
# NAMIBIA'S FIRST BIENNIAL TRANSPARENCY REPORT AND FIFTH NATIONAL COMMUNICATION TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE AND THE PARIS AGREEMENT

A CONSOLIDATED REPORT

DECEMBER 2024

MET, Private bag 13306, Windhoek, Namibia
Phone: +264612842701



Contributors:
Dr. Tendai Nzuma – NDC Tracking, National circumstances and Other Information Relevant to the Convention chapters
Climagric Ltd – GHG Inventory and support received and needed chapters
Inference (PTY) Ltd – Vulnerability and Adaptation chapter

# FOREWORD

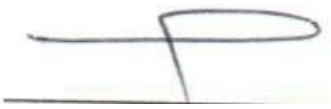
On behalf of the Government of the Republic of Namibia, it is an honour and a privilege to present Namibia's combined First Biennial Transparency Report (BTR1) and Fifth National Communication (NC5) to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement (PA).

Namibia ratified the UNFCCC in 1995 and the Paris Agreement in 2016, reaffirming our commitment to global efforts in combating climate change. As a Non-Annex I Party, Namibia has diligently fulfilled its reporting obligations, submitting four National Communications and four Biennial Update Reports to date. This combined BTR1 and NC5 report marks a significant milestone, as it reflects our transition to the Enhanced Transparency Framework (ETF) under the Paris Agreement, ensuring comprehensive and coherent reporting of our climate actions and support.

This integrated report provides detailed updates on Namibia's greenhouse gas inventories, mitigation and adaptation actions, support needed and received, and progress towards our Nationally Determined Contributions (NDCs). By combining the BTR and NC, we enhance efficiency and accessibility of climate information, demonstrating our unwavering commitment to transparency and accountability in addressing climate change.

I extend my sincere gratitude to all stakeholders, including government ministries, private sector entities, civil society organizations, and international partners, whose collaborative efforts have been instrumental in the preparation of this report. We remain steadfast in our dedication to implementing effective climate policies and actions, contributing to the global objective of limiting temperature rise and fostering a sustainable future for all.

Sincerely,



**Hon. Pohamba Shifeta**
**Minister of Environment, Forestry and Tourism**

**Acknowledgements**

This combined report received contributions from various Departments of the Ministries, Private Sector Institutions including social and community organizations of the Republic of Namibia. Their contributions are gratefully acknowledged. Namibia also acknowledges the financial contribution made by the Global Environment Facility through the UNDP country office as implementing Agency. Namibia also wishes to put on record the support provided by the Consultants of CLIMAGRIC Ltd, Dr. Tendai Nzuma and Inference Ltd for capacity building of the national experts, production of the chapters on various themes and Dr. Tendai Nzuma for compilation of the combined BTR1 and NC5. The main contributors are listed below.

**PROJECT TEAM AND CONTRIBUTORS:**

- Overall supervision by Mr. Timoteus Mufeti
- Project Supervisor Mr. Petrus Muteyauli
- Project Coordinator Mr. Reagan Sibanga Chunga

**MAIN CONTRIBUTORS:**

- Ministry of Environment, Forestry and Tourism
- Ministry of Mines and Energy
- Ministry of Works and Transport
- Ministry of Agriculture, Water and land Reform
- Ministry of Industrialization and Trade
- Ministry of Fisheries and Marine Resources
- National Planning Commission
- NamPower
- Namibia Statistics Agency
- Namibia Energy Institute
- City councils and municipalities
- TransNamib Holdings Ltd
- Namibia Airports Company
- Petroleum products dealers
- Namport
- Electricity Control Board
- Meatco Namibia

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AAL | Average Annual Losses |
| AD | Activity Data |
| AdCom | Adaptation Communication |
| AFOLU | Agriculture, Forestry, and Other Land Use |
| AI | Aridity Index |
| AR | Assessment Report |
| ART | Antiretroviral Therapy |
| BAU | Business-As-Usual |
| BCBU | Bush Control and Biomass Utilisation |
| BCLME | Benguela Current Large Marine Ecosystem |
| BMZ | Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung/ German Federal Ministry for Economic Cooperation and Development |
| BRs | Biennial Reports |
| BTR | Biennial Transparency Report |
| CBD | Convention on Biological Diversity |
| CBIT | Capacity-building Initiative for Transparency |
| CBNRM | Community-Based Natural Resource Management |
| CC | Climate Change |
| CCIU | Climate Change and Inclusive Use of Natural Resources |
| CCKP | Climate Change Knowledge Portal |
| CCU | Climate Change Unit |
| CCVAA | Climate Change Vulnerability and Adaptation Assessment |
| CEPA | Communication, Education and Public Awareness Strategy |
| CH4 | Methane |
| CMIP6 | Coupled Model Inter-Comparison Project Phase 6 |
| CO2 | Carbon dioxide |
| CO | Carbon monoxide |
| COP | Conference of Parties |
| CORSIA | Carbon Offsetting and Reduction Scheme for International Aviation |
| COVID-19 | Coronavirus Disease 2019 |
| CRAN | Communications Regulatory Authority of Namibia. |
| CRAVE | Climate Resilient Agriculture in three of the Vulnerable Extreme northern crop-growing |

| | |
|---|---|
| CSA | Climate-Smart Agriculture |
| CSOs | Civil Society Organizations |
| CTF | Climate Technology Fund |
| DTMC | Discrete-Time Markov Chain Model |
| DEA | Department of Environmental Affairs |
| DoF | Directorate of Forestry |
| DRM | Disaster Risk Management |
| DRFN | Desert Research Foundation of Namibia. |
| DRR | Disaster Risk Reduction |
| EAWMPCI | Division of Environmental Assessment, Waste Management and Pollution Control, and Inspections |
| ECB | Electricity Control Board |
| EF | Emission Factors |
| EIA | Environmental Impact Assessment |
| EIF | Environmental Investment Fund |
| EIMS | Environmental Information and Monitoring System |
| ENSO | El Niño–Southern Oscillation |
| ESKOM | Electricity Supply Commission of South Africa |
| ETF | Enhanced Transparency Framework |
| EU | European Union |
| EUR | Euro |
| EVs | Electric Vehicles |
| FAO | Food and Agriculture Organization of the United Nations |
| FAOSTATS | Food and Agriculture Organization Statistics Database. |
| GCCA+ | Global Climate Change Alliance Plus Initiative |
| GCF | Green Climate Fund |
| GEF | Global Environment Facility |
| GCOS | Global Climate Observing System |
| GDP | Gross Domestic Product |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit/German Agency for International Cooperation |
| GNDI | Gross National Disposable Income |
| GNI | Gross National Income |
| GIS | Geographic Information System |

| | |
|---|---|
| GSP | Global Support Programme |
| GWPs | Global Warming Potentials |
| GVM | Gross Vehicle Mass |
| HFCs | Hydrofluorocarbons |
| HIV/AIDS | Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome |
| HPP | Harambee Prosperity Plan |
| HSSP | Health Sector Strategic Plan |
| ICAO | International Civil Aviation Organization |
| ICAT | Initiative for Climate Action Transparency |
| IEA | International Energy Agency |
| IMO | International Maritime Organization |
| INC | Initial National Communication |
| IPCC | Intergovernmental Panel on Climate Change |
| IPPs | Independent Power Producers |
| IPPU | Industrial Processes and Product Use |
| ITCZ | Inter-Tropical Convergence Zone |
| ITMOs | Internationally Transferred Mitigation Outcomes |
| IWRM | Integrated Water Resources Management |
| LDCF | Least Developed Countries Fund. |
| LULUCF | Land Use, Land Use Change, and Forestry |
| LPG | Liquid Petroleum Gasses |
| MAWLR | Ministry of Agriculture, Water and Land Reform |
| MCH | Maternal and Child Health |
| MDR-TB | Multidrug-Resistant Tuberculosis |
| MEAC | Ministry of Education, Arts, and Culture |
| MEFT | Ministry of Environment, Forestry, and Tourism |
| MME | Ministry of Mines and Energy |
| MoHSS | Ministry of Health and Social Services |
| MPGs | Modalities, Procedures, and Guidelines |
| MPI | Multidimensional Poverty Index |
| MRV | Measurement, Reporting and Verification |
| MW | Megawatts |
| NAD | Namibian Dollar |
| NACSO | Namibian Association of CBNRM Support Organisations |

| | |
|---|---|
| NATIS | Namibia Traffic Information System |
| NBSAP | National Biodiversity Strategy and Action Plan |
| NCCP | National Climate Change Policy |
| NCCSAP | National Climate Change Strategy and Action Plan |
| NCRC | National Committee on the Rio Conventions |
| NCSA | National Capacity Self-Assessment |
| NDC | Nationally Determined Contributions |
| NDC ISAP | Nationally Determined Contributions Implementation Strategy and Action Plan |
| NDP | National Development Plan |
| NDRMP | National Disaster Risk Management Plan |
| NF3 | Nitrogen trifluoride |
| NGHGI | National Greenhouse Gas Inventory |
| NGO | Non-Governmental Organisation |
| NHIES | Namibia Household Income and Expenditure Survey |
| NID | National Inventory Document |
| NIR | National Inventory Report |
| NMVOC | Non-Methane Volatile Organic Compounds |
| NMS | Namibia Meteorological Service |
| NNFU | Namibia National Farmers Union |
| N2O | Nitrous oxide |
| NOx | Nitrogen oxides |
| NPC | National Planning Commission |
| NPCC | National Policy on Climate Change |
| NSA | National Statistics Agency |
| NTLP | National Tuberculosis and Leprosy Programme |
| NUST | Namibia University of Science and Technology |
| NYCA | Namibia Youth for Climate Action |
| OECD | Organisation for Economic Co-operation and Development |
| PA | Paris Agreement |
| PFCs | Perfluorocarbons |
| PHC | Primary Health Care |
| QA/QC | Quality Assurance/Quality Control |
| RCMRD | Regional Centre for Mapping of Resources for Development |
| RCPs | Representative Concentration Pathways |

| | |
|---|---|
| REFIT | Renewable Energy Feed-In Tariff |
| SADC | Southern African Development Community |
| SAFs | Sustainable Aviation Fuels |
| SASSCAL | Southern African Science Service Centre for Climate Change and Adaptive Land Management |
| SCCF | Special Climate Change Fund |
| SCORE | Scaling up Community Resilience to Climate Variability and Climate Change in Northern Namibia |
| SDGs | Sustainable Development Goals |
| $SF_6$ | Sulphur Hexafluoride |
| SLM | Sustainable Land Management |
| SME | Small and Medium Enterprises |
| SNC | Second National Communication |
| SO2 | Sulphur dioxide |
| SOx | Sulphur oxides |
| SSPs | Shared Socioeconomic Pathways |
| STEM | Short-Term Energy Market |
| TAP | Technology Action Plan |
| TB | Tuberculosis |
| TBD | To be determined |
| TNC | Third National Communication |
| TNA | Technology Needs Assessment |
| TWG | Technical Working Group |
| TVET | Technical and Vocational Education and Training |
| UN | United Nations |
| UNAM | University of Namibia |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme. |
| UNFCCC | United Nations Framework Convention on Climate Change. |
| UNISDR | United Nations Office for Disaster Risk Reduction |
| USD | United States Dollar |
| WAM | With Additional Measures |
| WM | With Measures |
| WHO | World Health Organisation |

# EXECUTIVE SUMMARY

Namibia's First Biennial Transparency Report (BTR1) and Fifth National Communication (NC5) provide a comprehensive account of the country's progress in combating climate change, in alignment with its obligations under the Paris Agreement. This integrated report reflects Namibia's commitment to transparency, accountability, and sustainability, detailing achievements, challenges, and future plans in mitigation, adaptation, and international cooperation. Covering the period from 2015 to 2024, the document presents insights into Namibia's climate actions across key sectors and establishes a foundation for future efforts

**National Circumstances:** Namibia's unique geographic and socio-economic conditions shape its climate challenges and responses. As one of the driest countries in sub-Saharan Africa, Namibia is highly vulnerable to climate risks, including prolonged droughts, erratic rainfall, rising temperatures, and desertification. These risks impact critical sectors such as agriculture, water resources, biodiversity, and public health, with rural communities and marginalized populations being most affected (Government of Namibia, 2020). Namibia's economy, heavily dependent on natural resources, necessitates the integration of climate resilience into development planning. Institutional arrangements, led by the Ministry of Environment, Forestry, and Tourism (MEFT), foster cross-sectoral collaboration to ensure climate resilience while aligning with the Enhanced Transparency Framework (ETF) (Dale et al., 2020).

**Greenhouse Gas Inventory and Trends:** Namibia remains a net carbon sink, primarily due to carbon sequestration in the Land Use, Land Use Change, and Forestry (LULUCF) sector. The updated Greenhouse Gas (GHG) Inventory for the period 1990–2022, prepared using IPCC 2006 guidelines, provides detailed emissions and removal data across sectors (MEFT, 2023). Key trends include:

- *Total Emissions* - Emissions have remained stable at approximately 20,000 kt $CO_2e$, reflecting Namibia's sustainable practices.
- *Energy Sector* - Fossil fuel use in electricity generation and transportation contributed to a significant rise in emissions, underscoring the need for renewable energy deployment.
- *LULUCF Sector* - Carbon removals increased by 45% over the reporting period, driven by afforestation, sustainable forest management, and reduced deforestation.
- *Agriculture* - Methane and nitrous oxide emissions from livestock and fertilizer use have shown moderate growth.
- *Waste Sector* - Emissions from solid waste disposal and wastewater treatment have also grown but remain a smaller proportion of total emissions.

This inventory highlights the effectiveness of existing mitigation efforts and identifies areas requiring targeted interventions, particularly in the energy and agriculture sectors.

**Progress on Implementing Nationally Determined Contributions (NDCs):** Nationally Determined Contributions (NDCs) set an ambitious target to reduce GHG emissions by 7.669 $MtCO_2e$ relative to the Business-As-Usual (BAU) scenario of 31.380 $MtCO_2e$ by 2030 while maintaining its net sink status (Government of Namibia, 2021). Mitigation measures include:

- *Energy Transition* - Accelerating renewable energy adoption, particularly solar and wind, to reduce reliance on fossil fuels.
- *Agriculture* - Expanding climate-smart agriculture practices to minimize methane and nitrous oxide emissions.
- *Forestry* - Enhancing afforestation and reforestation initiatives to increase sink capacity by 5.481 $MtCO_2e$ beyond BAU levels.

The report emphasizes robust Measurement, Reporting, and Verification (MRV) systems to track progress, ensure transparency, and identify opportunities for improvement. Monitoring systems ensure transparency and accountability in achieving the mitigation potential of 11.902 $MtCO_2e$, as detailed in Namibia's updated climate strategies (MEFT, 2023).

**Adaptation Strategies and Outcomes:** Adaptation is central to Namibia's climate response, addressing vulnerabilities in agriculture, water resources, health, and ecosystems. Key strategies and outcomes include:

- *Water Resources* - Implementing Integrated Water Resource Management (IWRM) to enhance water security and manage drought risks.
- *Agriculture* - Promoting drought-resistant crops, improving irrigation systems, and supporting sustainable farming practices to ensure food security.
- *Ecosystems* - Expanding protected areas, restoring degraded lands, and supporting Community-Based Natural Resource Management (CBNRM) programs to conserve biodiversity while enhancing community resilience.
- *Health and Infrastructure* - Strengthening climate-resilient public health systems and developing infrastructure capable of withstanding climate impacts.

These actions align with Namibia's commitments under Article 7 of the Paris Agreement, supported by robust monitoring and evaluation frameworks (UNFCCC, 2019).

**Financial, Technological, and Capacity-Building Support:** Namibia's climate actions rely on a mix of domestic funding, international finance, and technical assistance. The report highlights the following:

- *International Finance* **-** Support from the Green Climate Fund (GCF) and bilateral donors has funded renewable energy projects, afforestation programs, and climate-resilient infrastructure development.
- *Technological Support* - Namibia has deployed cutting-edge renewable energy technologies and innovations in sustainable agriculture to enhance mitigation and adaptation efforts.
- *Capacity-Building* - Training programs, technical workshops, and partnerships with academic and international institutions have strengthened Namibia's institutional and human capacities to implement and monitor climate actions effectively (Dale et al., 2020).

However, limited and unpredictable access to climate finance and technical expertise poses challenges to scaling these efforts.

**Key Achievements**

- *Greenhouse Gas Mitigation* - Namibia has successfully maintained its net sink status, achieving a 45% increase in carbon removals in the Land Use, Land Use Change, and Forestry (LULUCF) sector between 1990 and 2022. Total emissions have been stabilized at approximately 20,000 kt $CO_2e$, demonstrating the effectiveness of sustainable practices across key sectors. Additionally, the country has made significant progress in adopting renewable energy, particularly solar and wind, which has contributed to notable emission reductions in the energy sector.
- *Adaptation Efforts* - Namibia has strengthened Integrated Water Resource Management (IWRM) to address the challenges of prolonged droughts and ensure the security of water resources. The country has expanded drought-resistant agriculture and promoted sustainable farming practices, thereby enhancing food security. Additionally, biodiversity conservation efforts have been intensified, with a particular focus on

community-based natural resource management (CBNRM) to support both ecological resilience and community livelihoods.

- *Financial, Technological, and Capacity Support* - Namibia has successfully accessed funding from the Green Climate Fund (GCF) to support renewable energy projects and resilience initiatives. The country has also deployed innovative technologies to enhance climate-smart agricultural practices and advance clean energy systems, contributing to its climate adaptation and mitigation efforts.

**Challenges and Opportunities:** Namibia faces key challenges in meeting its climate objectives:

- *Data Gaps* - Limited data availability and inconsistencies in monitoring systems hinder accurate reporting and decision-making.
- *Financial Constraints* - Dependence on external funding limits the scale and sustainability of ambitious climate initiatives.
- *Capacity Limitations* - A lack of technical expertise affects the implementation and scaling of climate actions.

Despite these challenges, Namibia has significant opportunities to strengthen its climate response:

- *Renewable Energy Expansion* - With abundant solar and wind resources, Namibia is well-positioned to lead regional energy decarbonization efforts.
- *Ecosystem-Based Adaptation* - Leveraging its natural landscapes, Namibia can enhance biodiversity conservation and promote sustainable livelihoods.
- *International Collaboration* - Strengthening partnerships with global stakeholders offers avenues for increased financial and technical support.

**Vision for 2050 and Global Collaboration:** Namibia's long-term climate vision aligns with global goals for net-zero emissions and sustainable development by 2050. Key priorities include:

- *Decarbonizing Energy Systems* - Expanding renewable energy, improving energy efficiency, and phasing out fossil fuels.
- *Enhancing Climate Resilience* - Mainstreaming climate adaptation into national policies and fostering community-based solutions.
- *Leveraging Innovation* - Investing in clean technologies and research to drive sustainable economic growth.

Namibia's collaborative approach, guided by the Enhanced Transparency Framework (ETF), strengthens its contribution to global climate action. By integrating climate considerations into national development planning, Namibia aims to balance environmental protection with socio-economic progress (Government of Namibia, 2021).

**Summary:** Namibia's integrated BTR1 and NC5 report captures the country's comprehensive approach to addressing climate change through mitigation, adaptation, and international collaboration. The report highlights Namibia's achievements in reducing emissions, enhancing resilience, and mobilizing resources while addressing barriers such as financial and technical constraints. By prioritizing transparency, accountability, and innovation, Namibia reinforces its commitment to the Paris Agreement and positions itself as a leader in sustainable climate action. Through this document, Namibia charts a path toward a more resilient, sustainable, and equitable future.

# 1 NATIONAL CIRCUMSTANCES

## 1.1 INTRODUCTION

Namibia's development is guided by its long-term National Policy Framework, Vision 2030, which transcribes into National Development Plans [1] for 5-year periods, and recently through the Harambee Prosperity Plan (HPP).[2] The country is currently in its Fifth National Development Plan (NDP5) that outlines a development strategy that aims at improving the living conditions of every Namibian through sustainable development and a low carbon economy. The vision is to have a prosperous and industrialized Namibia, developed by its human resources, enjoying peace, harmony and political stability.

This section presents the national circumstances of Namibia, detailing the national development priorities, objectives and circumstances that serve as the basis for addressing issues relating to climate change.

## 1.2 CONVENTION OBLIGATIONS

Namibia ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1995 as a Non-Annex 1 Party, and as such, is obliged to report certain elements of information in accordance with Article 4, paragraph 1 of the Convention. These elements include:

a) A national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHG) not controlled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be promoted and agreed upon by the Conference of the Parties (COP). Namibia's most recent and comprehensive inventory, the First National Inventory Document (NID1), 1990–2022, prepared under the framework of the First Biennial Transparency Report (BTR1), has been compiled following the 2006 IPCC Guidelines, including the Wetlands Supplement and the 2019 Refinements. This inventory provides updated and detailed insights into Namibia's GHG emissions and removals trends, as submitted in December 2024 (Ministry of Environment, Forestry and Tourism, 2024).
b) A general description of steps taken or envisaged by the Party to implement the Convention; and
c) Any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including, if feasible, material relevant for calculations of global emission trends.

[1] NPC, "Namibia's 5th National Development Plan (NDP 5)," 2017.
[2] Konrad-Adenauer-Stiftung e. V., "The Harambee Prosperity Plan II (2021-2025)" (2020).

In order to meet its reporting obligations, Namibia has submitted four national communications (NCs)[3], namely: the INC in 2002;[4] the SNC in 2011;[5] and the TNC in 2015.[6] These reports were prepared with support from the Global Environmental Facility (GEF) through the United Nations Development Programme (UNDP) country office. The Cancun Agreements arrived at during COP 16 in 2011 stipulated that NC reports by non-Annex I Parties, including national GHG inventories, be enhanced to include information on mitigation actions and their effects as well as support received. It was also decided that developing countries, consistent with their capabilities and the level of support provided for reporting, should submit BURs. The latter, containing updates of national GHG inventories, inventory report and information on mitigation actions, needs and support received and Institutional Arrangements are produced every two years, with the first one due in December 2014 as decided in COP 17. Namibia also met this obligation and submitted its BUR1[7] during COP 20 in Lima in 2014 and further followed up with submitting its second and third BURs in 2016 and 2019 respectively, making Namibia one of the most compliant Non-Annex 1 Party to the Convention, in terms of reporting.

Reporting guidelines agreed during COP 8 for the preparation of NCs from Parties not included in Annex I to the Convention and contained in decision 17/CP.8 have been adopted for the preparation of this report.

The National Committee on the Rio. Conventions (NCRC), chaired by the Ministry of Environment and Tourism (MEFT), provided the overall oversight and advisory role for the implementation of the Fourth National Communication (NC4)[8] project. Like for previous NCs and BURs, NC4 was coordinated by the Climate Change Unit (CCU) of the Department of Environmental Affairs (DEA) of the MEFT, which is responsible for overseeing the coordination of climate change issues in Namibia in its role as national focal point of the Convention.

[3] Republic of Namibia, "Namibia's Fourth National Communication to the United Nations Framework Convention on Climate Change" (Windhoek, 2020).

[4] MEFT, "Intended Nationally Determined Contributions (INDC) of The Republic of Namibia to the United Nations Framework Convention on Climate Change" (Windhoek. Namibia, 2015), https://www.meft.gov.na/files/files/Intended Nationally Determined Contributions (INDC) of Namibia to the UNFCCC 2015.pdf.

[5] Republic of Namibia, "Second National Communication to the United Nations Framework Convention on Climate Change for the Republic of Namibia" (Windhoek, Namibia, 2011).

[6] Republic of Namibia, "Third National Communication to the United Nations Framework Convention on Climate Change for the Republic of Namibia" (Windhoek, Namibia, 2015).

[7] Republic of Namibia, "First Biennial Update" (Windhoek, Namibia, 2014).

[8] Republic of Namibia, "Namibia's Fourth National Communication to the United Nations Framework Convention on Climate Change" (Windhoek, 2020).

## 1.3 INSTITUTIONAL ARRANGEMENTS

The Cabinet of Namibia is the Government entity entrusted with the overall responsibility for the development of Policies, including those on climate change. The NCRC oversees the implementation of the climate change policy, including the preparation of the reports for submission to the Convention, and plays an advisory role to Government on climate change issues. It comprises representatives of the various ministries and other stakeholders such as the private sector and NGOs amongst others. The NCRC was established in 1999 by a Cabinet directive to advise it on climate change issues, including reporting obligations. MEFT, the official government agency acting as national focal point of the Convention, is responsible for coordinating and implementing climate change activities, including the preparation of both NCs and BRs to enable the country to meet its reporting obligations. This is done through the Climate Change Unit (CCU) established within the DEA. Being a formalized and multi-sectoral committee, the NCRC provides the necessary support to the CCU by advising and guiding it for sector-specific and cross-sector implementation and coordination of climate change activities.

The NCRC is chaired by MEFT and the deputy chair is the National Meteorological Service of the Ministry of Works and Transport. The NCRC reports to the Executive Director of MEFT via the head of the DEA. The NCRC has the powers to establish working groups and subcommittees as required for implementing and conducting specific climate change activities. Such working groups have been active and very useful for overseeing and providing guidance on the different thematic areas during the preparation of previous NCs. Given that climate change has a bearing on all socio-economic sectors, various Ministries, Organizations and Agencies actively address climate change related issues either solely or in collaboration with other stakeholders as required. The CCU within MEFT usually directly assists these different bodies with planning, development, implementation and coordination of the activities at the local, regional and national levels. The collaboration of existing local and regional structures is secured for supporting implementation and coordination at the level required.

These existing arrangements worked well for the preparation of the first three submitted national communications. Preparation of these national communications was on an *ad-hoc* basis and did not require a permanent set-up that would have proven too onerous for the country being given the scarcity of resources. Thus, reporting on the different thematic areas was outsourced and the CCU of MEFT overlooked the whole process until the final report had been circulated, reviewed and approved by all stakeholders concerned for submission to the Cabinet for final clearance and to the COP. With the enhancement of the reporting requirements that came into force since the advent of the BUR and also the required higher standards of the national communication, these past institutional arrangements have shown their limitations. The present situation demands for a permanent structure to enable the sustainable production of these reports while guaranteeing their quality. In addition, there is a need to develop and establish permanent systems for monitoring, reporting and verifying mitigation actions within the transparency framework of the Paris Agreement. And for other activities related to the Convention so that Namibia may honour its reporting obligations on both the national and international fronts.

Conscious that the existing frameworks are no longer appropriate and suitable under these new circumstances, MEFT embarked on a full exercise of reviewing the existing set-up towards developing and implementing new and more robust institutional arrangements for meeting the enhanced and more frequent reporting obligations, including the production of BURs and revision of Nationally Determined Contributions (NDCs).

One important decision was to shift from outsourcing the different elements of the Convention reports to having them produced in-house. The exercise started after the decision taken during COP 17 and the preparation of the BUR1 in 2014. While the NCRC and CCU were kept in place, an institutional mapping was done by the latter, which kept the responsibility of coordinating the production of the reports. The mapping exercise enabled the identification of all stakeholders who have a role and contribution to bring in the production of better quality NCs, BURs, NDCs and the forthcoming Biennial Transparency Reports (BTRs) and in the eventual MRV systems. Two working groups which were established during the previous NCs and BURs were kept and used during the preparation of this combined BTR1 and NC5. However, due to limited capacity and other competing tasks the role of this working groups was mainly on data collection. However various trainings on the IPCC 2006 guidelines and software and other models like GACMO and LEAP we conducted under the Capacity Building Initiative for Transparency (CBIT) project which was being implemented at the time the BTR1 and NC5 was being prepared. In order to strengthen and formalise the current ad-hoc institutional arrangements Memorandum of Agreements were prepared and are currently with the legal drafters for finalization this will then be implemented when preparing the next BTRs.

Namibia is busy developing a robust institutional arrangements and within the planned institutional arrangements, there will be a sharing of responsibilities with the coordinating body taking on most of the planning, preparation, quality control, archiving, evaluation and validation with the other stakeholders concentrating on the more technical components, including data collection and provision of other information to the Consultant for compilation of the GHG inventory, reviewing draft reports and validation of these.

During the exercise of preparing this BTR1 and NC5 and from previous BURs and NCs, numerous and very daunting challenges cropped up. The most urgent ones were:

- Insufficient capacity of the coordinating body as well as lack of institutional and technical skills on the different thematic areas of the NC;
- The need to maintain a motivated permanent coordinating body and/or personnel;
- Staff scarcity / unavailability in collaborating institutions due to their already overloaded schedules and high staff turn-over; and
- Lack of incentives and adequate funds to develop and maintain the system in place.

It was also evident that the development and implementation of robust institutional arrangements will take substantial time to become fully operational and to run smoothly. It is anticipated that this will take two to three rounds of BTRs and NCs. The revamped institutional arrangement is presented in Figure 1.1.

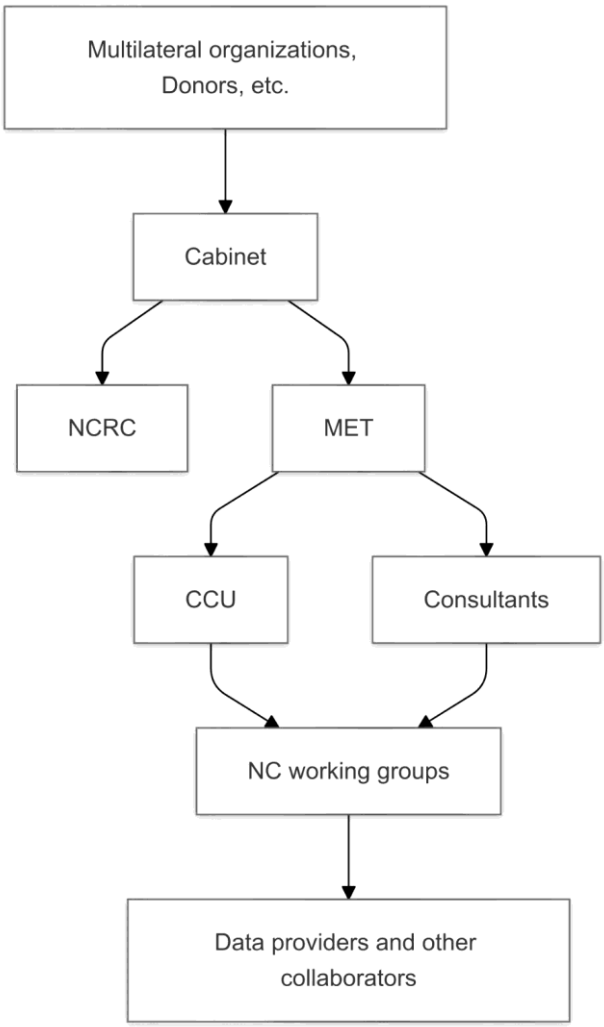



*Figure 1-1. Institutional arrangements for implementing climate change activities*

## 1.4 GEOGRAPHICAL CHARACTERISTICS

Namibia is situated in the southwestern region of the African continent and lies between latitude 17° and 29°S and longitude 11° and 26°E. The country covers a land area of 825,418 km$^2$ and has a 1,500 km long coastline on the South Atlantic Ocean. It is sandwiched between Angola to the North and South Africa to the South and also borders with Zambia to the far North, and Botswana to the East (Figure 1.2)[9].

[9] UPDATED NAMIBIA NDC 2023


*Figure 1-2. Namibia Geographical Position*

The physical geographic context of Namibia is determined by its position at the border of the continental shelf of the Southern African subcontinent in the climatic sphere of influence of the Tropic of Capricorn and the cold Benguela Current. The land surface ascends from the Namib Desert to the mountains of the continental border range with peaks at 2,606 metres above mean sea level (mamsl). To the East and North the country then descends into the Kalahari basin with a mean altitude of 1000 mamsl.

## 1.5 CLIMATE

Namibia is one of the biggest and driest countries in sub-Saharan Africa. It is characterized by high climatic variability in the form of persistent droughts, unpredictable and variable rainfall patterns, variability in temperatures and scarcity of water[10]. The climate of Namibia is a consequence of the country's location on the Southwestern side of the African continent, situated at the interface between different climate systems. The cold Benguela Current along the West coast and Namibia's position, straddling the sub-tropical high-pressure belt, determine the main features of the climate. The Benguela Current brings in cold water to its western shores. The climate of the Northern part of the country is influenced by the Inter-Tropical Convergence Zone (ITCZ) and the Mid-Latitude High Pressure Zone, while the Southern part of the country lies at the interface between the Mid-Latitude High Pressure Zone and the Temperate Zone. The different seasons experienced in Namibia are driven by the northward and southward movements of these zones, in response to the apparent movement of the sun.

The cold water from the Western shores (Benguela Current) is adverted from the South and is partly driven by a high-pressure system over the South Atlantic. The combination of cold water and high pressures leads to subsidence of cold dry air over much of the country which commonly suppresses rainfall. This situation is dominant during most of the year, except in summer when heating of the continent is greatest and the southerly position of the ITCZ draws moisture and rainfall from the tropics over northern and eastern Namibia. Therefore, the ITCZ and the Temperate Zone bring rainfall, while the Mid-Latitude High Pressure Zone brings drier conditions.

The movement of the ITCZ towards the south during the Namibian summer results in the rainfall season, normally starting in November and ending in April. In the far south, the Temperate Zone

[10] Namibia Country Profile 2021

moves northwards during the winter, resulting in the winter rains that occur in the far Southwest of the country. Small variations in the timing of these movements result in the considerable differences in the weather experienced in Namibia from one year to the other.

Namibia is one of the driest countries in southern Africa with mean annual rainfall ranging from just above 600 mm in the Northeast to less than 25 mm in the Southwest and West of the country. The rainfall isohyets generally follow a gradient from the North-East to the Southwest (Figure 1.3). There are exceptions to this general pattern, e.g. the maize triangle of Tsumeb, Grootberg and Otavi receives more rainfall than would be expected in that geographic location. The reason for this is the undulating topography, which gives rise to orographic rainfall. On the other hand, the coastal zone receives almost no rainfall at all.

In the Western part of the Namib Desert, coastal fog is an important source of water for the desert fauna and flora. Fog precipitation is five times greater than that of rain and is far more predictable.

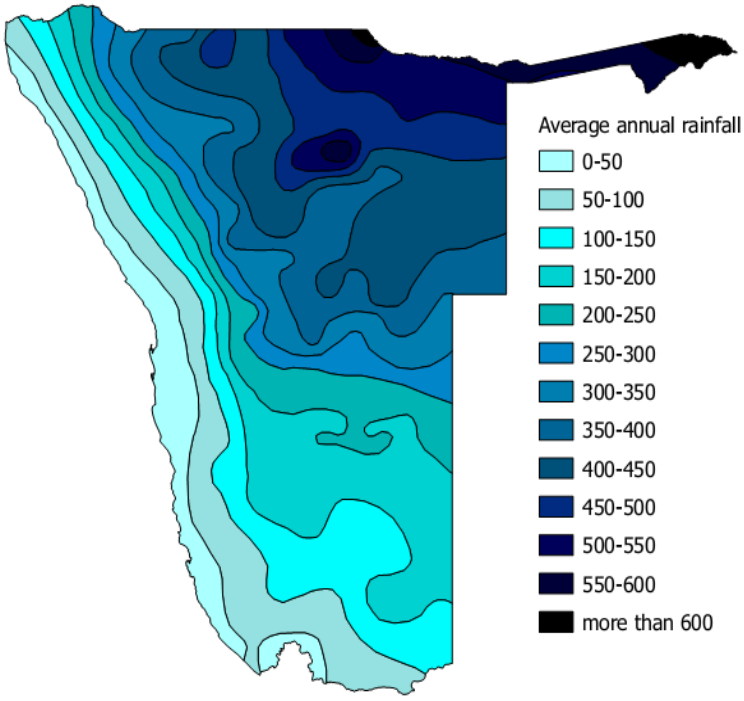



*Figure 1-3. Distribution of average annual total rainfall in Namibia*

Namibia is characterized by high temperatures (Figure 2.3). Apart from the coastal zone, there is a marked seasonal temperature regime, with the highest temperatures occurring just before the wet season in the wetter areas or during the wet season in the drier areas.

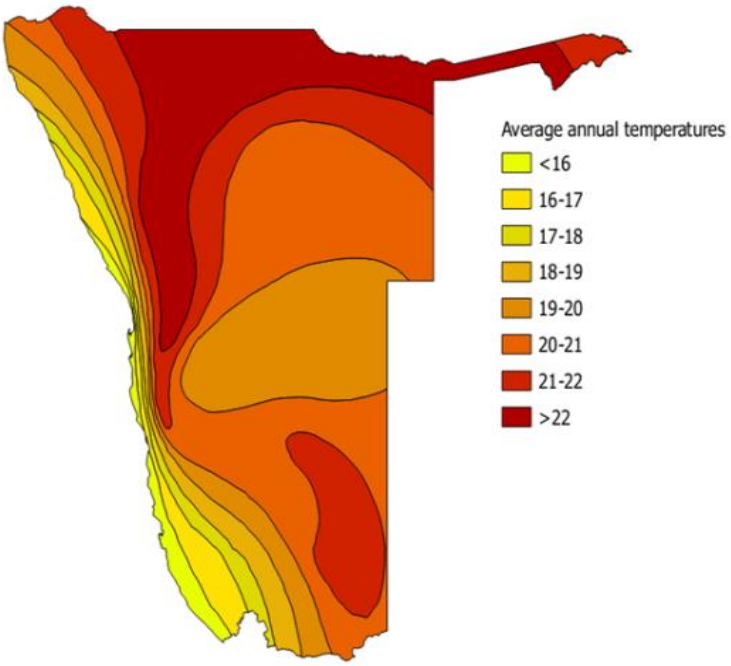



*Figure 1-4. Average annual temperature in Namibia*

The lowest temperatures occur during the dry season months of June to August. Mean monthly minimum temperatures do not, on average, fall below 0°C. However, several climate stations in the central and southern parts of Namibia have recorded individual years with negative mean minimum monthly temperatures, and individual days of frost occur widely.

From a hydrological point of view, Namibia is an arid, water deficient country. High solar radiation, low humidity and high temperatures lead to very high evaporation rates, which vary between 3800 mm per annum in the south to 2600 mm per annum in the north. Over most of the country, potential evaporation is at least five times greater than average rainfall. In those areas where rainfall is at a minimum, evaporation is at a maximum. Surface water sources such as dams are subject to high evaporation rates.

Wind speeds are generally low in Namibia, only at the coast do mean wind speeds exceed 3 m/s, and it is only at isolated climate stations inland, e.g. Keetmanshoop, that the mean wind speeds exceed 2 m/s. These winds, and the occasional stronger gusts, do not cause any real problem apart from some wind erosion in the drier parts of the country during the driest part of the year. Away from the coast, relative humidity averages between 25% and 70%, with the dry season being less humid than the wet.

## 1.6 BIODIVERSITY

Despite its very dry climate, Namibia holds a remarkable variety of species, habitats and ecosystems ranging from deserts to subtropical wetlands and savannas[11]. Namibia is one of the very few countries in Africa with internationally recognized "biodiversity hotspot". Namibia's most significant "biodiversity hotspot" is the Sperrgebiet, which is the restricted diamond mining area in the Succulent Karoo floral kingdom, shared with South Africa. The Succulent Karoo is the world's only arid hotspot. It constitutes a refuge for an exceptional level of succulent plant

[11] https://conservationnamibia.com/

diversity, shaped by the winter rainfall and fog of the Southern Namib Desert. A large portion of its plants is endemic (MEFT, 2001). Other notable features of the rich Namibian biodiversity include:

- The world's largest populations of cheetah and free-roaming black rhino, and increasing populations of other globally threatened mammals
- An entire Coastline under national park status, and a network of national parks covering over 17% of the country
- The Benguela Current Large Marine Ecosystem, which graces Namibia's 1,500 km coastline with cold, nutrient-rich waters and sustains abundant shoals of fish and other marine and bird life
- It should also be noted that by end 2017, about 20% of the country are under community-based resource management including 83 communal conservancies and 32 community forests

### 1.6.1 Threats to Biodiversity

The most significant threats to the biodiversity of Namibia are:

- Unsustainable Water Uses mainly through large scale irrigation, pollution, damming and over-abstraction of groundwater.
- Climate change, mainly through increased drought and flood events; shifts in vegetation types and species distribution; and effects on the Benguela Current system.
- Mining and prospecting, especially in ecologically sensitive areas (including offshore) and through habitat loss and destruction, and increased demand for water and electricity.
- Unsustainable Land Management Practices leading to soil erosion, land degradation, deforestation and bush encroachment.
- Alien Invasive Species, which are causing species loss and ecosystem simplification and breakdown.

## 1.7 HUMAN WILDLIFE CONFLICT WITH INCREASING DAMAGES TO COMMUNITY LIVELIHOODS IN TERMS OF CROP DESTRUCTION AND WATER RESOURCES

Namibia is the driest country in Southern Africa. Water is a scarce resource and one of the major primary factors limiting development of the country. The effects of climate change, rapid population growth, and rural exodus pose additional challenges and threaten people's livelihoods as well as the balance of the ecosystems. Namibia's rainfall is skewed, with the Northeast getting more that the West and Southwestern parts of the country. Namibia's international boundaries, both northern and southern are marked by perennial rivers, the Kunene in the northwest, the Okavango in the central north and the Zambezi and Kwando rivers in the northeast. The Orange River marks Namibia's southern border. These rivers are all shared with neighbouring riparian states with an obligation for them to be managed and used in terms of the relevant rules of international water law.

Of the water that Namibia receives as precipitation, it is estimated that only 2% ends up as surface run-off and a mere 1% becomes available to recharge groundwater. The balance of 97% is lost through direct evaporation (83%) and evapotranspiration (14%). Rainfall often evaporates before it reaches the ground. Another source of moisture comes from fog in the cooler coastal regions where it is an extremely valuable source of water to desert fauna and flora.

The primary sources of water supply are perennial rivers, surface and groundwater (alluvial) storage on ephemeral rivers, and groundwater aquifers in various parent rocks. Additionally, unconventional water sources have been adopted to augment the limited traditional sources. About 45% of Namibia's water comes from groundwater sources, 33% from the Border Rivers, mainly in the north, and about 22% from impoundments on ephemeral rivers (Christelis and Struckmeier, 2001).

## 1.8 AGRICULTURE AND FORESTRY

The share of Agriculture and Forestry in GDP (current prices) stood at 7.9% in 2023.[12] Nonetheless, sustained efforts have continued to move the country from an exporter of live animals to an exporter of value-added agricultural goods.

Despite its relatively modest contribution to GDP, agriculture remains a strategic sector as it impacts directly on the livelihood of more than 70% of the population and employs about one third of the workforce of Namibia. The sector is crucial for its contribution to food security as it addresses the livelihood concerns of a significant section of the Namibian population. In 2016, the proportion of food insecure individuals in Namibia stood at 25%. The production of white maize, wheat, pearl millet and livestock including cattle, goat and sheep is divided in the intensive commercial production units and the extensive communal production system. The commercial sector though occupying 44% of land involves only 10% of population while the communal sector occupies 41% of the land and involves 60% of the population.

Approximately 48% of Namibia's rural households depend on subsistence agriculture (NDP4). Most rural communities, particularly in the higher rainfall areas of the North, depended directly on forest resources for use as fuel wood, building materials, fodder, food and medicine. However, this has changed significantly now as it is necessary to ensure the systematic management and sustainability of forest resources.

The variability of climate, particularly rainfall, has a profound impact on the availability aspect of food security. The recent droughts at the start of this decade have highlighted this important feature of the Namibian society. According to the NDP5 report, a three-year long drought that lasted between 2013 and 2016 led to low production in both the crop and livestock farming sub-sectors. The livestock sub-sector contracted by 13% in 2015 from a positive 13.9% in 2014 due to a foot and mouth disease outbreak and fluctuations in prices of cattle and small livestock.

A recent 2013 survey by the FAO has revealed that 330,000 people particularly in the poor north-western areas are food insecure and a further 447,000 moderately food insecure. This situation also puts pressure on forest resources.

## 1.9 FISHERIES

Namibia has one of the most productive fishing grounds in the world, primarily due to the presence of the Benguela current. The upwelling, caused by the current, brings nutrient-rich waters up from the depths that stimulate the growth of microscopic marine organisms. These in

[12] NSA, "Agriculture and Fishing Indicators Statistical Bulletin" (Windhoek. Namibia, 2023), https://nsa.org.na/wp-content/uploads/2024/07/Agriculture-and-fishing-indicators-Statistical-Bulletin-–-First-Quarter-2023-.pdf.

turn support rich populations of fish, which form the basis of the marine fisheries sector. As is the case in other upwelling systems, relatively few species dominate, and their abundance can vary greatly in response to changing environmental conditions. Over 20 commercially important fish species are landed using various fishing methods. The offshore commercial fishery represents the largest component of the fishing industry. Small pelagic (open water) species (pilchard, anchovy and juvenile mackerel) and lobster are fished along the shallower onshore waters on the continental shelf. Large pelagic species including adult mackerel, demersal (bottom dwelling) hake and other deep-sea species, such as monkfish, sole and crab, are fished in the waters further offshore.

Since independence in 1990, the fishing industry has grown to become one of the pillars of the Namibian economy. The commercial fishing and fish processing sectors significantly contribute to the economy in terms of employment, export earnings, and contribution to GDP. The fishery sector contributed 4.6% in 2009, compared to 3.7% in 2010, representing a 20% reduction. Its contribution increased by 0.2% to 3.9% in 2012. As for 2013, the GDP contribution was 3.45% indicating a decrease of 0.45%. The sector is a substantial export earner, with over 85% of Namibia's fish output destined for international markets, contributing 15% of Namibia's total exports.

## 1.10 TOURISM

Namibia's unique landscapes and biodiversity support a rapidly developing tourism industry. Travel and tourism's contribution to the Namibian economy is illustrated by their combined direct and indirect impacts. According to the Tourism satellite account, the tourism sector in 2015 is estimated at N$5.2 billion of direct value added and more than 44,700 job directly created. However, when considering both direct and indirect contributions, the tourism sector's contribution rises to N$15.1 billion, representing 10.2% of overall GDP and 100,700 jobs, equivalent to 14.5% of total employment. Preliminary estimates for 2016 show an improvement on these figures: N$16.7 billion, equivalent to 10.5% of overall GDP and 101,000 jobs equivalent to 14.9% of total employment.[13]

## 1.11 COMMUNAL-AREA CONSERVANCIES

According to the state of community conservancy report of 2017, community conservation in Namibia covers 166,267 $km^2$, which is about 53.2% of communal land with an estimated 212,092 residents and approximately another 6,170 members of the Kyaramacan association who live in the Bwabwata National Park. From the beginning of 1990 to the end of 2017, community conservation contributed an estimated N$7.11 billion to Namibia's net national income. During the year 2017 alone, community conservation generated over N$132 million in returns for local communities and facilitated 5,350 jobs.

As of the end of 2017 there were 83 registered communal conservancies and one community conservation association in a national park, which is managed like a conservancy. A total of 19 concessions in national parks or on other state land held by 23 conservancies of which some

[13] NTB, "Annual Report 2015/16 Namibia Tourism Board" (Windhoek, Namibia, 2016), https://visitnamibia.com.na/wp-content/uploads/2022/03/Annual-Report-2015_16.pdf.

conservancies share concessions. By end 2017, conservancies covered 163,151 km$^2$ which is equivalent to 19.8% of Namibia's total land surface.[14]

## 1.12 COMMUNITY FORESTS

At the end of 2017 there were 32 registered community forests, covering a total of 30,828 km$^2$ of Namibia, 89% of which overlaps with conservancies. The use of all indigenous plant resources is regulated by the Directorate of Forestry (DoF) within the Ministry of Agriculture, Water and Forestry. The Forestry Act of 2001 and the Forestry Amendment Act of 2005 enable the registration of community forests through a written agreement between the Directorate and a committee elected by a community with traditional rights over a defined area of land. The agreement is based on an approved management plan that outlines the use of resources. All residents of community forests have equal access to the forest and the use of its produce. Communities have the right to control the use of all forest produce, as well as grazing, cropping and the building of infrastructure within the classified forest (NACSO, 2017).

## 1.13 MINING

Namibia is known world-wide for producing gem quality rough diamonds, uranium oxide, special high-grade zinc and acid grade fluorspar. As well, Namibia produces gold bullion, blister copper, lead concentrate, salt and dimension stone. According to the Chamber of Mines annual review report of 2018, mining is one of the major contributors in Namibia's national economy with 14% of the country's GDP in 2018. The sector's contribution has grown by 22% from 2017, where it contributed 13.3%.[15]

## 1.14 MANUFACTURING

Namibia's manufacturing sector is inhibited by its small domestic market, dependence on imported goods, limited supply of local capital, widely dispersed population, small skilled labour force and high relative wage rates, and subsidized competition from South Africa. The manufacturing sector is estimated to have recorded a slow growth of 1.3% in real value added for 2017 compared to a strong growth of 5.6% recorded in 2016. The slow performance in this sector is mainly attributed to the decline in the meat processing, other food products and textile and wearing apparel.[16]

## 1.15 ENERGY

On the supply side, Namibia currently has three electricity power stations, these include: the Ruacana hydroelectric power station with a generation capacity of 240 Megawatts (MW), which depends on the inflow of rainfall from the catchment areas in Angola; the Van Eck coal power station with a production capacity of 120 MW with coal imported from South Africa; and the Paratus diesel plant with a capacity of 20 MW. This translates to a total of 380 MW. Current local electricity peak demand stands at 656 MW, exceeding the local generation capacity of 484 MW at peak (NDP5). The local supply does not meet the demand. Currently, Namibia imports most of

[14] NACSO, "State of Community Conservation in Namibia - Annual Report 2017" (Windhoek, Namibia, 2017), https://www.nacso.org.na/sites/default/files/State of Community Conservation book web_2017.pdf.

[15] NSA, "Annual National Accounts 2023" (Windhoek, Namibia, 2023), https://nsa.org.na/wp-content/uploads/2024/08/ANNUAL-NATIONAL-ACCOUNTS-2023-report.pdf.

[16] NSA.

this difference from South Africa and other Southern Africa Development Community (SADC) member states. A special arrangement between the Namibian power utility NamPower and ESKOM, the South African Power utility, enables Namibia to buy and utilize the surplus energy from South Africa at affordable rates. NamPower also imports on a smaller scale from Zambia for supply to the Caprivi region and exports on a small scale to Angola and Botswana.[17]

## 1.16 TRANSPORT

Namibia's road network is regarded as one of the best on the continent with road construction and maintenance being at international standards. Namibia has a total road network of more than 64,189 km, including 5,477 km of tarred roads which link the country to its neighbours Angola, Botswana, South Africa, Zambia and Zimbabwe. The management and maintenance of the national road network is under the responsibility of the Roads Authority governed by the Roads Authority Act of 1999 (Act 18 of 1999).

