the key terms which are to be frequently used

vii) *Acknowledgements* must contain all people who have made considerable contribution to the research including funders and those who provided technical support

viii) *Introduction/Background*- this orientates the reader. It highlights the problem being investigated, the objectives and justifies the research. It must provide enough background information and cite all relevant references and must be at correct depth for readership. It must indicate the central hypothesis which the work tackles.

ix) *Material and methods*- this must explain how the work was done including data sources, data collection instruments, actual data collection methodology and analyses. It should contain sufficient detail to allow another competent worker to do the work.

x) *Results and Discussion*- these display and describe the research findings obtained. It should be presented in the form which is easily assimilated (graphs, rather than tables, small tables rather than large ones. It also discusses the results: their meaning, their importance, compares results with those of others, suggests what to do next. The significance of the results must be explained and a comparison with published data must be done. It must be checked if the sequences of research components are adequately linked? Are all findings presented in the

clearest way possible? Are all the materials relevant to the objectives of the study included? Are all figures and tables numbered in the order of their appearance? Are the titles appropriate? Do the figure and table legends provide all the necessary detail to interpret the data without reference to text?

xi) *Conclusions* - The section contains a summary of the research findings as their implications for practice. Conclusions must be justified by the research done. Recommendations and further studies may be part of this Chapter

xii) Acknowledgements- these give credit to those who helped to carry out the research hence everyone who significantly helped in the research must be listed.

xiii) *References* - list all the references cited in the appropriate format: provides enough information for the reader to find the reference in the library. All the references that appear in the text must be included, years of publication and authors must match, all journal details must be complete and in the correct format. List must be in alphabetic order or correct numerical order.

xiv) Annexes may include other material which is supplementary but key to understanding of the report.

6.6 How to Prepare and Deliver an Oral Presentation

Climate Change is a multi-disciplinary field hence its presentation may be highly technical, simplified or presented orally or pictorially. The objective of an oral presentation is to portray large amounts of often complex information in a clear, bite sized fashion which is understandable to the audience. Although some of the success lies in the content and nature of audience, the rest lies in the speaker's skills in transmitting the information to the audience as well as the preparation and packaging of the research work. The delivery time is equally of essence.

Preparation - "If you fail to prepare, prepare to fail"- unknown.

Preparation is central to a good oral presentation as it gives you confidence when presenting. It is therefore critical to decide on the type of presentation with the most common being a power point presentation or poster presentation. Other key issues which will assist in delivering the presentation is taking time to familiarise with the venue in person, and find out the time allowed for your presentation and for questions, and the size of the audience and their backgrounds, which will allow the presentation to be pitched at the appropriate level. For visual aids, Microsoft PowerPoint is very popular. Other aids for visual presentations include Posters which can be prepared in Microsoft Publisher or PowerPoint

When preparing the presentation, start with an opening slide containing the title of the study, your name, and the date. Begin by addressing and thanking the audience and the organisation that has invited you to speak. Typically, the format includes background, study aims, methodology, results, strengths and weaknesses of the study, and conclusions (Rovira et.al.2013). Most modern styles of presentations however now start with a conclusion to capture the attention of the audience. If following the usual format and if the presentation is a bit long, you may need to include an Outline slide which gives the key components of the presentation If the study takes a lecturing format, consider including "any questions?" on a slide before you conclude, which will allow the audience to remember the take home messages. Ideally, the audience should remember three of the main points from the presentation. Have a maximum of four short points per slide. If you can display something as a diagram, video, or a graph, use this instead of text and talk around it. Animation is

available in Microsoft PowerPoint, and its use in presentations has been demonstrated to assist in the retention and recall of facts. But do not overuse it, though, as it could make you appear unprofessional.

Delivery

It is important to dress appropriately, stand up straight, and project your voice towards the back of the room. Practise using a microphone, or any other presentation aids, in advance. If you don't have your own presenting style, think of the style of inspirational scientific speakers you have seen and learn from them. The slides or videos should be an adjunct to your presentation, so do not hide behind them. You should avoid reading the wording on the slides, but instead talk around the content on them.

Maintain eye contact with the audience. Speak slowly and concisely, highlighting key points. Do not assume that the audience is completely familiar with the topic you are passionate about, but don't patronise them either. Use every presentation as an opportunity to teach, even your seniors. The information you are presenting may be new to them, but it is always important to know your audience's background. You can then ensure you do not patronise world experts. To maintain the audience's attention, vary the tone and inflection of your voice. If appropriate, use humour. Check every now and again that the audience is following and offer them the opportunity to ask questions.

Finishing

Finishing up is the most important part, as this is when you send your take home message with the audience. Slow down, even though time is important at this stage. Conclude with the three key points from the study and leave the slide up for a further few seconds. Do not ramble on. Give the audience a chance to digest the presentation. Conclude by acknowledging those who assisted you in the study, and thank the audience and organisation. If you wish to show references, insert a text box on the appropriate slide with the primary author, year, and paper, although this is not always required.

Poster Presentation

A poster presentation is one of the critical aid for an oral presentation especially at large conferences.

Activity 6.7

1) Identify one climate -related research issue in your focus geographic area
2) Formulate the research proposal in a word document of not more than 3 pages
3) Prepare and present the proposal in power-point of not more than 10slides.