The country has two ports handling imported and exported merchandise and servicing the fishing industry. The only deep-sea harbour is Walvis Bay in the Erongo Region. The other harbour is Luderitz in the Karas Region. The Port of Walvis Bay receives approximately 3,000 vessels each year and handles about 5 million tonnes of cargo.

Passenger transport is mainly carried out by minibuses and sedans and is increasing in intensity. For businesspeople and tourists, air travel has become a more important means of transport to bridge the long distances. As of December 2013, Namibia had a total of 300,045 vehicles, representing an increase of 66,405 as compared with March 2007, when there was a total of 233,640. Out of the total number of vehicles 43.8% of them are light passenger motor vehicle (less than 12 persons), closely followed by light load vehicle (GVM 3,500 kg or less), with 43.5%.

The railway network comprises 2,382 km of narrow-gauge track with the main line running from the border with South Africa via Keetmanshoop to Windhoek, Okahandja, Swakopmund and Walvis Bay. Omaruru, Otjiwarongo, Otavi, Tsumeb and Grootfontein are connected to the northern branch of the railway network.

## 1.17 WASTE

Namibia, as a medium income country with a growing wealthy urban middle class and significant urban drift, is feeling the pressure of amounts of waste generated on its facilities throughout the country and more especially in the urban areas. Solid municipal waste is dumped in landfills or open dumps while almost all urban settlements are connected to reticulated waste-water treatment systems. Management of the landfills and dumps are not at the best standards and very often, the waste is burnt in the open dumps to reduce the volume and health risks. Additionally, in most areas there is no segregation of waste and no separate landfills or dumps implying that industrial waste is dumped along with municipal waste. MEFT is responsible for managing solid waste. To this end, Namibia has developed and is currently enforcing the solid waste management strategy which aims at better management of solid waste in rural and urban areas.

[17] NSA.

## 1.18 Economic Growth

According to the National Accounts estimates, compiled by NSA in 2017 the domestic economy is estimated to have registered a contraction in real value-added of 0.9% compared to a growth of 0.6% recorded in 2016. This is the lowest rate recorded over the last 10 years. The drop was attributed to a weak performance in the secondary and tertiary industries that recorded declines in real value-added of 6.7% and 1.4% respectively. However, on the backdrop of good rainfall and an increase in production of major export commodities, the primary industries in 2017 registered a strong growth of 10.6% in real value-added.

Gross National Income (GNI) measures national income generated by the Namibian factors of production, which are labour, land and capital, both inside and outside of Namibia. Over the period 2007 to 2017, Gross National Disposable Income (GNDI) has been consistently higher than the GNI because of net inflows in current transfers that have been influenced mainly by high SACU receipts. Gross National Income stood at N$ 173.88 billion in 2017 as compared to N$ 162.18 billion recorded in 2016, representing an increase of 7.2 percent in nominal terms. GNDI improved to N$ 191.95 billion in 2017 from N$ 178.79 billion of the preceding year.

## 1.19 Population

According to the 2016 Namibia Inter-censal Demographic survey, the total population of Namibia was estimated at 2,324,388 people. Woman outnumbered man with 1,194,634, compared to 1,129,754 male individuals. The age composition of the Namibian population indicates that 14% of the population is under the age of 5 years, 23% between the 5 and 14 years, 57% between the 15 - 59 years, and only 7% of 60 years and above. A total of 43% of Namibia's population lived in urban areas with 57% in rural areas. The urban population grew by 49.7% between 2001 and 2011, while the rural counterpart decreased by 1.4% over the same period. This trend illustrates the high rate of rural-urban migration. The population density is low at 2.6 people per square kilometre in the Khomas Region, where the nation's capital is situated and has the highest population, followed by the northern regions. In Namibia 56% of households are headed by males and 44% by females.

## 1.20 Health

Namibia's provision of health services is shared between the public and the private sectors, the latter focusing on urban areas. Infant and child mortality is comparatively low, but the maternal mortality ratio has increased, even though over 70% of births take place in hospitals. General life expectancy has not improved, partly because of the HIV/AIDS epidemic. Malnutrition levels in children under the age of five years are as high as 38% in some regions. The five leading causes of inpatient deaths (all age groups) are HIV/AIDS, diarrhoea, tuberculosis, pneumonia and malaria[18].

Malaria is one of the major health problems. However, year-on-year incidences of malaria are highly variable, and closely correlated with the prevailing temperature, rainfall and humidity. Malaria is endemic in parts of the north-central and north-eastern regions. In contrast, in the north-western and parts of central Namibia, malaria transmission is seasonal and follows the onset of rains, these unstable occurrences increase the risk of malaria epidemics. Approximately 15% of the population aged 15-49 is living with HIV/AIDS, but the infection level

[18] Namibia Country Disease Outlook 2023

appears to have stabilized. Seven per cent of all people living with HIV/AIDS are under the age of 15, and 60% are women. The very high incidence of tuberculosis in Namibia is fuelled by the HIV/AIDS epidemic, which has reduced life expectancy from 62 years in 1991 to 49 years.

# 2 NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES

## 2.1 INTRODUCTION AND BACKGROUND

The atmospheric level of greenhouse gases (GHGs) has continued to increase during the past five decades, causing global warming and the resulting climate change which is worsening and becoming a serious burden to sustainable socio-economic development. The Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) clearly brought forward the fact that observed changes in weather extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, are due to human influence through its increasing GHG emissions. IPCC considers that the global surface temperature will continue to increase until at least the mid-century under all emissions scenarios and increases of 1.5°C and 2°C will be exceeded during the 21st century unless meaningful reductions in CO2 and other GHGs are realized in the coming decades. The average rate of global sea level rise has increased from 1.3 mm annually between 1901 and 1971, to 1.9 mm between 1971 and 2006, and further to 3.7 mm between 2006 and 2018 (AR6). Inadequate action would raise the global temperature by between 1.7 °C and 2.4 °C compared to pre-industrial levels and further exacerbate the climate systems.

The Paris Agreement (PA) is now the platform for the global community to address this most urgent situation. All signatory Parties to the PA made commitments in the form of their Nationally Determined Contributions (NDCs). Furthermore, most signatory Parties have revised and updated their NDCs and will undertake future revisions every 5 years, making the PA a long-term dynamic agreement. The Agreement also called on Parties to report by 2020 on their long-term low emissions development strategies. Most Parties reviewed and updated their NDCs to make them more ambitious in view of tackling the cause of the problem, namely the continuing increase in the atmospheric level of GHGs.

The Republic of Namibia ratified the Convention on 16 May 1995 as a Non-Annex 1 Party, its Kyoto Protocol on 04 September 2003 and the PA on 21 September 2016. To meet its obligations to these ratifications, Namibia has submitted 4 national communications (NCs) and 4 Biennial Update Reports (BURs), including 5 National Inventory Reports (NIRs) in association with these national reports with the objective of being transparent. Namibia is eager to stay compliant and has thus prepared this sixth NIR (NIR6) within the framework of its first Biennial Transparency Report (BTR1) combined with its fifth NC (NC5) to honour its commitments in accordance with the Enhanced Transparency Framework of the PA. Namibia has also prepared and submitted its Intended Nationally determined Contributions (INDC) in 2015 to conform with decisions 1/CP.19 and 1/CP.20 of the Conference of the Parties (COP). In line with Article 4 of the PA and Decision 1/CP.21 of the UNFCCC, Namibia revised the INDC (to produce the first Nationally Determined

Contribution (NDC)[19] which was submitted in 2021[20] and updated to give the second revised version in 2023.[21]

Namibia has so far compiled and submitted 8 GHG inventories. The country has progressed substantially since the first submission but still has challenges to fully comply with Article 13 of the PA on the Enhanced Transparency Framework (ETF). The first 3 GHG inventories were submitted as chapters in the NC1[22], NC2[23] and NC3[24] in 2002, 2011 and 2015 respectively.

[19] MEFT, "Intended Nationally Determined Contributions (INDC) of The Republic of Namibia to the United Nations Framework Convention on Climate Change."
[20] MEFT, "Namibia's Updated Nationally Determined Contribution" (Windhoek, Namibia, 2021), https://unfccc.int/sites/default/files/NDC/2022-06/Namibia%27s Updated NDC_ FINAL 25 July 2021.pdf.
[21] MEFT, "Namibia's Second Updated Nationally Determined Contribution" (Windhoek, Namibia, 2023).
[22] Republic of Namibia, "Initial National Communication to the United Nations Framework Convention on Climate Change" (Windhoek, Namibia, 2002).
[23] Namibia, "Second National Communication to the United Nations Framework Convention on Climate Change for the Republic of Namibia."
[24] Namibia, "Third National Communication to the United Nations Framework Convention on Climate Change for the Republic of Namibia."

With the advent of the BURs as from 2014, Namibia has presented stand-alone NIRs with all its national reports submitted, namely the NIR1 with the BUR1[25] in 2014, the NIR2 with the BUR2[26] in 2016, the NIR3 with the BUR3[27] in 2019, the NIR4 with the NC4 in 2020 and the NIR5 with the BUR4[28] in 2021. Preparation of the NIRs progress over time to conform to COP decisions through adoption of the latest recommended methodologies and guidelines, enhancing transparency, accuracy and completeness while improving consistency and completeness. To-date, Namibia's latest GHG inventory spanned over the full timeseries 1990 to 2016, has been prepared using the IPCC 2006 guidelines, covered the direct GHGs carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and hydrofluorocarbons (HFCs). Perfluorocarbons and nitrogen trifluoride (NF3) have not been identified as GHGs being emitted up to now. The indirect gases nitrogen oxides (NOx), carbon monoxide (CO), Non-Methane Volatile Organic Compounds (NMVOCs) and sulphur dioxide (SO2) have also been estimated in previous GHG inventories.

## 2.2 METHODS

### 2.2.1 Methodologies, parameters and data

The methodological approach adopted for all sectors and sub-sectors covered in the inventory report follows IPCC guidelines[29] for data presentation. Detailed procedures are outlined in the relevant sections addressing individual IPCC categories. Emissions were calculated by multiplying activity data (AD) with the corresponding emission factors (EF). To ensure transparency and consistency, the approach incorporates a clear comparison between base years and target years, facilitating the tracking of trends and progress toward mitigation targets.

All the methods and tools recommended by IPCC for the computation of emissions in an inventory were used and followed to be in line with Good Practices and the Modalities,

[25] Namibia, "First Biennial Update."
[26] Republic of Namibia, "Second Biennial Update Report (BUR2) of the Republic of Namibia" (Windhoek, Namibia, 2016).
[27] Republic of Namibia, "Third Biennial Update Report (BUR3) to the United Nations Framework Convention on Climate Change," 2018.
[28] Republic of Namibia, "Fourth Biennial Update Report of the Republic of Namibia under the United Nations Framework Convention on Climate Change" (Windhoek, Namibia, 2021).
[29] H S Eggleston et al., "2006 IPCC Guidelines for National Greenhouse Gas Inventories" (Japan, 2006), http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm.

Procedures and Guidelines contained in the Annex to Decision 18/CMA.1.[30] The IPCC 2006 Guidelines,[31] its Wetlands Supplement and 2019 Refinements,[32] including the category-specific decision tree as applicable, were complemented with the European Monitoring and Evaluation Programme / European Environment Agency (EMEP/EEA) Guidebook 2023 for estimation of emissions of non-CO2 gases as applicable.[33] Equations from the Guidebook were programmed in Excel worksheets, estimations made and entered manually in the sectoral tables generated by the IPCC Inventory Software for reporting in the NID1.

The Tier 2 method has been adopted for estimating emissions in the Road Transportation (1.A.3.b) sector where the vehicle population has been disaggregated in different classes to fit IPCC requirements, coupled with estimated mileage run annually and consumption by vehicle class. Additionally, national EFs and stock factors as appropriate have been derived and adopted to compile estimates at the Tier 2 level for Enteric Fermentation (3.A.1) for Dairy Cows and Non-dairy Cattle in the Livestock and Forest land Remaining Forest land (3.B.1.a) in the LULUCF sector. Thus, the inventory has been compiled using a mix of Tiers 1 and 2. This is good practice and improved the accuracy of the emission estimates of these key categories and reduced the uncertainty level. The method and Tier level adopted for estimated categories are provided for under the 2006 IPCC Guidelines.

Default EFs were assessed for their appropriateness prior to their adoption, based on the conditions under which they have been developed and the extent to which these were representative of national circumstances. Country-specific EFs and stock factors derived using national data and the IPCC equations as appropriate for the Livestock and Land sub-sectors were used instead of the default ones which do not reflect the national context.

Country-specific AD is readily available as a fairly good statistical system exists since 2003 whereby data pertaining to most of the socio-economic sectors are collected, verified and processed to produce official national statistics reports. Additional and/or missing data, and those required to meet the level of disaggregation for higher than the Tier 1 level, were sourced directly from both public and private sector operators by the working groups and inventory coordinator. Data gaps were filled by the national experts by personally contacting stakeholders and/or from results of surveys, scientific studies and by statistical modelling. All the data and information collected during the inventory process have been stored in the software database.

---

[30] UNFCCC, "Decision 18/CMA.1 Modalities, Procedures and Guidelines for the Transparency Framework for Action and Support Referred to in Article 13 of the Paris Agreement (FCCC/PA/CMA/2018/3/Add.2)," 2018, https://unfccc.int/resource/tet/0/00mpg.pdf.

[31] Eggleston et al., "2006 IPCC Guidelines for National Greenhouse Gas Inventories."

[32] IPCC, "2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories — IPCC," 2019, https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/.

[33] EEA, *EMEP/EEA Air Pollutant Emission Inventory Guidebook 2023: Technical Guidance to Prepare National Emission Inventories*. (Copahagen, Denmark: European Environmental Agency, 2023), https://www.eea.europa.eu/publications/emep-eea-guidebook-2023.

In some cases, due to the restricted timeframe and lack of a functional National framework for data collection and archiving to meet the requirements for preparing GHG inventories, derived data and estimates were used to fill in the gaps. These were considered reliable and sound since they were based on scientific findings and other observations. Estimates used included fuel used for navigation, domestic aviation, food consumption and forest areas by type. Only data for the period 2017 to 2022, the new years added to the previous time series are provided in this NID1. Readers are referred to the NIR3[34] for AD for the period 1990 to 2016 for all categories except those recalculated when the full time series 1990 to 2022 are given in this NID1. The data sources for estimated categories for the period 2017 to 2022 are given in Table 2.1.

*Table 2-1: Summary of data sources for estimated categories*

| Greenhouse gas source and sink categories | Data sources |
|---|---|
| **1 - Energy** | |
| **1.A - Fuel Combustion Activities** | |
| **1.A.1 - Energy Industries** | |
| **1.A.1.a – Public electricity and heat production** | |
| **1.A.1.a.i - Electricity generation** | NamPower |
| **1.A.2 - Manufacturing Industries and Construction** | |
| **1.A.2.e - Food processing, beverages and tobacco** | Annual reports of some Namibian producers |
| **1.A.2.f - Non-metallic minerals** | One cement producer, NSA and gap filling using IPCC splicing techniques |
| **1.A.2.g.iii - Mining (excluding fuels) and quarrying** | (i) ECB Project "Energy Policy, Regulatory Framework and Energy Future of Namibia (2011-2013)".<br>(ii) NSA<br>(iii) Gap filling using IPCC splicing techniques |
| **1.A.2.g.viii - Other** | (i) Ministry of Industrialization, Trade and SME Development<br>(ii) Gap filling using IPCC splicing techniques<br>(iii) Biomass estimates from AFOLU sector |
| **1.A.3. Transport** | |
| **1.A.3.a. Domestic Aviation** | (i) Airports authorities<br>(ii) NSA<br>(iii) Gap filling using IPCC splicing techniques |
| **1.A.3.b - Road transportation** | (i) NATIS<br>(ii) Road Authority<br>Gasoline and diesel estimated for the different IPCC vehicles classes in the fleet using mileage run by each and fuel consumption indicators for respective years |

[34] Republic of Namibia, "National GHG Inventory Report NIR 3" (Windhoek, Namibia, 2018).

| | |
|---|---|
| **1.A.3.c - Railways** | (i) NSA<br>(ii) TransNamib<br>(iii) National reports |
| **1.A.4 - Other Sectors** | |
| **1.A.4.b - Residential** | (i) NSA censuses<br>(ii) National imports and exports data<br>(iii) IEA<br>(iv) Ministry of Industrialization, Trade and SME Development<br>(v) Fuelwood and charcoal from AFOLU sector<br>(v) Gap filling using IPCC splicing techniques |
| **1.A.4.c - Agriculture/Forestry/Fishing** | |
| **1.A.4.c.iii - Fishing** | (i) National imports and exports data<br>(ii) Annual reports of Ministry of Fisheries<br>(iii) National statistics on consumption reports<br>(iv) Gap filling using IPCC splicing techniques |
| **1.A.5 - Other** | |
| **1.A.5.b. – Mobile** | (i) NATIS<br>(ii) Road Authority<br>(iii) Gap filling using IPCC splicing techniques |
| **1.B - Fugitive emissions from fuels** | |
| **1.B.1 - Solid Fuels** | |
| **1.B.1.b - Fuel transformation** | |
| **1.B.1.b.i - Charcoal and biochar production** | (i) National imports and exports data<br>(ii) National statistics on consumption. |
| **1.B.2 - Oil and natural gas and other emission from energy production** | |
| **1.B.2.a - Oil** | |
| **1.B.2.a.i. - Exploration** | Ministry of Mines and Energy |
| **2 - Industrial Processes and Product Use** | |
| **2.A - Mineral Industry** | |
| **2.A.1 - Cement production** | (i) Cement producer<br>(ii) National imports and exports data |
| **2.A.2 - Lime production** | |
| **2.D - Non-Energy Products from Fuels and Solvent Use** | |
| **2.D.1 - Lubricant Use** | National imports and exports data |
| **2.D.2 - Paraffin Wax Use** | National imports and exports data |
| **2.D.3 - Solvent Use** | National imports and exports data |
| **2.F - Product Uses as Substitutes for Ozone Depleting Substances** | |

| | |
|---|---|
| **2.F.1 - Refrigeration and Air Conditioning** | (i) GIZ (2017). Green Cooling Africa Initiative: Final Report Green Cooling Africa Initiative Final Report Part III Refrigeration and Air Conditioning Greenhouse Gas Inventory Technology Gap Analysis Policy Analysis Roadmap Report for Namibia Green Cooling Africa Initiative: Final Report. [online] Available at: https://www.ctc-n.org/system/files/dossier/3b/3000035954_gcai_final_report_part_iii.pdf<br>(ii) NATIS<br>(iii) Road Authority |
| **2.G - Other Product Manufacture and Use** | |
| **2.G.1 - Electrical Equipment** | NamPower survey |
| **2.G.3 - N2O from Product Uses** | (i) National census reports (2003, 2012 and 2016) of Namibia<br>(ii) World Health Organisation |
| **2.H - Other** | |
| **2.H.2 - Food and Beverages Industry** | (i) National imports and exports data<br>(ii) World Health Organisation |
| **3 - Agriculture** | |
| **3.A - Enteric Fermentation** | (i) Department of veterinary services – Ministry of Agriculture, Water and Land Reform<br>(ii) Survey for animal population segregation for cattle (NNFU, 2006)<br>(iii) Meat Co slaughterhouse data – Direct communication<br>(iv) Food and Agricultural Organisation - FAOSTATS<br>(v) Characterization of beef cattle breeds by virtue of their performances in the National Beef Cattle Performance and Progeny Testing Scheme (S.J. Schoeman, 1996) - https://www.ajol.info/index.php/sajas/article/view/138388 |
| **3.B - Manure Management** | (i) Same as 3.A.1 above<br>(ii) Expert judgement for manure management systems |
| **3.D – Agricultural soils** | (i) Same as 3.A above<br>(ii) National imports and exports data |
| **4 - Land use and land use change and forestry** | |
| **4.A – Forest land**<br>**4.B – Cropland**<br>**4.C – Grassland**<br>**4.D – Wetlands**<br>**4.E – Settlements**<br>**4.F – Other land** | (i) Forestry Department – Ministry of Environment, Forestry and Tourism<br>(ii) National imports and exports data<br>(iii) National census reports (2003, 2012 and 2016) of Namibia<br>(iv) RCMRD land use and land cover maps<br>(v) Forest Assessments reports Namibia (2010) - Food and Agricultural Organisation (https://www.fao.org/docrep/013/al577E/al577E.pdf) |
| **4.G – Harvested wood products** | (i) Forestry Department – Ministry of Environment, Forestry and Tourism<br>(ii) National imports and exports data<br>(iii) National census reports (2003, 2012 and 2016) of Namibia |
| **5 - Waste** | |

| | |
|---|---|
| **5.A - Solid Waste Disposal** | (i) Solid waste division – Ministry of Environment, Forestry and Tourism<br>(ii) City councils |
| **5.C - Incineration and Open Burning of Waste** | (i) Solid waste division – Ministry of Environment, Forestry and Tourism<br>(ii) City councils |
| **5.D - Wastewater Treatment and Discharge** | (i) City councils<br>(ii) National census reports (2003, 2012 and 2016) of Namibia |
| **1.D. Memo items** | |
| **1.D.1. International bunkers** | |
| **1.D.1.a. Aviation** | (i) ECB Project "Energy Policy, Regulatory Framework and Energy Future of Namibia (2011-2013)"<br>(ii) Airport Authorities<br>(iii) Extrapolation |
| **1.D.1.b. Navigation** | (i) Ministry of Works and Transport, Maritime Affairs<br>(ii) SNC and national statistics<br>(iii) Ministry of Mines and Energy<br>(iv) Interpolation |

## 2.3 SECTORS AND GASES

### 2.3.1 Trends in greenhouse gas emissions and removals

The trend of national total emissions, removals and net emissions/removals are presented in Figure 2.1. Namibia remained a net sink over the full time series 1990 to 2022 since removals always exceeded emissions. Total emissions do not show a clear increasing or decreasing trend over the time series but stayed rather stable at slightly above 20,000 kt CO2 e due to implementation of mitigation measures and sustainable use of woody biomass. However, a slight increase of 11% is observed when considering the national emissions of 2022 compared to those of 1990. Removals increased from 89,977 kt CO2 e in 1990 to 122,411 kt CO2 e in 2022 resulting in an increase of 32,434 kt CO2 e (45%) in net removals also for the same period. From 1990 to 2022, the net removals increased by 36%.

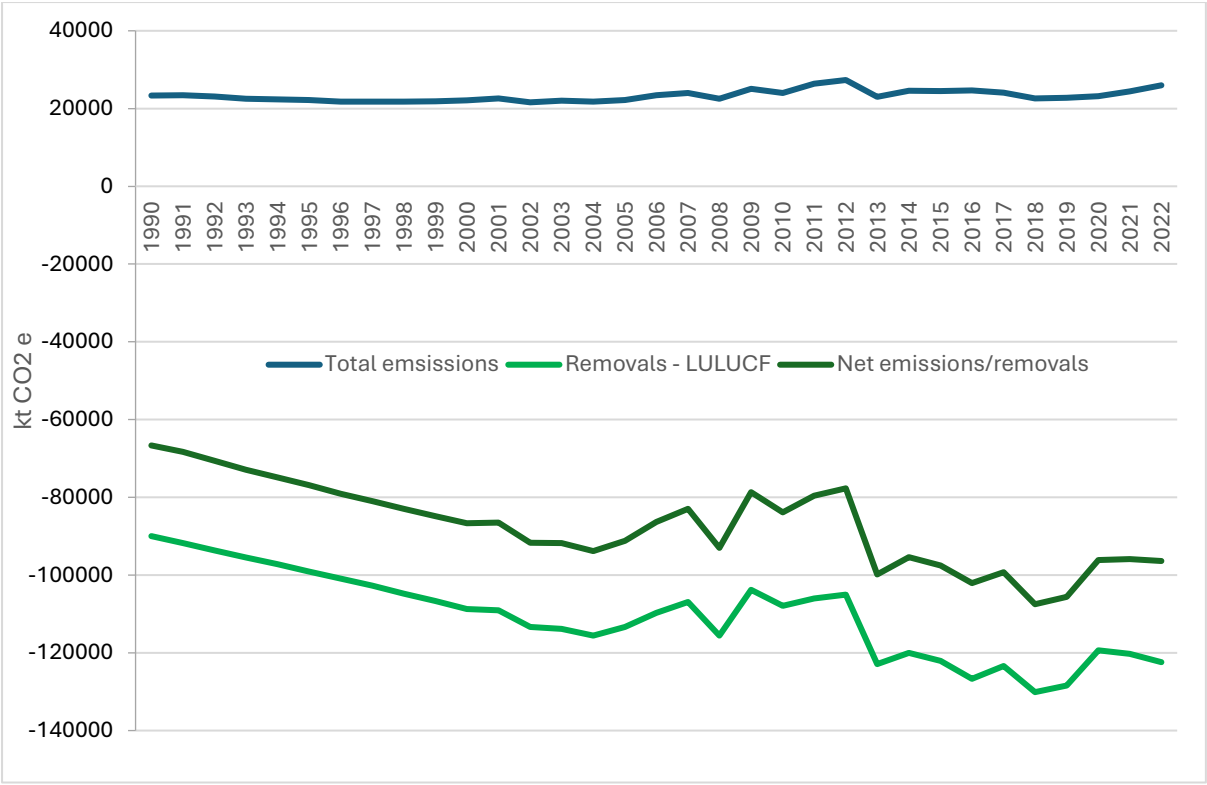



*Figure 2-1. Trend of total national emissions (kt CO2 e), removals and the resultant net removals (1990-2022)*

#### *2.3.1.1 Description of emissions and removals trends by sector and by gas*

The gross emissions trends by sector are provided in Figure 2.2.

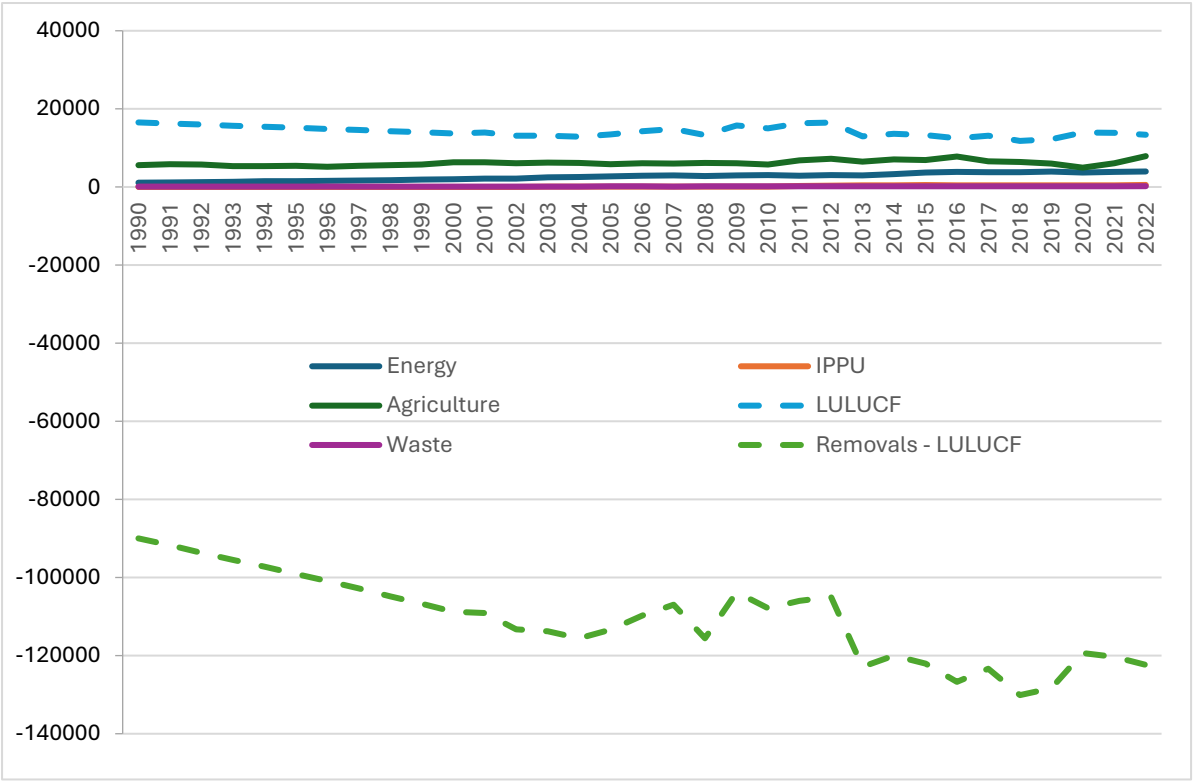



*Figure 2-2. Trend of aggregated gross emissions (kt CO2 e) by sector (1990-2022)*

The highest emitting sector remained LULUCF over the full time series followed by Agriculture, Energy and Waste and Industrial Production and product use (IPPU). In 2022, the LULUCF sector was responsible for significant removals of 122,411 kt CO2 e. Between 1990 and 2022, gross emissions decreased by 19% in the LULUCF sector but increased by 42% for Agriculture, 258% for Energy, 89% for Waste and 6,324% for IPPU. This abnormal increase in emissions of the IPPU sector is explained by the cessation in Lime Production coupled with a high production of Cement as from 2011. The removals increased by 36% between 1990 and 2022.

The aggregated emissions by gas are given in Figure 2.3 while the share is provided in Figure 2.4. CO2 dominated (more than 50% except for 1990 and 1991) emissions throughout the full time series with 11,373 kt CO2 e in 1990 and 15,469 kt CO2e in 2022, representing an increase of 36%. A reduction of 14% in CH4, from 8,921 kt CO2 e in 1990 to 7,703 kt CO2 e in 2022. Similarly, N2O emissions regressed by 12% from 3,030 kt CO2 e to 2,654 kt CO2e. Emissions of HFCs and SF6 stayed at negligible levels throughout the time series.

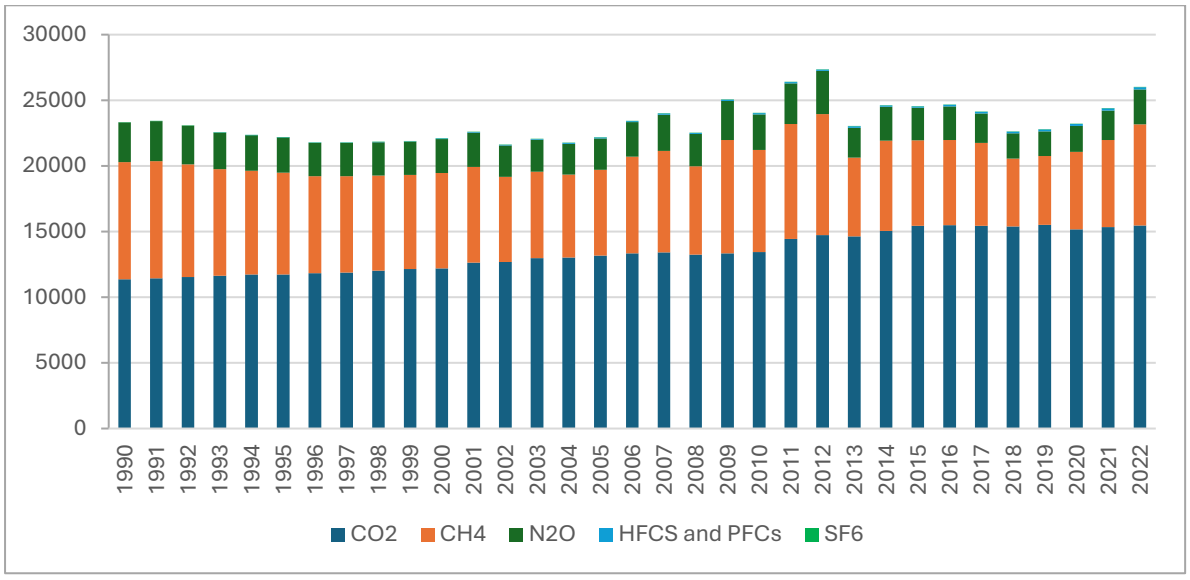



*Figure 2-3. National aggregated emissions (kt CO2 e) trends by gas (1990-2022)*

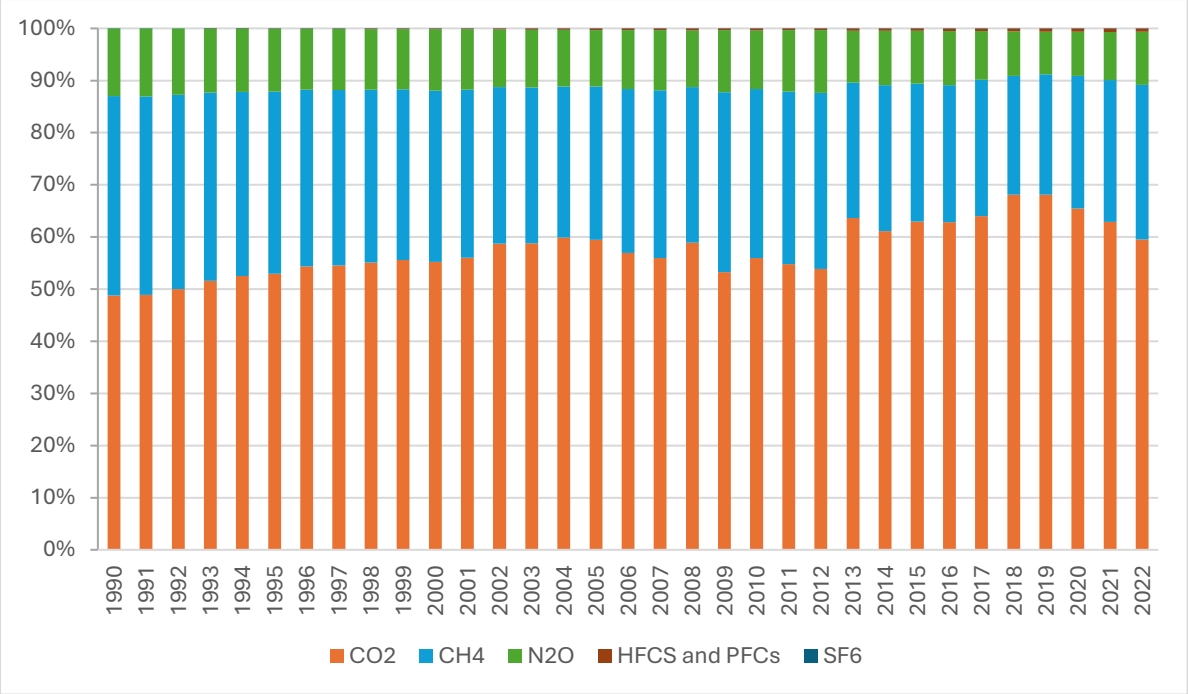



*Figure 2-4. Share (%) of aggregated emissions by gas (1990-2022)*

In absolute terms, CO2 emissions increased by 36% from 11,373 kt in 1990 to 15,469 kt in 2022. N2O stayed stable at around 10 kt while CH4 regressed from 319 kt in 1990 to 275 kt in 2022 (Figure 2.5).

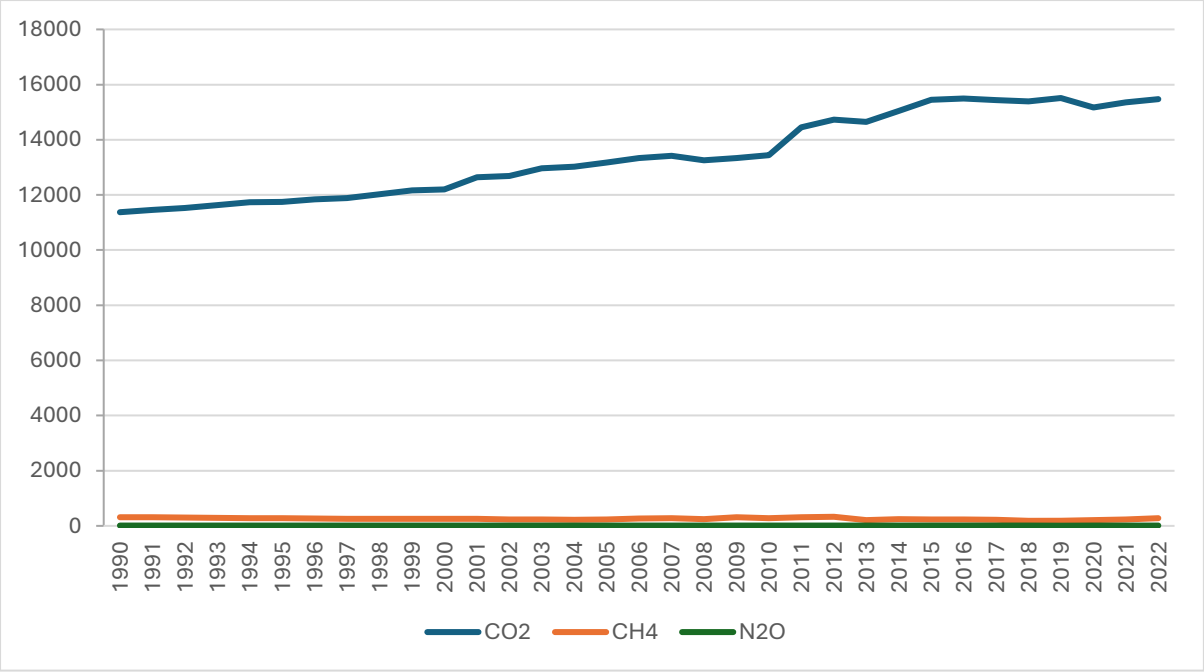



*Figure 2-5. Trends of absolute emissions (kt) by gas (1990-2022)*

#### *2.3.1.2 Indirect gases*

Emissions of indirect GHGs are provided in Figure 2.6. Overall, CO emissions decreased by 66% from 2,685 kt in 1990 to 902 kt in 2022. SO2 increased from 1.1 kt to 2.7 kt, NMVOC from 15 to 27 kt while NOx decreased from 51 to 37 kt over the same period.

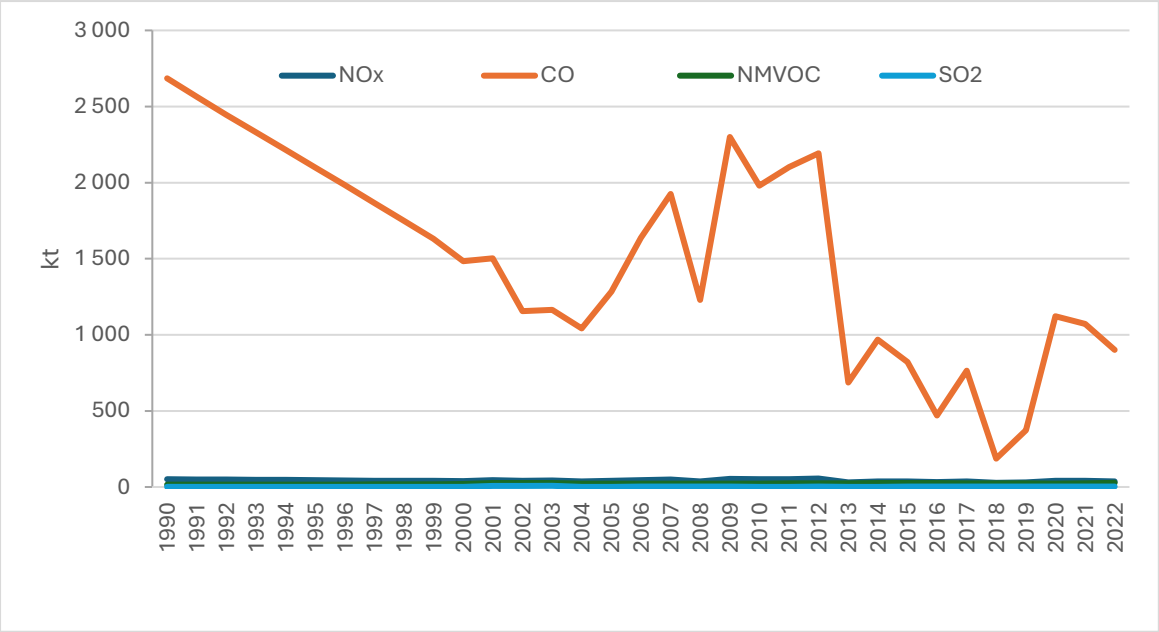



*Figure 2-6. Trends of emissions (kt) of Indirect GHGs (1990-2022)*

### 2.3.2 Interdependences between sectors

The trends in greenhouse gas emissions and removals reveal significant interdependencies between key sectors, which are critical for achieving Namibia's NDC targets. The energy, agriculture, and water resources sectors, in particular, demonstrate a high degree of interconnectedness, underscoring the need for integrated strategies to address emissions effectively.

#### *2.3.2.1 Energy Sector:*

- Energy production and consumption are major contributors to Namibia's GHG emissions. Transitioning to renewable energy sources not only reduces emissions but also enhances resilience in other sectors, such as agriculture and water[35].
- Electrification of agricultural processes (e.g., irrigation systems) can reduce reliance on fossil fuels, while improved energy efficiency in water pumping systems minimizes operational costs and emissions[36].

#### *2.3.2.2 Agriculture Sector:*

- Agriculture is a significant source of methane ($CH_4$) and nitrous oxide ($N_2O$), primarily from livestock and fertilizer use. Effective management practices, such as precision farming, can reduce emissions while optimizing resource use[37].

[35] Updated Namibia NDC 2023
[36] GCCA+ Support on Coordination and Implementation of the Nationally Determined Contributions (NDC) for Namibia, 2021-2024

- Sustainable agricultural practices are dependent on reliable energy supply for mechanization and irrigation, emphasizing the linkage with the energy sector.
- Water availability directly impacts agricultural productivity and GHG emissions from irrigation and land use. Integrated water management strategies are essential for reducing emissions while ensuring agricultural sustainability[38].

#### *2.3.2.3 Water Resources Sector:*

- The water sector's energy footprint, particularly from pumping, treatment, and distribution, highlights its dependence on cleaner energy solutions.
- Water efficiency measures in agriculture, such as drip irrigation, reduce water demand and associated energy requirements, creating synergies across sectors.
- Climate-induced changes in water availability can exacerbate challenges in agriculture and energy production, necessitating coordinated adaptation measures.

#### *2.3.2.4 Integrated Approach to Achieving NDC Targets*

The interplay between these sectors demonstrates that actions in one area can have cascading effects on others. For example:

- Implementing renewable energy solutions reduces emissions in the energy sector while supporting sustainable agricultural practices and water management.
- Enhancing water-use efficiency decreases the energy required for pumping and supports agricultural resilience against climate variability.

Addressing these interdependencies through a systems approach is essential for achieving Namibia's NDC targets while maximizing co-benefits across sectors.

[38] Updated Namibia NDC 2023.

# 3 INFORMATION NECESSARY TO TRACK PROGRESS MADE IN IMPLEMENTING AND ACHIEVING NATIONALLY DETERMINED CONTRIBUTIONS

## 3.1 OVERVIEW

This chapter outlines Namibia's comprehensive framework for tracking progress in implementing and achieving its Nationally Determined Contributions (NDCs) under the Paris Agreement. It details updates to Namibia's NDC, including enhanced targets for greenhouse gas (GHG) reductions and adaptation strategies across priority sectors like clean energy, sustainable land management, and economic diversification. Methodologies, metrics, and indicators are aligned with international standards to ensure transparent and consistent monitoring, evaluation, and reporting. The chapter highlights mitigation policies, measures, and actions, alongside an analysis of GHG emissions and removals trends and future projections, illustrating Namibia's trajectory toward its climate goals. Concluding reflections address achievements and challenges, ensuring Namibia remains aligned with its commitments and contributes effectively to global climate action.

## 3.2 BACKGROUND AND INSTITUTIONAL ARRANGEMENTS

### 3.2.1 Background

Namibia's unique national circumstances play a pivotal role in shaping its approach to implementing and achieving its Nationally Determined Contribution (NDC). The country's socio-economic context, geographic vulnerabilities, and institutional framework influence the strategies and mechanisms used to track progress under the Enhanced Transparency Framework (ETF) of the Paris Agreement.

#### *3.2.1.1 Geographic and Climate Vulnerabilities*

Namibia, identified as one of the driest countries in sub-Saharan Africa, is highly susceptible to the impacts of climate change due to its predominantly arid and semi-arid environment. This geographic predisposition is outlined in Namibia's reports to the UNFCCC, including its National Communications and Biennial Update Reports (BURs), which underscore the acute vulnerabilities to droughts, erratic rainfall, rising temperatures, and desertification. These climatic changes pose significant threats to the country's water security, agricultural productivity, biodiversity, and socioeconomic stability.

##### *3.2.1.1.1 Water Resources*

Namibia's reliance on limited and highly variable water resources is a key vulnerability highlighted in its Fourth National Communication (NC4). The country experiences frequent droughts and increasing evapotranspiration rates, which reduce the availability of surface and groundwater. Climate models referenced in Namibia's UNFCCC submissions predict a decline in average rainfall and more severe drought episodes, intensifying water scarcity. Progress in tracking NDC implementation includes monitoring water-related adaptation initiatives, such as Integrated Water Resource Management (IWRM) strategies, and the resilience of rural and urban water supply systems.

#### *3.2.1.1.2 Agriculture and Food Security*

Agriculture, which is vital for Namibia's rural livelihoods and food security, is severely affected by climate variability. Reports to the UNFCCC, including the NC4 and the Biennial Update Report (BUR), document how erratic rainfall and prolonged dry periods disrupt crop yields and livestock health. Namibia's adaptation measures in its NDC emphasize climate-resilient agricultural practices, including conservation agriculture and drought-resistant crops. Tracking progress in these areas requires detailed monitoring of implementation metrics, such as hectares under conservation agriculture and adoption rates of sustainable farming technologies[39].

### ***3.2.1.2 Biodiversity and Ecosystems***

Namibia is home to a remarkable array of biodiversity, encompassing unique ecosystems and a high number of endemic species. The country's biodiversity spans desert landscapes, savannas, and coastal wetlands, which provide critical habitats for wildlife and are essential for ecological balance. However, Namibia's biodiversity is increasingly under threat from rising temperatures, changing rainfall patterns, desertification, and human activities such as overgrazing, deforestation, and unsustainable land use practices. These vulnerabilities are well-documented in Namibia's Biennial Update Reports (BURs) and National Communications (NCs) to the UNFCCC, which underscore the urgent need for integrated biodiversity and climate strategies.

#### *3.2.1.2.1 Climate Impacts on Biodiversity*

The effects of climate change, including prolonged droughts and unpredictable rainfall, disrupt ecosystems by altering species distribution, reducing vegetation cover, and affecting water availability in critical habitats. Namibia's Fourth National Communication (NC4) highlights significant risks to wildlife populations, which are essential for the country's renowned conservation programs and ecotourism sector. The increasing aridity also places stress on plant species, many of which are vital for local livelihoods and traditional medicine.

#### *3.2.1.2.2 The Role of LULUCF in Mitigation and Adaptation*

The Land Use, Land Use Change, and Forestry (LULUCF) sector is central to Namibia's climate mitigation efforts, as emphasized in its NDC and BURs. Forests and woodlands act as carbon sinks, helping to offset emissions while providing ecosystem services such as water regulation and soil conservation. However, unsustainable practices, including charcoal production and land clearing for agriculture, threaten these vital resources. Namibia's NDC prioritizes sustainable land management and reforestation programs as key mitigation strategies, integrating biodiversity preservation with emissions reduction.

#### *3.2.1.2.3 Adaptation Actions for Ecosystem Resilience*

Namibia has implemented various adaptation measures to enhance ecosystem resilience, many of which are tracked as part of NDC implementation. These include:

- **Afforestation and Reforestation Projects**: Initiatives to restore degraded lands and expand forest cover are vital for improving carbon sequestration and supporting biodiversity. Namibia's BURs report progress in implementing afforestation projects, particularly in arid regions where vegetation cover is sparse.
- **Protected Area Expansion**: Namibia has one of the world's most extensive protected area networks, covering approximately 44% of its land area. Efforts to expand and manage these areas are critical for conserving habitats and mitigating climate risks.

[39] Fourth National Communication to the United Nations Framework Convention on Climate Change, 2020

Progress is tracked through indicators such as the area under legal protection and the status of key species.

- **Community-Based Natural Resource Management (CBNRM)**: Recognized in Namibia's National Communications, the CBNRM program empowers local communities to sustainably manage natural resources. This approach links conservation with livelihoods, ensuring that adaptation measures address both ecological and socioeconomic needs.
- **Water Ecosystem Restoration**: Efforts to rehabilitate wetlands and restore water ecosystems, such as the Etosha Pan, are critical for supporting aquatic biodiversity and mitigating the impacts of climate-induced water scarcity.

#### *3.2.1.2.4 Monitoring Biodiversity as Part of NDC Implementation*

Namibia employs a robust Monitoring, Reporting, and Verification (MRV) system to track the impacts of climate change on biodiversity and ecosystems. Indicators such as changes in forest cover, species populations, and the extent of protected areas are regularly updated in Namibia's BURs and NCs. Data from satellite monitoring, field surveys, and community-based observation systems feed into national reports to the UNFCCC, providing transparency and accountability in tracking adaptation outcomes.

#### *3.2.1.2.5 Integration of Biodiversity in Policy and Planning*

Namibia's NDC emphasizes the integration of biodiversity considerations into broader climate and development planning. This includes aligning conservation programs with the Harambee Prosperity Plan II and the National Biodiversity Strategy and Action Plan (NBSAP). These strategies prioritize ecosystem-based adaptation (EbA) approaches, which leverage natural systems to mitigate climate risks while enhancing biodiversity.

Namibia's focus on biodiversity and ecosystems as a core component of its NDC demonstrates a holistic approach to climate action. By coupling ecosystem resilience with mitigation and adaptation efforts, Namibia not only fulfils its UNFCCC obligations but also strengthens the foundation for sustainable development and community well-being.

#### *3.2.1.2.6 Livelihoods and Vulnerable Populations*

Climate change exacerbates socioeconomic inequalities, disproportionately affecting Namibia's rural and vulnerable populations. Recurrent droughts and resource scarcity lead to migration and heightened competition for natural resources. Namibia's UNFCCC submissions highlight the need to integrate climate resilience into community-based adaptation programs. These programs, such as those supported through the Environmental Investment Fund (EIF), are tracked to evaluate their impact on reducing vulnerabilities and enhancing adaptive capacities.

#### *3.2.1.2.7 Tracking and Integrating Vulnerability Data*

Namibia employs a systematic approach to integrating climate vulnerability data into its adaptation measures, as outlined in its reporting to the UNFCCC. The Monitoring, Reporting, and Verification (MRV) framework incorporates climate data collection, analysis, and application to monitor adaptation progress. For example, national indicators such as changes in water availability, crop yields, and forest cover are key to tracking climate vulnerabilities and aligning adaptation measures with NDC targets.

By continuously refining its vulnerability assessments and adaptation tracking mechanisms, Namibia ensures that its progress under the NDC is informed by its geographic and climatic realities, as documented in its comprehensive UNFCCC reports.