References

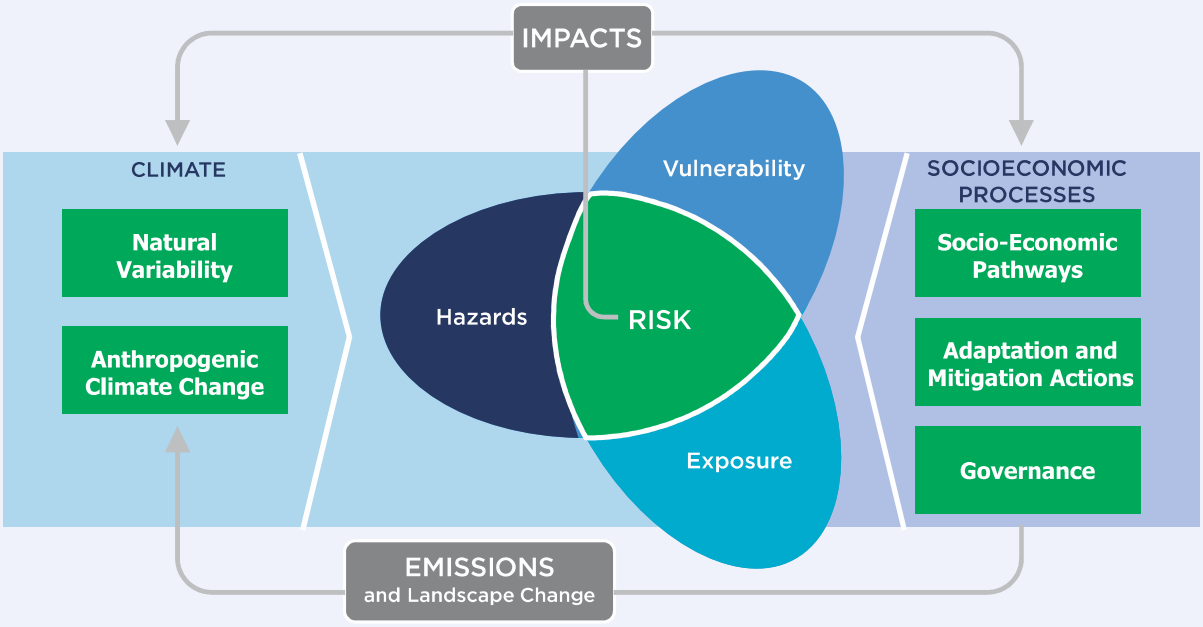
1. Downing T.E. et al (2002) *Vulnerability assessment for climate adaptation:* Adaptation Planning Framework Technical Paper 3, Oxford.
2. FAO (2018) *A review of existing approaches and methods to assess climate change vulnerability of forest and forest-dependent people,* Forestry Working Paper No. 5. Rome, FAO.
3. Government of Zimbabwe (2012) *Baseline Report on Economic Development and Climate Change: Towards sustainable inclusive growth, human centred developement, transformation and poverty reduction.* Government of Zimbabwe, Harare.
4. Government of Zimbabwe (2014) *National Climate Change Response Strategy.* Government of Zimbabwe, Harare.
5. IPCC (2014) *Summary for policymakers. In : Climate Change 2014 : Impacts , Adaptation and Vulnerability. Part A: Global and Sectoral Aspects . Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press, Cambridge, United Kingdom and New York , NY, USA, pp. 1-32.
6. Osbahr H. et al. (2010) *Evaluating Successful Livelihood Adaptation to Climate Variability and Change in Southern Africa.* Ecology and Society 15(2) : 27. www.ecologyandsociety.org/vol15/iss2/art27
7. UNEP (2019) *Emissions Gap Report 2019. Executive Summary.* United Nations Environment Programme, Nairobi
8. UNFCCC (2008) *UNFCCC Resource Guide Module 2: Vulnerability and Adaptation to Climate Change for Preparing the National Communications of Non-Annex I Parties: Module 2 Vulnerability and Adaptation to Climate Change.* UNFCCC, Bonn.
9. United Nations Convention to Combat Desertification (2017) *Global Land Outlook: First Edition UNCCD,* Bonn.
10. Dillman, D.A., Eltinge, J.L., Groves, R.M., & Little , R.J.A. (2002). *"Survey nonresponse in design,data collection and analysis".* In: R.M. Groves , D.A.
11. Gorgens, M. & Kusek, J.Z., 2009, *Making monitoring and evaluation systems work: A capacity development tool kit ,* The International Bank for Reconstruction and Development/The World Bank, Washington , DC.
12. Government of Kenya(2019), *A TRAINING HANDBOOK CLIMATE FINANCE: CODING, TRACKING AND REPORTING ,* Enhanced Transparency of Climate Finance in Kenya 2019
13. Haque A. N. (2016), *Application of Multi-Criteria Analysis on Climate Adaptation Assessment in the Contxt of Least Developed Countries ,* https://www.researchgate.net/journal/1099-1360_Journal_of_Multi-Criteria_Decision_Analysis. DOI:10.1002/mcda1571
14. Kusek, J.Z. and Rist, R.C. 2004. *Ten Steps to a Results-Based Monitoring and Evaluation System: A Handbook for Development Practitioners, Washington DC,* The Internation Bank for Reconstruction and Developmen/The World Bank.
15. Ssekamatte, D., 2018, *The role of monitring and evaluation in climate change mitigation and adaptation interventions in developing countries,* African Evaluation Journal 6(1), 254. https://doi.o/10.10.42/aej.v6i.254
16. https://unfccc.int/Adaptation-Fund

17. https://unfccc.int/topics/climate-finance/the-ig-picture/introductionto-climate-finance accessed 21 Aug 2020

18. United Nations Development Programme (2017) *Zimbabwe Human Development Report 2017. Climate Change and Human Development : Towards Building a Climate Resilient Nation.* UNDP, Harare.

19. United Nations Development Programme (2018) *Climate Change Adaptation in Africa.UNDP Synthesis of Experiences and Recommendatons.* UNDP, Bangkok.

20. Zimbabwe National Statistics Agency (2017) *Zimbabwe Poverty Report 2017*. ZimStat Harare.



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