#### *3.2.1.3 Socio-Economic Context*

Namibia's socio-economic context shapes its climate action strategies and underscores the complexity of balancing economic development with environmental sustainability. As an upper-middle-income country, Namibia relies heavily on its resource-based economy, with key contributions from the mining, agriculture, fisheries, and tourism sectors. While these industries drive economic growth, they also present significant challenges, particularly in terms of greenhouse gas (GHG) emissions and vulnerability to climate change impacts.

##### *3.2.1.3.1 Resource-Based Economy and Emissions*

The mining sector is a cornerstone of Namibia's economy, contributing significantly to its GDP and export revenues. However, it is also energy-intensive, with operations relying heavily on fossil fuels, which contribute to GHG emissions. Namibia's National Communications (NCs) to the UNFCCC highlight the mining sector as a critical area for emissions reduction strategies, including the integration of renewable energy into mining operations and improving energy efficiency. Similarly, agriculture, which supports rural livelihoods and food security, is a major source of methane ($CH_4$) emissions due to livestock farming and nitrous oxide ($N_2O$) emissions from fertilizer use. Efforts to promote climate-smart agriculture and reduce emissions from these sources are essential for aligning economic activities with the NDC.

##### *3.2.1.3.2 Economic Diversification for Sustainability*

To reduce dependence on resource-extractive industries and build a more resilient economy, Namibia is prioritizing economic diversification as part of its NDC implementation. Key focus areas include:

- **Renewable Energy Development**: Namibia has immense potential for solar and wind energy, and its NDC emphasizes scaling up renewable energy investments to meet growing energy demands while reducing emissions. Tracking progress involves monitoring installed renewable energy capacity and its contribution to the national grid.
- **Sustainable Tourism**: Tourism is a major contributor to GDP and a significant employer, particularly in rural areas. Namibia's NDC integrates climate-resilient tourism strategies, such as ecotourism and sustainable management of natural heritage sites. Progress tracking includes metrics such as visitor numbers, income generated from sustainable tourism, and community benefits.
- **Low-Carbon Industries**: The government is actively promoting green industrial initiatives, such as manufacturing products with lower carbon footprints and developing a circular economy. These efforts align with Namibia's goals for job creation and emissions reduction.

##### *3.2.1.3.3 Socio-Economic Co-Benefits of Climate Action*

Climate action under Namibia's NDC is designed to deliver socio-economic co-benefits, including poverty reduction, job creation, and improved quality of life. Renewable energy projects, for example, not only reduce emissions but also enhance energy security and create employment opportunities in rural areas. Similarly, climate-resilient agricultural practices help safeguard food security while boosting incomes for farmers. Tracking these co-benefits requires

comprehensive metrics that go beyond emissions reductions, such as employment rates, income levels, and access to sustainable resources.

#### *3.2.1.3.4 Vulnerabilities and Inequities*

Namibia faces significant socio-economic disparities, with rural communities being particularly vulnerable to climate impacts. Droughts and floods disproportionately affect rural livelihoods, amplifying existing inequalities. Women, who play a central role in agriculture, are often more affected due to limited access to resources and decision-making platforms. Namibia's NDC recognizes the need for inclusive climate policies that address these vulnerabilities and ensure equitable access to adaptation and mitigation benefits. Progress tracking includes monitoring gender equity and the participation of marginalized groups in climate action programs.

#### *3.2.1.3.5 Institutional and Financial Challenges*

Namibia's upper-middle-income status limits access to international climate finance, creating challenges in fully funding NDC implementation. The country relies on a combination of domestic resources, private sector engagement, and international partnerships to advance its climate goals. Monitoring financial flows and the effectiveness of investments in mitigation and adaptation projects is critical to assessing progress and identifying funding gaps.

By addressing these socio-economic challenges and leveraging opportunities, Namibia aims to create a sustainable, inclusive economy that aligns with its NDC commitments. Progress tracking systems must capture the interplay between economic growth, emissions reductions, and the equitable distribution of benefits to ensure that climate action supports both environmental and socio-economic goals.

#### *3.2.1.3.6 Institutional Framework and Capacity*

Namibia's institutional arrangements are designed to support inter-sectoral collaboration in tracking NDC progress. Key institutions, such as the Ministry of Environment, Forestry, and Tourism (MEFT), lead coordination efforts, supported by sectoral ministries for energy, agriculture, forestry, and waste management. However, limited financial and technical capacity poses challenges to fully institutionalizing tracking processes. External support, including international partnerships and capacity-building initiatives, plays a crucial role in bridging these gaps.

#### *3.2.1.3.7 Policy and Legislative Environment*

Namibia's climate action is guided by its National Climate Change Strategy and Action Plan, the Harambee Prosperity Plan II, and its revised NDC. These policies emphasize sustainable development, adaptation, and mitigation. Progress tracking is aligned with these frameworks, ensuring consistency in policy implementation and reporting.

#### *3.2.1.3.8 Data Availability and Challenges*

Accurate and comprehensive data is critical for tracking NDC progress. Namibia has made strides in improving data collection systems, including establishing working groups for sectoral data management. However, challenges remain in achieving consistent data quality, especially in remote and resource-constrained areas. Efforts to enhance data infrastructure, including Monitoring, Reporting, and Verification (MRV) systems, are ongoing.

Namibia's national circumstances underline the importance of tailoring progress tracking mechanisms to address its specific vulnerabilities, economic priorities, and institutional

capacities. By leveraging its policy framework and international support, Namibia is advancing toward achieving its NDC goals while addressing systemic challenges.

### 3.2.2 Institutional arrangements in place to track progress made in implementing and achieving the NDC

Namibia Namibia has established a comprehensive institutional framework to ensure effective tracking of progress in implementing and achieving its Nationally Determined Contribution (NDC) under the Paris Agreement (Figure 3.1). These arrangements leverage national expertise, sectoral leadership, and external support to coordinate efforts across mitigation, adaptation, and support activities while maintaining alignment with the Enhanced Transparency Framework (ETF).

Key responsibilities within the institutional arrangements include:

- **Climate Change Unit (CCU), MEFT**: Acts as the central coordinating body for NDC implementation and progress tracking. The CCU oversees data compilation, reporting, and submission processes, monitors capacity-building needs, and ensures alignment with the latest IPCC methodologies and Conference of the Parties (COP) decisions.
- **Ministry of Mines and Energy (MME)**: Leads NDC-related activities in the Energy Sector, including the development, monitoring, and reporting of sectoral mitigation actions and outcomes.
- **Ministry of Industrialization and Trade**: Manages NDC implementation for the Industrial Processes and Product Use (IPPU) sector, overseeing sector-specific actions and tracking progress toward mitigation targets.
- **Ministry of Agriculture, Water, and Land Reform**: Coordinates implementation in the Agriculture Sector, including monitoring progress in achieving NDC adaptation and mitigation targets within the sector.
- **Forestry Directorate, MEFT**: Oversees Land Use, Land Use Change, and Forestry (LULUCF) sector contributions to the NDC, focusing on tracking efforts to reduce deforestation, enhance forest carbon stocks, and adapt to climate impacts.
- **Division of Environmental Assessment, Waste Management and Pollution Control, and Inspections (EAWMPCI), MEFT**: Leads efforts in the Waste Sector, ensuring progress in mitigation and adaptation measures, including waste management improvements.

This institutional structure enables Namibia to systematically monitor, evaluate, and report on its NDC progress while ensuring collaboration across sectors. It also integrates capacity-building initiatives and international support to address financial and technical challenges, ensuring that Namibia remains on track to fulfil its commitments under the Paris Agreement.

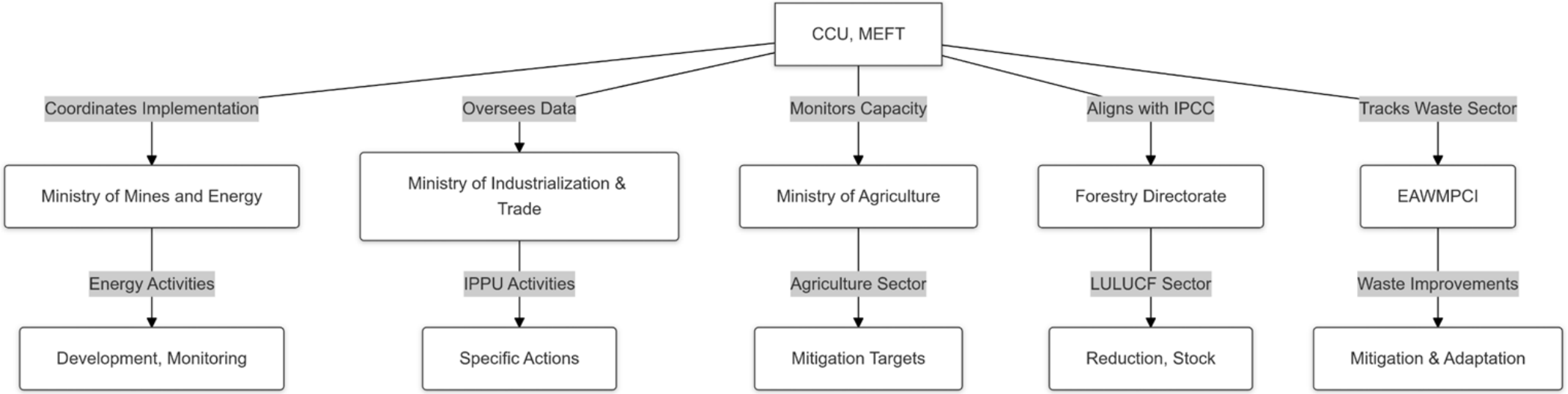



*Figure 3-1. Institutional arrangements for tracking progress in NDCs.*

The CCU of the MEFT monitors and coordinates the production of the GHG inventories for the latter ministry as National Focal Point of the Convention.

#### *3.2.2.1 Transforming Awareness, Changing Behaviour, and Strengthening Coordination in Namibia*

To effectively track progress in implementing and achieving Namibia's NDC, robust institutional arrangements are critical. Addressing the challenges posed by climate change—including persistent droughts, desertification, and extreme weather—requires coordinated actions involving diverse stakeholders, such as government entities, local authorities, private enterprises, civil society, and individual citizens. Namibia's institutional framework emphasizes participatory approaches to climate action, fostering collaboration across all sectors and levels of governance.

Namibia prioritizes raising awareness and building capacity to ensure stakeholders are equipped to contribute to national climate goals. Through initiatives such as the Environmental Information and Monitoring System (EIMS) and capacity-building programs under the NDC Implementation Strategy, Namibia enhances knowledge sharing and coordination. These platforms integrate data and information from regional and local authorities, ensuring accurate tracking of mitigation and adaptation actions.

Educational campaigns and community engagement programs further support behaviour change and societal alignment with NDC objectives. This multi-level approach strengthens coordination and facilitates the integration of climate action into socio-economic activities. Namibia's Biennial Transparency Reports (BTRs) and National Communications (NCs) emphasize these institutional arrangements as pivotal for achieving both transparency and accountability in its climate commitments.

#### *3.2.2.2 Contribution to Reducing Global GHG Emissions through Research, Development, and Technology Dissemination*

Namibia's institutional arrangements also focus on leveraging research, innovation, and technology dissemination to track and achieve its NDC goals. Recognizing that reducing GHG emissions requires transformative solutions, Namibia integrates decarbonization technologies across critical sectors such as energy, agriculture, and waste management. These efforts are anchored in Namibia's NDC Implementation Strategy, which aligns with international best practices and facilitates the adoption of innovative solutions.

The country's institutional framework actively supports research and development (R&D) in clean energy technologies, sustainable agriculture, and circular economy practices. Namibia collaborates with global partners, including the Green Climate Fund (GCF), to implement renewable energy projects, enhance energy efficiency, and promote low-emission technologies in transportation and industry. These initiatives are managed through inter-ministerial committees and technical working groups, ensuring consistent oversight and integration of innovations into national systems.

Namibia also focuses on ensuring that technological advancements address local challenges and are accessible to all stakeholders. Programs under the Harambee Prosperity Plan II and the Climate Change Strategy and Action Plan support the widespread adoption of solar and wind energy technologies, along with sustainable land-use practices. By embedding these

technologies within its institutional arrangements, Namibia ensures that progress toward decarbonization is both measurable and sustainable.

The integration of research, development, and technology dissemination into Namibia's institutional framework enhances its capacity to monitor and achieve its NDC targets. These efforts not only contribute to national emissions reductions but also position Namibia as a leader in climate-resilient and sustainable development. Through these coordinated actions, Namibia demonstrates its commitment to global climate goals while addressing its unique national circumstances.

## 3.3 DESCRIPTION OF A PARTY'S NATIONALLY DETERMINED CONTRIBUTION UNDER ARTICLE 4 OF THE PARIS AGREEMENT, INCLUDING UPDATES

### 3.3.1 Emission Reduction Target for 2030

Namibia's greenhouse gas (GHG) emission reduction target under the Paris Agreement is to achieve a 24% reduction in emissions compared to the Business-As-Usual (BAU) scenario by 2030, while maintaining its net carbon sink status. This ambitious target aligns with Namibia's long-term vision of achieving sustainable development and contributing to the global climate goals of the Paris Agreement. The target was submitted as part of Namibia's updated Nationally Determined Contribution (NDC) in 2023.

Namibia's updated NDC includes a detailed breakdown of mitigation measures across key sectors, including Energy, Agriculture, Forestry, and Other Land Use (AFOLU), Industrial Processes and Product Use (IPPU), and Waste. The country has committed to enhancing its sink capacity by increasing removals and reducing emissions through sector-specific strategies, such as the expansion of renewable energy, sustainable land management, and waste management practices.

Furthermore, Namibia has quantified its total mitigation potential as 11.902 $MtCO_2e$ by 2030, representing a 13.1% increase in sink capacity beyond the BAU scenario. These mitigation measures include conditional and unconditional contributions, highlighting the importance of international support in the form of climate finance, technology transfer, and capacity building to achieve these ambitious targets. This commitment underscores Namibia's proactive role in the global effort to limit temperature increases and foster resilience to climate impacts, as detailed in its submissions to the UNFCCC.

Based on Namibia's latest NDC document for 2023[40], the Table 3.1 provides detailed information to track the progress of Nationally Determined Contributions (NDCs) as per the guidelines:

*Table 3-1. CTF Description of Namibia's nationally determined contribution under Article 4 of the Paris Agreement, including updates*

| Element | Description |
|---|---|
| Target(s) and description | Economy-wide absolute greenhouse gas emission reduction target. (Reduction of projected national emissions by 7.669 |

[40] MEFT, "Namibia's Second Updated Nationally Determined Contribution."

| Element | Description |
|---|---|
| | Mt CO2e (24%) and increase of removals by 4.213 Mt CO2e for a total mitigation potential of 11.902 Mt CO2e). |
| Target year(s) or period(s) | Target year:2030,<br>Single-year target. |
| Reference point(s), level(s), baseline(s) | The base year is 2010 with net removals at -85.823 Mt CO2e. Under the BAU scenario, the sink capacity is projected to increase to -90.713 Mt CO2e by 2030. |
| Time frame(s) and/or periods for implementation | 2023 to 2030. |
| Scope and Coverage | Covers the 4 IPCC sectors: Energy, IPPU, AFOLU, and Waste. Gases covered include CO2, CH4, N2O, and HFCs. |
| Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards NDCs under Article 4 of the Paris Agreement | Namibia intends to use voluntary cooperation under Article 6 of the Paris Agreement. |
| Updates or clarifications of previously reported information | Not applicable |

## 3.4 VISION 2050: STRATEGIC GOALS FOR SUSTAINABLE PROGRESS

Namibia's long-term goal for 2050 focuses on fostering sustainable development while addressing climate change challenges in alignment with the Paris Agreement. This vision is anchored in achieving net-zero greenhouse gas emissions, enhancing climate resilience, and promoting a low-carbon economy.

Key strategic priorities under Vision 2050 include:

- **Decarbonizing Key Sectors:** Transitioning to renewable energy sources, implementing energy-efficient technologies, and promoting sustainable practices in agriculture, transportation, and industry.
- **Enhancing Adaptation Measures:** Strengthening infrastructure, water resource management, and ecosystem preservation to build resilience against climate impacts.
- **Socioeconomic Transformation:** Creating green jobs, reducing inequalities, and ensuring that all citizens benefit from sustainable development initiatives.
- **Technological Innovation:** Leveraging emerging technologies and fostering research to support sustainable practices and climate-friendly solutions.
- **International Collaboration:** Strengthening partnerships with global stakeholders to mobilize resources, share knowledge, and promote sustainable policies.

This vision underscores Namibia's commitment to contributing to global climate goals while advancing national priorities for economic growth and social well-being. The Biennial Transparency Report highlights progress made towards these goals and identified pathways to bridge gaps in achieving Vision 2050.

## 3.5 INFORMATION NECESSARY TO TRACK PROGRESS MADE IN IMPLEMENTING AND ACHIEVING NATIONALLY DETERMINED CONTRIBUTIONS UNDER ARTICLE 4 OF THE PARIS AGREEMENT.

### 3.5.1 Description of selected indicators

Namibia has selected **total greenhouse gas (GHG) emissions and removals** as the key indicator to track progress in implementing and achieving its Nationally Determined Contribution (NDC) under the Paris Agreement (Table 3.2). This indicator aligns with Namibia's commitment to enhancing its net sink capacity while implementing mitigation actions across key sectors such as Energy, Agriculture, Forestry, and Other Land Use (AFOLU), Industrial Processes and Product Use (IPPU), and Waste. The selected indicator will be monitored and reported for the target year of 2030, as outlined in Namibia's updated NDC submitted to the UNFCCC.

*Table 3-2. Details of the Selected Indicator.*

| Indicator | Description |
|---|---|
| **Name** | Total Greenhouse Gas (GHG) Emissions and Removals |
| **Purpose** | To track progress in reducing emissions and enhancing removals, in line with Namibia's NDC targets. |
| **Scope** | Covers all sectors included in Namibia's NDC: Energy, AFOLU, IPPU, and Waste. |
| **Base Year** | 2010 |
| **Target Year** | 2030 |
| **Methodology** | IPCC 2006 Guidelines for National Greenhouse Gas Inventories, using the latest Global Warming Potentials (GWPs) from AR5. |
| **Units** | Million metric tonnes of $CO_2$ equivalent ($MtCO_2e$). |
| **Data Sources** | National statistics, sectoral reports, remote sensing, and stakeholder input from public and private entities. |
| **Frequency of Assessment** | Annual monitoring with periodic updates as part of Biennial Transparency Reports (BTRs). |
| **Alignment** | Aligned with the Enhanced Transparency Framework (ETF) requirements of the Paris Agreement. |

Namibia's monitoring framework will track this indicator using a robust Measurement, Reporting, and Verification (MRV) system, ensuring compliance with the Modalities, Procedures, and Guidelines (MPGs) of the UNFCCC (Table 3.3 and 3.4). This approach supports transparency, accuracy, completeness, consistency, and comparability in reporting. Progress will be shared in Namibia's Biennial Transparency Reports to inform the global stocktake and demonstrate alignment with international climate goals.

*Table 3-3. CTF Table 1 Structured Summary: Description of selected indicators.*

| Indicator(s) Selected to Track Progress | Description |
|---|---|

| | |
|---|---|
| **Total Greenhouse Gas (GHG) Emissions and Removals** | The economy-wide total national GHG emissions and removals, including $CO_2$, $CH_4$, $N_2O$, and HFCs, and covering all IPCC sectors: Energy, AFOLU, IPPU, and Waste. |
| **Information for the Reference Point(s), Level(s), Baseline(s), Base Year(s), or Starting Point(s)** | **Base year:** 2010<br>**Reference point (base year emissions):** -85.823 $MtCO_2e$ (net sink). This base year represents the most recent validated national GHG inventory as reported in Namibia's NIR5 submitted to the UNFCCC. |
| **Updates in Accordance with Any Recalculation of the GHG Inventory** | Base year emissions and removals may be updated in subsequent national GHG inventory submissions as per improvements in data accuracy, methodologies, and availability. |
| **Relation to NDC** | Namibia's NDC is based on an economy-wide emission reduction target expressed as an increase in net sink capacity (13.1% above BAU by 2030). Therefore, tracking total GHG emissions and removals is the most appropriate indicator. |

*Table 3-4. CTF Table 2 Structured Summary: Definitions Needed to Understand NDC*

| **Definitions** | |
|---|---|
| Definition Needed to Understand Each Indicator | |
| **Total GHG Emissions** | The total GHG emissions selected as an indicator include the economy-wide national total GHG emissions, including $CO_2$, $CH_4$, $N_2O$, and HFCs, and excluding indirect $CO_2$ and removals from the LULUCF sector. The values correspond to total GHG emissions in $CO_2$-equivalent as reported in Namibia's most recent National GHG Inventory.<br><br>In tracking and evaluating progress in implementing and achieving the NDC, total GHG emissions will include contributions from the LULUCF sector (activity-based approach) and any internationally transferred mitigation outcomes (ITMOs) consistent with Article 6 of the Paris Agreement. |
| Any Sector or Category Defined Differently than in the National Inventory Report | |
| **Sector** | Not applicable. |
| **Category:** | LULUCF |
| | While the GHG emissions and removals of the LULUCF sector reported in the National Inventory Report are land-based, the contributions from LULUCF for tracking progress under the NDC are activity-based. The activities include: land restoration through bush harvesting, forest management, reforestation, cropland management |
| **Definition Needed to Understand Mitigation Co-Benefits of Adaptation Actions and/or Economic Diversification Plans** | Not applicable. |

| Definitions | |
|---|---|
| **Any Other Relevant Definitions** | Not applicable. |

## 3.6 METHODOLOGIES AND ACCOUNTING APPROACHES

This summary provides an overview of Namibia's comprehensive approach to NDC tracking and accounting, highlighting the methodologies, assumptions, and standards employed to ensure transparent, accurate, and consistent reporting of its climate actions.

### 3.6.1 Overview of methodologies and accounting approaches

Table 3.5 provides a structured summary of the methodologies and accounting approaches.

*Table 3-5. - CTF Table 3 Structured Summary: Structured summary: Methodologies and accounting approaches – consistency with Article 4, paragraphs 13 and 14, of the Paris Agreement and with decision 4/CMA 1.*

| *Reporting requirement* | *Description or reference to the relevant section of the BTR* |
|---|---|
| *For the first NDC under Article 4:*[a] | |
| Accounting approach, including how it is consistent with Article 4, paragraphs 13–14, of the Paris Agreement (para. 71 of the MPGs) | For its updated NDC, Namibia will account for its anthropogenic GHG emissions and removals using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories and the Global Warming Potentials (GWPs) from the Fifth Assessment Report (AR5) of the IPCC, as recommended in Decision 18/CMA.1. Namibia's accounting approach aligns with Article 4, paragraphs 13 and 14, of the Paris Agreement, ensuring transparency, accuracy, completeness, comparability, and consistency (TACCC principles), while avoiding double counting. Namibia has also adopted the sectoral approach for estimating emissions and removals, utilizing methodologies that are consistent with existing methods and guidance under the Convention. |
| *For the second and subsequent NDC under Article 4, and optionally for the first NDC under Article 4:*[b] | |
| Information on how the accounting approach used is consistent with paragraphs 13–17 and annex II of decision 4/CMA.1 (para. 72 of the MPGs) | To be reported for second and subsequent NDC under Article 4. |
| Explain how the accounting for anthropogenic emissions and removals is in accordance with methodologies and common metrics assessed by the IPCC and in accordance with decision 18/CMA.1 (para. 1(a) of annex II to decision 4/CMA.1) | To be reported for second and subsequent NDC under Article 4. |

| *Reporting requirement* | *Description or reference to the relevant section of the BTR* |
|---|---|
| Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party's GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1) | To be reported for second and subsequent NDC under Article 4. |
| Explain how overestimation or underestimation has been avoided for any projected emissions and removals used for accounting (para. 2(c) of annex II to decision 4/CMA.1) | To be reported for second and subsequent NDC under Article 4. |
| *For each NDC under Article 4:*[b] | |
| *Accounting for anthropogenic emissions and removals in accordance with methodologies and common metrics assessed by the IPCC and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (para. 12(a) of decision 4/CMA.1 and para 1 of its annex II):* | |
| Each methodology and/or accounting approach used to assess the implementation and achievement of the target(s), as applicable (para. 74(a) of the MPGs) | Namibia will assess the implementation and achievement of its NDC target by accounting for its anthropogenic GHG emissions and removals using the 2006 IPCC Guidelines, specifically, by way of the Sectoral approach. This approach ensures alignment with international standards and supports accurate monitoring and reporting of Namibia's progress towards enhancing its net sink capacity and achieving its mitigation targets . |
| Each methodology and/or accounting approach used for the construction of any baseline, to the extent possible (para. 74(b) of the MPGs) | Not applicable. Namibia's NDC target, which aims to enhance its net sink capacity, is referenced against a Business-as-Usual (BAU) scenario, with a 2010 base year used for projections. Unlike absolute emission reduction targets, Namibia's approach focuses on maintaining and increasing its sink status rather than solely peaking emissions. |
| If the methodology or accounting approach used for the indicator(s) in table 1 differ from those used to assess the implementation and achievement the target, describe each methodology or accounting approach used to generate the information generated for each indicator in table 4 (para. 74(c) of the MPGs) | Not applicable. The accounting approach for the indicator does not differ from the accounting approach used to assess the implementation and achievement of Namibia's NDC target, which follows the 2006 IPCC Guidelines and adopts the sectoral approach for accuracy and consistency. |
| Any conditions and assumptions relevant to the achievement of the NDC under Article 4, as applicable and available (para. 75(i) of the MPGs) | Namibia's targets are heavily dependent on external resources for the successful implementation of mitigation and adaptation measures, as outlined in its NDC. |

| *Reporting requirement* | *Description or reference to the relevant section of the BTR* |
|---|---|
| Key parameters, assumptions, definitions, data sources and models used, as applicable and available (para. 75(a) of the MPGs) | As Namibia's NDC is based on enhancing its net sink capacity by 2030, the accounting approach is aligned with the methodologies detailed in its NID. Any key parameters, assumptions, definitions, data sources, and models used within the NID, including the 2006 IPCC Guidelines and AR5 Global Warming Potentials, are also applied to account for Namibia's NDC target. |
| IPCC Guidelines used, as applicable and available (para. 75(b) of the MPGs) | Namibia will account for its anthropogenic GHG emissions and removals using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. Namibia's accounting approach specifically uses the Sectoral approach for consistency and accuracy in line with international standards (IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and 2013 Supplement to the 2006 IPCC). |
| Report the metrics used, as applicable and available (para. 75(c) of the MPGs) | Namibia's emissions for CO2, CH4, N2O, and HFCs will be derived using the 2006 IPCC Guidelines via the Sectoral approach. The Tier 1 methodology will be used for most emissions estimates, with higher-tier methodologies applied where relevant and data availability permits. Aggregation of GHG emissions and removals will be reported using the 100-year time-horizon global warming potential (GWP) values from the IPCC Fifth Assessment Report (AR5). |
| For Parties whose NDC cannot be accounted for using methodologies covered by IPCC guidelines, provide information on their own methodology used, including for NDCs, pursuant to Article 4, paragraph 6, of the Paris Agreement, if applicable (para. 1(b) of annex II to decision 4/CMA.1) | Not applicable. Namibia's NDC will be accounted for using the IPCC guidelines, specifically the 2006 IPCC Guidelines. |
| Provide information on methodologies used to track progress arising from the implementation of policies and measures, as appropriate (para. 1(d) of annex II to decision 4/CMA.1) | Namibia will track progress arising from the implementation of policies and measures by accounting for its anthropogenic GHG emissions and removals using the 2006 IPCC Guidelines. |
| *Where applicable to its NDC, any sector-, category or activity-specific assumptions, methodologies and approaches consistent with IPCC guidance, taking into account any relevant decision under the Convention, as applicable (para. 75(d) of the MPGs):* | |

| *Reporting requirement* | *Description or reference to the relevant section of the BTR* |
|---|---|
| How the Party has drawn on existing methods and guidance established under the Convention and its related legal instruments, as appropriate, if applicable (para. 1(c) of annex II to decision 4/CMA.1) | Namibia will assess the implementation and achievement of its NDC target by accounting for its anthropogenic GHG emissions and removals using the 2006 IPCC Guidelines, specifically by way of the Sectoral approach. Namibia also takes into account, where appropriate, existing methods and guidance under the Convention to ensure consistency and transparency. |
| Any methodologies used to account for mitigation benefits of adaptation actions and/or economic diversification plans (para. 75(e) of the MPGs) | Not applicable. Namibia will account for any mitigation co-benefits from adaptation actions and/or economic diversification as mitigation actions in accordance with the assumptions and methodological approaches outlined in its NDC, including the use of the 2006 IPCC Guidelines and AR5 Global Warming Potentials. |
| Describe how double counting of net GHG emission reductions has been avoided, including in accordance with guidance developed related to Article 6 if relevant (para. 76(d) of the MPGs) | As of 2023, Namibia has not participated in cooperative approaches that involve the use of internationally transferred mitigation outcomes (ITMOs) under Article 6. Namibia intends to explore such opportunities and will report the relevant information accordingly when it engages in these mechanisms. |
| Any other methodologies related to the NDC under Article 4 (para. 75(h) of the MPGs) | NA |
| *Ensuring methodological consistency, including on baselines, between the communication and implementation of NDCs (para. 12(b) of the decision 4/CMA.1 and para 1 of its annex II)):* | |
| Explain how consistency has been maintained in scope and coverage, definitions, data sources, metrics, assumptions and methodological approaches including on baselines, between the communication and implementation of NDCs (para. 2(a) of annex II to decision 4/CMA.1) | All categories of anthropogenic GHG emissions and removals in Namibia will be accounted for using the 2006 IPCC Guidelines, specifically, by way of the Sectoral approach. |
| Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party's GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1) and explain methodological inconsistencies with the Party's most recent national inventory report, if applicable (para. 76(c) of the MPGs) | As Namibia's NDC is based on net GHG emissions and removals in 2030, the methodologies used for accounting will be equivalent to, and therefore consistent with, the methodologies outlined in its NID. |
| *For Parties that apply technical changes to update reference points, reference levels or projections, the changes should reflect either of the following (para. 2(d) of annex II to decision 4/CMA.1):* | |

| *Reporting requirement* | *Description or reference to the relevant section of the BTR* |
|---|---|
| Explain how any methodological changes and technical updates made during the implementation of their NDC were transparently reported (para. 2(e) of annex II to decision 4/CMA.1) | Any methodological changes and technical updates in Namibia's accounting approaches will be reflected in future updates of its NID to ensure transparency and consistency. |
| *Striving to include all categories of anthropogenic emissions or removals in the NDC and, once a source, sink or activity is included, continuing to include it (para. 12 (c) of decision 4/CMA.1 and para. 3 of annex II to decision 4/CMA.1):* | |
| Explain how all categories of anthropogenic emissions and removals corresponding to their NDC were accounted for (para. 3(a) of annex II to decision 4/CMA.1) | All anthropogenic GHG emissions and removals in Namibia will be accounted for under the 2006 IPCC Guidelines using the Sectoral approach, ensuring consistency with established methodologies. |
| Explain how Party is striving to include all categories of anthropogenic emissions and removals in its NDC, and, once a source, sink or activity is included, continue to include it (para. 3(b) of annex II to decision 4/CMA.1) | Namibia's NDC includes all categories of anthropogenic emissions and removals and will maintain this comprehensive coverage in future updates. |
| Provide an explanation of why any categories of anthropogenic emissions or removals are excluded (para. 12 (c) of decision 4/CMA.1 and para. 4 of annex II to decision 4/CMA.1) | |
| *Each Party that participates in cooperative approaches that involve the use of ITMOs towards an NDC under Article 4, or authorizes the use of mitigation outcomes for international mitigation purposes other than achievement of its NDC* | |
| Provide information on any methodologies associated with any cooperative approaches that involve the use of ITMOs towards an NDC under Article 4 (para. 75(f) of the MPGs) | As of 2023, Namibia has not engaged in cooperative approaches involving internationally transferred mitigation outcomes (ITMOs) under Article 6. The country intends to explore these opportunities in the future and will provide relevant information when it participates. |

## 3.7 INFORMATION TO TRACK PROGRESS MADE IN IMPLEMENTING AND ACHIEVING ITS NDC UNDER ARTICLE 4

Namibia's total greenhouse gas (GHG) emissions (excluding LULUCF) are projected to align with its Nationally Determined Contribution (NDC) targets, which focus on achieving a 24% reduction relative to the Business-As-Usual (BAU) scenario by 2030. Namibia's net sink status remains a cornerstone of its climate strategy, with significant removals from the Land Use, Land Use Change, and Forestry (LULUCF) sector.

According to Namibia's latest National Inventory Report (NIR) and Fourth Biennial Update Reports (BURs), total GHG emissions in 2021 were significantly offset by removals from LULUCF,

maintaining the country's net sink status. By increasing removals and reducing emissions, Namibia is demonstrating progress toward achieving its ambitious mitigation potential of 11.902 $MtCO_2e$ by 2030, as specified in the updated 2023 NDC.

While Namibia does not currently rely on international market mechanisms, such as credits under Article 6 of the Paris Agreement, for meeting its targets, it has expressed interest in exploring opportunities like the Voluntary Carbon Market (VCM) mechanism to enhance its mitigation efforts. These mechanisms could provide additional support for Namibia's climate ambitions if implemented in the future.

Namibia's proactive actions, such as scaling up renewable energy, implementing sustainable agricultural practices, and enhancing forest management, reflect its commitment to sustainable development and the global goal of net-zero emissions by 2050. Regular monitoring and updates through the Biennial Transparency Reports will ensure transparency and accountability in tracking its progress toward achieving the 2030 emission reduction target.

Based on the detailed review of Namibia's NDC document[41], it represents the indicators, reference levels, implementation periods, target levels, target years, and progress made towards achieving Namibia's NDC goals. The information presented includes:

- **Unit**: Metric tons of CO2 equivalent (Mt CO2e).
- **Reference level**: -85.823 Mt CO2e in 2010 for total GHGs, including LULUCF sector contributions.
- **Implementation period of the NDC**: 2021 to 2030.
- **Target level**: A reduction of projected national emissions by 7.669 Mt CO2e and an increase in removals by 4.213 Mt CO2e for a total mitigation potential of 11.902 Mt CO2e.
- **Target year**: 2030.
- **Progress made (comparison of most recent and ref. level)**: The progress towards these targets would be evaluated based on the BAU scenario projection and the actual mitigation actions taken, but specific progress updates require current data which which is still pending from the latest NIR.

### 3.7.1 Indicators

a) Total GHGs, consistent with NDC coverage:

- **Reference level**: -85.823 Mt CO2e in 2010.
- **Implementation period**: 2021-2030.
- **Target level**: Increase sink capacity to -90.713 Mt CO2e in 2030 under BAU; with mitigation actions, further enhance sink capacity to 102.615 Mt CO2e.
- **Target year**: 2030.
- **Progress made**: The net sink capacity of Namibia increased from -85.823 Mt CO2e in 2010 to -104.206 Mt CO2e in 2016, indicating progress towards enhancing sink capacity.

[41] MEFT.

b) Contribution from the LULUCF sector, as applicable:

- **Reference level**: Significant net sink of -89.103 Mt CO2e in 2010.
- **Implementation period**: 2021-2030.
- **Target level**: Improvement in sink capacity aligned with total GHG targets.
- **Target year**: 2030.
- **Progress made**: Detailed progress would depend on specific LULUCF actions and their outcomes.

c) Assessment of the achievement of the NDC:

- **Restatement of the target**: Reduction in emissions by 7.669 Mt CO2e and increase in removals by 4.213 Mt CO2e by 2030.
- **Information for reference level**: -85.823 Mt CO2e in 2010.
- **Final information for the indicator at the target year**: Target is a net sink capacity enhancement, aiming for a more significant sink than the -90.713 Mt CO2e projected under BAU for 2030.
- **Comparison**: This would involve comparing the actual sink capacity in 2030 with both the BAU scenario and the 2010 baseline.
- **Achievement of NDC**: The assessment would be based on actual data in 2030, but the document outlines ambitious plans to exceed BAU projections and enhance sink capacity significantly.

This summary represents a structured approach to understanding Namibia's NDC targets, the baseline from which progress is measured, and the ambitious goals set for 2030. The summary provides a comprehensive outline of Namibia's strategies to mitigate climate change impacts, with specific emphasis on enhancing sink capacity and reducing emissions across various sectors.

## 3.8 MITIGATION POLICIES AND MEASURES, ACTIONS AND PLANS, INCLUDING THOSE WITH MITIGATION CO-BENEFITS RESULTING FROM ADAPTATION ACTIONS AND ECONOMIC DIVERSIFICATION PLANS, RELATED TO IMPLEMENTING AND ACHIEVING AN NDC.

### 3.8.1 Overview

Based on the extensive details extracted from reports on Namibia's mitigation actions[42], the provided details in the table below encompass various sectors, including energy, waste management, and transport, alongside their objectives, types of instruments, and expected outcomes. This information represents a subset of the broader scope of Namibia's efforts toward climate change mitigation and adaptation, showcasing the country's commitment to sustainable development and environmental protection.

Namibia employs an integrated governance framework to promote climate actions, led by the Ministry of Environment, Forestry, and Tourism (MEFT) and supported by other ministries, local governments, and private sector partners. Stakeholder engagement ensures that policies reflect local and national priorities, while integration with Vision 2030 and Sustainable Development Goals (SDGs) ensures alignment with broader development objectives (MEFT, 2011; NPC, 2004). The country leverages international support, such as the Green Climate Fund (GCF), for financing and technical assistance (GCF, 2023).

Namibia's global warming countermeasures focus on mitigation and adaptation. Mitigation efforts target GHG reductions in key sectors, such as energy and agriculture, through policies like the Renewable Energy Feed-In Tariff (REFIT) Program, National Reforestation Program, and Climate-Smart Agriculture initiatives. These actions have resulted in significant emissions reductions, such as a 2,500 kt $CO_2$-eq annual decrease from renewable energy measures (MEFT, 2023). Adaptation strategies enhance resilience in sectors like water and agriculture by promoting sustainable practices and ecosystem-based approaches (UNFCCC, 2019).

Namibia's efforts reflect its commitment to sustainable development and international climate goals, demonstrating how climate actions can deliver both environmental and socio-economic benefits. The country continues to optimize its policies and measures to meet its ambitious NDC targets and build a resilient, low-carbon future.

[42] Namibia, "Namibia's Fourth National Communication to the United Nations Framework Convention on Climate Change"; Namibia, "Fourth Biennial Update Report of the Republic of Namibia under the United Nations Framework Convention on Climate Change"; Republic of Namibia, "Namibia's NDC UPDATE" (Windhoek, Namibia, 2021), https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwidm5SPtLqEAxWzUkEAHR2qAn0QFnoECBEQAQ&url=https%3A%2F%2Fclimatepromise.undp.org%2Fwhat-we-do%2Fwhere-we-work%2Fnamibia&usg=AOvVaw0ZgL8nA2R46St78fedIXNi&opi=89978449; MEFT, "National Policy on Climate Change for Namibia," 2013; MEFT, "Namibia's Second Updated Nationally Determined Contribution."

### 3.8.2 Institutional Arrangements

Namibia's climate governance structure is anchored by the Ministry of Environment, Forestry, and Tourism (MEFT), which serves as the central authority responsible for climate policy formulation and implementation. MEFT is tasked with coordinating the country's climate commitments and overseeing climate-related projects, ensuring alignment with national and international goals (Namibia Environmental Laws, 2016). Within MEFT, the Climate Change Unit (CCU) functions as the operational arm, managing Namibia's Nationally Determined Contribution (NDC) and ensuring compliance with reporting obligations under the Enhanced Transparency Framework (ETF). The CCU transforms MEFT's strategic directives into actionable programs, bridging the gap between policy and practice (MEFT, 2023).

To facilitate interministerial coordination, Namibia relies on the NCRC, an inclusive body comprising representatives from key ministries, private sector stakeholders, academia, and civil society organizations. The NCRC ensures robust cross-sectoral collaboration, integrating climate considerations into both national and sector-specific development plans. By providing a platform for stakeholder consultations and joint task forces, the NCRC helps align the efforts of diverse actors, addressing the multifaceted challenges posed by climate change. Regular information-sharing platforms further enable coordinated actions across ministries, particularly the Ministry of Mines and Energy and the Ministry of Agriculture, Water, and Land Reform (Namibian Transport Policy, 2018). The roles and relationships within this governance structure are depicted in Figure 3.2.

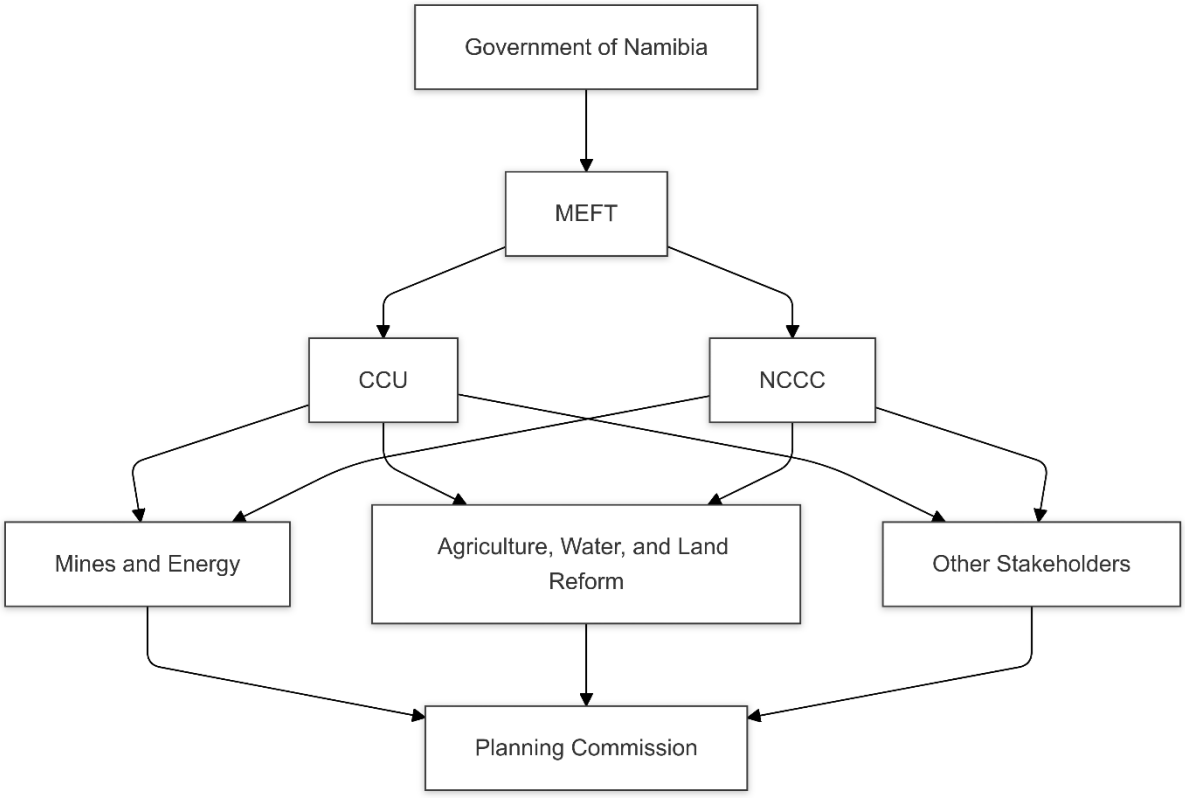



*Figure 3-2. Climate Governance Structure in Namibia*

The Ministry of Mines and Energy is a critical partner in Namibia's climate governance framework, spearheading renewable energy policies and decarbonization initiatives (National Renewable Energy Policy, 2017). Meanwhile, the Ministry of Agriculture, Water, and Land Reform drives

climate-smart agricultural practices and sustainable water management strategies. These sectoral ministries, along with other stakeholders like NGOs and private sector actors, work closely with the CCU and NCRC to implement specific climate actions (NDC ISAP, 2022).

Ultimately, the outputs and strategies from these ministries are integrated into the work of the National Planning Commission (NPC), which aligns sectoral actions with Namibia's long-term national development frameworks, such as Vision 2030. The NPC ensures that climate efforts contribute to a cohesive national strategy, balancing sustainable development with economic growth (Namibia Environmental Laws, 2016). This interconnected governance structure reflects Namibia's commitment to addressing climate change through coordinated, inclusive, and strategic approaches.

### 3.8.3 Legal and Policy Frameworks

Namibia's legal and policy frameworks provide the foundation for addressing climate change challenges and achieving its Nationally Determined Contribution (NDC) targets. These frameworks encompass national laws, policies, and strategies that guide climate mitigation, adaptation, and governance, ensuring alignment with Namibia's international obligations under the Paris Agreement and the UNFCCC. By fostering sustainable practices, these frameworks contribute to the achievement of national and global climate goals, though significant gaps and opportunities for enhancement remain.

#### *3.8.3.1 Key Legal and Policy Frameworks*

Namibia has developed a range of frameworks to support its climate agenda. These frameworks cover critical areas such as environmental protection, renewable energy, disaster management, and sustainable water and forest resource management. Each framework plays a unique role in advancing Namibia's NDC targets, with specific areas of focus and relevance to climate change mitigation and adaptation (Table 3-6).

*Table 3-6. Summary of the key legal and policy frameworks supporting climate change governance and NDC implementation.*

| Framework | Description | Focus Area | Relevance to NDC/Climate Change Issues | Enforcement Mechanisms | International Linkages |
|---|---|---|---|---|---|
| **Environmental Management Act (2007)** | Establishes sustainable environmental governance and mandates Environmental Impact Assessments (EIAs). | Environmental protection | Integrates climate considerations into project approvals and planning. | EIAs required for all major developments. | Aligns with SDG 13 and Paris Agreement. |
| **National Climate Change Policy (2011)** | Provides strategic guidance for climate mitigation, adaptation, | Cross-sectoral governance | Guides climate action in agriculture, energy, and water; supports NDC targets. | Monitoring through National Climate Change Committee. | Supports NDC reporting and transparency. |

| Framework | Description | Focus Area | Relevance to NDC/Climate Change Issues | Enforcement Mechanisms | International Linkages |
|---|---|---|---|---|---|
| | and awareness. | | | | |
| **Renewable Energy Policy (2017)** | Promotes renewable energy development, including solar, wind, and biomass. | Energy transition | Aligns with the target of 70% renewable energy by 2030 in electricity generation. | Incentives and fiscal benefits for investors. | Supports GCF-funded renewable projects. |
| **Water Resources Management Act (2013)** | Provides guidelines for sustainable water management and equitable allocation. | Water resource management | Enhances resilience to climate variability through water security measures. | Regulation of water use and conservation plans. | Links to regional water management agreements. |
| **Forestry Act (2001)** | Governs sustainable forest management and conservation. | Forest conservation | Contributes to NDC goals through carbon sequestration and reforestation programs. | Permits required for logging and deforestation. | Aligns with REDD+ initiatives. |
| **Disaster Risk Management Act (2012)** | Strengthens disaster response and preparedness for climate-related events. | Disaster risk reduction | Supports adaptation by integrating disaster preparedness into planning frameworks. | Disaster response plans at national and local levels. | Links to Sendai Framework. |
| **Drought Policy and Strategy (1997)** | Focuses on land and water management for drought resilience. | Climate adaptation | Builds adaptation capacity in agriculture and rural communities. | Early warning systems for drought events. | Needs updating for alignment with current climate risks. |

Namibia's legal and policy frameworks represent the backbone of its efforts to address climate change and support the implementation of its Nationally Determined Contributions (NDCs). These frameworks, including the Environmental Management Act (2007) and the National Climate Change Policy (2011), provide a structured approach to addressing mitigation and adaptation challenges.

Namibia's legal and policy frameworks emphasize the integration of adaptation actions that yield significant mitigation co-benefits, aligning these efforts with relevant NDC targets. For example, policies promoting sustainable land management and reforestation under the Agriculture,

Forestry, and Other Land Use (AFOLU) sector not only enhance climate resilience but also contribute to carbon sequestration and reduced greenhouse gas emissions. Similarly, water conservation strategies, such as improved irrigation systems and integrated water resource management, mitigate emissions associated with energy-intensive water pumping while adapting to water scarcity challenges. These synergies ensure that adaptation measures are leveraged to advance mitigation goals, fostering a holistic approach to climate action that maximizes co-benefits and supports the achievement of Namibia's NDC commitments. Strengthening legal and policy coherence in these areas remains critical to fully harness these opportunities and close existing gaps.

### 3.8.4 Policymaking Process

Namibia's policymaking process for addressing climate change reflects a comprehensive and inclusive approach. It ensures alignment with the country's Nationally Determined Contribution (NDC) under the Paris Agreement and its commitments to the United Nations Framework Convention on Climate Change (UNFCCC). The process integrates multi-level governance, stakeholder engagement, scientific evidence, and international cooperation to design and implement effective policies targeting both mitigation and adaptation (UNFCCC, 2019; MEFT, 2023).

### 3.8.5 Governance Framework for Climate Policymaking

Namibia's climate change policymaking operates within a comprehensive governance framework that integrates national, regional, and local efforts. The Ministry of Environment, Forestry, and Tourism (MEFT) serves as the national focal point for climate action under the United Nations Framework Convention on Climate Change (UNFCCC). MEFT oversees the development, implementation, and reporting of Namibia's climate policies, including its Nationally Determined Contributions (NDCs) and Biennial Transparency Reports (BTRs), ensuring alignment with international obligations (MEFT, 2020).

The NCRC plays a crucial advisory role, bringing together representatives from government ministries, non-governmental organizations (NGOs), academia, and the private sector. The NCRC provides strategic guidance and fosters coordination across various sectors, ensuring that climate policies are comprehensive and inclusive (UNFCCC, 2019).

Key line ministries also contribute to Namibia's climate governance. The Ministry of Mines and Energy (MME) leads efforts in renewable energy development and energy efficiency, while the Ministry of Agriculture, Water, and Land Reform (MAWLR) focuses on climate-smart agricultural practices and sustainable water resource management. The Ministry of Transport supports low-carbon mobility through initiatives like electric vehicle adoption and sustainable transport systems. Together, these ministries ensure sector-specific policies align with national climate goals.

At the local level, municipalities and regional councils are instrumental in implementing localized initiatives. These include waste management programs and urban resilience measures tailored to community needs. This multi-tiered governance structure ensures coherence, collaboration, and effective implementation of climate change actions across Namibia, fostering integration between national strategies and local execution (MEFT, 2023).

### 3.8.6 Policy Formulation and Approval

Namibia's climate policy development process is structured, participatory, and guided by both national priorities and international commitments. This multi-step approach ensures that policies are comprehensive, evidence-based, and inclusive (MEFT, 2020; UNFCCC, 2019).

The process begins with problem identification, where climate-related vulnerabilities and emission sources are assessed through sectoral evaluations, greenhouse gas (GHG) inventories, and scientific research. These assessments help identify priority areas for intervention, ensuring that policies address critical climate challenges effectively (MEFT, 2023). In the policy drafting phase, government agencies collaborate to develop draft policies, incorporating inputs from diverse stakeholders. These drafts are informed by Namibia's Nationally Determined Contribution (NDC) under the Paris Agreement and its long-term development objectives, ensuring alignment with both mitigation and adaptation goals (UNFCCC, 2018).

Stakeholder engagement is central to Namibia's policy formulation process. Consultations with civil society, local communities, private sector representatives, and academia provide a platform for integrating diverse perspectives. This inclusive approach enhances the relevance and acceptability of policies, fostering broader support during implementation (MEFT, 2023). To ensure consistency with global and regional commitments, Namibia emphasizes alignment with international frameworks. Policies are developed in accordance with the Paris Agreement, the Sustainable Development Goals (SDGs), and regional strategies outlined by the Southern African Development Community (SADC). This alignment strengthens Namibia's contribution to global climate action while addressing local and regional priorities (SADC, 2022).

The approval and adoption phase involves rigorous reviews of draft policies by the Cabinet, followed by legislative approval where necessary. This ensures that policies are legally binding and well-integrated into the country's governance systems (NPC, 2004). Finally, implementation is carried out by relevant ministries and local governments. Supported by national budgets and international funding sources such as the Green Climate Fund (GCF), these agencies operationalize policies through targeted programs and initiatives, ensuring their practical impact on the ground (GCF, 2023).

This structured and inclusive process allows Namibia to develop robust climate policies that address vulnerabilities, reduce emissions, and build resilience while aligning with national development and international climate commitments.

### 3.8.7 Integration with International Frameworks

Namibia aligns its climate policies with global commitments to ensure consistency with international climate goals. This alignment enhances Namibia's contribution to global efforts to combat climate change while addressing national and regional priorities.

#### *3.8.7.1 UNFCCC Compliance*

Namibia's climate policies are designed to meet the reporting and implementation requirements of the United Nations Framework Convention on Climate Change (UNFCCC). The country adheres to Decisions 6/CP.25 and 18/CMA.1, which provide guidance on reporting obligations, such as Biennial Transparency Reports (BTRs) and Nationally Determined Contributions (NDCs). These compliance measures ensure transparency, comparability, and accountability in Namibia's climate actions (UNFCCC, 2019).

#### *3.8.7.2 Regional Collaboration*

Namibia engages in cross-border initiatives under the Southern African Development Community (SADC) to foster regional knowledge sharing and address transboundary climate challenges. Regional strategies focus on shared issues such as water resource management, food security, and biodiversity conservation. Collaborative efforts ensure that regional policies align with global frameworks while addressing localized needs, particularly in vulnerable ecosystems and communities (SADC, 2022).

#### *3.8.7.3 Global Climate Finance*

Namibia leverages international climate finance mechanisms, such as the Green Climate Fund (GCF) and Global Environment Facility (GEF), to support the implementation of its climate policies and measures. These funding sources provide critical financial and technical assistance for renewable energy projects, climate-smart agriculture, and ecosystem restoration initiatives. For example, GCF funding has enabled Namibia to expand renewable energy access, while GEF resources support biodiversity and conservation programs (GCF, 2023).

Through alignment with international frameworks, regional collaboration, and access to global climate finance, Namibia ensures that its climate policies remain consistent with global objectives while addressing national and regional challenges effectively.

### 3.8.8 Mitigation policies and measures, actions and plans, related to implementing and achieving a nationally determined contribution

Namibia's commitment to addressing climate change is reflected in its comprehensive suite of mitigation and adaptation policies and measures. These actions align with the country's Nationally Determined Contribution (NDC) under the Paris Agreement and its broader national development goals, including Vision 2030 and the Sustainable Development Goals (SDGs). Namibia's approach recognizes the dual necessity of reducing greenhouse gas (GHG) emissions and enhancing resilience to the impacts of climate change across all sectors.

Table 3.7 provides a detailed overview of Namibia's sector-specific policies and measures, highlighting their objectives, implementation status, mitigation impacts, and challenges. By focusing on sectors such as energy, forestry, agriculture, waste management, and water resources, Namibia aims to transition to a low-carbon, climate-resilient economy. The integration of international frameworks, stakeholder collaboration, and innovative financing mechanisms underscores the country's determination to meet its climate goals while fostering sustainable development and socio-economic co-benefits.

*Table 3-7. Mitigation and Adaptation Policies and Measures by Sector.*

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| National Climate Change Policy | Guide Namibia's climate change responses and align them with international frameworks. | Cross-Sectoral | $CO_2$, $CH_4$, $N_2O$ | Policy Guidance | Adopted | 2011 | MEFT | Both | N/A | The policy provides a strategic framework that aligns Namibia's climate responses with international agreements, fostering cross-sectoral collaboration. It has prioritized areas for action and influenced Namibia's commitments under the Paris Agreement. However, resource constraints, particularly in rural regions, limit the implementation of planned measures. Measures such as capacity building for local authorities and securing international funding mechanisms like the Global Environment Facility (GEF) are essential. *(MEFT Reports, 2020).* |
| Renewable Energy Policy | Increase renewable energy | Energy | $CO_2$ | Regulatory | Implemented | 2019 | MEFT, Ministry of Mines | Mitigation | 500 | The policy has significantly boosted |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | generation to 70% by 2030, reducing reliance on fossil fuels and enhancing energy security. | | | | | | | | | renewable energy projects, reducing reliance on fossil fuels and enhancing energy security. For instance, the Omburu Solar Power Plant commissioned in 2022 reflects this progress. High initial infrastructure costs are a challenge, but Namibia is mitigating this issue through international funding mechanisms such as the Green Climate Fund. *( NamPower Reports, 2022)*. |
| NDC Implementation Action Plan for Energy Generation and Use | Expand renewable energy capacity, including green hydrogen and biomass energy. | Energy | $CO_2$ | Economic /Policy Guidance | Implemented | 2020 | Ministry of Mines and Energy | Mitigation | 2,000 | Achievements include projects like the Omburu Solar Plant, which adds renewable capacity to the grid, and green hydrogen feasibility studies advancing clean energy initiatives. |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Challenges, such as grid instability, are being addressed through planned infrastructure upgrades to enhance reliability and support renewable energy integration |
| Environmental Management Act | Provide a legal framework for sustainable environmental management, including climate interventions. | Cross-Sectoral | N/A | Regulatory | Adopted | 2007 | MEFT | Both | N/A | This foundational framework integrates sustainable practices into national development projects. Environmental Impact Assessments (EIAs) mandated under the act have been instrumental in minimizing negative environmental impacts, such as those from large-scale mining projects. However, enforcement in rural and informal areas remains limited due to resource and capacity constraints. Introducing digital monitoring tools and allocating more funds |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | to enforcement agencies can address these issues. *(MEFT Reports, 2021)*. |
| NDC Implementation Action Plan for Biodiversity & Ecosystems | Protect biodiversity and ecosystems while enhancing carbon sequestration. | Biodiversity & Ecosystems | $CO_2$ | Economic /Policy Guidance | Adopted | 2021 | Ministry of Environment, Forestry & Tourism | Both | TBD | Along with other strategies there has been an improved ecosystem health, such as restoring wetlands in Kavango. Challenges include land-use conflicts. Measures to address these challenges include stakeholder collaboration and enhanced policy enforcement. |
| Integrated Water Resources Management Plan | Ensure sustainable water supply for agriculture, industry, and domestic use, addressing water scarcity exacerbated | Cross-Sectoral | N/A | Regulatory | Adopted | 2018 | Ministry of Agriculture, Water, and Land Reform | Adaptation | N/A | The plan has effectively improved water-use efficiency across agriculture, industry, and domestic sectors. For example, pilot projects using water-saving technologies in agriculture have reduced water use by up to 30%. However, climate-induced droughts continue to |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | by climate change. | | | | | | | | | pose risks. Measures such as integrating rainwater harvesting techniques and expanding desalination plants are critical for strengthening resilience. *(MAWLR Reports, 2020)*. |
| Circular Economy Strategy | Reduce waste through recycling and resource efficiency, minimizing landfill emissions. | Waste Management | $CH_4$ | Economic /Policy Guidance | Planned | 2024 | Ministry of Environment, Forestry & Tourism | Mitigation | 500 | Targets reduction of landfill methane emissions. Kupferberg landfill project demonstrates feasibility. Challenges include low public participation. Measures involve public awareness campaigns and subsidies for recycling facilities. |
| NDC Implementation Action Plan for Circular Economy | Transition to low-carbon transport modes, including electrificatio | Transport | $CO_2$ | Economic /Policy Guidance | Adopted | 2022 | Ministry of Mines and Energy; Ministry of Transport | Mitigation | 1,500 | The focus is on developing electric vehicle (EV) infrastructure, with a notable example being the |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | n of vehicles and public transport. | | | | | | | | | deployment of EV charging stations in Windhoek. However, challenges remain, including the high costs associated with purchasing EVs. To address these challenges, measures such as subsidies and public-private partnerships are being implemented to promote the adoption of EVs and expand the necessary infrastructure (NDC ISAP - Cross-cutting). |
| NDC Implementation Action Plan for Healthy and Resilient Society | Address health vulnerabilities to climate change, including malaria and heat stress. | Health | N/A | Economic /Policy Guidance | Adopted | 2022 | Ministry of Health and Social Services | Adaptation | N/A | Malaria eradication efforts and improved disease surveillance systems have strengthened climate resilience in the health sector. Challenges, such as funding gaps, are |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | addressed through partnerships with WHO and other health organizations, ensuring sustained progress. |
| Green Economy Strategy | Mitigation: Promote green investments and low-carbon technologies; Adaptation: Strengthen economic resilience against climate shocks. | Cross-Sectoral | $CO_2$, $CH_4$, $N_2O$ | Economic | Adopted | 2020 | MEFT, Ministry of Finance | Both | N/A | The strategy promotes investments in green technologies, strengthening economic resilience while creating jobs. Projects like the Kavango Renewable Energy Hub highlight Namibia's commitment to fostering a green economy. Despite good initial progress, challenges such as a lack of sectoral coordination impede implementation. Multi-stakeholder workshops and periodic reviews are necessary to ensure |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | effective collaboration. |
| Renewable Energy Feed-In Tariff (REFIT) Program | Attract private investments in solar, wind, and biomass energy to drive the renewable energy transition. | Energy | $CO_2$ | Economic | Implemented | 2016 | MEFT, Ministry of Mines | Mitigation | 2,000 | This program has successfully attracted private sector investments in renewable energy, leading to projects like the Rosh Pinah Wind Farm. While the program has catalysed renewable energy production, grid integration remains a challenge due to infrastructure limitations. Planned upgrades to the national grid will enhance its capacity to handle increased renewable energy inputs. |
| National Solar Energy Strategy | Scale up solar energy deployment, particularly in rural areas, to enhance energy | Energy | $CO_2$ | Economic | Adopted | 2020 | Ministry of Mines | Mitigation | TBD | The strategy has advanced solar energy deployment, particularly in rural areas, improving energy access and |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | access and reduce emissions. | | | | | | | | | reducing emissions. Positive progress has been made in rural electrification; however, logistical challenges in reaching remote areas have caused delays. Exploring off-grid solar solutions, such as standalone photovoltaic systems, could accelerate the process. |
| Energy Efficiency Policy | Improve energy efficiency in buildings, industries, and appliances, reducing energy consumption and emissions. | Energy | $CO_2$ | Regulatory, Voluntary | Planned | 2024 | Ministry of Mines | Mitigation | 300 | This policy aims to reduce energy consumption and emissions by promoting energy-efficient practices in buildings, industries, and appliances. Although not yet adopted, it has the potential to significantly lower energy demand. Public awareness campaigns and incentives for |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | energy-efficient appliances are needed to drive adoption once implemented. |
| Forest Restoration Plan | Mitigation: Enhance carbon sequestration through reforestation; Adaptation: Restore ecosystems to improve resilience to climate-induced land degradation. | Forestry/LULUCF | $CO_2$ | Voluntary | Planned | 2025 | MEFT | Both | 100 | The plan aims to enhance carbon sequestration and restore degraded ecosystems. Despite its high potential, funding limitations have delayed large-scale implementation. The Ministry of Environment, Forestry, and Tourism (MEFT) is pursuing international grants to support these efforts. |
| National Reforestation Program | Mitigation: Increase forest carbon stocks through afforestation; Adaptation: Enhance biodiversity and restore | Forestry/LULUCF | $CO_2$ | Fiscal | Implemented | 2023 | MEFT | Both | 5,000 | The program has shown initial success, with significant local community involvement in afforestation projects. For example, tree-planting initiatives in northern Namibia have enhanced carbon |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | degraded ecosystems. | | | | | | | | | sequestration and biodiversity. However, challenges such as land tenure disputes hinder scaling efforts. Stakeholder dialogues and conflict resolution mechanisms are being implemented to address these issues. |
| Forest Conservation Policy | Mitigation: Prevent deforestation and promote sustainable forest management ; Adaptation: Protect ecosystems and enhance water security. | Forestry/LULUCF | $CO_2$ | Regulatory | Adopted | 2020 | MEFT | Both | 2,000 | The policy has reduced deforestation rates by promoting sustainable forest management. For instance, digital forest monitoring systems have been piloted in some regions. However, enforcement remains limited due to inadequate monitoring resources. Expanding digital monitoring and increasing funding for conservation enforcement can help mitigate these challenges. |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| NDC Implementation Action Plan for Agriculture & Food Security/ Climate-Smart Agriculture (CSA) Initiatives | Mitigation: Reduce emissions from livestock and soil management ; Adaptation: Build resilience in food production systems against climate variability. | Agriculture | $CH_4$, $N_2O$ | Voluntary | Adopted | 2018 | Ministry of Agriculture, Water, and Land Reform | Both | 300 | This program has positively impacted agricultural productivity and resilience to climate variability. Techniques such as rotational grazing have increased yields and improved soil carbon retention, as reported by farmers. Broader adoption is hindered by limited technical support and awareness among farmers. Strengthening extension services and providing tailored training programs can overcome these barriers. |
| Livestock Methane Management Initiative | Mitigation: Implement biogas systems to reduce methane emissions; Adaptation: Enhance | Agriculture | $CH_4$ | Economic | Planned | 2025 | Ministry of Agriculture, Water, and Land Reform | Both | TBD | This initiative offers substantial potential to reduce methane emissions and enhance rural energy access through biogas systems. However, limited awareness of |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | energy access for rural communities. | | | | | | | | | biogas technologies among rural communities poses a challenge. Scheduled awareness campaigns and demonstration projects aim to address these gaps. |
| Soil Carbon Management Policy | Mitigation: Increase soil carbon storage through improved agricultural practices; Adaptation: Enhance soil health and productivity. | Agriculture | $CO_2$ | Research, Voluntary | Planned | 2024 | Ministry of Agriculture, Water, and Land Reform | Both | TBD | This policy seeks to increase soil carbon storage through improved agricultural practices while enhancing soil health and productivity. As an early-stage policy, it requires integration into existing agricultural frameworks. Pilot programs should be implemented to test its viability. |
| Cross-Cutting Climate Resilience Actions | Build resilience in climate data systems and infrastructure for | Cross-Sectoral | N/A | Regulatory | Implemented | 2022 | Ministry of Environment, Forestry & Tourism | Both | N/A | Strengthened disaster risk management systems, such as the Drought Early Warning System in |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | multiple sectors. | | | | | | | | | northern Namibia, have improved response times and reduced losses from climate-induced disasters. Challenges include capacity gaps in local institutions. Measures like enhanced funding and training programs have enabled communities to better prepare and adapt to drought and floods, showcasing a positive impact on resilience and livelihoods (NDC ISAP - Cross-cutting). |
| Urban Waste-to-Energy Initiative | Reduce methane emissions from landfills by converting waste into energy, supporting | Waste Management | $CH_4$ | Public-Private | Planned | 2026 | Local Municipalities | Mitigation | 800 | The initiative has significant potential to reduce landfill methane emissions while generating clean energy. Windhoek's landfill methane capture pilot project |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | urban sustainability and clean energy development. | | | | | | | | | demonstrates its feasibility. However, high initial costs and limited private sector investment are significant challenges. Public-private partnerships and tax incentives for waste management companies are being explored to attract investment. |
| National Recycling Policy | Decrease landfill methane emissions through recycling initiatives, contributing to sustainable waste management practices. | Waste Management | $CH_4$ | Regulatory | Implemented | 2021 | Local Municipalities | Mitigation | 200 | The policy has been successful in reducing methane emissions from urban landfills by encouraging recycling. Uptake has been positive in urban areas; however, rural areas face challenges due to limited recycling infrastructure. Plans for mobile recycling units are underway to address this disparity. *The policy has been successful in reducing* |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | *methane emissions from urban landfills by encouraging recycling. Uptake has been positive in urban areas; however, rural areas face challenges due to limited recycling infrastructure. Plans for mobile recycling units are underway to address this disparity.* |
| Low-Emission Vehicle Program | Promote electric vehicles and expand charging infrastructure to reduce transportation emissions and improve air quality. | Transport | $CO_2$ | Economic Incentive | Planned | 2025 | Ministry of Transport | Mitigation | 500 | The program promotes the transition to low-emission transport, improving air quality and reducing fuel imports. Namibia's pilot project for EV charging stations in Windhoek demonstrates progress. However, the high costs of electric vehicles (EVs) remain a barrier to widespread adoption. Introducing financial incentives, subsidies, and |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | partnerships with international EV manufacturers can address these cost challenges. *(Ministry of Transport Reports, 2023). The program promotes the transition to low-emission transport, improving air quality and reducing fuel imports. Namibia's pilot project for EV charging stations in Windhoek demonstrates progress. However, the high costs of electric vehicles (EVs) remain a barrier to widespread adoption. Introducing financial incentives, subsidies, and partnerships with international EV manufacturers can address these cost challenges.* |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| Sustainable Urban Transport Plan | Develop low-carbon public transportation systems and integrate non-motorized transport options to minimize emissions. | Transport | $CO_2$ | Research, Economic | Adopted | 2020 | Ministry of Transport | Mitigation | TBD | The plan promotes low-carbon public transportation systems and non-motorized transport options. Pilot projects, such as improved bus transit systems in Windhoek, have shown promise. However, budget limitations constrain full-scale implementation. Securing donor funding is critical for scaling up. |
| Integrated Water Resources Management Plan | Ensure sustainable water supply for agriculture, industry, and domestic use, addressing water scarcity exacerbated by climate change. | Cross-Sectoral | N/A | Regulatory | Adopted | 2018 | Ministry of Agriculture, Water, and Land Reform | Adaptation | N/A | Effective in improving water-use efficiency. Climate-related droughts pose ongoing risks, requiring integration with broader climate adaptation strategies. |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| NDC Implementation Action Plan for Water Resources | Enhance water security through desalination, recycling, and efficient use. | Water Resources | N/A | Economic /Policy Guidance | Implemented | 2022 | Ministry of Agriculture, Water and Land Reform | Adaptation | N/A | Improved access to potable water through desalination plants and infrastructure upgrades. Challenges include high operating costs. Measures involve partnerships with international donors. |
| Green Economy Strategy | Mitigation: Promote green investments and low-carbon technologies; Adaptation: Strengthen economic resilience against climate shocks. | Cross-Sectoral | $CO_2$, $CH_4$, $N_2O$ | Economic | Adopted | 2020 | MEFT, Ministry of Finance | Both | TBD | It has indicated good initial progress as it has primarily focuses on developing its renewable energy potential, particularly green hydrogen production, alongside initiatives in sustainable agriculture, eco-tourism, waste management, and resource efficiency, aiming to transition towards a low-carbon economy while leveraging its natural advantages like abundant sunlight and |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | wind power. However, it requires more coordination across sectors for maximum impact. This can be addressed through planned capacity-building workshops for implementing agencies. |
| Drought Policy and Strategy | Mitigate the impacts of drought on vulnerable communities and sectors. | Agriculture, Water Resources | N/A | Policy Guidance | Adopted | 1997 | MAWLR | Adaptation | N/A | This policy addresses recurring droughts, aiming to mitigate their impacts on vulnerable communities and sectors. However, its strategies are outdated and lack integration with current climate data. Updating the policy to include recent climate projections and enhancing drought resilience measures are necessary steps. |
| Disaster Risk Management Act | Address vulnerabilities to climate-induced disasters, such as | Cross-Sectoral | N/A | Regulatory | Adopted | 2012 | Office of the Prime Minister | Adaptation | N/A | The act enables disaster preparedness by addressing vulnerabilities to climate-induced events, such as |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | droughts and floods. | | | | | | | | | droughts and floods. It has facilitated timely responses to emergencies; however, insufficient funding and slow mechanisms during extreme events remain challenges. Increasing financial allocations and streamlining response protocols are critical. |
| NDC Implementation Action Plan for Industry And, Refrigeration, Air Conditioning and Heat Pumps | Reduce emissions from refrigerants through improved management and recovery systems. | Industry | HFCs, $CO_2$ | Economic /Policy Guidance | Planned | 2025 | Ministry of Environment, Forestry & Tourism | Mitigation | 1,200 | Focuses on reducing HFC emissions through recovery programs and clean technologies. Challenges include the cost of retrofitting systems. Measures include subsidies and capacity-building programs. |
| Summary NDC Integration | Enhance alignment across all sectoral NDC implementation plans | Cross-Sectoral | N/A | Strategy | Adopted | 2022 | Ministry of Environment, Forestry & Tourism | Both | N/A | Strengthened monitoring and reporting mechanisms under the National MRV portal. Challenges include coordination |

| Policy/ Measures | Objective | Sector(s) Affected | GHGs Targeted | Type of Instrument | Status (Planned/Adopted /Implemented) | Start Year | Implementing Entity | Adaptation /Mitigation Focus | Mitigation Impact (kt $CO_2$-eq) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | for effective delivery of targets. | | | | | | | | | across multiple agencies. Measures include capacity-building workshops and dedicated MRV funding. |
| NDC Implementation Action Plan for Industry And, Refrigeration, Air Conditioning and Heat Pumps | Enhance alignment across all sectoral NDC implementation plans for effective delivery of targets. | Cross-Sectoral | N/A | Economic /Policy Guidance | Adopted | 2022 | Ministry of Environment, Forestry & Tourism | Both | N/A | Strengthened monitoring and reporting mechanisms under the National MRV portal. Challenges include coordination across multiple agencies. Measures include capacity-building workshops and dedicated MRV funding. |

#### *3.8.8.1 Policies and Measures No Longer in Place*

Table 3.8 identifies policies and measures previously reported by Namibia that have been discontinued. The rationale for discontinuation is provided, including reasons such as policy ineffectiveness, funding constraints, redundancy with newer initiatives, or shifts in policy priorities. These changes aim to refine Namibia's approach to climate action, biodiversity conservation, and sustainable development.

*Table 3-8. Phased out Polices*

| Policy/Measure Name | Sector(s) Affected | Reason for Discontinuation | Comments |
|---|---|---|---|
| **National Climate Change Strategy and Action Plan (NCCSAP) 2013–2020** | Cross-Sectoral | Superseded by updated strategies aligning with Namibia's enhanced Nationally Determined Contribution (NDC) and new international climate commitments. | The NCCSAP was instrumental in guiding initial climate actions. Its discontinuation in 2020 paved the way for more comprehensive and updated frameworks to address evolving climate challenges. |
| **National Climate Change Strategy and Action Plan (NCCSAP) 2013–2020** | Cross-Sectoral | Superseded by updated strategies aligning with Namibia's enhanced Nationally Determined Contribution (NDC) and new international climate commitments. | The NCCSAP was instrumental in guiding initial climate actions. Its discontinuation in 2020 paved the way for more comprehensive and updated frameworks to address evolving climate challenges. |
| **Biofuel Subsidy Program** | Energy | Policy ineffectiveness and lack of uptake due to high production costs and insufficient market demand. | Discontinued in 2015; lessons learned include the need for detailed feasibility studies and incentives tailored to local conditions. |
| **National Clean Cooking Initiative** | Energy | Funding constraints and technological barriers in scaling clean cooking technologies to rural areas. | Efforts are being redirected to smaller-scale pilot projects and international funding to reintroduce improved clean cooking solutions. |
| **Community Forestry Revolving Fund** | Forestry/LULUCF | Limited impact due to challenges in fund distribution and monitoring of community-led forestry projects. | Discontinued in 2020; current efforts focus on integrating community forestry into larger-scale reforestation programs supported by international donors. |

| Policy/Measure Name | Sector(s) Affected | Reason for Discontinuation | Comments |
|---|---|---|---|
| **Landfill Methane Capture Pilot** | Waste Management | Policy redundancy with the adoption of broader waste-to-energy initiatives under the Urban Waste-to-Energy Program. | The pilot program's limited scale and overlap with newer measures led to discontinuation; insights are being applied to more comprehensive waste management policies. |
| **Rural Biogas Program** | Agriculture | Insufficient capacity for operation and maintenance of biogas systems in rural communities. | Program ended in 2018; awareness campaigns and technical training initiatives are being designed to support future renewable energy programs in rural areas. |
| **Fuel-Efficient Vehicle Incentives** | Transport | Overlap with the planned Low-Emission Vehicle Program and lack of sufficient infrastructure for monitoring compliance. | Discontinued in 2021; resources redirected to focus on promoting electric vehicles and building charging infrastructure for broader emission reductions. |
| **Biodiversity Policy (2001)** | Cross-Sectoral (Forestry, Agriculture, Ecosystems) | Replaced with the National Biodiversity Strategy and Action Plan (NBSAP). | The Biodiversity Policy was phased out in 2020 as it was integrated into the NBSAP, which adopts a more comprehensive and updated framework for biodiversity conservation, addressing climate and ecosystem resilience. |

### 3.8.9 Monitoring and Evaluation

Monitoring and evaluation (M&E) systems are crucial to assessing the progress and effectiveness of Namibia's climate policies. These systems ensure accountability under the United Nations Framework Convention on Climate Change (UNFCCC) reporting requirements while providing data-driven insights to refine and improve policy implementation.

Namibia has implemented comprehensive monitoring systems to track greenhouse gas (GHG) emissions and removals across all sectors, ensuring accurate assessment of mitigation efforts and policy effectiveness. At the core of these systems is the National Greenhouse Gas Inventory (NGHGI), which provides detailed data on emissions and removals from key sectors such as

energy, agriculture, forestry, and waste management. This inventory supports Namibia in identifying trends, evaluating the effectiveness of climate policies, and reporting progress to international bodies such as the UNFCCC (MEFT, 2023).

To ensure meaningful evaluation, each policy and measure is linked to specific performance indicators and benchmarks. For instance, renewable energy policies are monitored based on metrics such as additional capacity installed, measured in megawatts (MW). One example is the Renewable Energy Feed-In Tariff (REFIT) program, which has successfully added over 100 MW of solar and wind capacity since its inception (GCF, 2023). Another critical metric involves measuring GHG emissions reductions in kilotons of $CO_2$-equivalent (kt $CO_2$-eq), with the Renewable Energy Policy contributing to an estimated annual reduction of 2,500 kt $CO_2$-eq (MEFT, 2020). Similarly, afforestation and reforestation initiatives, such as the National Reforestation Program, are tracked by the number of hectares reforested, supporting both carbon sequestration and biodiversity restoration (UNFCCC, 2018).

These indicators provide Namibia with the tools to quantify progress effectively, identify areas requiring additional focus, and refine its strategies to achieve its Nationally Determined Contribution (NDC) targets. By linking policies to clear, measurable outcomes, Namibia ensures that its climate actions are both transparent and impactful.

### 3.8.10 Challenges and Opportunities

Namibia faces both challenges and opportunities in implementing its climate change policies and measures. Addressing these barriers while leveraging opportunities is crucial for achieving the country's Nationally Determined Contribution (NDC) and advancing its sustainable development goals.

#### *3.8.10.1 Barriers to Implementation*

One of the primary barriers to implementing climate policies in Namibia is limited funding and technical capacity. Financial constraints hinder the scaling-up of critical initiatives such as renewable energy projects and adaptation strategies in vulnerable sectors like agriculture and water resources. Additionally, there is a shortage of skilled professionals and advanced technical infrastructure, which limits the ability to conduct comprehensive data collection, monitoring, and evaluation (MEFT, 2023).

Another significant challenge is coordination across government and sectors. Effective climate action requires collaboration between ministries, regional councils, and local governments, as well as engagement with private sector actors and civil society. However, fragmented responsibilities and weak communication channels often lead to inefficiencies and delays in policy implementation (NPC, 2004).

#### *3.8.10.2 Opportunities*

Despite these challenges, Namibia has significant opportunities to strengthen its climate actions. The country's abundant solar and wind resources provide a solid foundation for transitioning to a low-carbon energy system. With over 300 days of sunshine annually and vast potential for wind energy generation, Namibia is well-positioned to expand its renewable energy portfolio. For example, the Renewable Energy Feed-In Tariff (REFIT) program has already enabled the addition of over 100 MW of solar and wind capacity, reducing GHG emissions significantly (GCF, 2023).

Namibia can also benefit from international climate finance and technology transfer. Mechanisms like the Green Climate Fund (GCF) and Global Environment Facility (GEF) offer financial and technical support for implementing mitigation and adaptation measures. These resources enable Namibia to overcome domestic funding gaps and access cutting-edge technologies to enhance the efficiency and impact of its climate policies (UNFCCC, 2018).

While Namibia faces barriers such as funding limitations and coordination challenges, its renewable energy potential and access to international climate finance present significant opportunities for transformative action. By addressing these barriers and leveraging available resources, Namibia can accelerate progress toward its climate goals and contribute meaningfully to global efforts to combat climate change.

## 3.9 SUMMARY OF GREENHOUSE GAS EMISSIONS AND REMOVALS

With the data provided in the documents, Table 3.9 below summarizes the greenhouse gas emissions and removals for Namibia by sector. The reference year/period for Namibia's NDC is not explicitly mentioned in the excerpts, so this column remains empty. Additionally, specific years from 2021 to the latest reported year were not available in the quotes provided, so those columns are also empty.

*Table 3-9. Summary of greenhouse gas emissions and removals in accordance with the common reporting table 10 emission trends – summary*

| **GREENHOUSE GAS EMISSIONS AND REMOVALS** | **Reference year/period for NDC (1)** | **Base year (2)** | **1990** | **2000** | **2010** | **2022** | **Change from latest reported year (%)** |
|---|---|---|---|---|---|---|---|
| **$CO_2$ emissions without net $CO_2$ from LULUCF** | NA | 2010 | 11,373 kt $CO_2$e | N/A | N/A | 15,469 kt $CO_2$e | **+36%** |
| **$CO_2$ emissions with net $CO_2$ from LULUCF** | NA | 2010 | Net sink | Net sink | Net sink | Net sink | **N/A** |
| **$CH_4$ emissions without $CH_4$ from LULUCF** | NA | 2010 | 8,921 kt $CO_2$e | N/A | N/A | 7,703 kt $CO_2$e | **-14%** |
| **$CH_4$ emissions with $CH_4$ from LULUCF** | NA | 2010 | Net sink | N/A | N/A | Net sink | **N/A** |

| GREENHOUSE GAS EMISSIONS AND REMOVALS | Reference year/period for NDC (1) | Base year (2) | 1990 | 2000 | 2010 | 2022 | Change from latest reported year (%) |
|---|---|---|---|---|---|---|---|
| **$N_2O$ emissions without $N_2O$ from LULUCF** | NA | 2010 | 3,030 kt $CO_2e$ | N/A | N/A | 2,654 kt $CO_2e$ | **-12%** |
| **$N_2O$ emissions with $N_2O$ from LULUCF** | NA | 2010 | Net sink | N/A | N/A | Net sink | **N/A** |
| **HFCs** | NA | 2010 | Negligible | Negligible | Negligible | Negligible | **N/A** |
| **PFCs** | NA | 2010 | N/A | N/A | N/A | N/A | **N/A** |
| **Unspecified mix of HFCs and PFCs** | NA | 2010 | N/A | N/A | N/A | N/A | **N/A** |
| **$SF_6$** | NA | 2010 | Negligible | Negligible | Negligible | Negligible | **N/A** |
| **$NF_3$** | NA | 2010 | N/A | N/A | N/A | N/A | **N/A** |
| **Total (without LULUCF)** | NA | 2010 | 23,324 kt $CO_2e$ | N/A | N/A | 25,826 kt $CO_2e$ | **+11%** |
| **Total (with LULUCF)** | NA | 2010 | Net sink | Net sink | Net sink | Net sink | **+36%** |
| **Total (without LULUCF, with indirect)** | NA | 2010 | N/A | N/A | N/A | N/A | **N/A** |
| **Total (with LULUCF, with indirect)** | NA | 2010 | N/A | N/A | N/A | N/A | **N/A** |

***Key Notes:***

1. ***$CO_2$ Dominance:*** *$CO_2$ emissions remained the largest contributor, with a **36% increase** from 1990 to 2022, primarily due to increased emissions from the energy sector.*
2. ***Methane ($CH_4$):*** *$CH_4$ emissions decreased by **14%**, indicating progress in sectors like agriculture and waste management.*
3. ***Nitrous Oxide ($N_2O$):*** *$N_2O$ emissions decreased by **12%**, reflecting mitigation measures in agriculture.*
4. ***LULUCF Sector:*** *LULUCF remained a **net sink**, with removals increasing by **45%** between 1990 and 2022, emphasizing Namibia's reliance on sustainable land management practices.*

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Reference year/period for NDC (1) | Base year (2) | $CO_2$ equivalents (kt) (3) | Change from Base Year to Latest Reported Year (%) |
|---|---|---|---|---|
| **1. Energy** | NA | 2010 | 5,595 (1990) to 20,043 (2022) | **+258%** |
| **2. Industrial Processes and Product Use** | NA | 2010 | 10 (1990) to 642 (2022) | **+6,324%** |
| **3. Agriculture** | NA | 2010 | 8,360 (1990) to 11,860 (2022) | **+42%** |
| **4. Land Use, Land-Use Change and Forestry** | NA | 2010 | -89,977 (1990) to -122,411 (2022) | **+36% in net removals** |
| **5. Waste** | NA | 2010 | 50 (1990) to 2,645 (2022) | **+89%** |
| **6. Other** | NA | Not applicable | Not reported | Not reported |
| **Total (with LULUCF)** | NA | 2010 | Net sink maintained over time | Net removals improved by **36%** |

***Key Highlights:***

1. ***Energy Sector:*** *Significant growth in emissions due to increased energy demand and industrial activities. Mitigation measures are critical in this sector.*
2. ***Industrial Processes and Product Use (IPPU):*** *Explosive growth due to the rise in cement production after 2011.*
3. ***Agriculture:*** *Moderate increase due to livestock and agricultural practices; methane emissions dominate.*
4. ***LULUCF:*** *The largest net sink category, with a 36% improvement in removals since 1990, demonstrating Namibia's strong land management efforts.*
5. ***Waste:*** *Significant increase in emissions due to population growth and urbanization.*

## 3.10 PROJECTIONS OF GREENHOUSE GAS EMISSIONS AND REMOVALS, AS APPLICABLE

### 3.10.1 Purpose

The primary objective of the projections section is to provide a detailed understanding of future trends in Namibia's greenhouse gas (GHG) emissions and removals under different scenarios. This section outlines expected trajectories based on currently implemented, adopted, and planned policies and measures, while also presenting alternative scenarios to demonstrate the potential impact of additional or absent interventions (UNFCCC, 2018; MEFT, 2023).

By evaluating "with measures", "with additional measures", and "without measures" scenarios, the projections aim to:

- Highlight the anticipated effects of Namibia's Nationally Determined Contribution (NDC) commitments on future emissions and removals.

- Assess the extent to which existing and planned policies contribute to achieving Namibia's long-term climate goals, including its net-zero target by 2050 (UNFCCC, 2019; MEFT, 2023).
- Provide a baseline for identifying gaps and opportunities for strengthening climate action.

Future GHG emissions and removals trends will reflect Namibia's national circumstances, including socio-economic development pathways, resource availability, and sector-specific dynamics. For example, significant reductions in emissions are projected through the accelerated adoption of renewable energy sources, as outlined in the Renewable Energy Action Plan, and the implementation of climate-smart agriculture practices to reduce methane and nitrous oxide emissions (NDC Namibia, 2023). On the other hand, scenarios without these measures illustrate a potential increase in emissions due to continued reliance on fossil fuels and unsustainable land use practices.

This forward-looking analysis underpins Namibia's strategy for meeting its Paris Agreement commitments and provides essential insights for policymakers, stakeholders, and the international community regarding the country's climate trajectory.

### 3.10.2 Projections

#### *3.10.2.1 Scenarios*

Namibia's GHG emissions projections are analysed under three primary scenarios to illustrate the potential impact of climate policies on future emissions and removals. These scenarios provide critical insights into the effectiveness of current and planned interventions, as well as the implications of inaction, supporting strategic decision-making in climate policy.

The '*With Measures*' projection encompasses the effects of currently implemented and adopted policies and measures. This scenario reflects realistic future emissions reductions achieved through active interventions such as the Renewable Energy Action Plan and Climate-Smart Agriculture initiatives. These measures are essential to Namibia's commitment to reducing emissions in key sectors like energy and agriculture (MEFT, 2023).

In contrast, the '*With Additional Measures*' projection builds on the '*With Measures*' scenario by including planned policies and measures. Examples of these planned actions include the National Reforestation Program and expanded renewable energy projects, which are expected to enhance emissions reductions significantly, especially in the forestry and energy sectors (NDC Namibia, 2023). Finally, the '*Without Measures*' projection, or baseline/reference scenario, assumes no policies or measures have been implemented, adopted, or planned since the starting year. This scenario demonstrates the expected trajectory of GHG emissions in the absence of interventions, underscoring the importance of Namibia's climate policies (UNFCCC, 2019).

To provide clarity and structure, the assumptions underlying each scenario are summarized in Table 3.10

*Table 3-10 Summary of GHG Emissions Scenarios*

| Scenario | Definition | Key Assumptions |
|---|---|---|
| With Measures | Includes currently implemented and adopted policies and measures. | Active mitigation actions like renewable energy adoption and climate-smart agriculture. |
| With Additional Measures | Includes planned policies and measures in addition to implemented and adopted ones. | Expansion of renewable energy, reforestation programs, and improved energy efficiency. |
| Without Measures | Assumes no policies or measures have been implemented, adopted, or planned since the starting year. | Continuation of business-as-usual trends without climate policy interventions. |

### 3.10.3 Sensitivity Analysis

In addition to scenario analysis, Namibia conducts a sensitivity analysis to evaluate the robustness of its projections. This process examines how variations in key parameters—such as socio-economic growth rates, technological advancements, and the effectiveness of policy implementation—impact GHG emissions estimates. For instance, assumptions about population growth and GDP trends influence emissions trajectories, while the adoption rate of renewable energy technologies and improvements in energy efficiency significantly affect mitigation outcomes. Sensitivity analysis enhances the reliability of projections by accounting for uncertainties, ensuring that decision-makers can anticipate a range of possible outcomes under different conditions.

## 3.11 Presentation of Projections Relative to Actual Data

### 3.11.1 Emission Projections Compared to Actual Inventory Data

Namibia's emission projections are grounded in historical GHG inventory data from 1990 to 2022. The projections align with the country's mitigation commitments under the updated NDC (2023), specifically addressing Business-as-Usual (BAU), With Measures (WM), and With Additional Measures (WAM) scenarios.

### 3.11.2 Starting Point for Projections

- *With Measures (WM) and With Additional Measures (WAM)* - Projections are anchored on the 2022 inventory year as the baseline.
- *Without Measures (BAU)* - Projections for this scenario use 2010 as the starting point, consistent with the BAU baseline outlined in the NDC.

### 3.11.3 Adjusted vs. Unadjusted Inventory Data

Namibia's projections use adjusted data to ensure methodological consistency and reflect recalculations based on updated IPCC 2006 Guidelines. This includes adjustments for recalibrating emission factors and activity data. Unadjusted data, retained for transparency, highlight the raw historical trends.

### 3.11.4 Comparative Insights

Namibia demonstrates its commitment to maintaining its net sink status through effective land-use management and mitigation measures:

- *Historical Net Sink Data* - Between 2010 and 2022, Namibia's net sink capacity increased from -85.823 $MtCO_2e$ to -104.206 $MtCO_2e$.
- *BAU Scenario* - Under BAU, projections indicate a slight reduction in sink capacity to -90.713 $MtCO_2e$ by 2030, reflecting baseline emissions without additional mitigation.
- *Mitigation Scenarios* - The WM and WAM scenarios suggest improved sink capacities of -95.500 $MtCO_2e$ and -102.615 $MtCO_2e$ by 2030, achieving a combined mitigation potential of 11.902 $MtCO_2e$.

The trends in Namibia's net sink capacity from historical data (2010–2022) and projections (2025–2030) under BAU, WM, and WAM scenarios are illustrated in Figure 3.3 below.

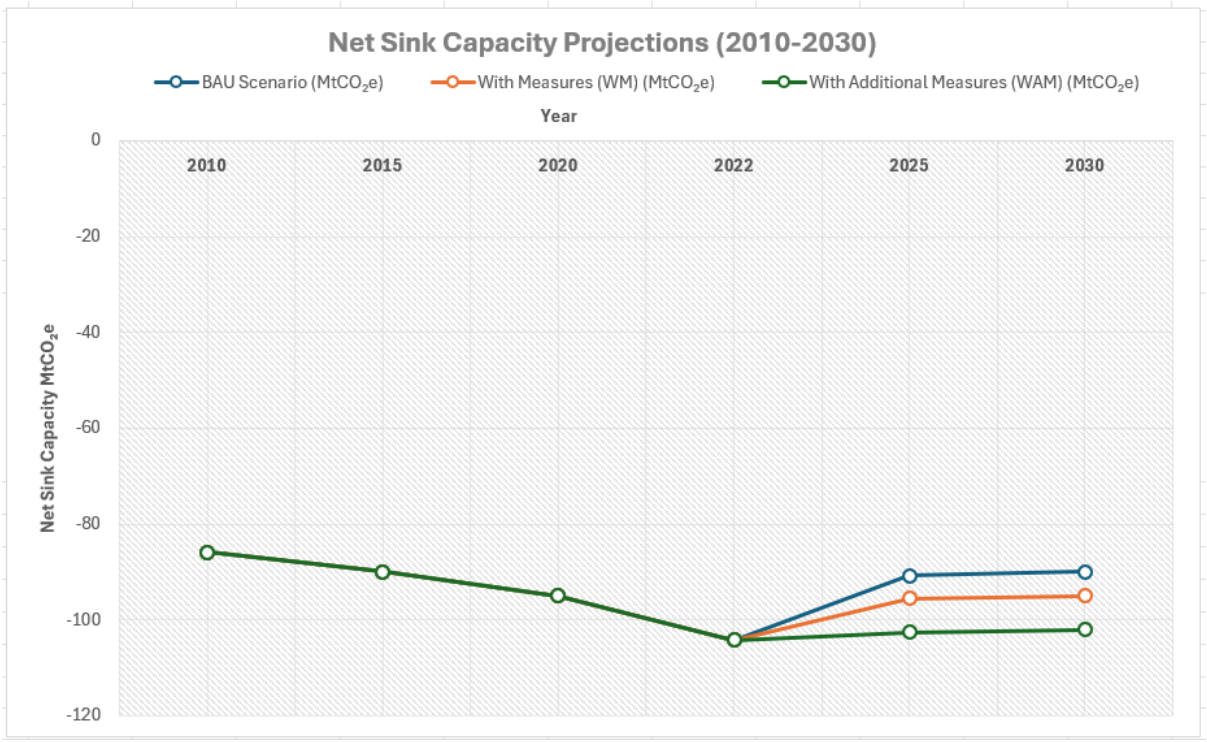



*Figure 3-3. Net Sink Capacity Projections (2010-2030)*

Figure 3.3 illustrates Net Sink Capacity Projections (2010–2030) for Namibia under three scenarios i.e. Business-as-Usual (BAU), With Measures (WM), and With Additional Measures (WAM). The trends reveal important insights into Namibia's ability to sequester greenhouse gases (GHGs) and the potential impact of different policy approaches.

From 2010 to 2020, there is a steady decline in net sink capacity, meaning the values become more negative over time. This indicates a gradual increase in the removal of GHGs from the atmosphere. The trend reflects Namibia's effective land management practices, particularly in the AFOLU (Agriculture, Forestry, and Other Land Use) sector. Actions such as reforestation, sustainable agriculture, and reduced deforestation have been instrumental in improving net removals during this period.

In 2022, the net sink capacity reaches its peak removal capacity at approximately -104.206 $MtCO_2e$ across all scenarios. This significant dip highlights a historical improvement in Namibia's ability to sequester carbon, largely due to cumulative efforts in land-use management, afforestation initiatives, and forestry programs. However, the dip may also indicate data recalibrations in the GHG inventory or temporary policy impacts, such as intensified land restoration activities or favourable environmental conditions like higher biomass growth.

After 2022, the net sink capacity becomes less negative, indicating a reduction in Namibia's ability to remove GHGs from the atmosphere. This trend is most pronounced in the BAU scenario, where emissions increase due to continued reliance on fossil fuels and unsustainable land-use practices. In contrast, the WM and WAM scenarios exhibit a slower decline in net sink capacity, supported by ongoing and planned mitigation measures. Programs such as the Renewable Energy Action Plan, the National Reforestation Program, and climate-smart agriculture practices help to stabilize the trend and mitigate the loss of sequestration potential.

The significance of the three scenarios is evident in the trajectory of emissions and removals. The BAU scenario serves as a cautionary baseline, illustrating the potential negative outcomes of inaction, with a steady decline in net sink capacity due to business-as-usual activities. The WM scenario demonstrates the effectiveness of currently implemented policies, such as renewable energy adoption and sustainable land-use practices, in slowing the decline. The WAM scenario highlights the transformative potential of planned policies, achieving the most significant mitigation outcomes and enhancing Namibia's net sink capacity. Collectively, these scenarios emphasize the importance of sustained and expanded mitigation efforts to meet Namibia's climate goals and maintain its net sink status.

## 3.12 Coverage and Presentation

### 3.12.1 Sectoral Basis

Namibia's emission projections are structured according to the four key sectors outlined in its First National Inventory Document (NID). This alignment ensures compatibility with international GHG inventory reporting standards and supports tracking progress across sectors effectively.

- *Energy Sector* - Includes emissions from fuel combustion in power generation, industrial processes, and transport, as well as fugitive emissions from oil and gas operations.
- *Industrial Processes and Product Use (IPPU)* - Encompasses emissions and removals from livestock management, soil activities, and land-use changes (e.g., deforestation and afforestation).
- *Agriculture, Forestry, and Other Land Use (AFOLU)* - Encompassing enteric fermentation, manure management, and land-use changes.
- *Waste Sector* - Addressing emissions from solid waste disposal, incineration, and wastewater treatment.

Figure 3.4 visually demonstrates the proportion of emissions from each sector under the Business-as-Usual (BAU) scenario for 2022 and projected contributions for 2030.

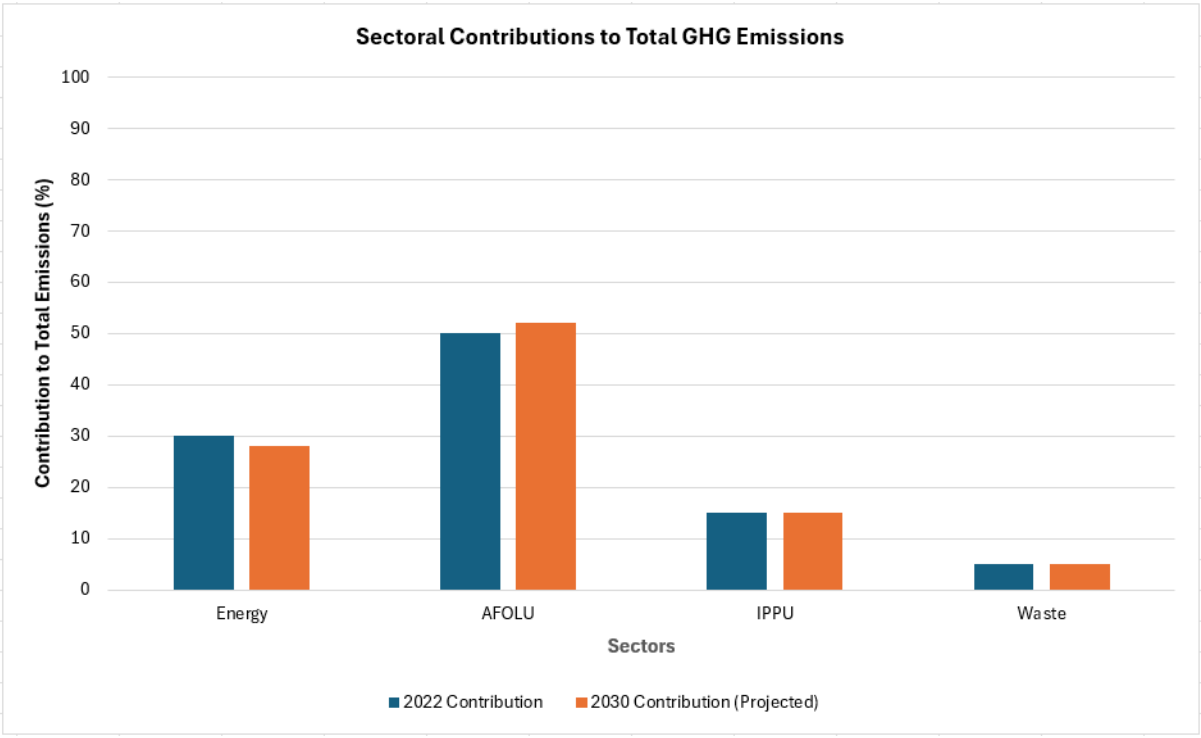



*Figure 3-4.Sectoral Contributions to Total GHG Emissions*

Figure 3.4 illustrates sectoral contributions to total GHG emissions for 2022 and projections for 2030 under current scenarios. The four key sectors, namely Energy, AFOLU, IPPU and Waste, highlight key trends in Namibia's emissions trajectory. These trends have critical implications for the country's climate strategy and mitigation priorities.

In the Energy Sector, emissions contributed 30% of the total in 2022, with a slight projected decline to 28% by 2030. This reduction reflects Namibia's progress in transitioning to renewable energy sources and improving energy efficiency, as outlined in the Renewable Energy Action Plan (MEFT, 2023). However, energy remains a significant contributor to emissions, necessitating continued investment in renewable energy projects, including solar, wind, and green hydrogen production (NDC Namibia, 2023).

The AFOLU Sector remains the dominant source of emissions, accounting for 50% in 2022 and projected to rise slightly to 52% by 2030. This trend underscores the dual role of AFOLU as both a major emitter and a critical contributor to Namibia's net sink capacity. The increase reflects ongoing challenges such as agricultural expansion, deforestation, and unsustainable land-use practices. Mitigation measures, such as reforestation, sustainable land management, and climate-smart agriculture, are essential to counteract these emissions and maintain Namibia's net sink status (UNFCCC, 2019).

Emissions from the IPPU Sector remain stable at 15% in both 2022 and 2030. This stability suggests limited industrial growth or mitigation interventions in this sector. To reduce emissions further, Namibia could focus on adopting cleaner industrial technologies and regulating the use of fluorinated gases in refrigeration and other industrial processes (MEFT, 2023). Similarly, the Waste Sector shows no significant change, contributing 5% of emissions in both years. This stability indicates that current waste management practices, including landfill operations and recycling, are effective at controlling emissions. However, with urbanization and economic growth, the waste sector may require expanded infrastructure for sustainable waste

management systems, such as methane capture and waste-to-energy technologies (UNFCCC, 2018).

The significance of these trends lies in their implications for Namibia's climate policies. The AFOLU (52%) and Energy (28%) sectors will contribute over 80% of total emissions by 2030, highlighting the need for targeted mitigation efforts in these areas. Investments in reforestation, renewable energy expansion, and climate-smart agriculture could significantly reduce emissions while supporting sustainable development (NDC Namibia, 2023). Moreover, balancing economic growth with sustainability is crucial, particularly for sectors like agriculture and mining, which are central to Namibia's economy.

Stable emissions from the IPPU and Waste sectors emphasize the importance of continued monitoring and the adoption of innovative technologies to maintain low emissions. Namibia's ability to achieve its net-zero goals depends heavily on preserving and enhancing its net sink capacity, especially through careful land-use management in the AFOLU sector. These findings underscore the importance of international collaboration and support to accelerate Namibia's transition to a low-carbon economy while maintaining its environmental resilience.

### 3.12.2 By-Gas Projections

Namibia's projections disaggregate emissions into key greenhouse gases (GHGs) for greater clarity:

- *Carbon Dioxide ($CO_2$)* - The largest share of emissions, primarily from fossil fuel combustion and land-use changes.
- *Methane ($CH_4$)* - Significant contributions from agriculture, especially enteric fermentation and manure management.
- *(Nitrous Oxide) $N_2O$* - Emissions from agricultural soil management, particularly fertilizer application.
- *Fluorinated Gases (F-gases)* - Include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride ($SF_6$), and nitrogen trifluoride ($NF_3$), mostly from industrial processes.

Optional indirect gases like carbon monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOCs), and sulfur oxides (SOx) are excluded in the projections but could be considered for future policy analyses.

Figure 3.5 complements this section by showing the proportion of emissions attributable to each gas. For example, the dominance of $CO_2$ highlights the importance of focusing on energy and land-use mitigation measures, while smaller contributions from fluorinated gases may call for targeted industrial reforms.

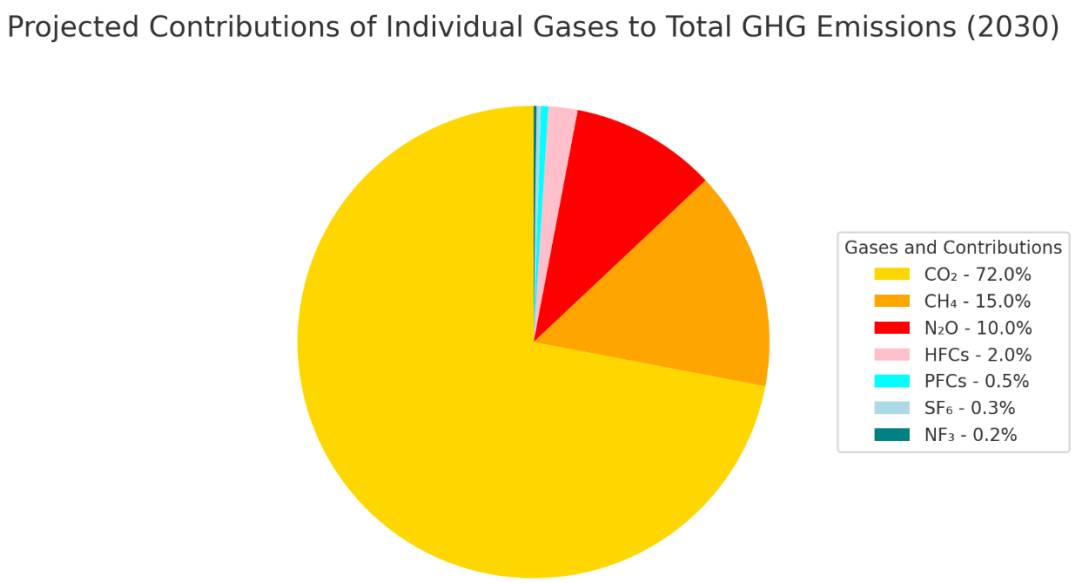



*Figure 3-5. Projected Contributions of Individual Gases To Total GHG Emissions (2030)*

Figure 3.5 illustrates the projected contributions of individual gases to total GHG emissions in 2030, highlighting the relative significance of each gas and the need for targeted mitigation strategies. The primary contributors are carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), and fluorinated gases (HFCs, PFCs, $SF_6$, $NF_3$), each linked to specific sectors and activities in Namibia.

Carbon dioxide ($CO_2$) accounts for 72% of total emissions, making it the dominant contributor. This reflects the significant role of energy and land-use sectors, with emissions largely stemming from fossil fuel combustion, deforestation, and land-use changes (MEFT, 2023). Mitigating $CO_2$ emissions is crucial and will require Namibia to expand its renewable energy generation, promote energy efficiency, and implement reforestation programs to offset emissions from deforestation. These interventions are critical to achieving Namibia's long-term climate commitments under its Nationally Determined Contribution (NDC).

Methane ($CH_4$) contributes 15% of total emissions, making it the second-largest source. $CH_4$ emissions primarily originate from agricultural activities, such as enteric fermentation in livestock and manure management, as well as waste decomposition in landfills (UNFCCC, 2019). Addressing methane emissions will require the adoption of climate-smart agriculture practices, including improved livestock management and the use of anaerobic digesters to capture methane emissions while enhancing agricultural productivity.

Nitrous oxide ($N_2O$) accounts for 10% of total emissions, predominantly associated with agricultural soil management. The use of synthetic fertilizers and organic inputs releases nitrogen into the atmosphere, contributing significantly to $N_2O$ emissions (MEFT, 2023). Mitigation strategies in this area include adopting precision agriculture techniques, optimizing fertilizer application, and encouraging alternatives to synthetic fertilizers, which can reduce emissions while maintaining soil health.

Fluorinated gases (HFCs, PFCs, $SF_6$, and $NF_3$) collectively account for 2.7% of emissions, with HFCs contributing the largest share at 2.0%. These gases are used in industrial applications, such as refrigeration, air conditioning, and specialized manufacturing processes, and have a

much higher Global Warming Potential (GWP) compared to other gases (NDC Namibia, 2023). Targeted interventions to reduce fluorinated gases include the adoption of low-GWP alternatives and the implementation of improved gas recovery systems.

The trends in the pie chart emphasize the need for sector-specific mitigation strategies to achieve Namibia's climate goals. Addressing $CO_2$ emissions requires prioritizing the energy and land-use sectors, where renewable energy expansion and reforestation are essential. For $CH_4$ and $N_2O$, sustainable agricultural practices, including livestock management and soil optimization, will play a key role. Additionally, mitigating fluorinated gas emissions will require industrial innovation and the transition to cleaner technologies.

These findings highlight the importance of a balanced and comprehensive climate strategy. By addressing the major contributors to emissions, Namibia can reduce its GHG emissions while maintaining socio-economic development. International support for mitigation efforts, particularly in the energy and agricultural sectors, will be vital for Namibia to meet its commitments under the Paris Agreement (UNFCCC, 2018).

### 3.12.3 Aggregation

National totals are aggregated using Global Warming Potential (GWP) values from the IPCC Fifth Assessment Report (AR5). This aggregation method translates emissions of various gases into a standardized metric, million metric tonnes of $CO_2$-equivalent ($MtCO_2e$). By using GWP values, Namibia ensures that its reporting aligns with international standards, facilitating transparency and comparability.

Aggregation simplifies complex data, making it easier for policymakers to assess total emissions and evaluate progress against national and international commitments. Figures 1.2 and 4.2 collectively illustrate how sectoral and gas-specific contributions combine into Namibia's total GHG inventory.

### 3.12.4 International Transport

In accordance with IPCC guidelines, emissions from international transport are separately reported under "bunker fuels" and excluded from national totals:

- *Aviation* **-** Emissions from jet fuel used in international flights.
- *Marine* **-** Emissions from fuels used in international trade routes.

Figure 3.6 provides a comparative analysis of emissions from these two sub-sectors.


*Figure 3-6. Emissions from International Aviation and Shipping (2022 vs 2030)*

This figure is essential to understand the trajectory of emissions growth in international transport and to identify opportunities for collaboration with international stakeholders on mitigation measures.

Figure 3.6 illustrates a projected increase in emissions from international aviation and shipping in Namibia between 2022 and 2030. Aviation emissions are expected to rise from 2.5 $MtCO_2e$ in 2022 to 2.8 $MtCO_2e$ in 2030 (a 12% increase), while shipping emissions are projected to grow from 2.0 $MtCO_2e$ to 2.4 $MtCO_2e$ (a 20% increase). These trends highlight the growing environmental impact of international transport due to increased trade, economic activity, and tourism (ICAO, 2019; IMO, 2020).

These trends underscore the environmental implications of international transport and the urgent need for mitigation efforts. While international aviation and shipping emissions are excluded from Namibia's national totals under IPCC guidelines, they contribute significantly to global greenhouse gas (GHG) emissions. To address these challenges, Namibia can adopt targeted mitigation strategies. For aviation, transitioning to sustainable aviation fuels (SAFs), enhancing operational fuel efficiency, and supporting research on alternative propulsion systems, such as hydrogen and electric-powered aircraft, are critical steps (ICAO, 2019). In the shipping sector, adopting low-carbon technologies like LNG-powered vessels, wind-assisted propulsion, and operational efficiencies, including optimized routing, can substantially reduce emissions (IMO, 2020).

Namibia's transport sectors also present an opportunity to contribute to global climate action. By integrating sustainable practices, the country can position itself as a regional leader in climate-conscious trade and tourism. For example, aligning with international initiatives such as the International Civil Aviation Organization's (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and the International Maritime Organization's (IMO)

decarbonization goals will strengthen Namibia's mitigation efforts and facilitate international collaboration (UNFCCC, 2019).

The trends also highlight the importance of embedding these mitigation strategies into Namibia's broader climate action frameworks. As these sectors grow, addressing emissions through policies, investment in cleaner technologies, and global cooperation will ensure Namibia's economic development aligns with sustainability goals. These efforts will not only contribute to reducing global GHG emissions but also reinforce Namibia's commitment to the Paris Agreement and its climate resilience objectives (MEFT, 2023).

## 3.13 HISTORICAL EMISSIONS AND PROJECTIONS

### 3.13.1 Quantitative Historical Emissions/Removals (1990–2022)

Namibia's historical GHG emissions and removals highlight the critical role of the Land Use, Land-Use Change, and Forestry (LULUCF) sector, which remains the primary contributor to net removals. Other sectors, such as energy, agriculture, and waste, display varying trends over time, influenced by population growth, urbanization, and economic development.

Table 1 presents historical emissions and removals by sector and gas.

*Table 3-11. Historical Emissions and Removals by Sector and Gas (1990–2022)*

| Year | Energy (kt $CO_2e$) | LULUCF (kt $CO_2e$) | Agriculture (kt $CH_4$) | Waste (kt $CH_4$) | IPPU (kt $CO_2e$) | Total Net (kt $CO_2e$) |
|---|---|---|---|---|---|---|
| 1990 | 11,373 | -89,977 | 8,921 | 2,685 | Negligible | -77,002 |
| 2000 | 12,104 | -97,453 | 8,500 | 3,200 | Negligible | -83,649 |
| 2010 | 14,003 | -110,329 | 7,934 | 3,598 | 2,000 | -92,794 |
| 2020 | 15,394 | -121,543 | 7,850 | 4,200 | 3,500 | -96,599 |
| 2022 | 15,469 | -122,411 | 7,703 | 4,500 | 3,800 | -98,939 |

*Source: GHG_NID NAMIBIA-Final version-2024.*

Key Insights include:

- *LULUCF* - The largest contributor to net removals, LULUCF saw an increase in removals from -89,977 kt $CO_2e$ in 1990 to -122,411 kt $CO_2e$ in 2022. This growth is attributed to afforestation, improved land management practices, and bush encroachment, which enhance Namibia's carbon sink capacity.
- *Energy* - Emissions from energy rose by 36% over the period due to increasing fossil fuel consumption in transportation and electricity generation, reflecting Namibia's economic development and population growth.
- *Agriculture and Waste* - Methane emissions from agriculture decreased marginally due to improved livestock management, while emissions from waste increased due to urbanization and population growth.

The trends underscore the importance of maintaining and scaling up LULUCF interventions, as they play a pivotal role in offsetting emissions from other sectors. Additionally, the rise in energy emissions highlights the need for transitioning to renewable energy sources, while the growth in waste emissions calls for enhanced waste management strategies.

### 3.13.2 Projections for Future Years

Projections extend to 2035, with milestone years 2025, 2030, and 2035. The scenarios modelled include:

- *Business-as-Usual (BAU)* - Assumes no additional mitigation actions beyond existing policies.
- *With Measures (WM)* - Reflects emissions reductions from current policies.
- *With Additional Measures (WAM)* - Considers planned but unimplemented mitigation measures.

Table 1.3 provides detailed projections by sector and gas under these scenarios.

*Table 3-12. Projections by Sector and Gas (2025–2035)*

| Year | Energy (kt $CO_2e$) | LULUCF (kt $CO_2e$) | Agriculture (kt $CH_4$) | Waste (kt $CH_4$) | IPPU (kt $CO_2e$) | Total Net (kt $CO_2e$) |
|---|---|---|---|---|---|---|
| 2025 | 14,500 | -125,000 | 7,500 | 4,600 | 4,000 | -94,400 |
| 2030 | 14,000 | -128,000 | 7,200 | 4,700 | 4,500 | -98,300 |
| 2035 | 13,500 | -130,000 | 7,000 | 4,800 | 5,000 | -100,200 |

**Data Source**: *GHG_NID NAMIBIA-Final version-2024*

The trends presented in Table 2 are visually depicted in Figure 1.6, highlighting the progressive improvements in net removals under the BAU, WM, and WAM scenarios from 2025 to 2035, with the WAM scenario demonstrating the most significant gains.

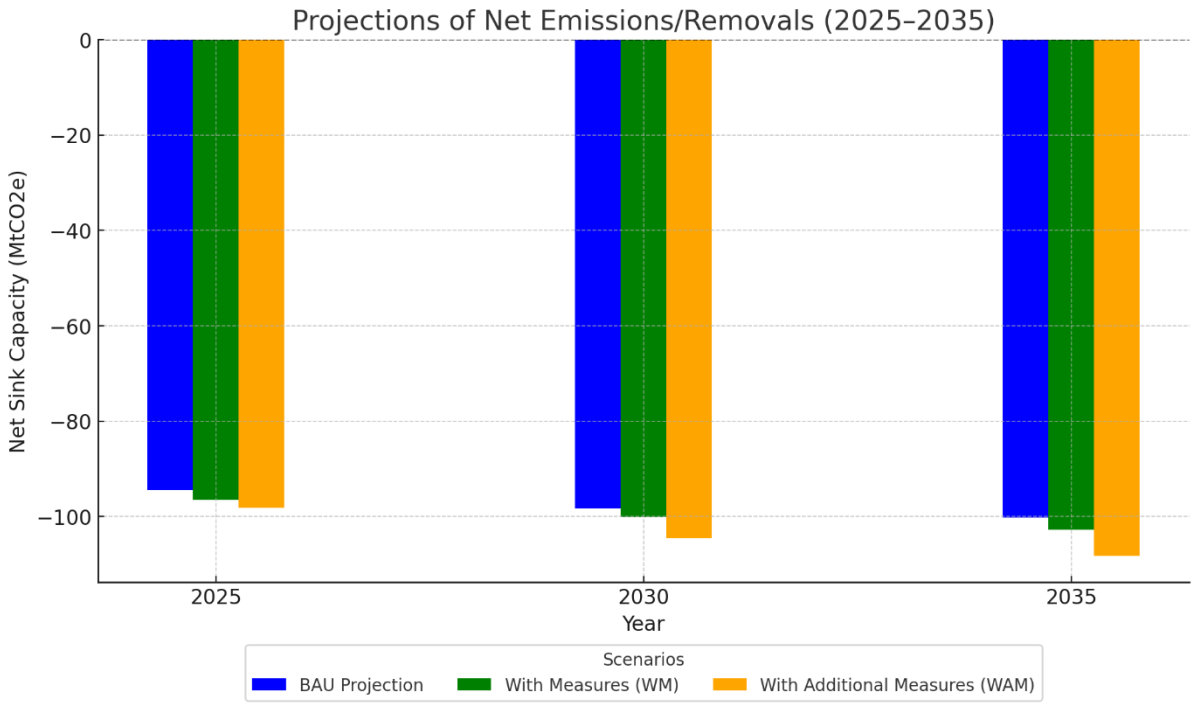



*Figure 3-7. Projections of Net Emissions/Removals (2025–2035).*

Key Insights include:

- *BAU Scenario* - Net removals improve modestly to -100.2 $MtCO_2e$ by 2035, reflecting limited mitigation actions.
- *WM Scenario* - Expanding renewable energy and improving efficiency result in enhanced removals of -102.8 $MtCO_2e$ by 2035.
- *WAM Scenario* - The most ambitious scenario, achieving -108.3 $MtCO_2e$ by 2035, underscores the transformative potential of planned measures like reforestation and land restoration.

The projections highlight the critical role of policy interventions. The WAM scenario demonstrates Namibia's capacity to align with the Paris Agreement goals, significantly reducing net emissions and enhancing resilience to climate change. Moreover, the adoption of renewable energy and land restoration under WM and WAM scenarios exemplifies Namibia's ability to achieve sustainable development.

### 3.13.3 Aggregated National Totals

Namibia's aggregated emissions and removals demonstrate a consistent trend of increasing net sink capacity. Historical data show an improvement from -89,977 kt $CO_2e$ in 1990 to -122,411 kt $CO_2e$ in 2022. Projections indicate further gains, with the WAM scenario achieving the most significant improvement, reaching -108.3 $MtCO_2e$ by 2035.

Key Issues:

- LULUCF continues to drive Namibia's net sink status, with its contribution increasing under all scenarios.

- Enhanced mitigation actions under WM and WAM scenarios significantly improve net removals, aligning Namibia with global climate commitments.
- Significance and Importance: These trends reinforce Namibia's position as a leader in climate mitigation. By implementing WAM measures, Namibia can maximize its carbon sequestration potential, contributing to global efforts to limit temperature rise while advancing its socio-economic development.

These trends reinforce Namibia's position as a leader in climate mitigation. By implementing WAM measures, Namibia can maximize its carbon sequestration potential, contributing to global efforts to limit temperature rise while advancing its socio-economic development.

Namibia’s integrated approach to climate action, combining governance, policy, and international collaboration, demonstrates its commitment to global objectives while addressing national development priorities (UNFCCC, 2019). This comprehensive strategy highlights the importance of balancing environmental protection with economic growth, setting a benchmark for sustainable and climate-resilient development.

# 4 CLIMATE CHANGE IMPACTS AND ADAPTATION

## 4.1 INTRODUCTION

This chapter provides a detailed account of the country's climate change adaptation efforts, aligning with the principles of the Paris Agreement. Its primary goal is to enhance transparency and accountability by documenting adaptation measures, outcomes, and progress, thereby fostering international trust and cooperation (UNFCCC, 2019; MEFT, 2023). Covering the reporting period from 2015 to 2024, the chapter builds on Namibia's earlier submissions, such as the Fourth National Communication (NC4) and Updated Nationally Determined Contributions (NDC), offering insights into nearly a decade of evolving strategies (Government of the Republic of Namibia, 2020, 2021).

Namibia's adaptation initiatives span key sectors such as agriculture, water resources, health, and infrastructure, addressing vulnerabilities through climate-resilient infrastructure, sustainable land management practices, and early warning systems. Supported by domestic resources and international climate finance, these efforts highlight Namibia's proactive approach to leveraging global support. Transitioning from the Measurement, Reporting, and Verification (MRV) system to the Enhanced Transparency Framework (ETF), Namibia has adopted a more robust and standardized reporting structure (Dale et al., 2020).

The chapter adheres to the Modalities, Procedures, and Guidelines (MPGs) under Article 13 of the Paris Agreement, ensuring consistency with international best practices. It covers the entire adaptation process, from identifying vulnerabilities to monitoring implementation and evaluating outcomes. By aligning its efforts with global standards, Namibia underscores its commitment to sustainable development, climate resilience, and international cooperation, reinforcing its leadership in adaptation efforts.

## 4.2 ADAPTIVE CAPACITY

Solid institutional frameworks, innovative water and agricultural management practices, biodiversity conservation efforts, resilient infrastructure development, and public health initiatives characterize Namibia's adaptive capacity. Education, capacity building, financial mechanisms, and international cooperation further support these efforts. While challenges persist, Namibia's proactive approach and commitment to enhancing adaptive capacity position it to effectively respond to the impacts of climate change and build a resilient future for its people and ecosystems.

Namibia's adaptive capacity is shaped by socioeconomic, environmental, and institutional factors that influence its ability to respond effectively to climate change impacts. As a country with a predominantly arid climate and highly variable rainfall patterns, Namibia faces significant challenges in addressing inequality, improving access to essential services, managing water resources, agricultural productivity, and overall resilience to climatic extremes. Figure 4.2 shows three indices that can be used to understand the spatial dynamics of adaptive capacity in Namibia. General, the north-western and north-eastern parts of the country have higher monetary and multidimensional poverty incidences, and hence lower adaptive capacity.

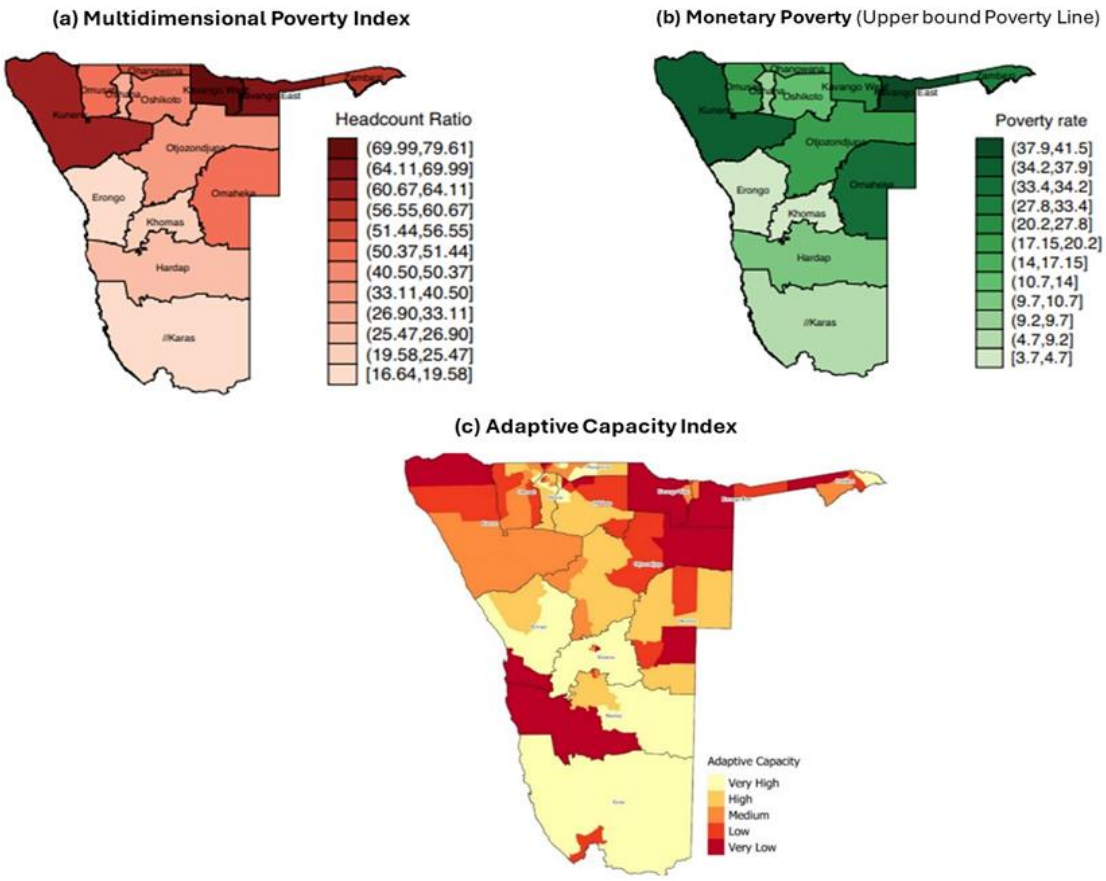



*Figure 4-1: Some of the adaptive capacity indices, Namibia (Sources: Namibian Statistics Agency (2021) for (a) multidimensional poverty index and (b) monetary poverty index; and Government of the Republic of Namibia (2020) for the adaptive capacity index).*

Despite these challenges, Namibia has made considerable strides in enhancing its adaptive capacity through various strategies and initiatives. At the institutional level, Namibia has established robust frameworks to support climate adaptation. The National Climate Change Policy (NCCP) (Ministry of Environment, Forestry, and Tourism (MEFT), 2011) and the National Climate Change Strategy and Action Plan (NCCSAP) (Ministry of Environment, Forestry, and Tourism (MEFT), 2013) provide comprehensive guidelines for integrating climate adaptation into national development planning. These policies are supported by the Environmental Management Act, which mandates environmental impact assessments for major projects, ensuring that climate risks are considered in development activities. Additionally, the Climate Change Unit within the Ministry of Environment, Forestry and Tourism (MEFT) coordinates climate adaptation efforts, fostering collaboration across government sectors and with international partners.

Water management is a critical component of Namibia's adaptive capacity. The country has implemented innovative water conservation and management techniques to address water scarcity, including desalination plants, wastewater recycling, and efficient irrigation systems. The Integrated Water Resources Management (IWRM) Plan promotes sustainable water use and allocates resources to areas with the greatest need. Community-based water management programs empower local communities to actively manage their water resources, enhancing resilience at the grassroots level (Government of the Republic of Namibia, 2020, 2021).

Agricultural adaptation is also a key focus area, given the sector's vulnerability to climate variability and its importance for rural livelihoods. To improve agricultural resilience, Namibia

has introduced climate-smart agriculture practices, such as drought-resistant crop varieties, conservation tillage, and agroforestry. Extension services provide farmers with the knowledge and tools needed to implement these practices, while early warning systems help them anticipate and respond to climate-related hazards. The Green Scheme Programme, which promotes irrigation-based agriculture, is another initiative to enhance food security and agricultural productivity (Government of Namibia, 2021; Government of the Republic of Namibia, 2020, 2021; National Planning Commission (NPC) Namibia, 2017).

Biodiversity conservation and ecosystem management are integral to Namibia's adaptation strategy. The country is renowned for its innovative conservancy model, which engages local communities in wildlife and natural resource management. This model enhances biodiversity conservation and provides economic benefits through eco-tourism and sustainable use of natural resources. Protected areas and conservancies cover nearly half of Namibia's land, creating a habitat network that supports climate adaptation by preserving ecosystem services and biodiversity (Government of the Republic of Namibia, 2020, 2021; National Planning Commission (NPC) Namibia, 2017).

Infrastructure development that accounts for climate risks is essential for enhancing adaptive capacity. Namibia has invested in resilient infrastructure projects, including climate-resilient roads, flood defences, and energy systems. These investments are designed to withstand extreme weather events and reduce vulnerability to climate impacts. The National Planning Commission (NPC) integrates climate resilience into national infrastructure planning, ensuring that new developments contribute to overall adaptive capacity (Government of the Republic of Namibia, 2020, 2021; Ministry of Environment, Forestry, and Tourism (MEFT), 2011, 2013; National Planning Commission (NPC) Namibia, 2017).

Public health is another critical area where adaptive capacity is being strengthened. Namibia faces health challenges related to climate change, such as increased incidence of vector-borne diseases and heat stress. The Ministry of Health and Social Services (MoHSS) has developed adaptation measures to address these challenges, including improving disease surveillance, expanding healthcare services in vulnerable areas, and raising public awareness about climate-related health risks. Strengthening health infrastructure and services is crucial for reducing the vulnerability of communities to climate impacts (Government of the Republic of Namibia, 2020, 2021; Ministry of Environment, Forestry, and Tourism (MEFT), 2011, 2013; National Planning Commission (NPC) Namibia, 2017).

Education and capacity building play a pivotal role in enhancing adaptive capacity. Namibia has integrated climate change education into the national curriculum, raising awareness and building the skills needed to address climate challenges. Various training programs target government officials, community leaders, and the private sector, promoting knowledge exchange and fostering a culture of resilience. Research institutions and universities conduct climate-related studies, providing data and insights that inform policy and practice (Government of the Republic of Namibia, 2020, 2021; Ministry of Environment, Forestry, and Tourism (MEFT), 2011, 2013; National Planning Commission (NPC) Namibia, 2017).

Financial mechanisms and international cooperation are vital for supporting adaptation efforts. Namibia accesses funding from international climate finance sources, such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF), to implement adaptation projects. An assessment done by Brown & Amuntenya (2021) shows that Namibia's climate finance flows in the period since the initial NDC, from 2015 to 2020, are estimated at NAD 9.8

billion (i.e., about $530 million), or approximately NAD 1.63 billion (i.e., about $89 million) per year. Most of this funding (63%) came from international OECD donors, including bilateral development agencies, climate funds, and multilateral development banks (Figure 4.2). About 35% of these funds were contributed through Namibia's national development budget, primarily through the Ministry of Agriculture, Water and Land Reform, and other ministries. Only 2% came from the private sector, although this figure is likely to be an underestimate, since data on private sector contributions to climate change is sparse. Private sector commercial investments are primarily in the renewable energy sector. The Namibian government also encourages private sector investment in climate-resilient projects through incentives and partnerships. International cooperation, including technical assistance and knowledge sharing, enhances Namibia's capacity to implement effective adaptation measures.

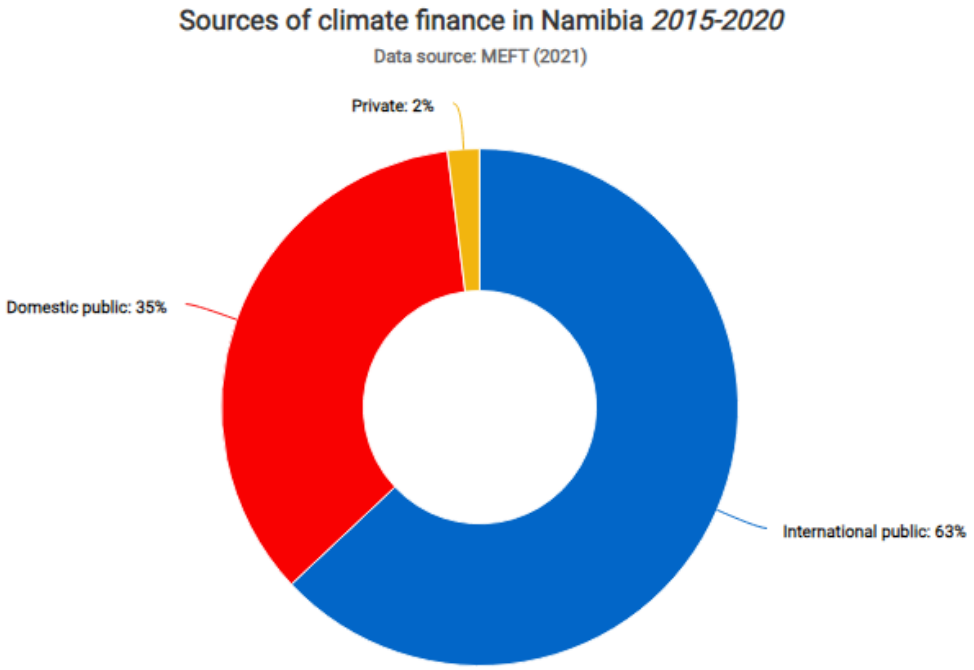



*Figure 4-2: Sources of climate finance in Namibia 2015-2020*

Despite these efforts, Namibia faces ongoing challenges in building adaptive capacity. For instance, Brown & Amuntenya (2021) estimated an annual climate finance gap of NAD 6.4 billion, which is the difference between the estimated annual climate finance flows and the required annual climate finance flows in the updated NDC (Government of the Republic of Namibia, 2021). As such, limited financial resources, gaps in data and research, and the need for further integration of climate adaptation into all development sectors remain key issues in Namibia's national adaptation plans. Addressing these challenges requires sustained commitment from the government, private sector, and international community, as well as continued innovation in adaptation practices and policies and mobilization of climate funding.

## 4.3 LEGAL FRAMEWORKS AND INSTITUTIONAL ARRANGEMENTS

### 4.3.1 Policy Frameworks for Adaptation

Namibia's policy framework for adaptation is anchored in a series of strategic documents and policies designed to enhance the country's resilience to climate change while promoting sustainable development. Central to this framework is the National Climate Change Policy (NCCP), adopted in 2011, which provides overarching guidance on addressing climate change impacts through mitigation and adaptation measures. The NCCP emphasizes the integration of climate change considerations into national development planning, sectoral policies, and local governance.

The National Climate Change Strategy and Action Plan (NCCSAP) operationalizes the NCCP by outlining specific adaptation actions, timelines, and responsibilities. It identifies priority sectors such as water, agriculture, health, and infrastructure and proposes targeted interventions to reduce vulnerability and enhance adaptive capacity. The NCCSAP is periodically updated to reflect new scientific findings, emerging challenges, and progress made in implementation, ensuring that Namibia's adaptation efforts remain relevant and effective.

The National Development Plans (NDPs), particularly the Fifth National Development Plan (NDP5), incorporate climate adaptation as a cross-cutting issue. These plans highlight the need for a climate-resilient economy and prioritize investments in sustainable agriculture, water management, renewable energy, and resilient infrastructure. By embedding adaptation into the NDPs, Namibia ensures that climate resilience is a core component of its socio-economic development agenda.

Namibia's Updated Nationally Determined Contributions (NDC) under the Paris Agreement further reinforce the country's commitment to climate adaptation. The NDC outlines specific adaptation goals, including enhancing food security through climate-smart agriculture, improving water security through integrated water resource management, and safeguarding health through strengthened public health systems. The NDC also highlights Namibia's efforts to protect biodiversity and ecosystems, which are critical for sustaining livelihoods and enhancing resilience.

The National Adaptation Plan (NAP) process, initiated in 2016, provides a structured approach to identifying medium- and long-term adaptation needs and developing strategies to address them. The NAP process is inclusive and participatory, involving stakeholders from government, civil society, the private sector, and local communities. This ensures that adaptation strategies are context-specific and responsive to the needs of vulnerable populations.

Sector-specific policies also play a crucial role in Namibia's adaptation framework. The Agriculture Policy emphasizes sustainable farming practices and drought-resistant crops to enhance food security. The Water Resources Management Act promotes integrated water resource management, aiming to improve water use efficiency and ensure equitable access to water. The National Health Policy addresses the health impacts of climate change by strengthening disease surveillance systems and improving healthcare infrastructure.

Namibia's Disaster Risk Management (DRM) framework is closely linked to its adaptation efforts. The Disaster Risk Management Act and the National Disaster Risk Management Plan focus on reducing vulnerability to climate-related hazards through preparedness, early warning systems,

and resilient infrastructure. These measures are essential for minimizing the adverse impacts of extreme weather events and ensuring rapid recovery.

Namibia has established various financial mechanisms and partnerships to support the implementation of these policies. The Environmental Investment Fund (EIF) is a key institution that mobilizes resources for climate adaptation projects. The EIF provides grants and facilitates access to international climate finance, supporting initiatives that enhance resilience at the community and national levels. Additionally, Namibia collaborates with international partners and participates in global climate funds, such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF), to secure funding for adaptation projects.

Capacity-building and knowledge-sharing are integral components of Namibia's adaptation policy framework. The country invests in research and development to improve understanding of climate impacts and adaptation options. Institutions like the University of Namibia (UNAM) and the Namibia University of Science and Technology (NUST) conduct climate research and provide training programs to build the stakeholders' capacity in adaptation planning and implementation.

Public awareness and community engagement are also prioritized to ensure that local populations understand and support adaptation measures. Government agencies, NGOs, and civil society organizations work together to raise awareness about climate risks and promote community-based adaptation practices. These efforts help to build local ownership of adaptation initiatives and enhance the resilience of communities.

### 4.3.2 Institutional Framework for Adaptation

Namibia's institutional framework for climate adaptation is comprehensive and well-coordinated, designed to integrate climate resilience into national development planning and sectoral policies. Figure 4.3 attempts to depict Namibia's institutional framework for climate change adaptation. The Ministry of Environment, Forestry and Tourism (MEFT) is central to the institutional framework for adaptation, which leads the country's climate change agenda. The Climate Change Unit within the MEFT is responsible for developing and implementing national climate policies, coordinating adaptation projects, and liaising with international climate bodies. This unit ensures that adaptation efforts align with the National Climate Change Policy (NCCP) and the National Climate Change Strategy and Action Plan (NCCSAP), which provide strategic direction for addressing climate vulnerabilities and enhancing resilience.

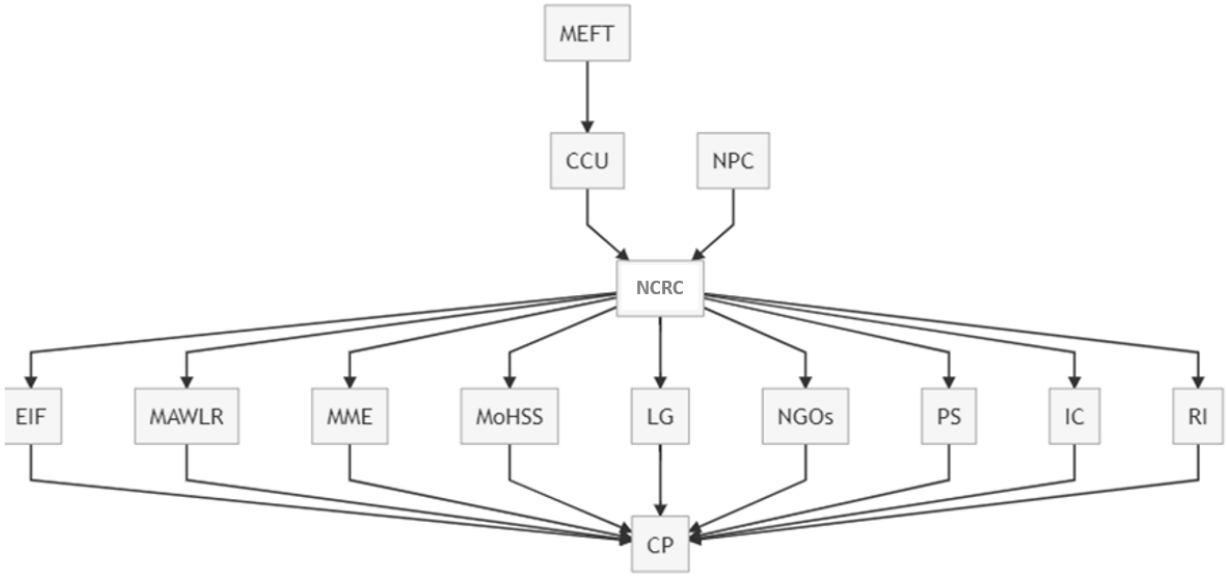



*Figure 4-3. Illustrative institutional framework for adaptation. Key: MEFT (Ministry of Environment, Forestry and Tourism), CCU (Climate Change Unit), NCRC (National Committee on the Rio Conventions), NPC (National Planning Commission), EIF (Environmental Investment Fund)*

The National Planning Commission (NPC) is crucial in embedding climate adaptation into broader development objectives. The NPC ensures that climate considerations are integrated into the National Development Plans (NDPs), which outline Namibia's socio-economic development goals. By mainstreaming climate adaptation into these plans, the NPC promotes a cohesive approach that addresses immediate and long-term climate risks across all sectors.

Sector-specific ministries are also key actors in Namibia's adaptation framework. The Ministry of Agriculture, Water and Land Reform (MAWLR) is instrumental in implementing climate-smart agricultural practices and sustainable water management strategies. The Ministry of Mines and Energy (MME) oversees efforts to enhance energy security and promote renewable energy sources, critical for reducing climate vulnerability. The Ministry of Health and Social Services (MoHSS) addresses health impacts related to climate change, such as disease outbreaks and heat stress, through improved healthcare services and public awareness campaigns.

Local governments and traditional authorities are vital in translating national adaptation policies into action at the community level. Regional and local councils are involved in developing and executing local adaptation plans, which consider their communities' specific vulnerabilities and needs. Traditional authorities, who deeply understand local ecosystems and practices, collaborate with governmental bodies to promote sustainable land and resource management.

Non-governmental organizations (NGOs) and civil society organizations (CSOs) significantly contribute to Namibia's adaptation efforts by implementing community-based projects, raising awareness, and advocating for vulnerable groups. These organizations often partner with government agencies to enhance the reach and impact of adaptation initiatives. For example, NGOs are crucial in water conservation projects, sustainable agriculture training, and biodiversity conservation programs.

The private sector is increasingly recognized as a key stakeholder in climate adaptation. Businesses and industries are encouraged to adopt resilient practices and invest in adaptation technologies. Through incentives and regulatory frameworks, the Namibian government

promotes private sector engagement in renewable energy projects, sustainable agriculture, and climate-resilient infrastructure development. Public-private partnerships are fostered to leverage resources and expertise for large-scale adaptation initiatives.

Research institutions and universities are essential in providing the scientific basis for adaptation planning and implementation. Institutions like the University of Namibia (UNAM) and the Namibia University of Science and Technology (NUST) research climate impacts, vulnerabilities, and adaptation strategies. Their findings inform policy development and practical interventions, ensuring that adaptation measures are evidence-based and effective.

International cooperation and funding are critical components of Namibia's institutional framework for adaptation. Namibia actively participates in global climate forums and agreements, such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. The country accesses international climate finance from sources like the Green Climate Fund (GCF) and the Global Environment Facility (GEF) to support its adaptation projects. Technical assistance and capacity-building programs from international partners enhance Namibia's ability to implement and sustain adaptation initiatives.

Namibia's Environmental Investment Fund (EIF) is a pivotal financial mechanism within this framework, dedicated to supporting environmental sustainability and climate adaptation projects. The EIF mobilizes resources to fund initiatives that enhance Namibia's resilience to climate change, focusing on sustainable land management, biodiversity conservation, and renewable energy. The EIF is crucial in enabling local communities, businesses, and government agencies to undertake effective adaptation measures by providing grants and facilitating access to international climate finance. The EIF's efforts help bridge the financial gap in implementing large-scale adaptation projects, ensuring Namibia can meet its climate resilience objectives.

The NCRC facilitates adaptation efforts and coordination, which is comprised of representatives from various ministries, NGOs, the private sector, and academia. The NCRC serves as a platform for stakeholders to share information, coordinate actions, and monitor progress on adaptation efforts. This multi-stakeholder approach ensures that adaptation strategies are comprehensive, inclusive, and responsive to the needs of different sectors and communities.

#### 4.3.3 Legal and Regulatory Framework for Adaptation

Namibia's legal and regulatory framework for adaptation is comprehensive, providing a solid foundation for implementing climate resilience measures across various sectors. The cornerstone of this framework is the Environmental Management Act of 2007, which mandates the sustainable use of natural resources and the protection of the environment. This Act requires environmental impact assessments (EIAs) for all major projects, ensuring that potential climate impacts are considered and mitigated. By integrating adaptation considerations into EIAs, Namibia ensures that new developments are resilient to climate change.

Complementing the Environmental Management Act, the Climate Change Policy 2011 lays the groundwork for national adaptation efforts. This policy emphasizes integrating climate change into national, regional, and local planning processes. It provides strategic direction for enhancing Namibia's adaptive capacity, prioritizing actions that address the specific vulnerabilities of different regions and communities. The policy also promotes using traditional knowledge and adaptation practices, recognising indigenous wisdom's value in building resilience.

The National Climate Change Strategy and Action Plan (NCCSAP) further operationalizes the Climate Change Policy by outlining specific legal and regulatory measures needed to achieve Namibia's adaptation goals. The NCCSAP identifies key sectors such as water, agriculture, health, and infrastructure and prescribes legal frameworks to support adaptation actions in these areas. For instance, it calls for revising water management laws to promote integrated water resource management and adopting climate-resilient agricultural practices.

The Water Resources Management Act of 2013 is pivotal in the water sector. This Act promotes the sustainable management and use of water resources, incorporating principles of integrated water resource management (IWRM). It establishes basin management committees that are responsible for developing and implementing water management plans, ensuring that water use is efficient and equitable. These plans include measures to address the impacts of climate change on water availability and quality, crucial for maintaining water security in a changing climate.

The Agriculture (Commercial) Land Reform Act and the Communal Land Reform Act are critical for promoting sustainable land use and enhancing agricultural resilience. These Acts regulate land tenure and use, encouraging practices that improve soil health and water retention, which are vital for adapting to increased variability in rainfall and temperature. By securing land tenure, these laws also empower local communities to invest in long-term adaptation measures.

Namibia's Disaster Risk Management Act of 2012 plays a significant role in the adaptation framework by addressing climate-related hazards. This Act provides the legal basis for disaster risk reduction (DRR) and management, establishing the National Disaster Risk Management Committee and regional committees responsible for coordinating DRR activities. The Act emphasizes the importance of early warning systems, preparedness, and resilient infrastructure, which are essential for minimizing the impacts of extreme weather events such as floods and droughts.

Health-related adaptation is supported by the Public Health Act, which incorporates provisions for addressing climate-sensitive health risks. This includes monitoring and controlling vector-borne diseases, which are expected to increase with climate change, and ensuring that healthcare facilities are resilient to climate impacts. The Act also promotes public awareness and community engagement in health-related adaptation activities.

Namibia's legal framework also includes provisions for biodiversity conservation, which is crucial for maintaining ecosystem services that support adaptation. The Nature Conservation Ordinance and the Environmental Management Act provide legal protection for biodiversity and habitats, promoting conservation practices that enhance ecosystem resilience. Protected areas and community-based natural resource management (CBNRM) programs established under these laws help preserve biodiversity and provide less vulnerable livelihoods to climate change.

In addition to these national laws, Namibia's legal framework for adaptation is supported by various international agreements and conventions. Namibia is a party to the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement, and the Convention on Biological Diversity (CBD). These international commitments guide the development of national adaptation policies and regulations, ensuring alignment with global standards and access to international support and funding.

The Environmental Investment Fund (EIF) Act of 2001 is another crucial component of Namibia's adaptation framework. The EIF mobilizes financial resources to support environmental and climate adaptation projects. By providing grants and facilitating access to international climate finance, the EIF enables the implementation of adaptation initiatives at the local and national levels. The Fund's activities are guided by the legal and policy frameworks, ensuring that financed projects align with national adaptation priorities.

Finally, Namibia's regulatory framework includes various guidelines and standards that promote adaptation. These include building codes and standards for infrastructure that incorporate climate resilience considerations. By ensuring that new buildings and infrastructure can withstand climate impacts, these regulations help reduce vulnerability and enhance the safety and well-being of communities.

#### 4.3.4 Strategic Insights and Way Forward

Applying the Modalities, Procedures, and Guidelines (MPGs) of the Paris Agreement provides a comprehensive framework for analysing and understanding the dynamics that shape national adaptation efforts in a country. Namibia's national adaptation context is shaped by its unique social, economic, demographic, and environmental circumstances, as well as its adaptive capacity and institutional and legal frameworks. The country's diverse ethnic composition and cultural heritage enrich its social fabric, yet they also demand inclusive and culturally sensitive adaptation policies to ensure equitable development across all communities. The country's demographic shifts, characterized by significant rural-to-urban migration, highlight the urgent need for robust urban planning and infrastructure development to accommodate the growing urban population and mitigate the associated vulnerabilities.

Namibia's arid environment, characterized by low rainfall and high evaporation rates, profoundly influences its national adaptation to climate change by necessitating strategies that enhance water management and promote sustainable land use practices. The country's rich biodiversity, encompassing unique flora and fauna adapted to harsh conditions, underscores the importance of preserving ecosystems while addressing climate impacts, leading to adaptation initiatives focused on ecosystem-based approaches that protect natural habitats and support community livelihoods. Additionally, Namibia's expansive ecosystems, such as the Namib Desert and the Kalahari, highlight the need for region-specific adaptation measures that recognize the ecological diversity and vulnerabilities across different areas. Together, these environmental factors drive Namibia to prioritize adaptive actions that mitigate the adverse effects of climate change and promote resilience, conservation, and sustainable development within its diverse landscapes.

Economically, Namibia faces considerable challenges, including poverty, inequality, and unemployment, exacerbating its vulnerability to climate change. These socio-economic conditions necessitate integrated approaches that combine climate adaptation with broader developmental goals to enhance resilience and ensure sustainable development. The environmental context of Namibia, marked by its arid and semi-arid landscapes, makes it particularly susceptible to climate variability and extremes, such as droughts and floods. This underscores the importance of developing and implementing adaptation strategies that are responsive to these environmental realities and capable of safeguarding the country's natural resources and ecosystems.

Namibia's adaptive capacity is shaped by socioeconomic, environmental, and institutional factors influencing its ability to respond effectively to climate change impacts. As a country with

a predominantly arid climate and highly variable rainfall patterns, Namibia faces significant challenges in addressing inequality, improving access to essential services, managing water resources, agricultural productivity, and overall resilience to climatic extremes. Furthermore, Namibia's adaptive capacity is also influenced by its technical expertise, financial resources, and institutional coordination. While significant technical capacity and financial resource gaps exist, ongoing efforts to build local expertise and secure international climate finance are crucial steps towards enhancing adaptive capacity. Institutional and legal frameworks are pivotal in shaping and guiding adaptation actions. Strengthening these frameworks to promote inter-agency collaboration, ensure policy coherence, and facilitate the effective implementation of adaptation measures is essential for building climate resilience.

The chapter has demonstrated that Namibia's adaptation strategy must be holistic, inclusive, and responsive to its national circumstances. By leveraging the MPGs of the Paris Agreement, Namibia can ensure that its adaptation actions are well-aligned with global climate goals while addressing the specific challenges and opportunities presented by its unique context. The development of the National Adaptation Plan, along with targeted efforts to enhance technical capacity, secure adequate financing, and strengthen institutional coordination, will be key to realizing Namibia's vision of a resilient and sustainable future. As Namibia continues to navigate the complexities of climate change adaptation, a concerted focus on inclusive policies, integrated development approaches, and robust governance will be critical in safeguarding its people's and ecosystems' well-being for future generations.

## 4.4 IMPACTS, RISKS, AND VULNERABILITIES

### 4.4.1 Introduction

This chapter leverages the MPGs to thoroughly examine the current and projected climate trends and hazards and the multifaceted impacts of these changes on Namibia. This chapter aims to offer a comprehensive understanding of climate change risks, impacts, and vulnerabilities by utilizing recent climate change literature and previous UNFCCC instruments such as national communications, nationally determined contributions, and other national adaptation plans and strategies. The chapter is logically structured around two broad themes. The first theme describes the past and future changes in Namibia's climate, focusing on the alterations in the frequency and severity of climate-related hazards such as droughts, floods, and temperature extremes. The second theme delves into how these climatic changes are expected to impact Namibia's social, environmental, and economic dimensions, alongside key sectors such as agriculture, water resources, energy, health, biodiversity and tourism. The second theme also provides information on the macroeconomic implications of climate change in Namibia.

Namibia's arid and semi-arid climate renders it particularly susceptible to the adverse effects of climate change. The country has experienced significant changes, including increased temperatures, frequent and severe droughts, and erratic rainfall patterns. These climatic shifts have profound implications for water availability, agricultural productivity, biodiversity, and public health. For instance, water scarcity, exacerbated by prolonged droughts, affects both urban and rural communities. At the same time, changes in precipitation patterns pose challenges for the agriculture sector, which is heavily dependent on predictable rainfall. Furthermore, rising temperatures and extreme weather events threaten the country's rich biodiversity, impacting ecosystems and species that are already vulnerable.

Projections indicate that these trends will likely intensify, with Namibia expected to face even higher temperatures, more severe droughts, and increased variability in rainfall in the coming decades. Such changes are anticipated to exacerbate existing vulnerabilities and create new challenges across various sectors. The economic implications are significant, particularly for sectors such as agriculture and tourism, which rely heavily on stable climate conditions. Socially, marginalized communities, who often have limited adaptive capacity, are at greater risk, highlighting the need for targeted adaptation measures to enhance resilience.

To ensure a thorough understanding of these impacts and vulnerabilities, this chapter also discusses the approaches, methodologies, and tools used in generating the information presented. This information is crucial for validating the processes undertaken to determine Namibia's exposure and vulnerability to climate change and guiding future research and policy development.

In summary, this chapter aims to provide a holistic view of the impacts, risks, and vulnerabilities associated with climate change in Namibia. By presenting both current observations and future projections, it underscores the urgent need for comprehensive adaptation strategies to mitigate climate change's adverse effects and enhance the resilience of Namibia's social, environmental, and economic systems. Through detailed analysis and transparent methodology, this chapter serves as a critical resource for policymakers, researchers, and stakeholders involved in addressing climate change challenges in Namibia. The chapter covers two broad themes, namely, describing:

- Past and future (projected) changes in Namibia's climate, including the frequency and severity of climate-related hazards.
- How have these changes impacted the various important dimensions of the country (i.e. social, environmental, and economic dimensions, as well as across key sectors of the national economy), and how are these impacts projected to develop in the future?

These two themes are structured around five (5) main sections, namely, Namibia's baseline climate; Namibia's future climate; climate natural hazards; climate change impacts and risks to key sectors of the Namibian economy; macroeconomic implications of climate change and climate variability; and vulnerability to climate risks. The primary source of information that is presented in these sections is derived from recent studies and reports on climate change in Namibia such as World Bank (2021), World Bank (2024c), and Atlas of Namibia Team (2023) as well as most recent UNFCCC communication instruments, e.g. fourth national communications (Government of the Republic of Namibia, 2020) and the updated nationally determined contributions (Government of the Republic of Namibia, 2021).

### 4.4.2 Namibia's Baseline Climate

Namibia's baseline climate is characterized by arid to semi-arid conditions, marking it as one of the regions with the most extreme and variable climates in sub-Saharan Africa. Extending from the Namib Desert along the Atlantic coast to the temperate highlands and semi-arid savannas in the east, Namibia's climate is predominantly influenced by the cold Benguela Current, the subtropical high-pressure zone, and the Intertropical Convergence Zone. These influences collectively result in low and highly variable rainfall, with annual precipitation ranging from less than 50 mm along the coast to approximately 600 mm in the northeast. This significant temporal and spatial variability in rainfall, typically occurring in a brief summer rainy season from

November to March, is interspersed with prolonged dry periods, reinforcing Namibia's classification as one of the driest countries in the world (Atlas of Namibia Team, 2023; World Bank, 2021, 2024c).

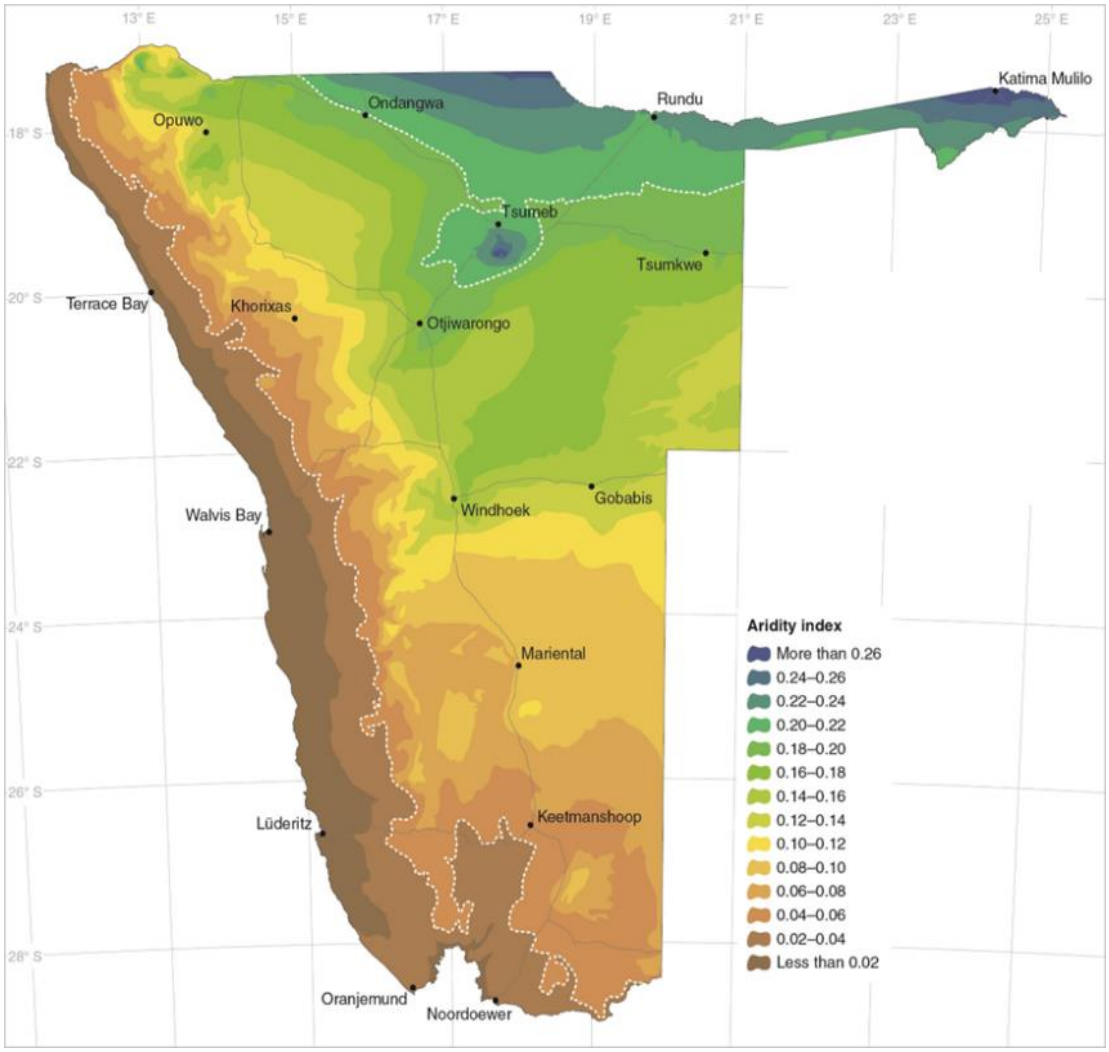



*Figure 4-4. Namibia's aridity index (Source: Atlas of Namibia Team (2023))*

The country's ecological zones range from hyper-arid deserts, mainly in the coastal areas, to arid in the central areas and semi-arid, particularly in the northeastern areas. Figure 4.4 shows the spatial variation of the Aridity Index AI) across Namibia. The AI is essential for a ratio between rainfall and potential evapotranspiration. An AI value of 1 means that the amount of potential moisture lost is offset by the amount of rainfall received. AI values above 0.5 imply more humid conditions, while values below 0.5 mean more arid conditions. Based on the AI classification, Namibia's aridity varies significantly across its territory, ranging from hyper-arid to semi-arid (see Figure 4.5).

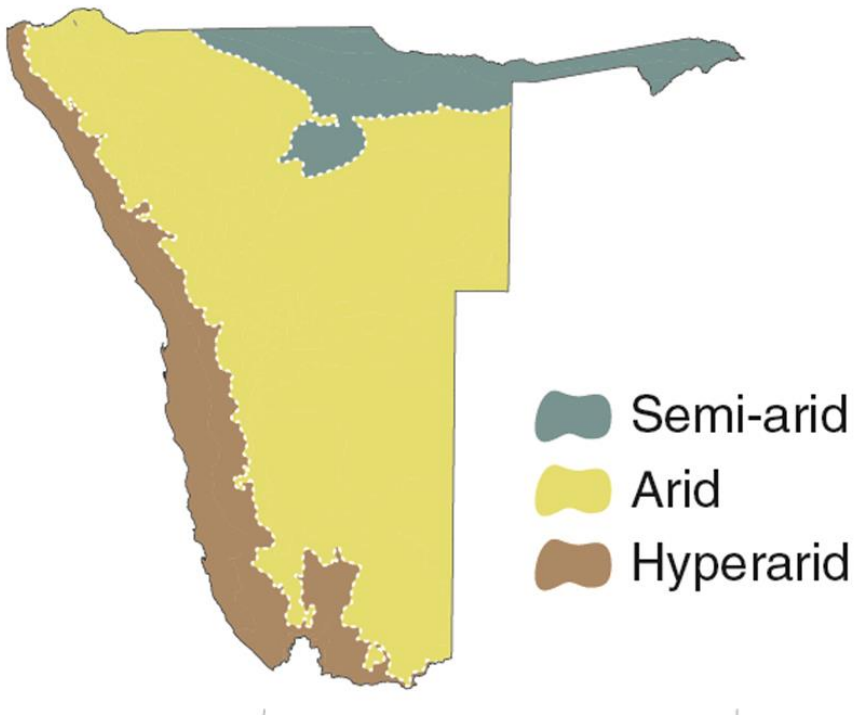



*Figure 4-5. Namibia's aridity classification (Source: Atlas of Namibia Team (2023)).*

The driest regions, classified as hyper-arid (AI < 0.006), hug the entire coastline, encompassing the Namib Desert. Potential evapotranspiration far exceeds limited precipitation in these areas, resulting in an extremely dry environment. Moving inland, the arid zone (AI 0.03 - 0.2) encompasses a vast portion of the country. This zone experiences low and variable rainfall, with evaporation rates still exceeding precipitation but to a lesser extent than in the hyper-arid zone. Areas along the northern and northeastern borders, including Tsumeb, experience semi-arid conditions (AI 0.2 - 0.5). These regions receive the highest rainfall amounts in Namibia, with potential evapotranspiration still significant but allowing for some limited vegetation growth.

Historically, rainfall in Namibia has been extremely variable. The mean annual rainfall is only 278 millimetres (mm), varying from 650 mm in the northeast to less than 50 mm in the southwest and coastal areas. In the Namib Desert, rainfall is exceptionally scarce (see Figure 4.6). Rainfall peaks in January, February, and March, where mean monthly rainfall averages approximately 62 mm, 66 mm, and 55 mm, respectively. From a hydrological perspective, Namibia is an arid, water-deficient country. High solar radiation, low humidity, and high temperatures lead to very high evaporation rates, which vary between 3,800 mm per annum in the south and 2,600 mm per annum in the north. Across most of the country, potential evaporation is at least five times greater than average rainfall (Atlas of Namibia Team, 2023; World Bank, 2021, 2024c). For detailed information on the monthly pattern of precipitation across the year, refer to Atlas of Namibia Team (2023) and World Bank (2024c).

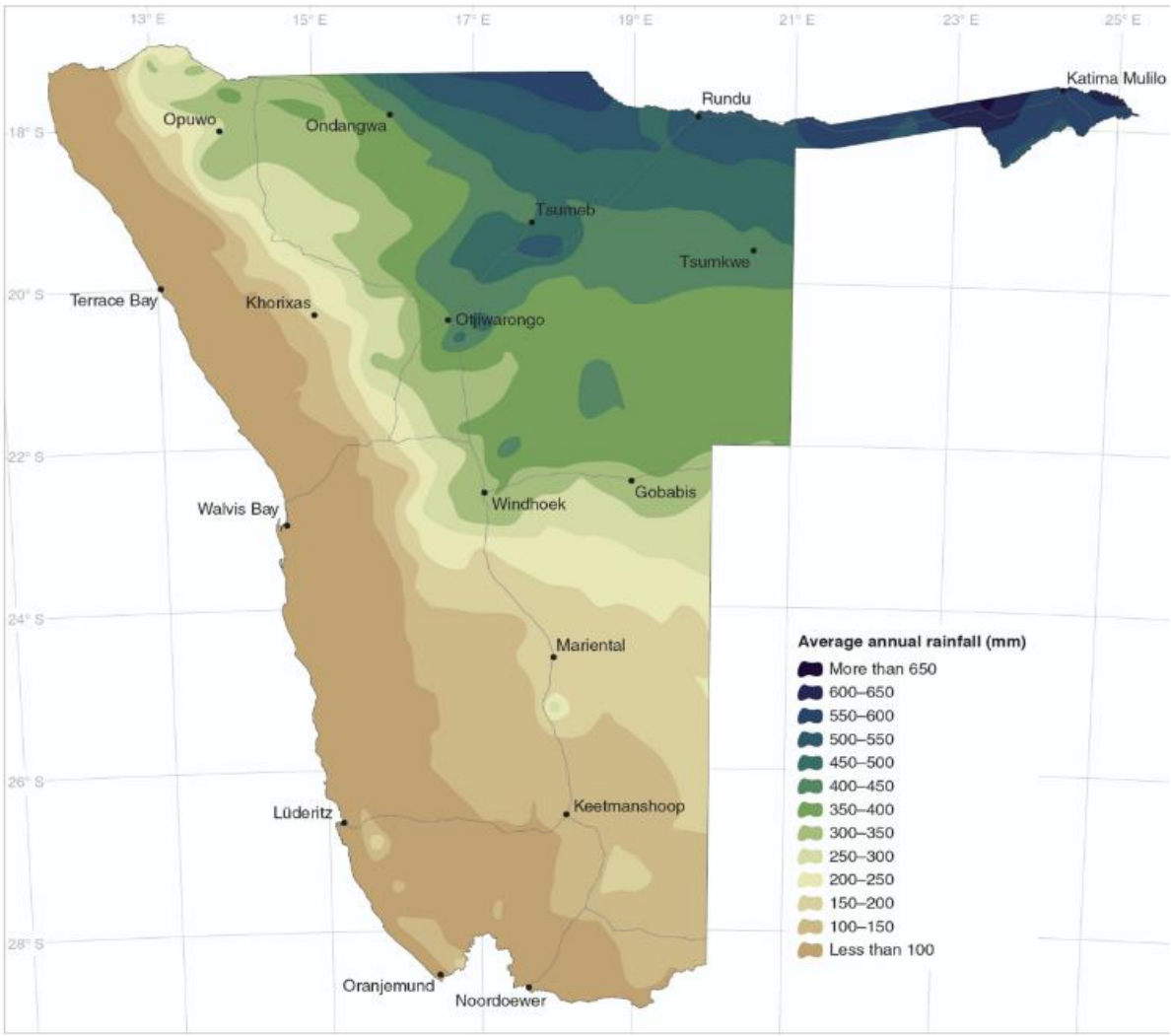



*Figure 4-6. Annual precipitation (Source: Atlas of Namibia Team (2023)).*

Namibia is characterized by high temperatures, with mean annual temperatures ranging from 14.3°C to 24.2°C. Mean annual temperatures are higher in continental regions, exceeding 22°C in the north and lower in coastal areas, moderated by the Benguela Current, dropping below 16°C on the southern coast (see Figure 4.7). Apart from the coastal zone, there is a distinct seasonal temperature regime, with the highest temperatures occurring just before the wet season in the wetter areas or during the wet season in the more arid parts of the country. The lowest temperatures occur during the dry season months of June to August. Daily maximum temperatures regularly exceed 40°C, and average temperatures do not fall below 0°C. In the continental regions, relative humidity averages between 25% and 70%. Both rainfall and temperature in Namibia are sensitive to the El Niño–Southern Oscillation (ENSO) effect, with below-average rainfall during El Niño conditions (Atlas of Namibia Team, 2023; World Bank, 2021, 2024c).

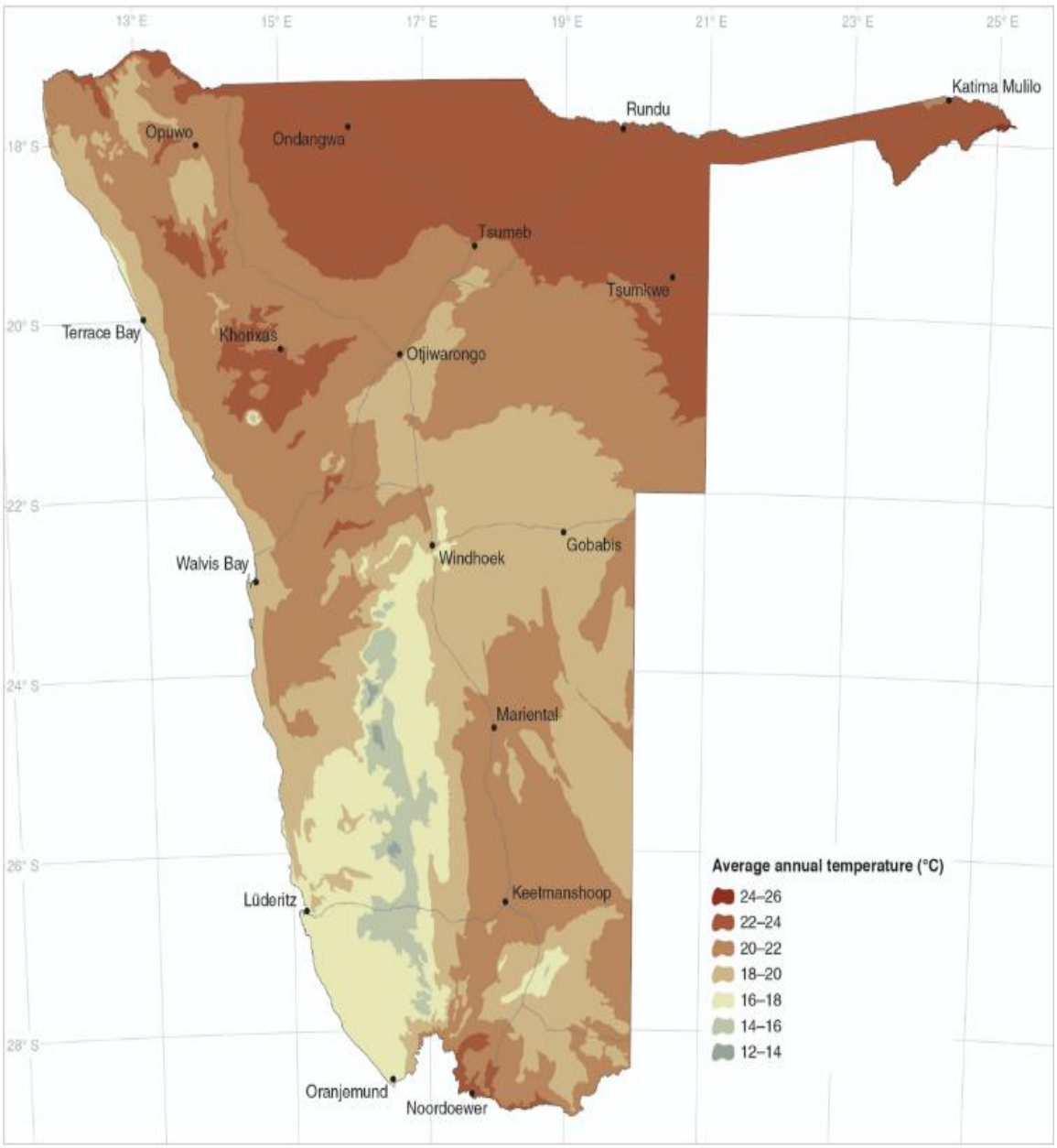



*Figure 4-7. Average annual temperature (Source: Atlas of Namibia Team (2023)).*

Using data from the World Bank (2024c), Table 4.2 presents summary statistics on the climatology normal (i.e., 30-year reference period) for temperature and precipitation in Namibia from 1901-2022. For the most recent period, 1991-2020, the mean annual temperature is estimated at 20.4°C, with the estimated mean minimum temperature and mean maximum temperature being 13°C and 28°C, respectively. The estimated mean annual precipitation is 277.3 mm. From the statistics presented in Table 4.2, an increasing trend in temperature variables is discernible. However, there is not a discernible trend in the precipitation variable. The next section elaborates further on the observed trends in climate variables.

*Table 4-1. Summary statistics of key climate variables in Namibia*

| Climate Variables | 30-year climatology intervals | | | |
|---|---|---|---|---|
| | 1991-2020 | 1961-1990 | 1931-1960 | 1901-1930 |
| Mean Annual Temperature (°C) | 20.4 | 19.9 | 19.9 | 19.8 |
| Mean Minimum Annual Temperature (°C) | 13.0 | 12.4 | 12.4 | 12.3 |
| Mean Maximum Annual Temperature (°C) | 28.0 | 27.5 | 27.5 | 27.3 |
| Mean Annual Precipitation (mm) | 277.3 | 288.9 | 295.1 | 275.7 |

Data source: World Bank Group's Climate Change Knowledge Portal (CCKP)

#### *4.4.2.1 Key trends: temperature*

Although Namibia is characterized by high temperatures, significant temperature variations are experienced throughout the year. While coastal areas exhibit a more constant temperature, inland regions see a distinct seasonal pattern. In wetter areas, the hottest period falls just before the rainy season (typically November to March). Drier regions experience their peak heat during the rainy season itself. Conversely, the country experiences its coldest temperatures during the dry winter months, from June to August.

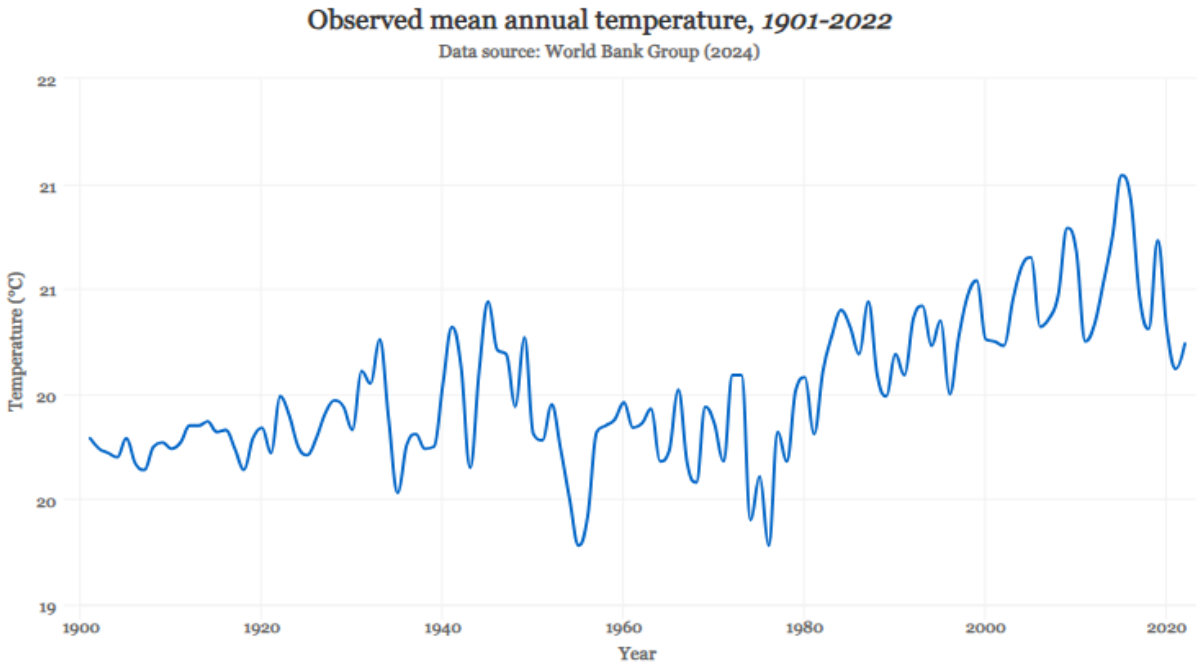



*Figure 4-8. Observed mean annual temperature, 1901-2022*

From 1901 to 2022, increased mean, maximum, and minimum temperatures have been observed, particularly since the 1960s. Figure 4.8 shows the trend in mean annual temperature in Namibia. The country's average annual temperature has increased by approximately 1.2°C over this period, reflecting a clear upward temperature trajectory. This warming is particularly pronounced in the latter half of the 20th century and into the 21st century. The increase in temperatures has been observed across all regions of Namibia, with the most significant rises occurring in the inland areas where average annual temperatures now frequently exceed 22°C.

Coastal areas, moderated by the Benguela Current, have also warmed but at a slightly slower rate. Figure 4.9 shows Namibia's annual mean temperature distribution, based on 30-year climatology intervals, from 1951 to 2020. It is also clear from Figure 4.9 that the mean (mode or median) and spread of the temperature distribution across the climatology intervals have changed. In other words, the average annual mean temperature and its variability have increased from 1901-2020. This rising temperature and variability trend is consistent with global climate change patterns. The observed mean, and temperature variability increases have contributed to more frequent and intense heat waves, altering hydrological cycles and exacerbating water scarcity and agricultural stress across Namibia.

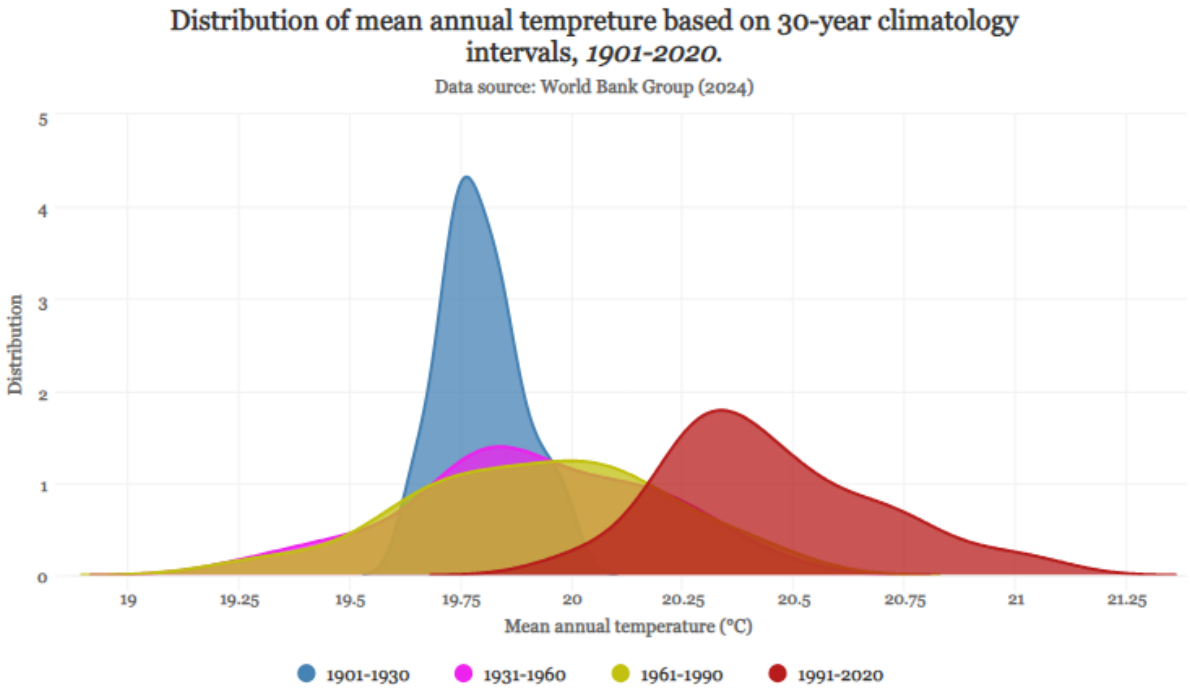



*Figure 4-9. Distribution of mean annual temperature based on 30-year climatology intervals, 1901-2020.*

#### *4.4.2.2 Key trends: precipitation*

The movement of the Intertropical Convergence Zone (ITCZ) southward during the Namibian summer triggers the rainy season from November through April. In the far south, the Temperate Zone shifts northward during the winter, resulting in winter rains in the country's southwestern part. Small variations in the timing of these movements lead to significant differences in Namibia's weather each year. The country's 'maize triangle'—Tsumeb, Grootfontein, and Otavi—typically receives more rainfall than expected for its location. In the southern regions, winter rains can contribute up to 50% of the annual precipitation. In the western Namib Desert, coastal fog is a crucial water source for desert flora and fauna, with fog precipitation being five times greater and more predictable than rain. Since the 1960s, while summer precipitation has been expected to increase, changes in the onset, duration, and intensity of rainfall have been observed, indicating a rise in heavy rainfall events.

The trend in precipitation over the period 1901-2022 shows that Namibia has experienced significant variability in precipitation patterns Figure 4.10. The overall trend indicates a decrease in annual precipitation, with notable fluctuations in intensity and distribution across different regions. The northeast, which traditionally receives higher rainfall, has seen reductions in total

annual precipitation. At the same time, the already arid southwest and coastal areas have remained extremely dry, receiving less than 50 mm annually. Rainfall patterns have also become increasingly erratic, with the rainy season, typically from November to March, showing greater unpredictability in onset and duration. These shifts contribute to prolonged dry periods and recurrent droughts, exacerbating water scarcity issues and placing additional stress on agricultural practices, water resources, and biodiversity throughout the country.

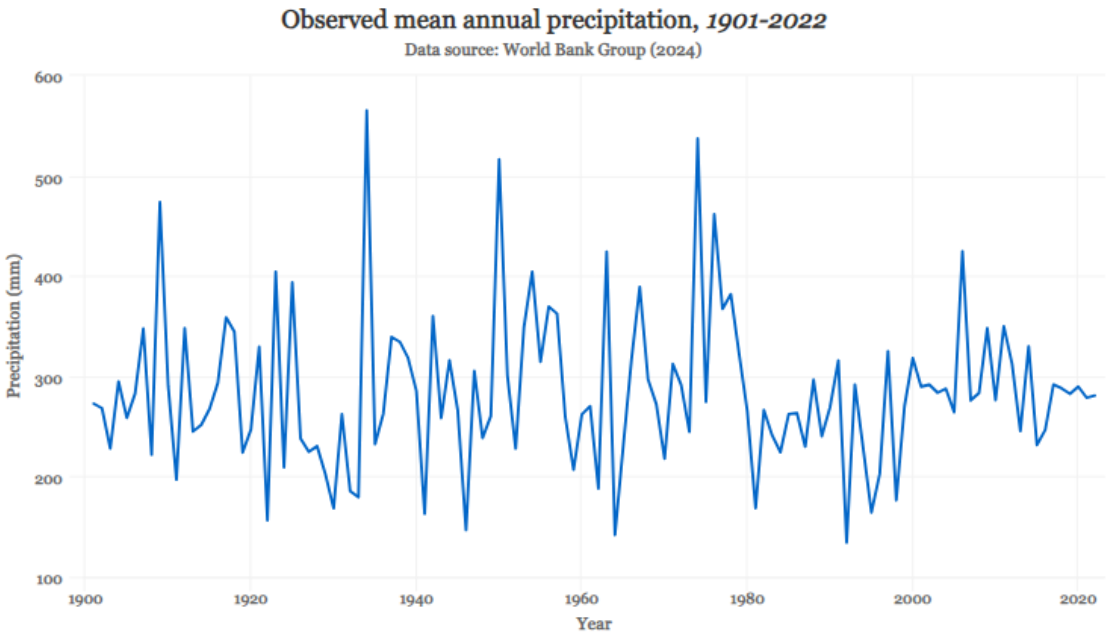



*Figure 4-10. Observed mean annual precipitation, 1901-2022.*

Detecting trends in mean annual precipitation data is typically more challenging than identifying trends in temperature data, particularly in arid climates such as Namibia. This difficulty arises because a single extreme rainfall event can constitute a significant portion of the annual precipitation due to the high variability in precipitation patterns. This high variability is illustrated in fig-fig_sec3_05a. The difficulty of discerning trends in precipitation data is further demonstrated in Figure 4.11, which displays the distribution of mean annual precipitation in Namibia based on 30-year climatology intervals from 1951 to 2020. The figure reveals that the mean annual precipitation mode (or median) has remained relatively stable over these intervals. However, the spread of the distributions has changed, indicating that years with high precipitation have become less frequent compared to years with low precipitation. This shift suggests increasing variability and a trend towards more dry years, even though the central tendency of annual precipitation has not significantly changed.

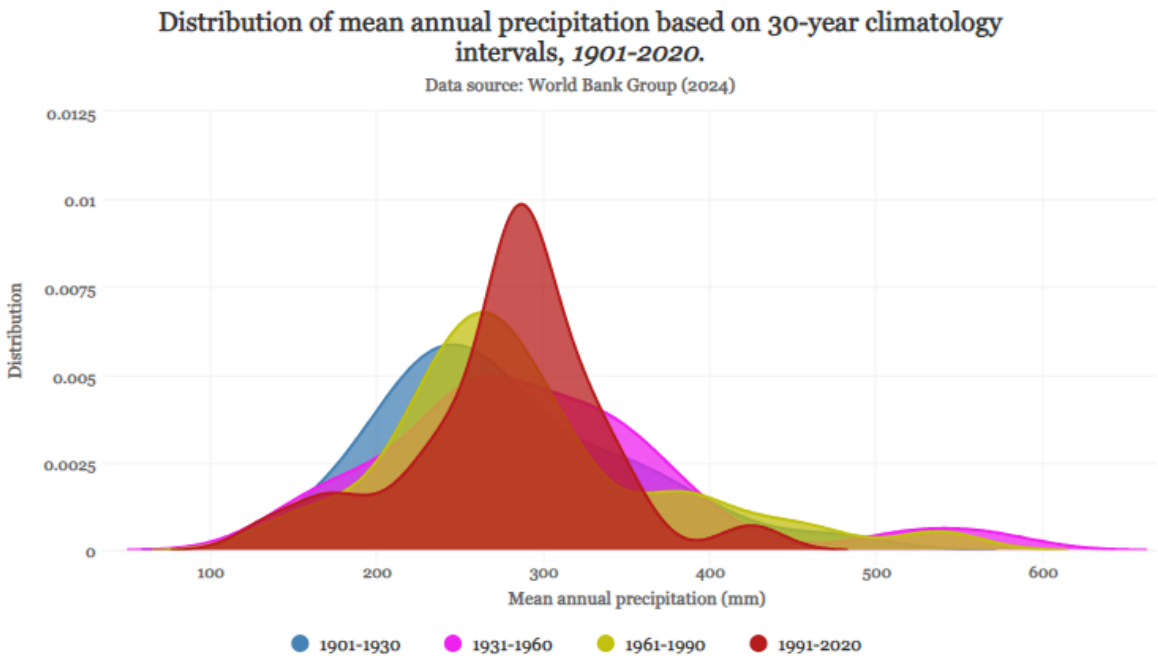



*Figure 4-11. Distribution of mean annual precipitation based on 30-year climatology intervals, 1901-2020.*

### 4.4.3 Namibia's Climate Future

This section presents potential future climate changes in Namibia based on information from the World Bank Group's Climate Change Knowledge Portal (CCKP) (World Bank, 2024c). The CCKP utilizes data from the Coupled Model Inter-Comparison Project Phase 6 (CMIP6), which serves as the foundation for global climate projections presented in the Sixth Assessment Report (AR6) by the Intergovernmental Panel on Climate Change (IPCC). These future climate projections are based on five Shared Socioeconomic Pathways (SSPs) scenarios. These five SSPs are integral components in the projection of future climate scenarios used in the Coupled Model Intercomparison Project Phase 6 (CMIP6) models, which inform the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). The SSPs provide a framework that integrates potential socioeconomic developments with climate change projections, allowing for a comprehensive analysis of future climate impacts under different socioeconomic trajectories (O'Neill et al., 2017). The SSPs comprise five distinct narratives, each representing a unique combination of demographic, economic, technological, social, and environmental trends:

- **SSP1: Sustainability (Taking the Green Road).** This pathway envisions a world that gradually shifts towards sustainability, emphasizing inclusive development and environmental stewardship. High investment in education, health, and environmental protection leads to reduced inequalities and more effective mitigation and adaptation efforts. It is characterized by low challenges to both mitigation and adaptation.

- **SSP2: Middle of the Road.** This pathway represents a continuation of historical trends where development and growth proceed unevenly. It envisions moderate challenges to mitigation and adaptation, with some regions achieving significant progress while others lag. Economic growth is moderate, and global population growth stabilizes.

- **SSP3: Regional Rivalry (A Rocky Road).** This narrative depicts a fragmented world driven by resurgent nationalism, with countries focusing on their interests. It is characterized by

slow economic growth, high population growth, and significant challenges to mitigation and adaptation due to limited international cooperation and investment in global public goods.

- **SSP4: Inequality (A Road Divided)**. This pathway foresees a world with high levels of inequality within and between countries. Economic growth and technological advancements benefit a small, wealthy segment of the global population, while large segments remain marginalized. Adaptation and mitigation efforts are hampered by limited access to resources and political power, presenting high challenges to adaptation and low challenges to mitigation.

- **SSP5: Fossil-fueled Development (Taking the Highway).** This narrative envisions rapid economic growth driven by intensive fossil fuel use and technological advancements. It focuses on achieving high living standards and technological solutions to climate issues but produces high greenhouse gas emissions. This pathway presents significant challenges to mitigation, although technological progress might offer some adaptation opportunities.

The implications of the SSP concerning socioeconomic, mitigation, and adaptation challenges is reflected in Figure 4.12. Each SSP combines with different Representative Concentration Pathways (RCPs), which describe greenhouse gas concentration trajectories, to provide comprehensive scenarios for climate projections. These combined scenarios help analyse the potential impacts of varying socioeconomic and emissions trajectories on future climate, informing policy decisions to address climate change.

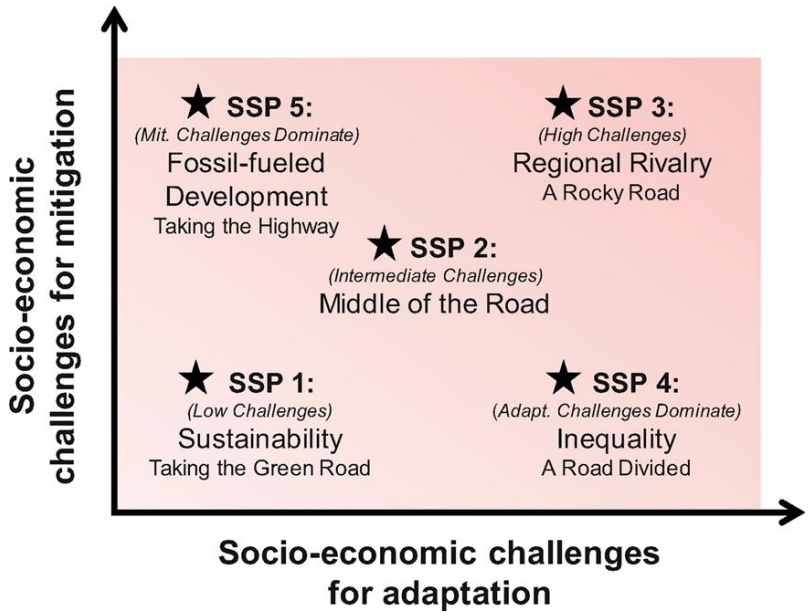



*Figure 4-12. Five shared socioeconomic pathways (SSPs) representing different combinations of challenges to mitigation and adaptation (Source: O'Neill et al. (2017)).*

For simplicity, the data and statistics presented in this section are based on an assembly of climate change models under the CMIP 6 based on the SSP3-7.0 scenario, which generally assumes high challenges and hence can be considered as the worst-case scenario. SSP3-7.0 is a medium to high reference scenario resulting from no additional climate policy under the SSP3

socioeconomic development narrative. SSP3-7.0 has particularly high non-CO2 emissions, including high aerosol emissions. Furthermore, the data and statistics are annual means and anomalies (changes) for the 2040-2059 (mid-century) and 2080-2099 (end-century) climatology periods for air surface temperature and precipitation. The baseline or reference climatology period for the anomalies (changes) is 1995-2014.

#### *4.4.3.1 Temperature Projections*

The temperature projections for Namibia up to 2100, as provided by the World Bank Group's Climate Change Knowledge Portal (CCKP) (World Bank, 2024c), indicate a significant increase in average temperatures across the country. Under all emission scenarios, Namibia is expected to experience a warming trend, with the magnitude of temperature rise dependent on the level of global greenhouse gas emissions (see Figure 4.13). In the high-emission scenario (SSP5-8.5), average temperatures could increase by as much as 4-6°C by the end of the century. Even in more moderate scenarios, Namibia is projected to see substantial warming, increasing to 2-3°C. This rise in temperatures will likely exacerbate existing climate challenges, including increased frequency and intensity of heatwaves, heightened evaporation rates, and intensified water scarcity. These changes pose significant risks to agriculture, water resources, and overall ecosystem health, underscoring the urgent need for robust climate adaptation and mitigation strategies.

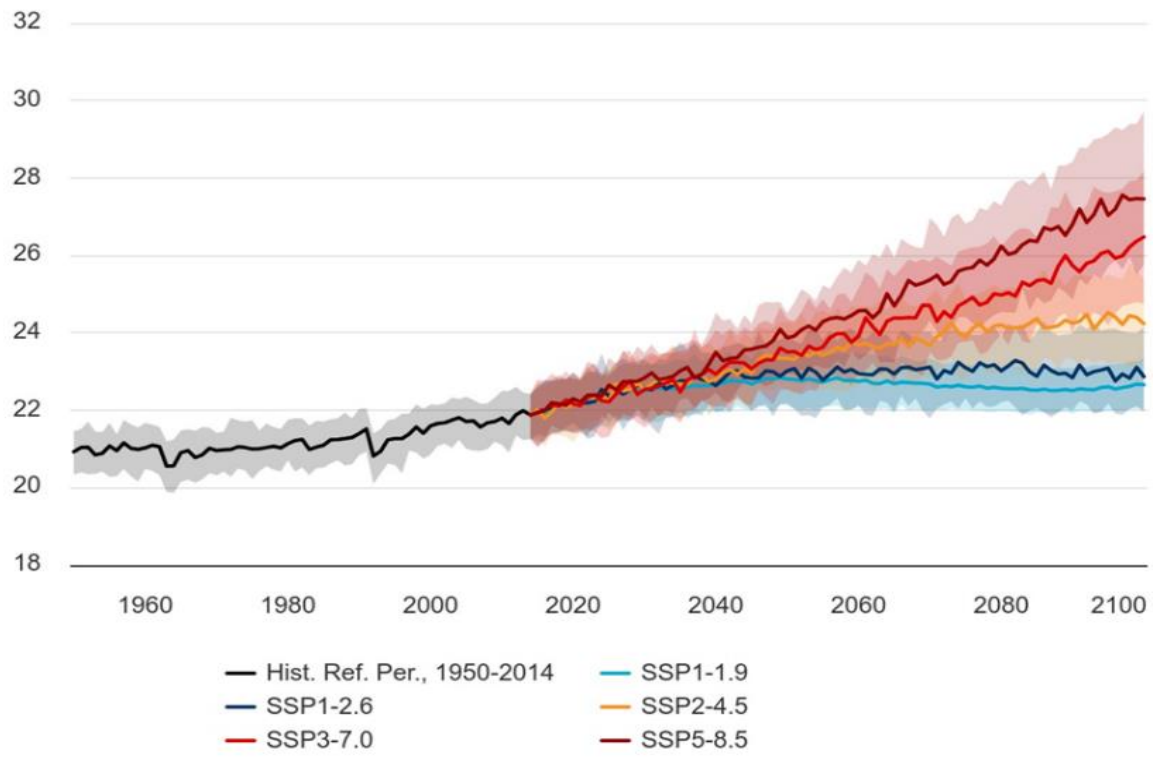



*Figure 4-13. Projected average mean surface air temperature in Namibia (reference period: 1995-2014), multi-model ensembles (Source: World Bank (2024c)).*

Temperature is projected to increase progressively across Namibia throughout the mid-century, i.e., 2040-2059. Figure 4.14 shows the anomaly (change) in average mean surface air temperature, with 1995-2014 being the reference period and based on multi-model assemble with SSP3-7.0 as the input or driver. Figure 4.14 shows that the most significant increases in the

average mean surface air temperature are projected for inland regions. In contrast, the ocean will moderate the increase in coastal temperatures. The key insight from Figure 4.14 is that under the worst-case scenario concerning socioeconomic, mitigation, and adaptation challenges (i.e., SSP83-7.0), temperatures across Namibia are expected to increase by 1°C to 2.0°C by the mid-century (Figure 4.14).

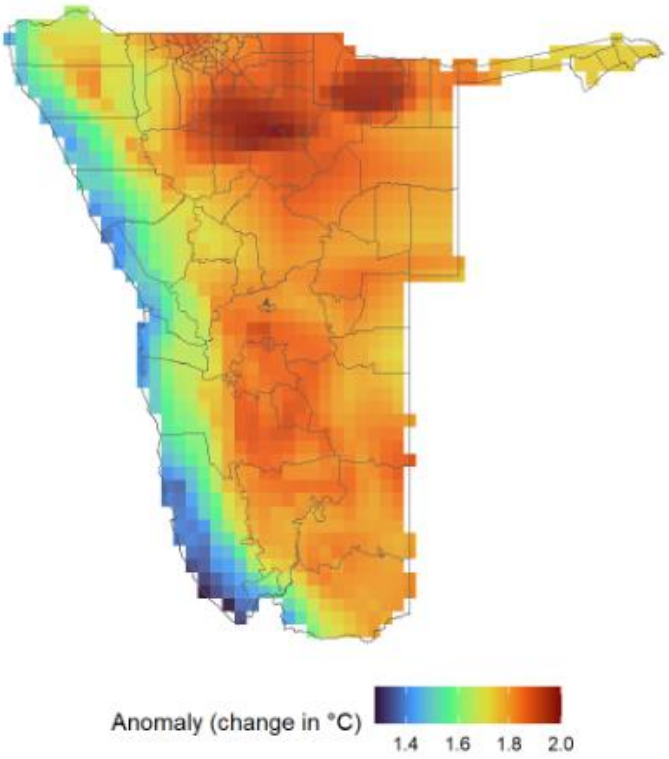



*Figure 4-14. Mid-century, 2040-2059, anomaly (change) in average mean surface air temperature. Reference period: 1995-2014, multi-model ensemble, SSP3-7.0.*

By the end of the century, 2080 to 2099, Namibia is also projected to experience a significant rise in temperatures across the country (Figure 4.15). According to the climate models, temperatures in coastal areas are expected to increase by approximately 2°C. The cooling effect of the Benguela Current along the Atlantic coast influences this relatively moderate increase. In contrast, inland areas are anticipated to see a much more significant temperature rise, with projections indicating increases of up to 5°C. This substantial warming in the interior regions is particularly concerning given Namibia's already high baseline temperatures and arid conditions. The differential warming between coastal and inland areas highlights the country's spatial variability of climate impacts. This increase in temperature is likely to intensify existing environmental stresses, including heightened evaporation rates, reduced water availability, and increased frequency of extreme heat events. Such changes will have profound implications for agriculture, water resources, human health, and biodiversity, necessitating comprehensive adaptation strategies to mitigate these adverse effects and enhance resilience against a warming climate.

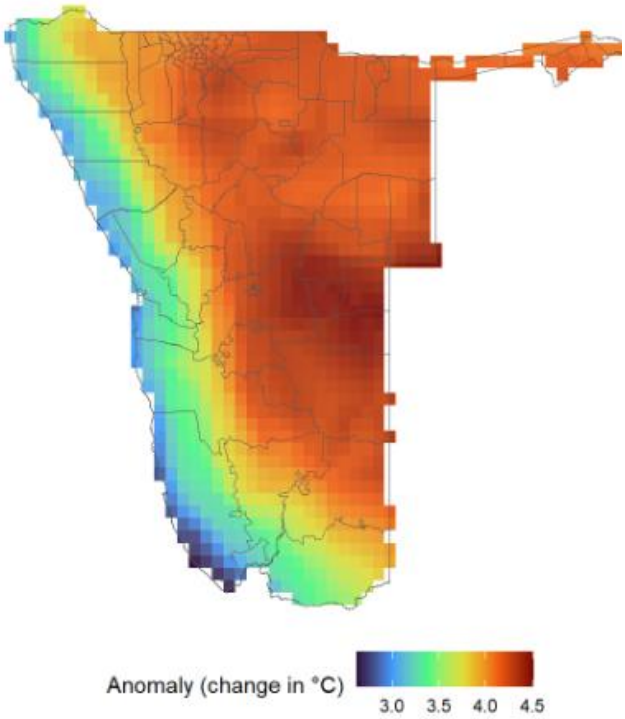



*Figure 4-15. End century, 2040-2059, anomaly (change) in average mean surface air temperature. Reference period: 1995-2014, multi-model ensemble, SSP3-7.0.*

#### *4.4.3.2 Precipitation Projections*

Projections, period 2020-2100, from the ensemble of climate models seem to imply, albeit at the national level, that average annual precipitation is expected to remain like historical observations (Figure 4.16). Although the trend in the projected precipitation across all the SSPs is generally negative, the rate of change (slopes of the projections) is small, implying insignificant changes in precipitation relative to the baseline. The ensembles of climate change models predict minimal changes in precipitation at the national scale in Namibia due to the inherent variability and complexity of precipitation patterns in arid and semi-arid regions. Namibia's climate is heavily influenced by large-scale atmospheric circulation patterns such as the Intertropical Convergence Zone (ITCZ) and the El Niño-Southern Oscillation (ENSO), leading to high interannual rainfall variability. This variability makes it challenging to detect clear trends in precipitation over long periods. Additionally, the coarse resolution of global climate models may not fully capture the localized factors affecting precipitation, such as topography and microclimates.

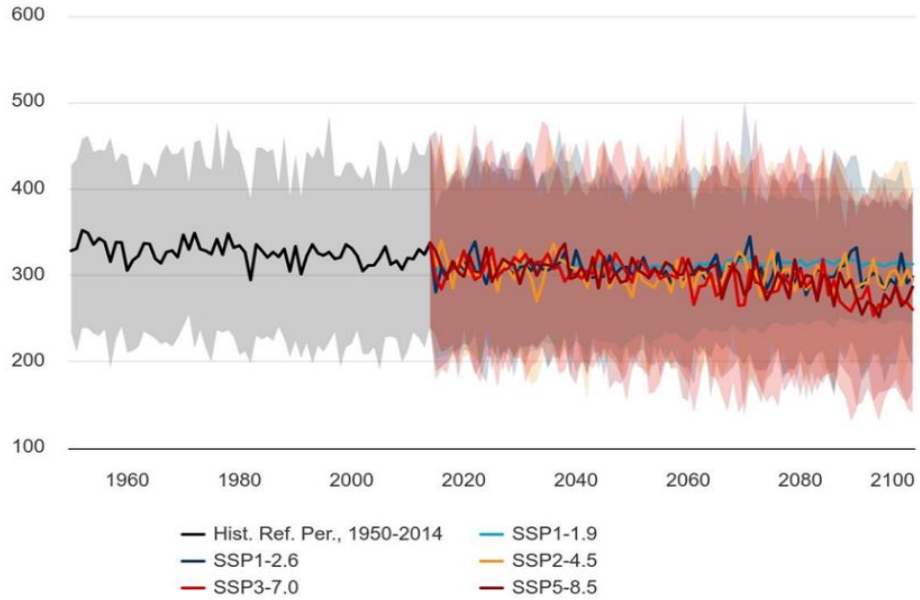



*Figure 4-16. Projected average annual precipitation in Namibia (reference period: 1995-2014), multi-model ensemble (Source: World Bank (2024c)).*

Furthermore, while temperature increases are more directly related to global greenhouse gas concentrations, precipitation is influenced by many factors, including ocean-atmosphere interactions, changes in atmospheric moisture content, and shifts in wind patterns, which can result in increases and decreases in rainfall. Thus, the aggregate effect of these diverse influences might average out at the national scale, leading to minimal net changes in projected precipitation despite potentially significant regional variations and extreme weather events.

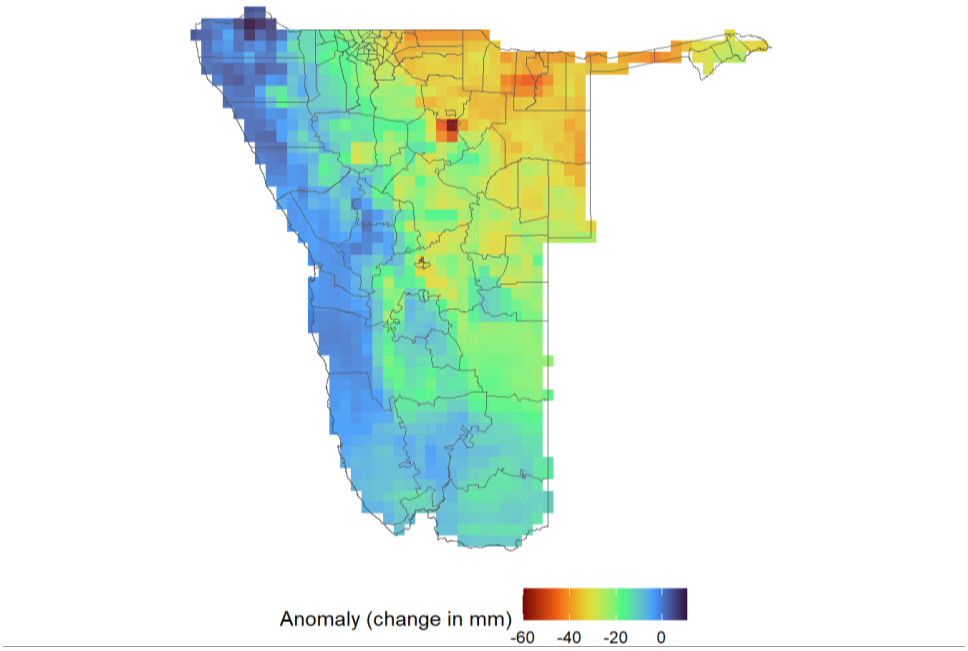



*Figure 4-17. Mid-century, 2040-2059, anomaly (change) in average annual precipitation for the reference period: 1995-2014 and multi-model ensemble based on the SSP3-7.0.*

While national-level projections for Namibia's future precipitation appear minimal, a closer look reveals significant potential variations at the local (micro) scale. This is often the case with climate change impacts, where regional and local effects can differ substantially from the national average. Figure 4.17 shows that specific areas, particularly in the northeastern country, may experience substantial precipitation reductions by mid-century, reaching up to 60 millimetres. This suggests these regions could face a drier climate than the national average implies. Furthermore, Figure 4.18 suggests even more significant precipitation reductions, particularly for the northeastern parts of Namibia, in the later decades of this century. This highlights the potential for a more pronounced drying trend in this region.

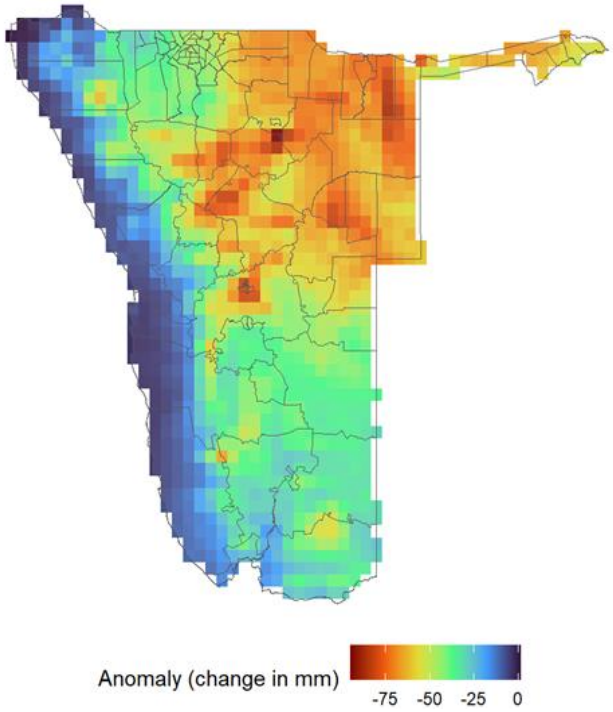



*Figure 4-18. Mid-century, 2080-2099, anomaly (change) in average annual precipitation for the reference period: 1995-2014 and multi-model ensemble based on the SSP3-7.0.*

These findings underscore the importance of analysing climate change projections beyond national averages. By examining local-scale data, policymakers and stakeholders can gain a more nuanced understanding of potential impacts and develop targeted adaptation strategies for vulnerable regions. This localized approach is crucial for effective climate resilience planning, as it allows for tailored solutions that address the specific needs and challenges of different areas, ensuring that resources are allocated efficiently and effectively to mitigate the adverse effects of climate change on local communities and ecosystems.

### 4.4.4 Climate-Related Natural Hazards

Namibia is increasingly vulnerable to climate change-related natural hazards, exacerbating the country's environmental and socioeconomic challenges. The primary natural hazards in Namibia are drought, floods, and epidemics. Each of these natural hazards related to climate change poses significant risks to communities, ecosystems, and economic sectors. World Bank (2024c) provides data summarised in Figure 4.19 on the average annual occurrence of natural hazards in Namibia from 1980-2020. It is clear from Figure 4.19 that floods are the most occurring natural hazard, with an average annual occurrence of 15 incidents, followed by drought and epidemics, whose average annual occurrences are 9 and 7 incidents, respectively. information on the risk

profiles or impacts of these three natural hazards are elaborated further in the following subsections.

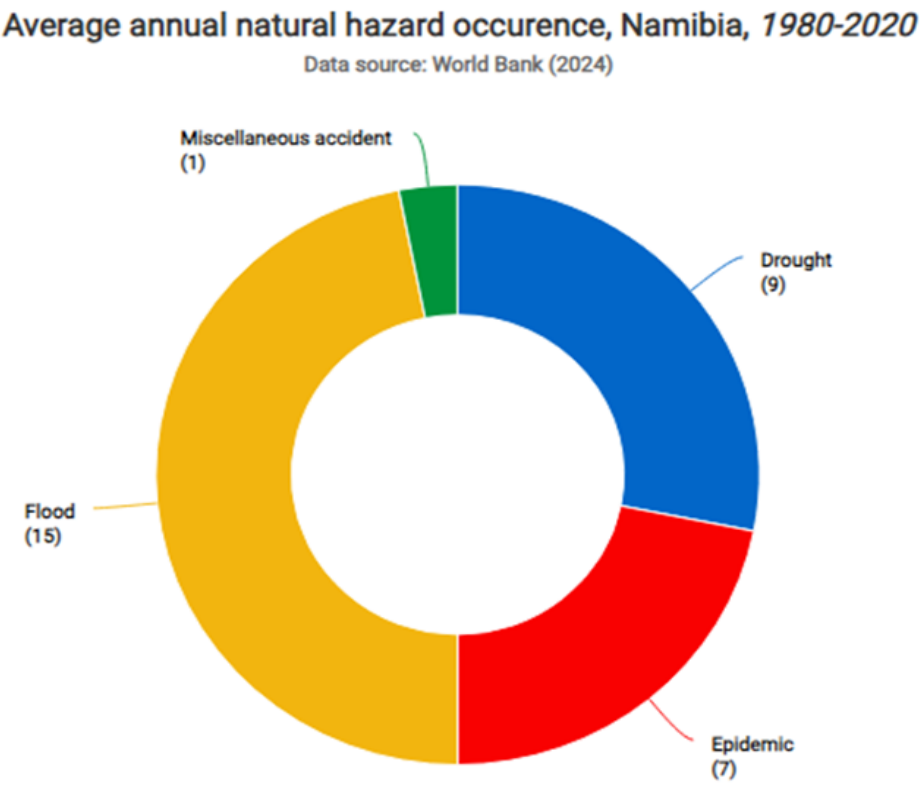



*Figure 4-19. Average annual natural hazard occurrence, Namibia, 1980-2020.*

Before insights on risks and/or impacts of floods, droughts, and epidemic are presented, it is important to state that UNISDR (2019), United Nations Development Programme (UNDP) (2021), and World Bank (2024c) were the primary source of information, data, and statistics on floods, droughts, epidemics that are presented in the following subsections. More specifically, information and data on floods and drought impacts and risks were obtained from UNISDR (2019) and World Bank (2024c), while information and data on epidemics were primarily obtained from the United Nations Development Programme (UNDP) (2021), which is essential information on the socioeconomic impacts of the COVID-19 pandemic.

#### *4.4.4.1 Floods*

Under the current climate, floods directly affect 4,000 people annually. Under future climate, the projected decrease in precipitation implies that less than 1000 people will be directly affected by floods. Furthermore, the yearly average value of direct economic losses associated with floods, under the current climate, is estimated at 41.8 million USD per year. Under future climate, the yearly economic losses are estimated at 13.8 million USD annually.

Flooding is a common phenomenon in Namibia, particularly in the north-central and northeastern parts of the country. Flooding also poses a significant risk. Intense and erratic rainfall events, projected to become more common due to climate change, can lead to flash floods and riverine flooding, particularly in northern Namibia. These floods can cause widespread damage to infrastructure, displace communities, and lead to loss of life. The economic costs are substantial, affecting transportation networks, housing, and agricultural

lands. Additionally, floods can exacerbate public health issues by contaminating water supplies and increasing the spread of waterborne diseases.

Using data from the World Bank (2024c), Figure 4.20 presents the number of people affected by floods from 2000-2020. UNISDR (2019) estimate that floods affect approximately 4,000 people every year, approximately 0.16% of the Namibian population. Most affected people are concentrated in the country's central, northern, and northeastern parts, with hotspots in the Khomas, Kavango (east and west), Oshana, and Zambezi regions. Under future climate, the number of people directly affected by floods is projected at about 900 people. The reduction in the number of people directly affected by drought under future climate can be attributed to the projected decrease in precipitation associated with future climate.

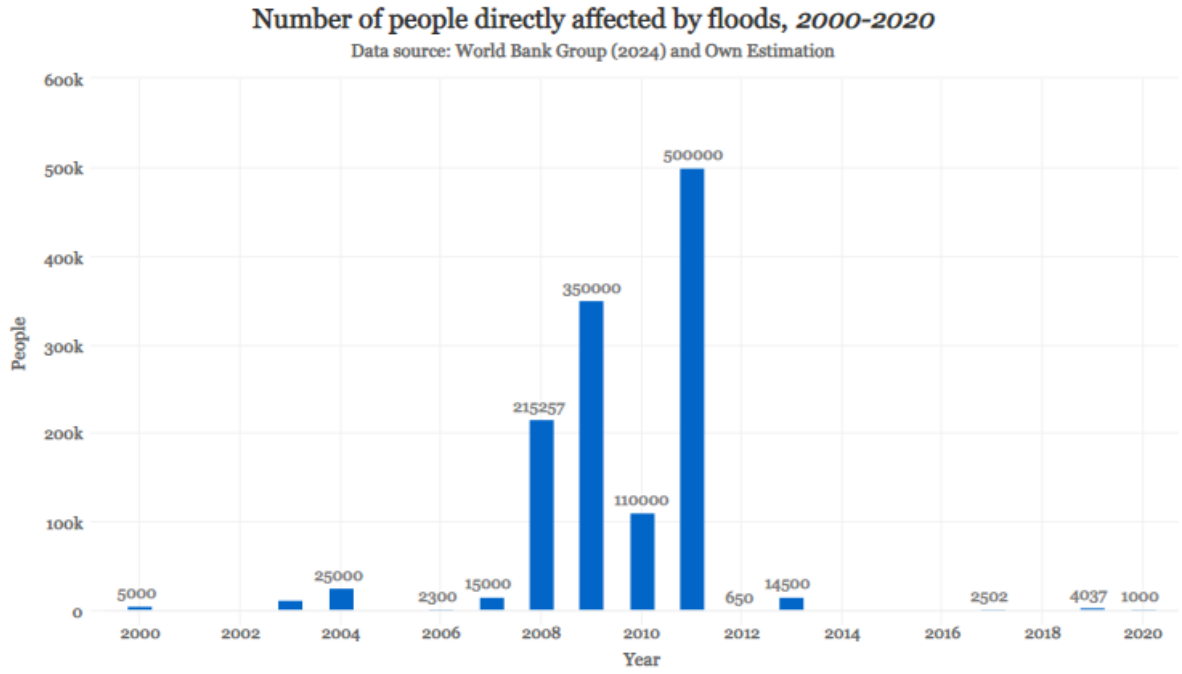



*Figure 4-20. Number of people directly affected by floods, 2000-2020*

The UNISDR (2019) also estimates Namibia's current and future Average Annual Losses (AAL) that can be attributed to floods. The AAL is a risk metric that captures or communicates the direct economic losses associated with a disaster (UNISDR, 2019). These funds are required annually to cover the average disaster loss over time cumulatively. Using data from UNISDR (2019), Figure 4.21 presents the AAL associated with floods in Namibia under the present and future climate. The future climate is based on the high emission scenarios (RCP8.5), the worst-case scenario. Under the current/present climate, the estimated AAL associated with floods is 41.8 million USD per year (in 2019 prices), which was about 604 million Namibian dollars per year.

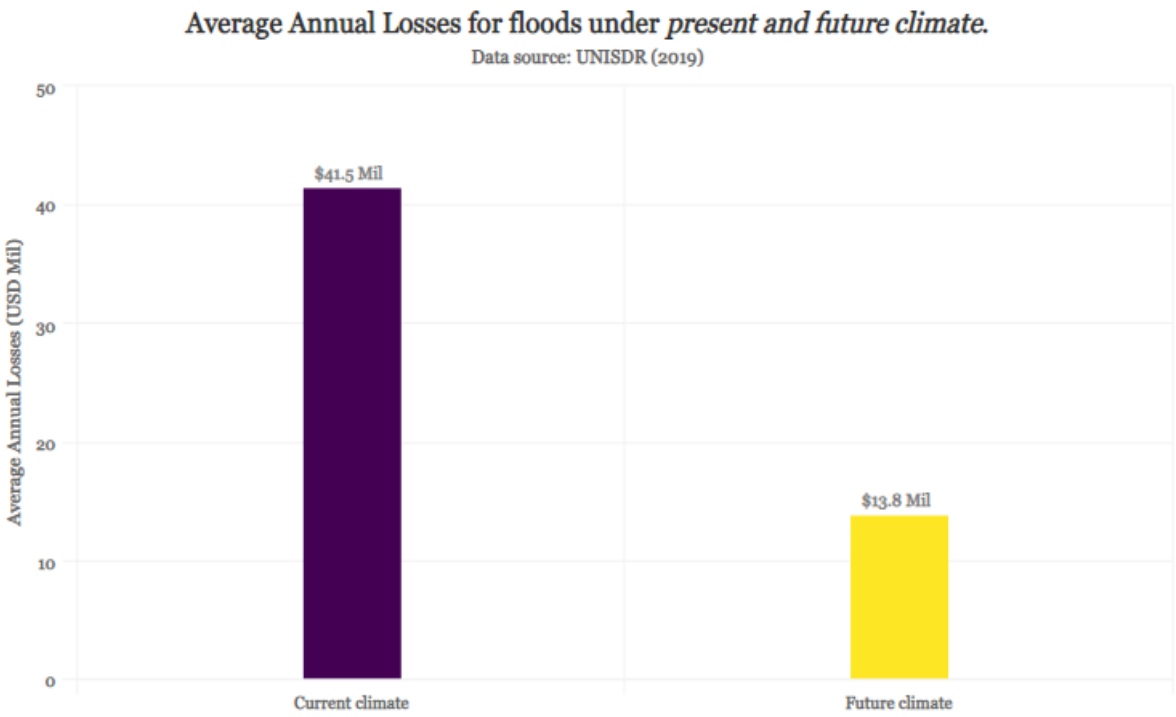



*Figure 4-21. Average Annual Losses for floods under present and future climate*

Under future climate, the AAL associated with floods is estimated at 13.8 million USD per year (in 2019 prices), translating to about 199 million Namibian dollars annually. Notice that the AAL associated with floods under the current climate is lower than anticipated under the future climate. This is because climate models predict decreases in precipitation, and, as a result, decreases in the frequency, magnitude, and likelihood of flood incidences. However, as already stated earlier, climate projections, particularly for precipitation, are inherently uncertain, and this should be considered when using these estimations in policy planning.

#### *4.4.4.2 Drought*

Under the current climate, drought affects 1 million people annually every year in Namibia. Under future climate, about 3 million people will be affected directly by droughts in Namibia. Furthermore, the yearly average value of direct economic losses under the current climate is estimated at 4 billion USD per year. Under future climate, the yearly average value of direct economic losses associated with droughts is estimated at 50 billion USD annually.

Drought is one of the most pressing climate-related hazards in Namibia. The country's arid to semi-arid climate, characterized by low and highly variable rainfall, makes it particularly susceptible to prolonged dry spells. Recently, the Namibian government declared national emergencies in 2013, 2016, 2019, 2022, and 2024 due to extreme drought events that left the agriculture sector in dire straits. The 2024 drought, which is the worst drought in over 100 years, resulted in about 331,000 households registering for the government-funded drought relief programme, which was estimated at 825 million Namibian dollars - i.e., about 44 million USD. Using data from the World Bank (2024c) and UNISDR (2019), Figure 4.22 shows the number of people directly affected by drought from 1990-2024.

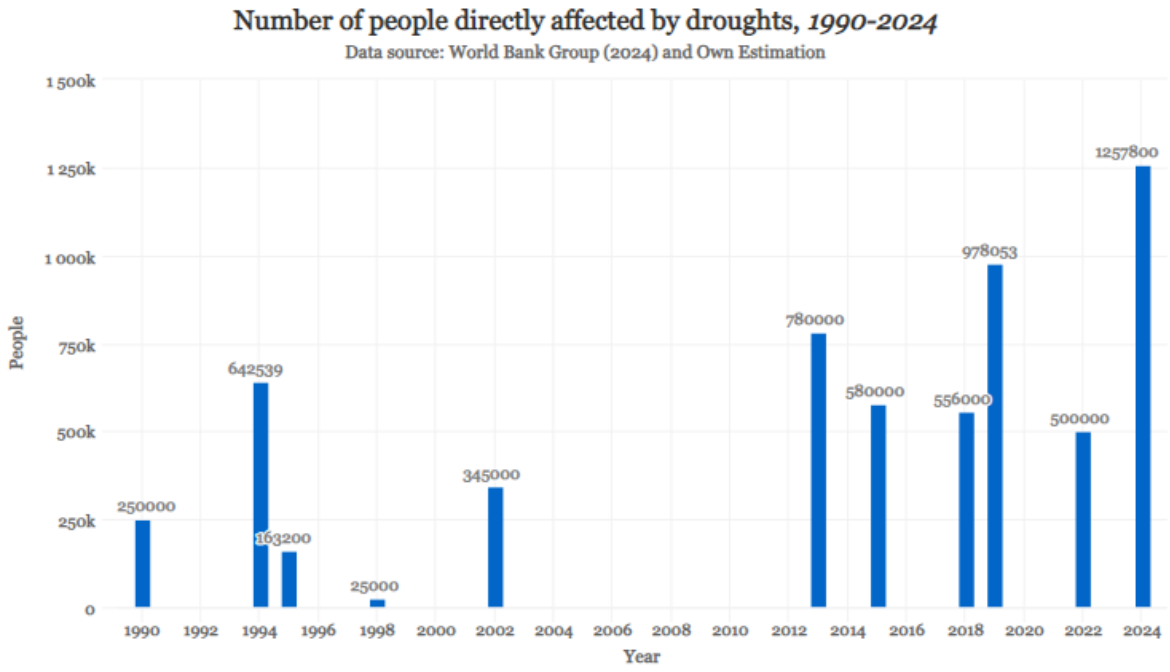



*Figure 4-22. Number of people directly affected by droughts, 1990-2024*

Under current climate conditions, UNISDR (2019) estimates that, on average, 1 million people (i.e., about 33% of the total 2023 population) are potentially annually affected by droughts in Namibia. In the future climate, this number will likely increase to up to 3 million people. Furthermore, using data from UNISDR (2019), Figure 4.23 presents AAL estimates for current and future droughts-associated climates. The estimated AAL associated with drought, under the current climate, is 4 billion USD per year (in 2019 prices), which translates to about 57 billion Namibian dollars (in 2019 prices). Under future climate, the estimated AAL associated with droughts increases to 50 billion USD per year (2029 prices), translating to about 722 billion Namibian dollars (2019 prices).

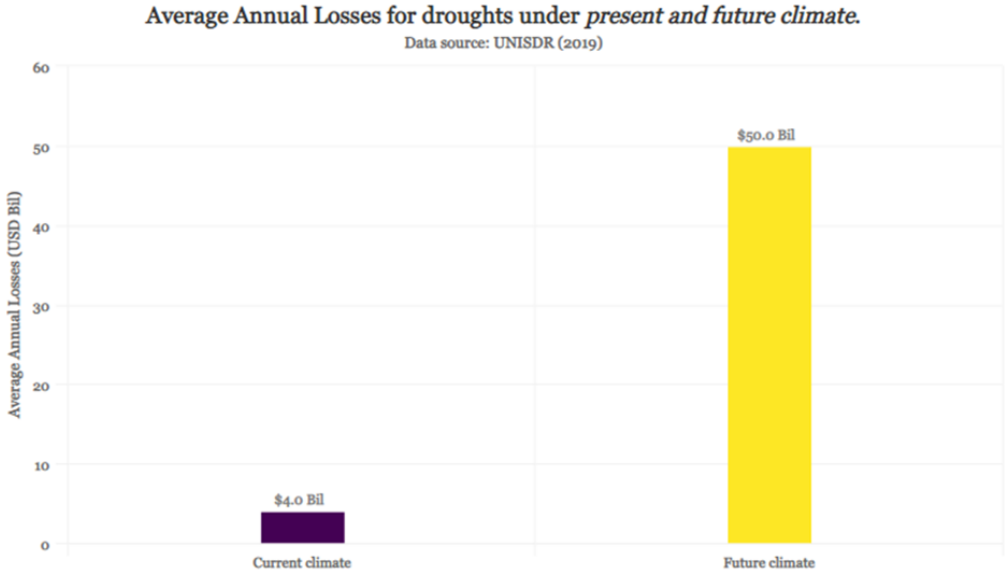



*Figure 4-23. Average Annual Losses for droughts under present and future climate*

These cost and impact projections underscore the escalating economic and social burden that climate change induced droughts are likely to impose on Namibia, particularly regarding water scarcity, food insecurity, and economic instability. Namibia must invest in drought-adaptive strategies such as sustainable water management, climate-resilient agricultural practices, and robust disaster risk reduction frameworks to mitigate these impacts. Proactive measures are essential to protect vulnerable populations and livelihoods and ensure sustainable development and resilience in the face of growing climatic challenges. Strengthening international cooperation and securing financial support for climate adaptation will be crucial for Namibia to effectively address and manage the increasing risks associated with climate change.

#### *4.4.4.3 Epidemics*

Namibia's history of epidemics highlights the critical need for robust healthcare infrastructure, effective disease surveillance, and comprehensive public health strategies. Addressing these health challenges is vital for Namibia to improve public health, reduce poverty, and achieve sustainable development objectives. Strengthening healthcare systems, enhancing public health education, and ensuring equitable access to healthcare services are essential steps toward mitigating the impacts of these diseases and safeguarding the nation's health, especially in the face of climate change and emerging global health threats.

Namibia has experienced several human disease outbreaks in the past that have necessitated state intervention. Epidemic-prone diseases in Namibia include Meningococcal Meningitis, Malaria, Dysentery, and Cholera. Diseases of public health significance also encompass HIV/AIDS, Schistosomiasis, Tuberculosis, Acute Respiratory Infections, and diarrhoea-related diseases, such as Hepatitis B. HIV/AIDS has had devastating impacts on livelihoods and is now one of Namibia's most significant challenges in its quest to achieve poverty reduction and other Sustainable Development Goals (SDGs).

Historically, Namibia has faced significant public health crises. For instance, during the 2009 cholera outbreak, more than 3,000 cases were reported, resulting in numerous fatalities and highlighting the country's vulnerability to waterborne diseases. Malaria, another primary public health concern, saw significant transmission rates in northern Namibia, with over 350,000 cases reported in 2001 alone. Although concerted efforts have reduced malaria, it remains a persistent threat, particularly in the Zambezi, Kavango, and Ohangwena regions.

HIV/AIDS continues to be a formidable challenge for Namibia. The prevalence rate among adults aged 15-49 was approximately 11.8% as of 2020, with over 200,000 people living with the virus. The epidemic has far-reaching impacts, affecting workforce productivity, increasing the number of orphans, and straining the healthcare system. Tuberculosis (TB) also presents a significant health challenge, often co-infecting those with HIV. Namibia's TB incidence rate was one of the highest globally, with 489 cases per 100,000 people in 2019.

Schistosomiasis, or bilharzia, affects communities with limited access to safe water and sanitation, primarily in the Kavango and Zambezi regions. Acute respiratory infections and diarrhoea-related diseases are prevalent among children under five, contributing to high child morbidity and mortality rates. Combating these diseases includes vaccination programs, improved water and sanitation infrastructure, and public health campaigns. Hepatitis B is another concern, with a significant portion of the population at risk of chronic infection, which can lead to severe liver disease. Namibia has implemented vaccination programs to control its spread, but challenges remain in reaching remote and underserved populations.

The COVID-19 pandemic has profoundly impacted Namibia, exacerbating existing public health challenges and introducing new ones. As of 2023, Namibia has reported over 172,389 COVID-19 cases and more than 4,106 deaths. The pandemic strained the healthcare system, disrupted essential health services, and negatively impacted the economy. Lockdowns and social distancing measures led to economic slowdowns, affecting livelihoods, particularly in the informal sector. The pandemic also highlighted gaps in healthcare infrastructure and the need for robust emergency preparedness and response mechanisms (UNDP, 2021).

The incidence and frequency of these epidemics are expected to change under climate change, exacerbating the public health burden. Rising temperatures, altered precipitation patterns, and increased frequency of extreme weather events can expand the habitat range of disease vectors such as mosquitoes, potentially leading to higher malaria transmission rates. Cholera and dysentery outbreaks may become more common due to water scarcity and contamination associated with prolonged droughts and flooding. Schistosomiasis transmission could also rise with changes in water bodies, facilitating the parasite's lifecycle.

### 4.4.5 Impacts on Key Sectors

This section presents the impacts and risks of climate change on key selected sectors of the Namibian economy, namely agriculture, water, energy, health, biodiversity, and tourism. These sectors were chosen because they have been consistently identified as the most vulnerable to climate change in Namibia's Initial National Communication (NC), Second National Communication (NC2), Third National Communication (NC3), and Fourth National Communication (NC4). By focusing on the selected sectors, the section aims to provide a comprehensive overview of how climate change is expected to impact Namibia's economy, highlighting the urgent need for targeted adaptation and mitigation strategies to protect and sustain these vital sectors. Through detailed analysis and presentation of current and projected impacts, risks, and vulnerabilities, policymakers and stakeholders can better understand the challenges ahead and develop informed, effective responses to safeguard Namibia's future.

#### *4.4.5.1 Agriculture*

Agriculture is a critical sector of the national economy, contributing approximately 5-7% to the Gross Domestic Product (GDP) (Namibia Statistics Agency (NSA), 2022) and employing around 31% of the workforce (World Bank, 2024a). Furthermore, the sector impacts directly on the livelihoods of 70% of the population which is largely dependent on rain-fed crop production, with nearly 48% of Namibia's rural households dependent on subsistence agriculture (World Bank, 2021). During the period 2014-2022, data from Namibia Statistics Agency (NSA) (2022) shows that the sector has had turbulent performance Figure 4.24 achieving an average annual growth of 1.2%. The observed fluctuations in performance can be attributed to the persistent drought conditions that the country has experienced over the same period.

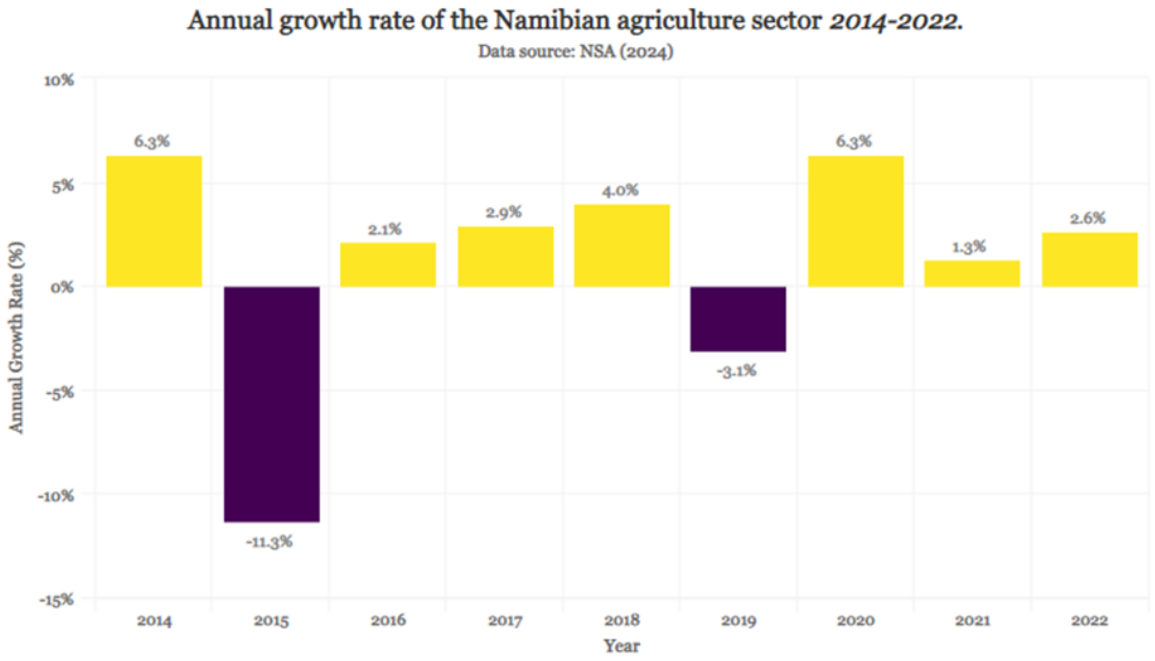



*Figure 4-24. Annual growth rate of the Namibian agriculture sector 2014-2022*

Agriculture in Namibia is diverse, encompassing subsistence farming, which is the mainstay for most rural households, and commercial farming, which is predominantly focused on livestock and crop production. The sector is characterized by its reliance on arid and semi-arid environments, which present unique challenges and opportunities. Subsistence farming is prevalent in the northern regions of Namibia, including the Kavango, Ohangwena, Omusati, Oshana, and Oshikoto regions. Smallholder farmers primarily cultivate staple crops such as maize, millet (mahangu), sorghum, and beans. These crops are essential for food security and nutrition in rural areas. Livestock, including cattle, goats, and sheep, also play a crucial role in subsistence farming systems, providing a source of income, food, and cultural value.

Commercial agriculture in Namibia is concentrated in the central and southern regions and is dominated by livestock farming, particularly cattle ranching. Namibia is known for its high-quality beef, a significant export product, with markets in the European Union, the United States, and other countries. The country also produces small stocks, such as sheep and goats, contributing to the export market and local consumption. Commercial crop production includes maize, wheat, grapes, and horticultural products, primarily grown under irrigation schemes. The Orange River valley and the areas around the Etunda and Hardap irrigation schemes are notable for their agricultural productivity. Grapes have become an important export crop, with the Namibian table grape industry gaining international recognition.

Namibia's agriculture sector is highly vulnerable to the impacts of climate change, which are already being observed. According to New & Bosworth (2018), Government of the Republic of Namibia (2020), World Bank (2021), Government of the Republic of Namibia (2021), Trisos et al. (2022), and several other studies have identified several key impacts and risks of climate change to the Namibian agriculture sector:

- *Temperature increases*: Namibia has experienced a notable rise in temperatures, with the Sixth Assessment Report of the IPCC (Trisos et al., 2022) indicating a significant warming trend across the Southern Africa region, including Namibia. This temperature

increase has led to heat stress in crops and livestock, reducing agricultural productivity. Higher temperatures also increase evaporation rates, exacerbating water scarcity and impacting irrigation.

- *Changes in precipitation patterns*: Namibia has seen shifts in precipitation patterns, characterized by more erratic and less predictable rainfall. Reduced and inconsistent rainfall has led to prolonged droughts, severely affecting crop yields and pasture availability. Conversely, occasional intense rainfall events have caused flooding, soil erosion, and damage to agricultural infrastructure (World Bank, 2021).

- *Droughts*: Recurrent droughts are a critical challenge Namibia faces. The frequency and severity of droughts are projected to increase due to climate change. Droughts have led to significant crop failures, loss of livestock, and reduced water availability, posing a threat to food security and livelihoods, particularly in rural areas reliant on subsistence farming (Atlas of Namibia Team, 2023; Government of the Republic of Namibia, 2020).

- *Water scarcity*: Water resources are under increasing pressure due to changing hydrological cycles and higher evaporation rates. This has reduced water availability for irrigation and livestock, necessitating the development of more efficient water management practices and irrigation techniques to sustain agricultural productivity (Atlas of Namibia Team, 2023; Trisos et al., 2022).

- *Pests and diseases*: Warmer temperatures and changing climate conditions have altered the distribution and prevalence of agricultural pests and diseases. This shift has increased the vulnerability of crops and livestock to pests and diseases, further threatening agricultural productivity (Atlas of Namibia Team, 2023).

The impacts and risks associated with climate change on Namibia's agriculture sector are expected to intensify. Insights from Trisos et al. (2022) and World Bank (2024c), as also demonstrated earlier in this chapter, highlight several potential climate change-related risks to the Namibian agriculture sector:

- *Increased temperature extremes*: Continued warming is projected, with temperature increases of up to 5°C in inland areas by the end of the century. This will exacerbate heat stress on crops and livestock, reduce agricultural productivity, and increase water demand for irrigation.

- *Further changes in precipitation*: projections indicate that precipitation patterns will continue to become more erratic, with the potential for more intense droughts and extreme rainfall events. This variability will pose significant challenges for water management, crop planning, and maintaining pasture for livestock.

- *Water resource constraints*: Water scarcity is expected to worsen with continued changes in precipitation and rising temperatures. This will put pressure on Namibia's limited water resources, affecting rain-fed and irrigated agriculture. Efficient use of water will be critical to sustaining agricultural activities.

- *Increased pest and disease pressure*: As temperatures rise and precipitation patterns shift, the range and intensity of agricultural pests and diseases are likely to expand. This will require the development of integrated pest management strategies and resilient crop and livestock varieties to mitigate these risks.

- *Food security threats*: Temperature increases, water scarcity, and increased pest and disease pressure will pose significant threats to food security. Subsistence farmers, who are already vulnerable, will face heightened risks, potentially leading to increased rural poverty and migration.

The Namibian agriculture sector is at a critical juncture, facing significant risks from climate change. However, with strategic adaptation measures, improved resource management, and sustainable practices, the sector can enhance its resilience and continue to support the country's economy and food security. Policymakers, stakeholders, and the farming community must collaborate to implement effective solutions that address the challenges posed by climate change and ensure the sustainable development of Namibia's agricultural sector. Through these efforts, Namibia can safeguard its agricultural heritage and ensure a prosperous future for its farming communities.

#### *4.4.5.2 Water resources*

Namibia is one of the most arid countries in sub-Saharan Africa, characterized by limited and highly variable water resources. The country's water supply predominantly depends on seasonal rainfall, groundwater, and perennial rivers, including the Kunene, Okavango, Zambezi, and Orange Rivers, which border the country (see Figure 2.25). Most of Namibia's internal water sources are ephemeral rivers that flow only during the rainy season (Figure 2.25). Although rainfall is an important water supply source, the hydrological cycle in Namibia indicates that just 2% of the rainfall becomes surface runoff, and a meagre 1% replenishes groundwater, which may later be extracted through boreholes for consumption. The vast majority of rain water (97%) is lost through evaporation (83%) and plant transpiration (evapotranspiration, 14%) (Ministry of Agriculture, Water and Land Reform (MAWLR), 2010). Often, rainfall evaporates before infiltrating the ground. Another source of moisture comes from fog in the cooler coastal regions, which is an extremely valuable source of moisture for desert animals and plants. Additionally, unconventional water sources (i.e., from recycling and desalination) have been adopted to augment the limited traditional sources.

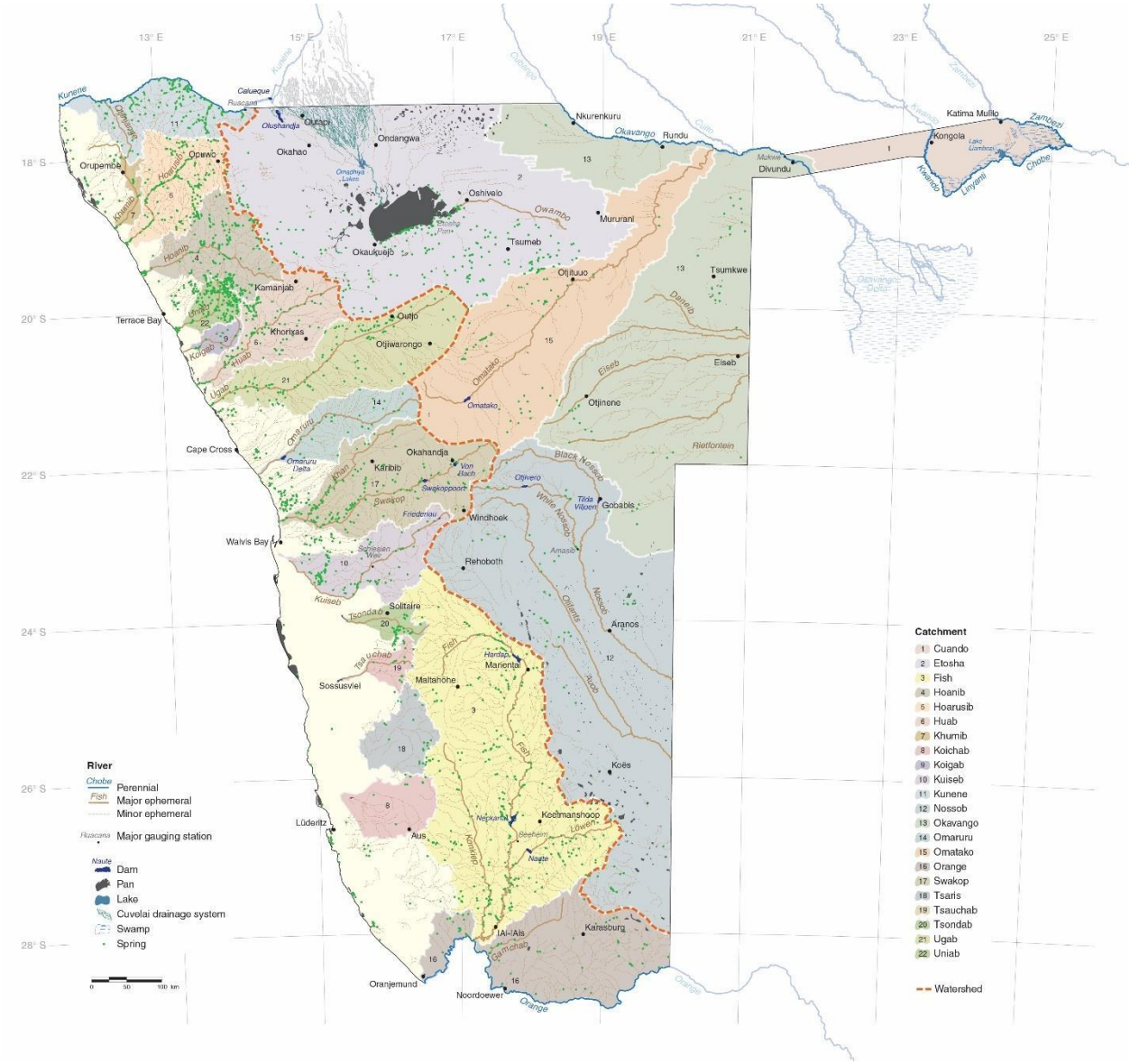



*Figure 4-25. Namibia's water resources - i.e., surface waters and river catchments (Source: Atlas of Namibia Team (2023)).*

In terms of water supply by source, the Government of the Republic of Namibia (2020) indicates that about 45% of Namibia's water comes from groundwater sources, 33% from the Border Rivers (i.e., Kunene, Okavango, Zambezi, and Orange rivers), and about 22% from impoundments on the ephemeral river (see Figure 4.25). As such, groundwater is a crucial water resource in Namibia, especially in rural areas with limited access to surface water. Figure 5.26 shows Namibia's groundwater resource, where water is stored in porous and fractured aquifers. Among Namibia's richest aquifers - i.e., in terms of water held - are the karst, Koichab, Kuiseb, Maltahöhe, Ohangwena II, Omdel, Stampriet and Windhoek aquifers (Figure 2.26). Despite the importance of groundwater in Namibia, this resource is somewhat intangible and poorly understood. For instance, critical information and data on how much groundwater there is in an area, how deep it is, where and how it is recharged and how to safely and sustainably abstract it, is not usually available in most areas across the country. This information and data availability requires a good knowledge of geology and aquifers and long-term monitoring (Atlas of Namibia Team, 2023).

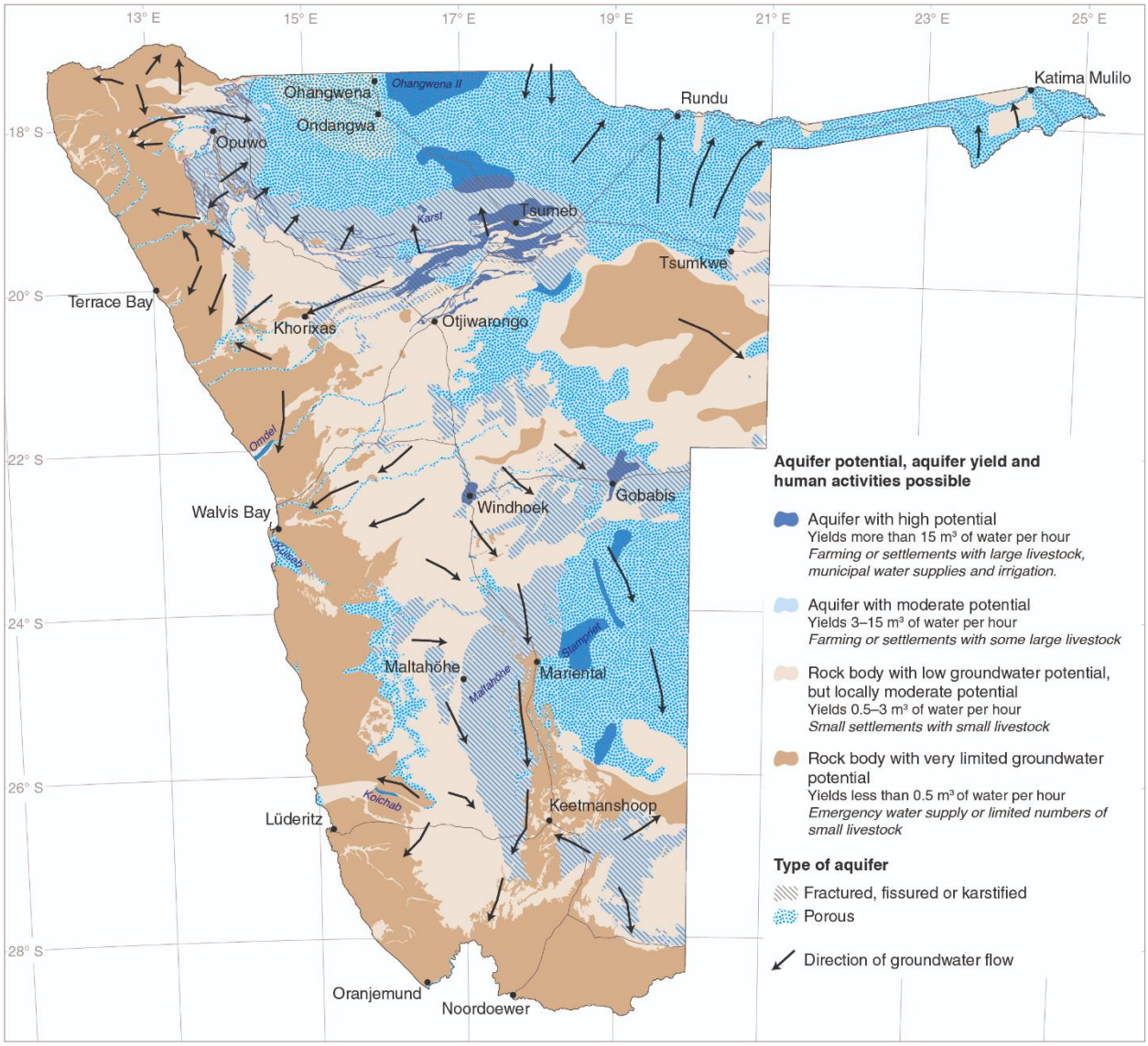



*Figure 4-26. Namibia's groundwater resources (Source: Atlas of Namibia Team (2023)).*

The most recent and comprehensive information and data on water demand in Namibia that is available is from the 2004 Water Accounts Namibia (Ministry of Agriculture, Water and Land Reform, 2006) and Integrated Water Resources Management Plan Namibia (Ministry of Agriculture, Water and Land Reform (MAWLR), 2010). Based on data from the Ministry of Agriculture, Water and Land Reform (MAWLR) (2010), Namibia's actual (2008) and projected (2015-2030) water demand together with its structure (i.e., demand source) is presented in Figure 4.27. It is projected that water demand will increase from about 334 million cubic metres in 2008 to more than double to 772 million cubic metres by 2030. Based on the actual water consumption in 2008, irrigation is by far the largest water user, accounting for more than 40 % of use, followed by livestock farming (26%) and urban use (domestic, industrial and other use) at 20%, whilst mining accounted for less than 5% of total use. In terms of water use, these shares are also maintained in all the projections for 2030 (see Figure 4.27).

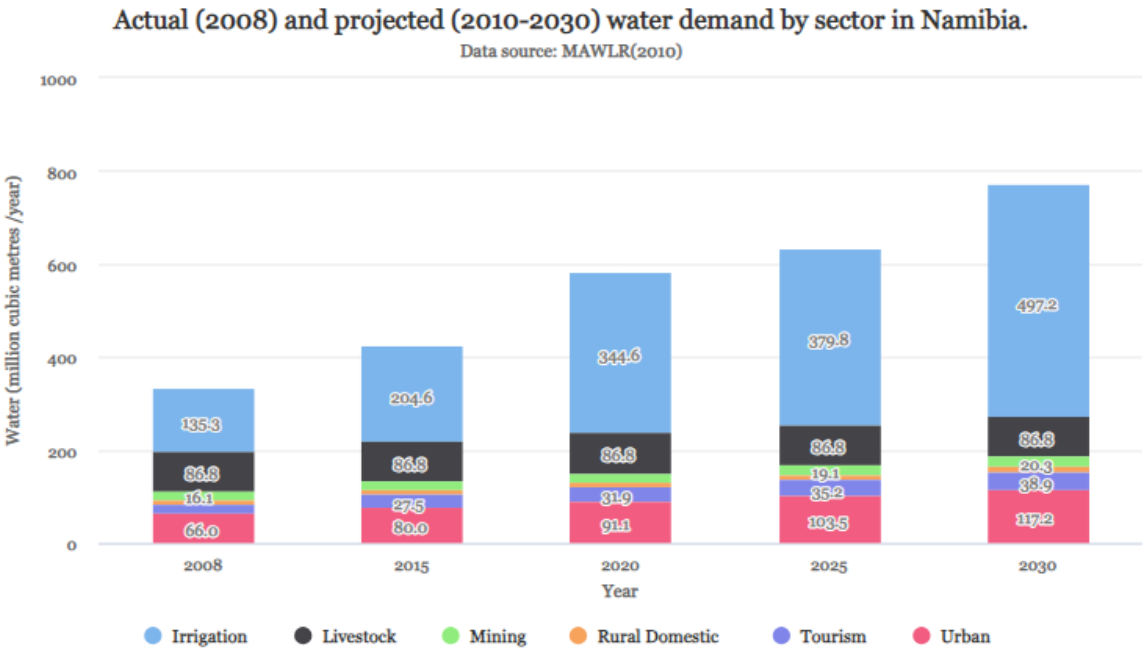



*Figure 4-27. Actual (2008) and projected (2010-2030) water demand by sector in Namibia*

The Ministry of Agriculture, Water and Land Reform (2006) also provides the water demand structure, albeit for 2002, from an economic perspective (see Figure 5.28). Despite its low contribution to GDP, agriculture uses up to 80% of Namibia's total water production. Commercial agriculture is the largest sub-sector through irrigation, while communal farmers are the least consumptive. The remaining 20% is split among the mining, manufacturing, utilities, services, and government (Figure 5.28). Water productivity in the agriculture sector is, however, very low. For instance, each cubic metre of water used to irrigate commercial crops is estimated to return $N\$0.55$, and $N\$18$ if used for commercial livestock farming. Other uses of water are estimated to produce average returns of $N\$261$ for manufacturing, $N\$127$ for mining and $N\$552$ for services per cubic metre of water (Atlas of Namibia Team, 2023).

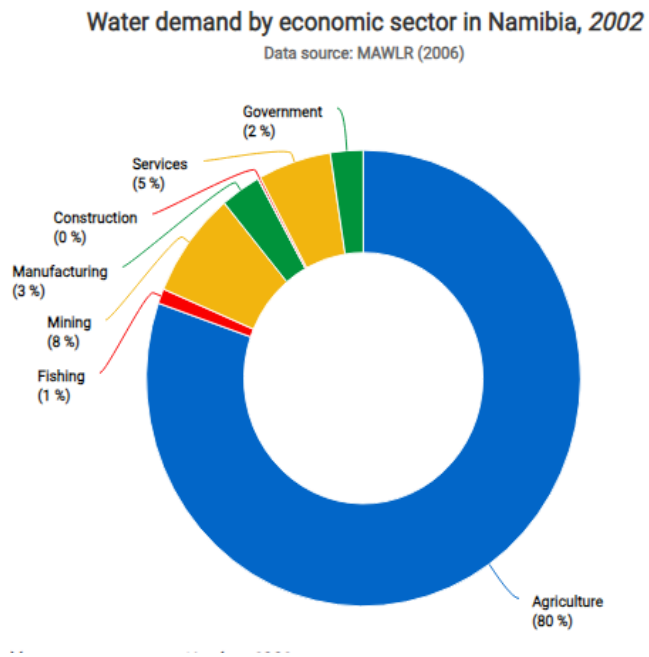



*Figure 4-28. Water demand by economic sector in Namibia, 2002.*

Using data from the 2015/2016 Namibia Household Income and Expenditure Survey (NHIES), Figure 5.29 shows the proportion of people, by constituency, with access to improved drinking water. Improved drinking water is defined as piped (tap) water into a dwelling; piped (tap) water on-site or in the yard/plot; public tap/standpipe; private tube well/borehole; protected dug well; protected spring; and bottled water. In certain areas of Namibia, particularly in the north-western, north-central, and north-eastern parts, access to improved drinking is less than 25% (see Figure 5.29). This means that most of the population in these areas does not have access to improved drinking water.

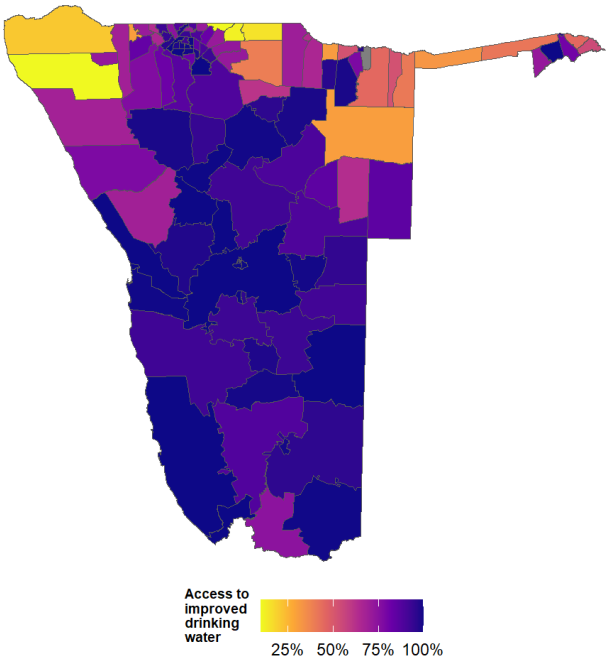



*Figure 4-29. Proportion of people with access to improved drinking water by constituency, 2015.*

The regional distribution of population without access to improved drinking water is shown in Figure 4.30. The regions with a high proportion of the population without drinking water are Kavango East (40.0%), Kunene (39.5%), and Kavango West (37.1%). Generally, most people without access to improved drinking water are in the country's northern parts.

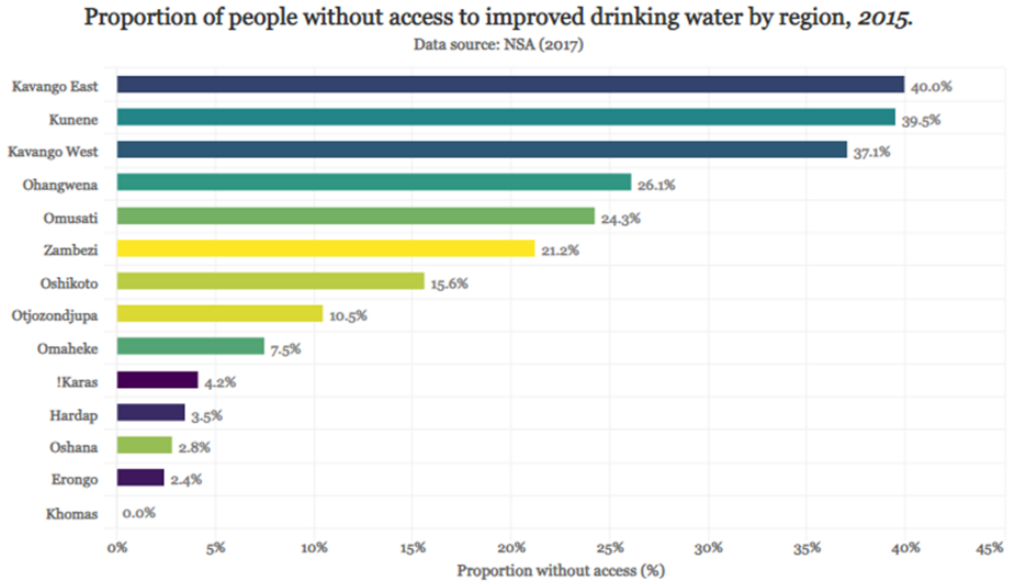



*Figure 4-30. Proportion of people without access to improved drinking water by region, 2015.*

Several studies as well as national and international documents like UNISDR (2019), Government of the Republic of Namibia (2020), World Bank (2021), Government of the Republic of Namibia (2021), and Trisos et al. (2022), show that climate change is already impacting Namibia's water resources. Key observed impacts include:

- *Decreased rainfall and increased variability*: There has been a noticeable decrease in average rainfall and an increase in rainfall patterns. This has led to more frequent and severe droughts, affecting the recharge of groundwater and the flow of ephemeral rivers. Drought conditions have strained domestic, agricultural, and industrial water supplies.

- *Higher evaporation rates*: Rising temperatures have led to higher evaporation rates from surface water bodies and soil moisture. This has reduced the amount of water available for agriculture, domestic use, and wildlife, further stressing the already scarce water resources.

- *Groundwater depletion*: Increased reliance on groundwater during drought has led to over-extraction and depletion of aquifers. The recharge rates of these aquifers are slow due to low and erratic rainfall, making them increasingly vulnerable to prolonged dry periods.

- *Impact on water quality*: Changes in precipitation and temperature have affected water quality. Reduced river flows, and higher temperatures can lead to higher concentrations of pollutants and increased salinity, impacting the usability of water for drinking and irrigation.

- *Flooding events*: While droughts are more common, occasional intense rainfall events have caused flooding, particularly in the northern and northeastern regions. These floods can disrupt water infrastructure, leading to contamination of water supplies and increased risk of waterborne diseases.

Future projections indicate that climate change will continue exacerbating Namibia's water resources challenges. Insights from the World Bank (2021), the Government of the Republic of Namibia (2021), and Trisos et al. (2022) highlight several potential risks:

- *Increased drought frequency and severity*: Climate models predict an increase in the frequency and severity of droughts. This will reduce the availability of surface and groundwater resources, impacting agriculture, livestock, and human consumption. Water scarcity could lead to conflicts over water use and increased migration from rural to urban areas.

- *Further decrease in rainfall*: Projections indicate that annual rainfall will continue to decrease, especially in the central and southern regions. This will reduce river flows and groundwater recharge, making water resource management even more challenging.

- *Heightened evaporation and transpiration*: With temperatures expected to rise further, evaporation and transpiration rates will also increase. This will exacerbate water loss from reservoirs (dams), rivers, and soils, reducing the effectiveness of water storage and conservation efforts.

- *Shifts in rainfall patterns*: Predicted changes in the timing and intensity of rainfall could lead to more frequent extreme weather events, such as heavy rains followed by prolonged dry periods. This variability will make it challenging to manage water resources effectively, as infrastructure may be unable to cope with the extremes.

- *Impact on agriculture and food security: Water* is a critical agricultural input and a significant part of Namibia's economy. Reduced water availability will affect crop yields and livestock production, threatening food security and livelihoods, particularly for subsistence farmers.

- *Challenges for urban water supply*: As urbanization increases, the demand for water in cities and towns will rise. Combined with reduced supply, this could lead to significant water shortages, affecting economic activities and the quality of life for urban residents.

- *Health risks*: Reduced water availability and quality can lead to health risks, including waterborne diseases. Inadequate water for sanitation and hygiene can exacerbate the spread of diseases, particularly in vulnerable communities.

The impacts and risks of climate change on Namibia's water resources are significant and multifaceted, affecting various sectors and communities across the country. Effective adaptation strategies, supported by robust policies, investments, and stakeholder engagement, are crucial to ensure the sustainable management of water resources. By addressing these challenges proactively, Namibia can safeguard its water resources, support economic development, and enhance its communities' resilience to climate change's impacts.

#### *4.4.5.3 Energy*

Namibia has various primary energy resources – renewable solar, wind, biomass, hydro, geothermal and tidal, and non-renewable oil, coal, natural gas, uranium, and thorium. However, statistics from Atlas of Namibia Team (2023) show that Namibia's national energy mix is dominated by non-renewable sources such as diesel, petrol, and heavy fuel oil, which account for about 64% of the total energy used in the country in 2019 (Figure 4.31). The remaining 36% was sourced from electricity, plant biomass, coal, and liquid petroleum gasses (LPG). Most petroleum products, coal, LPG, and a sizeable fraction of Namibia's electricity requirements are purchased from regional suppliers. Coal is mainly imported for electricity generation and heat production in commerce and industry. Only about 23 per cent of the country's total energy requirements in 2019 came from within Namibia, with biomass contributing the most (Atlas of Namibia Team, 2023).

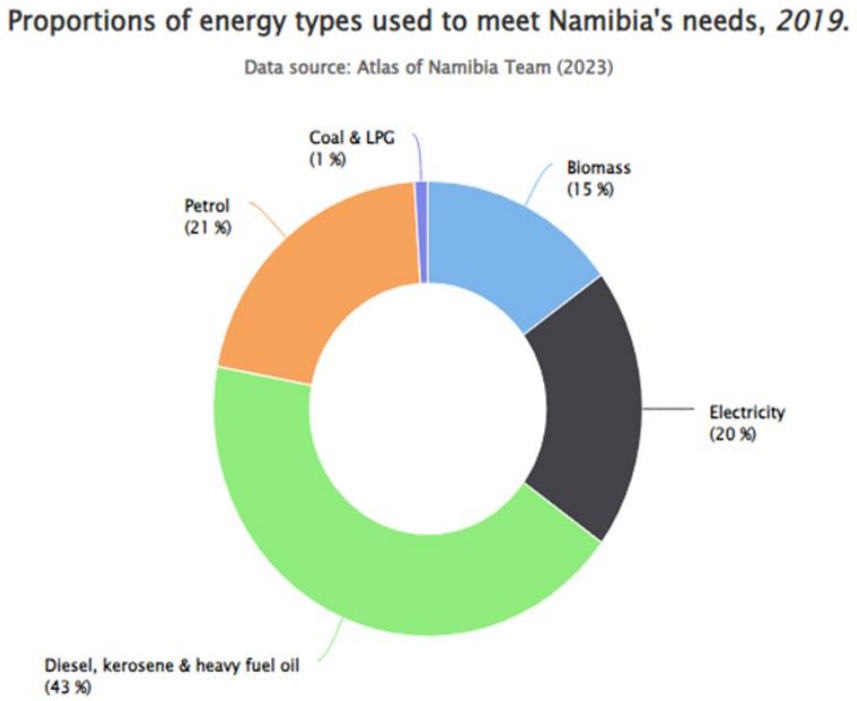



*Figure 4-31. Proportions of energy types used to meet Namibia's needs, 2019*

Electricity use in Namibia increased from 3800 gigawatt-hours in 2010 to 4800 gigawatt-hours in 2018 and decreased to 4400 gigawatt-hours in 2019 (Figure 5.32). Historically, electricity has been sourced from five (5) sources: NamPower (Namibia Power Corporation), South Africa's Eskom, and Mozambique, Zambia and Zimbabwe. However, recently, two (2) other sources became available, thus, the short-term energy market (STEM) offered by the Southern African Power Pool and independent power producers (IPPs) in Namibia. The IPPs produce electricity using renewable solar and wind power (Atlas of Namibia Team, 2023).

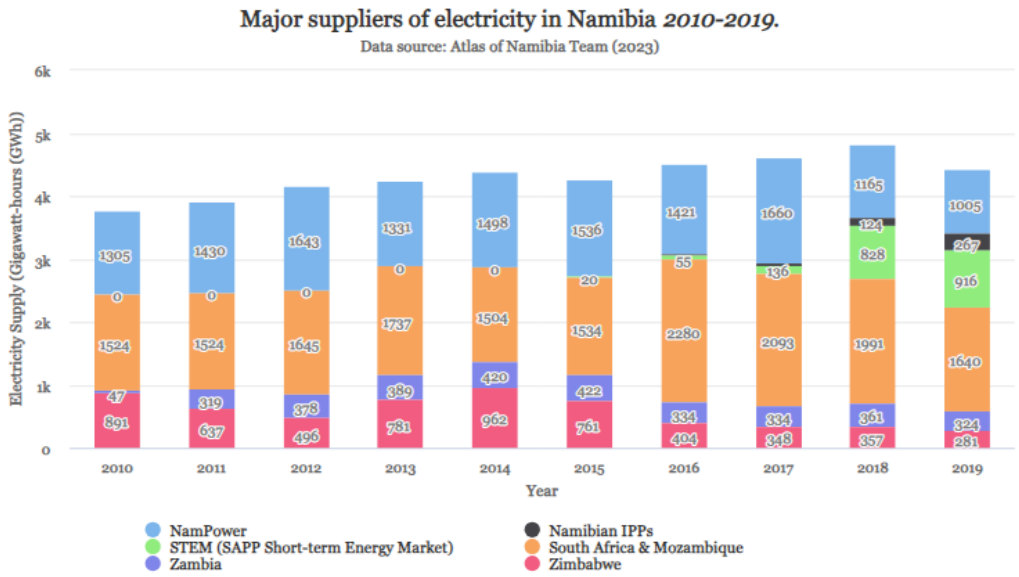



*Figure 4-32. Major suppliers of electricity in Namibia 2010-2019*

In the 2015/2016 Namibia Household Income and Expenditure Survey (NHIES) (Namibia Statistics Agency, 2016), about 47% of households reported that they used electricity for lighting, which was the highest energy source for lighting (see Figure 4.33). Battery-powered lamps, including torches and cell phones, were the second most used energy source for household lighting. However, firewood was reported in the 2015/2016 NHIES as the main source of energy for cooking among households. About 37% of households reported using electricity for cooking (see Figure 4.34). Data from the 2015/2016 NHIES shows that most households in urban areas have access to electricity for lighting (Figure 4.35). However, most households in rural areas do not have access to electricity for lighting. As such, households in rural areas remain challenged regarding access to electricity.

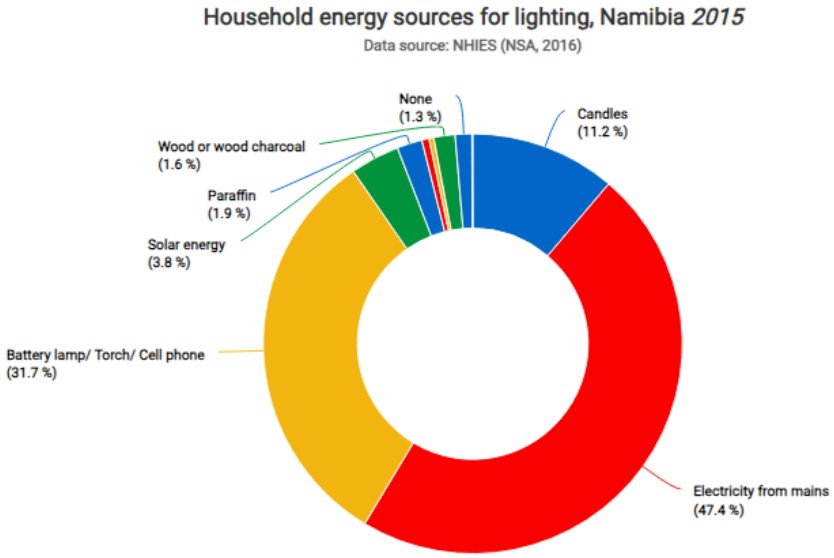



*Figure 4-33. Household energy sources for lighting, Namibia 2015.*

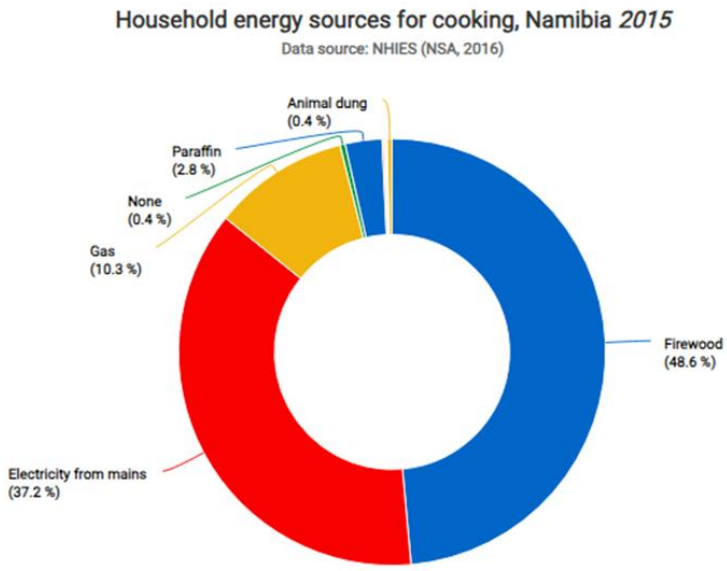



*Figure 4-34. Household energy sources for cooking, Namibia 2015*

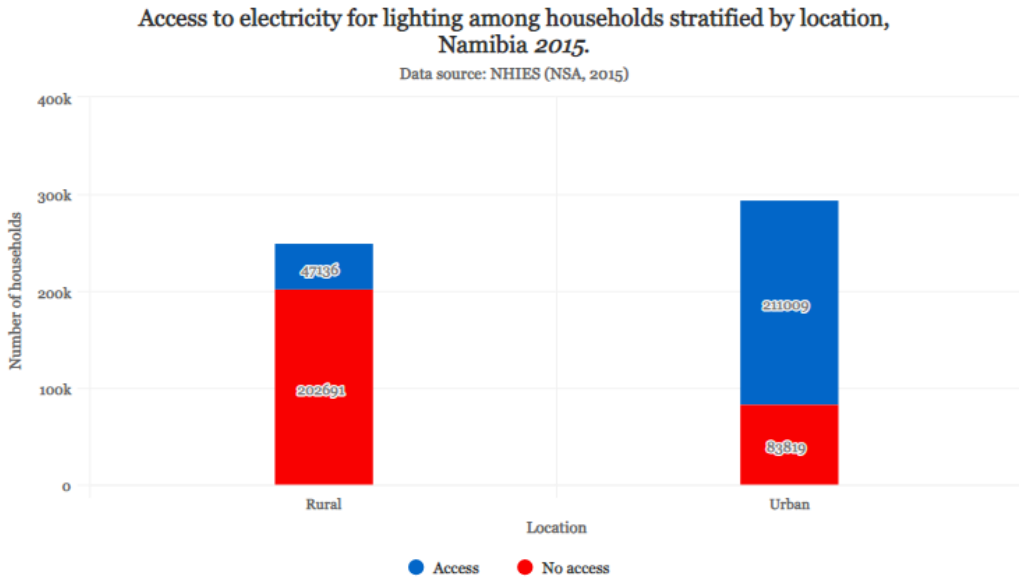



*Figure 4-35. Access to electricity for lighting among households stratified by location, Namibia 2015*

Insights from the World Bank (2021) and Trisos et al. (2022) show that Namibia is at risk of disrupted and/or limited power supply due to climate change trends of reduced precipitation, reduced river flow, and thus decreased hydropower generation. As Namibia depends on energy supply from southern Africa, regional trends can be highly impactful. A projected reduction in rainfall may lead to reduced runoff and surface water availability. Increasing evaporation rates for water storage facilities will impact production costs and increase consumer prices. Increasing temperatures will likely increase the demand for cooling energy with increased peak loads during hotter periods, with an overall net increase in electricity usage. The increased variability of river flows will impact hydropower generation plants, with the potential for undersupply of expected energy outputs.

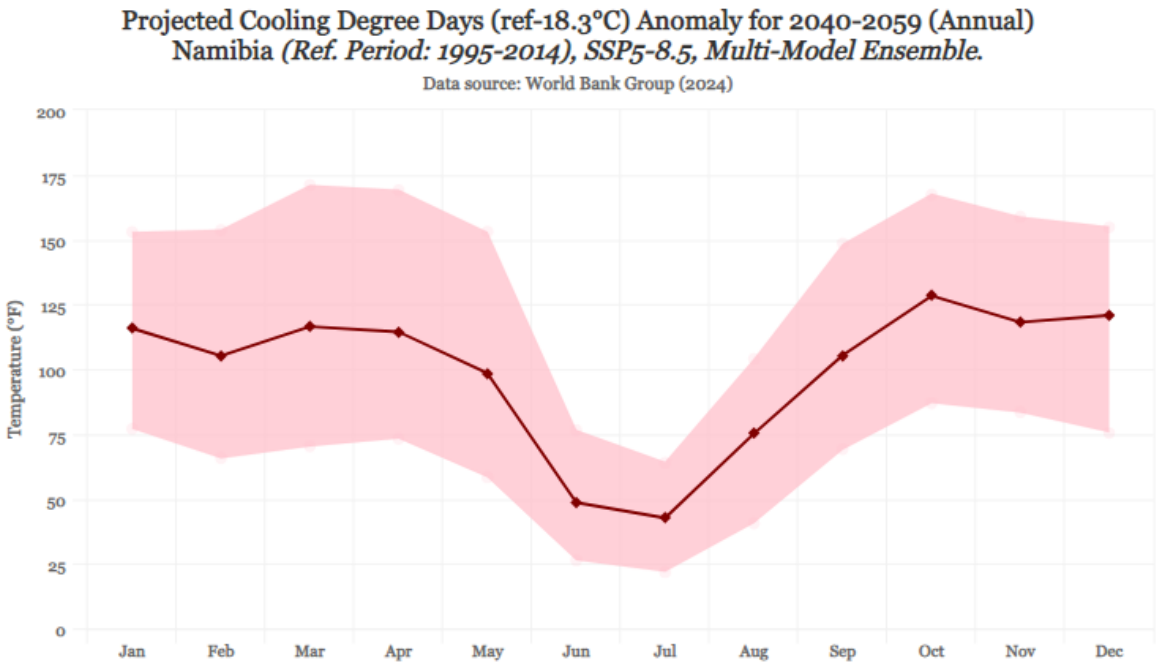



*Figure 4-36. Projected Cooling Degree Days (ref-18.3°C) Anomaly for 2040-2059 (Annual) Namibia (Ref. Period: 1995-2014), SSP5-8.5, Multi-Model Ensemble.*

Furthermore, increased temperatures will likely increase energy demand, especially during peak heat periods. The relationship between daily heat and the demand for electricity can be estimated through Cooling Degree Days (Figure 4.36). This quantity accumulates the temperatures above the 18°C threshold, broadly representing a comfortable living environment. Cooling Degree Days capture the amount of heat that society would like to get rid of by period through some form of active cooling, be it through air conditioning or evaporative processes that generally require pumps for water. The monthly changes provide insight into potentially extended seasons of power demand for cooling or highlighting when power demand increases might occur during the year. Figure 4.36 shows the increase in cooling days across the seasonal cycle. Sharp temperature increases are expected during Namibia's typical hot seasons across all SSP scenarios (World Bank, 2024c). As such, temperature projections for the mid-century (2040-2059) imply increased demand for energy in Namibia.

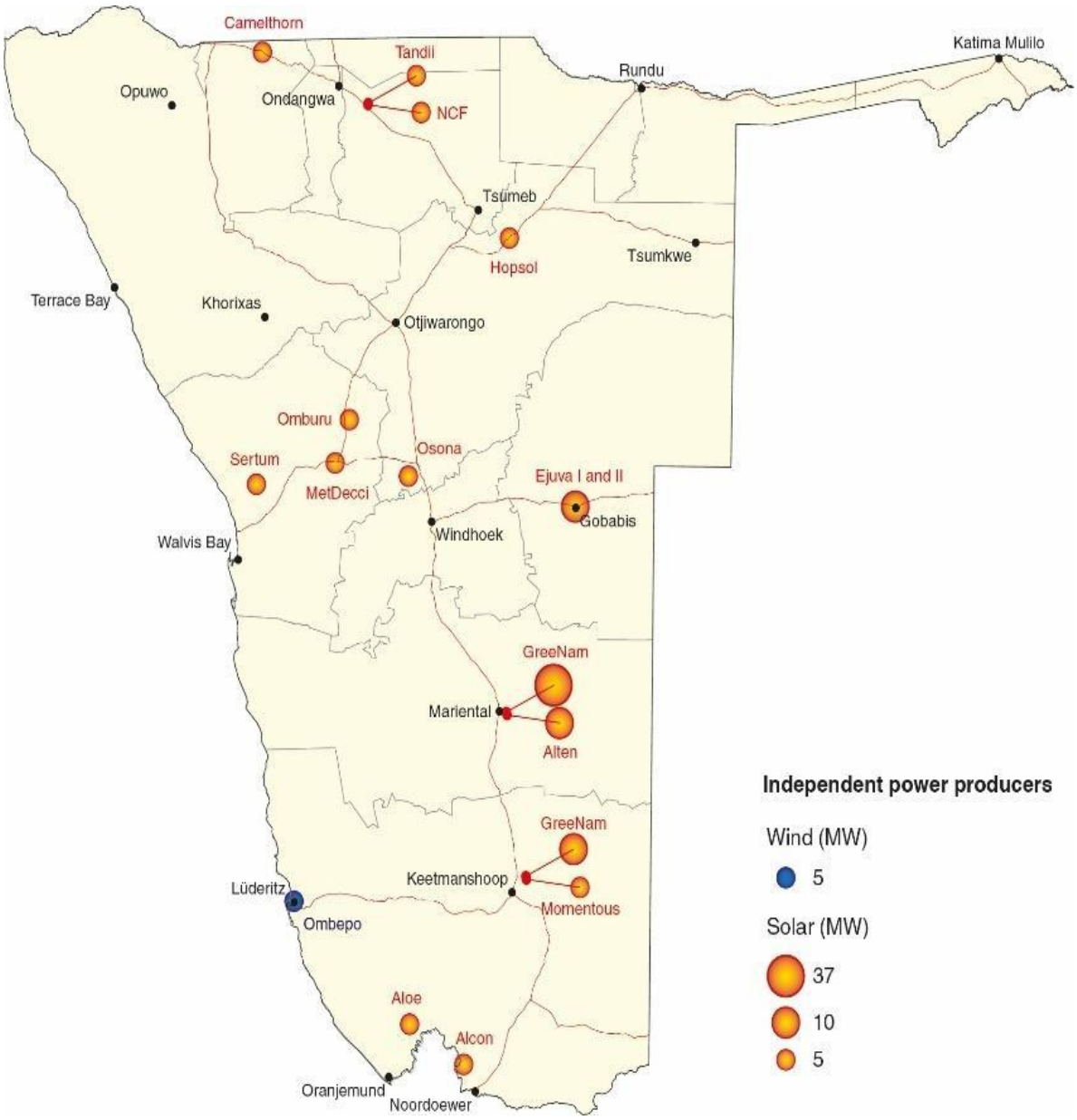



*Figure 4-37. Spatial distribution of independent power producers, 2021 (Source: Atlas of Namibia Team (2023)).*

Namibia has a high potential for solar, wind, and biomass generation. Biomass is widely spread in the country's northern areas, which allows a large-scale bioenergy-based production capacity. Off-grid renewable energy projects include the small/micro wind energy installations used for water pumping, which is common in Namibia, especially on farms. This technology has been used successfully for decades, with approximately 30,000 wind-driven water pumps installed as of 2005; however, the current trend is to replace these with solar energy sources. Leveraging the country's solar potential, 17 independent power producers are contributing about 126.5 megawatts of solar and wind power to the national electricity grid. Figure 4.37 shows the spatial location of independent solar and wind power producers across Namibia. The solar and wind power plants shown in Figure 4.37 exclude those that produce electricity for their own consumption. Furthermore, the following renewable and non-renewable energy resources exist in Namibia but are not (yet) used locally:

- Ocean waves: Namibia's coastline offers potential sites to utilise wave energy, but their feasibility has yet to be quantified.
- Waste: Municipal and other waste sources could be used to generate heat and electricity. Disposal sites in Namibia's main towns would be ideal for such energy-generating plants.
- Subterranean heat: Evidence of geothermal potential is found at various places across Namibia, for example |Ai-|Ais, Windhoek, Gross Barmen, and Rehoboth, but the scale of these resources remains largely unknown.
- Reserves of natural gas have been found offshore in the Atlantic Ocean, but their commercial development remains elusive because viable markets for the gas have yet to be secured.
- Coal: Using coal deposits in Namibia, such as those near Aranos, is not commercially viable with current technologies.
- Oil: Commercially viable oil reserves have not been discovered even though there are indications that exploitable resources potentially exist in various areas; exploration activities continue.

Finally, the Namibian government has prioritized enhancing energy access, yet a significant portion of the current energy demand remains unfulfilled. The existing grid struggles to reliably serve both industrial and urban customers. To address this, Namibia aims to increase the share of renewable energy sources (hydro, solar, wind, and biomass) in electricity production from 33% in 2010 to about 70% by 2030. Additionally, the country plans to implement an energy efficiency program to cut consumption by 10% by 2030. Other initiatives include launching a mass transport system in Windhoek to reduce the number of cars (both taxis and private) by approximately 40%, introducing a carpooling system to decrease fossil fuel consumption, and improving freight transportation through bulking to lower the number of light load vehicles by around 20% (Government of the Republic of Namibia, 2021).

#### *4.4.5.4 Health*

Namibia's healthcare system is divided between the public and private sectors, with distinct differences in access and quality of services across the country. Figure 4.38 shows the spatial distribution of health facilities by ownership - i.e., public or private - based on data from the 2023 Namibia Population and Housing Census. About 85% of the population access health care through the public sector, while 15% primarily depends on private health care and services. In urban areas, particularly in the capital, Windhoek and other major cities, residents generally have better access to healthcare facilities, which are often well-equipped and staffed. Conversely, rural areas face significant challenges, including a shortage of healthcare professionals, limited medical supplies, and inadequate infrastructure. This disparity is pronounced in remote regions, where residents may travel long distances to reach the nearest health centre.

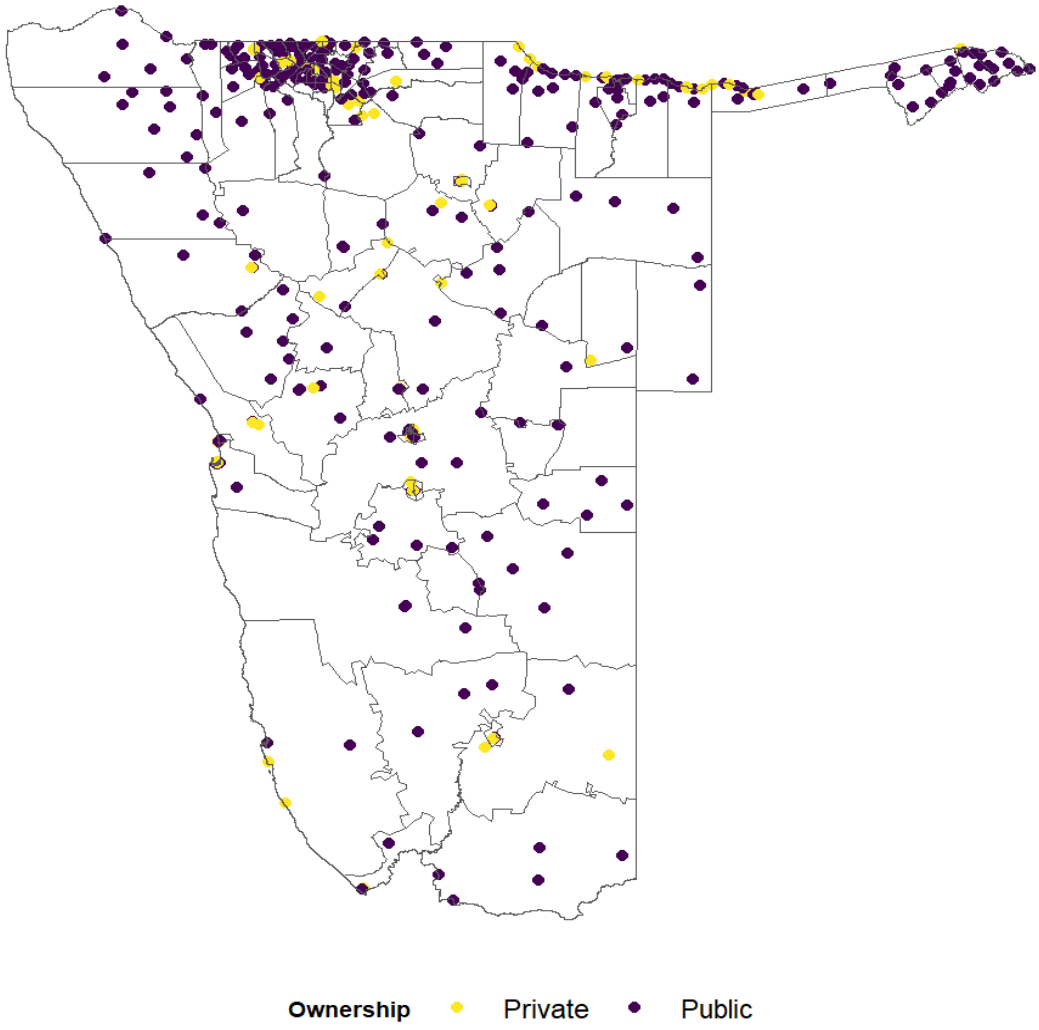



*Figure 4-38. Spatial distribution of health facilities in Namibia 2022*

Since 2000, Namibia's public expenditure on health has consistently been around 9.5% of GDP (see Figure 5.39). The Namibian government has made efforts to increase health funding to improve service delivery and infrastructure. However, the percentage of GDP allocated to health has slightly varied, often reflecting broader economic conditions and competing national priorities. Despite these efforts, the health sector still struggles with resource limitations, impacting the quality and accessibility of healthcare services, particularly in underserved rural areas. Moreover, the public healthcare system is heavily burdened by the high prevalence of communicable diseases, such as HIV/AIDS and tuberculosis, which consume a significant portion of the health budget. Investment in combating these diseases has been critical, yet it has sometimes overshadowed other essential health services, including maternal and child health, leading to mixed outcomes in public health indicators. While there have been strides in improving healthcare access and expenditure, Namibia continues to face challenges in ensuring equitable healthcare distribution and maintaining consistent public health funding to address both communicable and non-communicable diseases effectively.

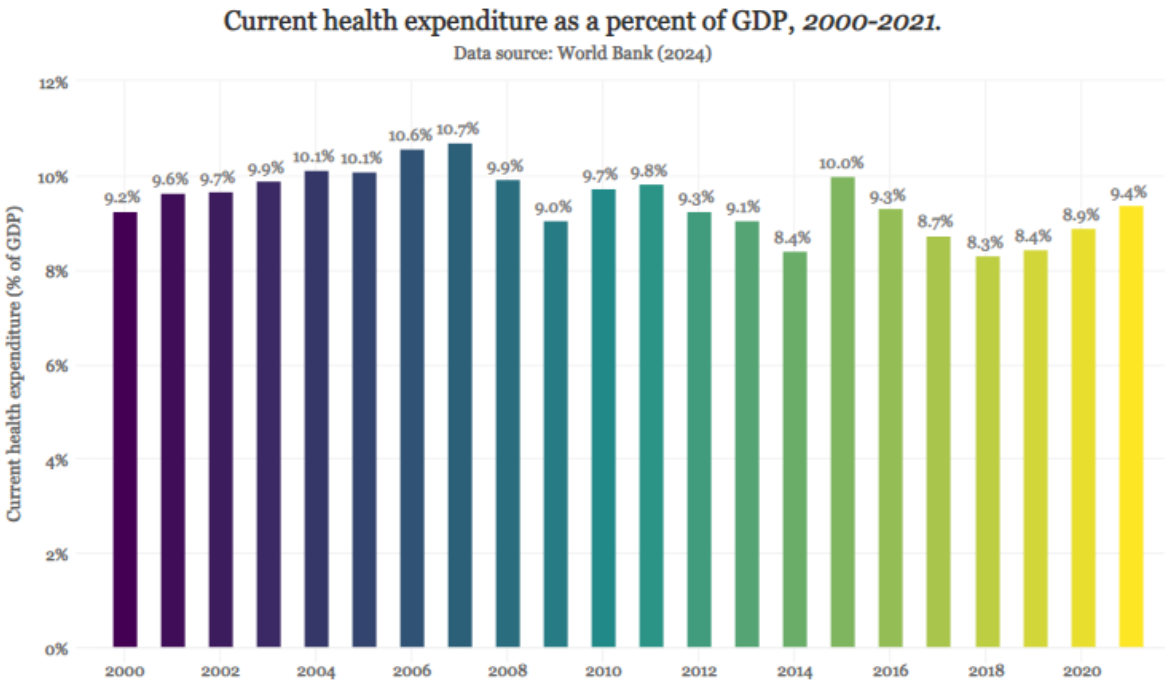



*Figure 4-39. Current health expenditure per cent of GDP, 2000-2021*

Namibia faces several significant healthcare challenges. While infant and child mortality rates are relatively low and on the decline since 2000 (see Figure 5.40), the level of under-5 mortality rate is still quite high for an upper-middle income country. Malnutrition is another severe concern, affecting up to 38% of children under five in some regions. This high rate of malnutrition can be attributed to several factors, including food insecurity, poverty, inadequate breastfeeding practices, and limited access to nutritious food. Malnutrition impacts children's physical growth, cognitive development, and overall health, making them more susceptible to diseases. The relatively high under-5 mortality rate and prevalence of malnutrition highlight critical issues in maternal healthcare, including insufficient prenatal and postnatal care, limited access to skilled birth attendants in rural areas, and a shortage of essential medical supplies and equipment.

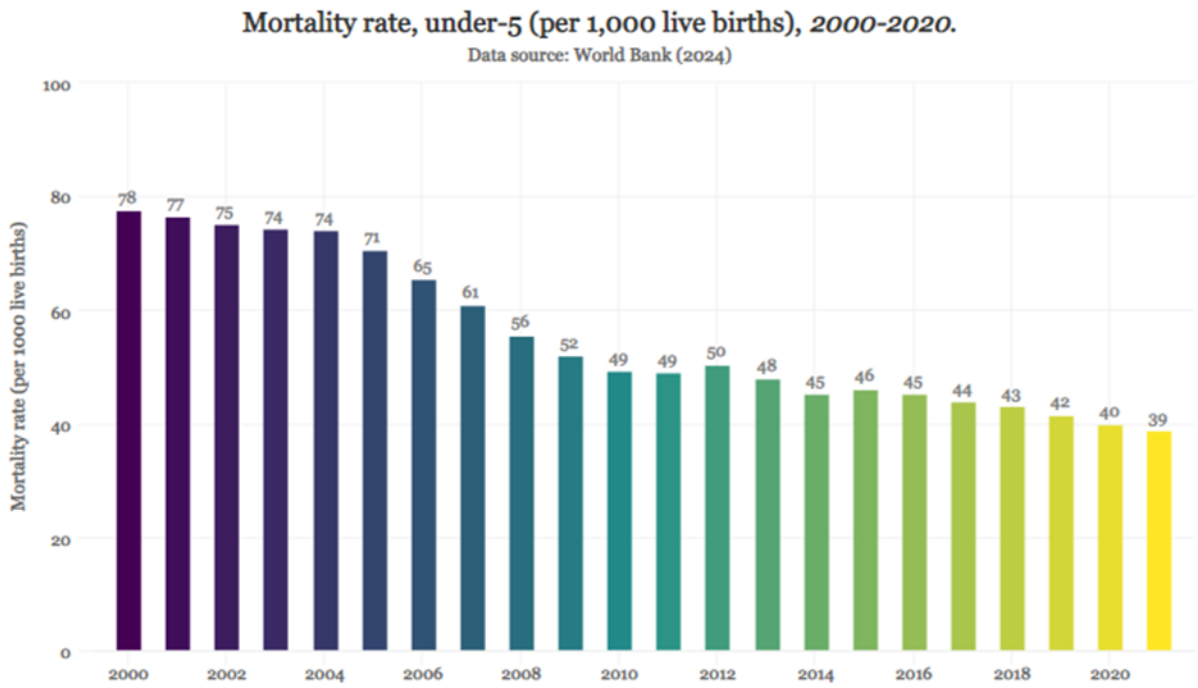



*Figure 4-40. Mortality rate, under 5 (per 1,000 live births), 2000-2020*

Life expectancy (Figure 5.41) has stagnated, primarily due to the ongoing HIV/AIDS epidemic, which has placed an immense burden on the healthcare system. The epidemic has strained resources, diverted attention from other crucial health services, and led to a high prevalence of opportunistic infections such as tuberculosis. The leading causes of inpatient deaths across all age groups are HIV/AIDS, diarrhoea, tuberculosis, pneumonia, and malaria. HIV/AIDS remains the most significant health challenge, contributing to a high number of deaths and complicating the management of other diseases. Diarrhoea and pneumonia, often linked to poor sanitation, limited access to clean water, and inadequate healthcare infrastructure, continue to claim lives, particularly among young children. Tuberculosis is a persistent threat exacerbated by the HIV/AIDS epidemic, which weakens the immune system and increases vulnerability to TB infection. The disease is challenging to control due to issues like drug resistance and the need for prolonged treatment regimens.

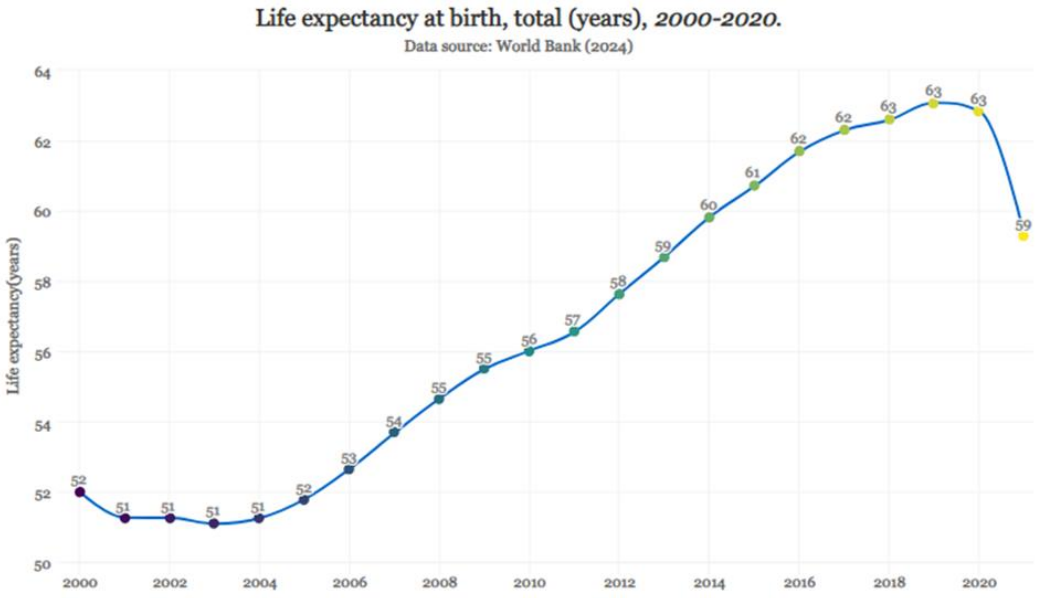



*Figure 4-41. Life expectancy at birth, total (years), 2000-2020*

Malaria is a major health problem, with its incidence fluctuating annually in correlation with climatic conditions such as temperature, rainfall, and humidity. Figure 5.42 shows the trend in malaria incidences per 1000 population at risk. Generally, malaria incidences are declining partly due to public investments in malaria prevention measures. However, malaria is endemic in the northcentral and northeastern regions of the country. In contrast, malaria transmission is seasonal in the northwestern and some central areas, following the rains and leading to potential epidemics. Efforts to control malaria are complicated by the variability in incidence and the need for sustained preventive measures, such as insecticide-treated nets and effective antimalarial drugs.

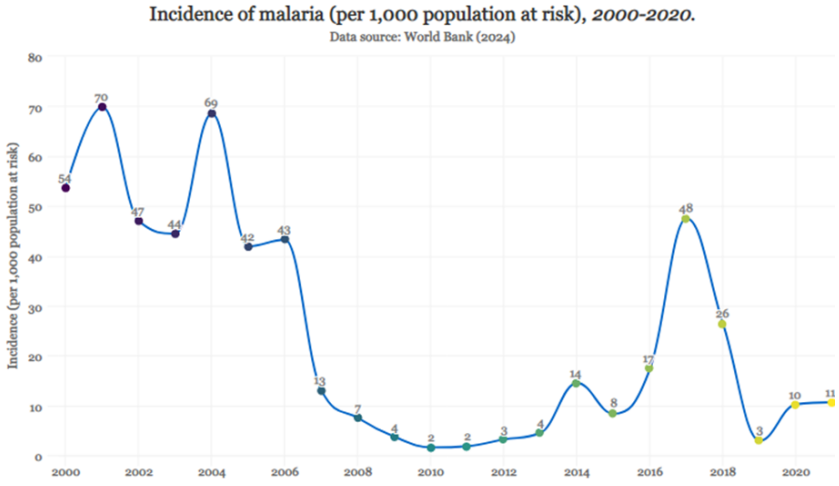



*Figure 4-42. Incidence of malaria (per 1,000 population at risk), 2000-2020*

Addressing these healthcare challenges in Namibia requires a multifaceted approach, including strengthening healthcare infrastructure, improving access to quality medical care in rural areas, enhancing disease prevention and control programs, and addressing underlying social determinants of health, such as poverty and malnutrition. Comprehensive and sustained investment in the health sector is crucial to improving overall health outcomes and ensuring

equitable access to healthcare for all Namibians. The Namibian government is responding to these challenges through a suite of policies, strategies, programmes, and plans. One such policy is the National Health Policy Framework 2010-2020 provides a comprehensive approach to improving the population's overall health status, focusing on health service delivery, strengthening health systems, and promoting health equity. Additionally, the Health Sector Strategic Plan (HSSP) outlines specific objectives to achieve these goals, prioritizing primary healthcare services, maternal and child health programs, combating major diseases such as HIV/AIDS, tuberculosis, and malaria, and improving health infrastructure and workforce capacity.

Another strategy is the National Strategic Framework for HIV and AIDS Response (2017-2022), which is aimed at reducing the incidence and impact of HIV/AIDS through prevention initiatives, expanding access to antiretroviral therapy (ART), and supporting community-based interventions. The National Tuberculosis and Leprosy Programme (NTLP) focuses on reducing tuberculosis and leprosy burdens by enhancing case detection, improving treatment outcomes, and addressing multidrug-resistant tuberculosis (MDR-TB). The National Malaria Strategic Plan (2017-2022) aims to eliminate malaria through vector control measures, strengthening surveillance systems, and promoting prompt and effective treatment.

The Maternal and Child Health (MCH) Strategy seeks to improve health outcomes for mothers and children by increasing access to prenatal and postnatal care, skilled birth attendance, and immunization programs. The National Health Information System Strategy enhances health data collection and utilization for evidence-based decision-making, while the Primary Health Care (PHC) Revitalization Strategy emphasizes the importance of primary healthcare as the system's foundation. The Health Workforce Development Plan addresses the shortage of healthcare professionals through training, retention strategies, and skills enhancement. The National Policy on Nutrition also aims to reduce malnutrition and promote healthy dietary practices. These policies and strategies are implemented and monitored through collaboration between the Ministry of Health and Social Services (MoHSS) and various stakeholders, ensuring that progress is tracked, and adjustments are made to create a more equitable, efficient, and effective healthcare system in Namibia.

On the climate change front, significant impacts and risks on Namibia's health sector manifest under the current climate and are anticipated under the future climate. Rising temperatures and changing precipitation patterns have influenced the prevalence and distribution of vector-borne diseases such as malaria. The fluctuation in temperature, rainfall, and humidity directly affects mosquito populations, potentially leading to increased incidence and outbreaks of malaria, particularly in northern and northeastern regions. These areas experience endemic malaria, while other parts of the country face seasonal transmission that heightens epidemic risks during and after rainy seasons (Atlas of Namibia Team, 2023; Government of the Republic of Namibia, 2020; World Bank, 2021).

Water scarcity, exacerbated by prolonged droughts and erratic rainfall, poses another critical challenge. Namibia is highly arid, and climate change intensifies water shortages, impacting sanitation and access to safe drinking water. Poor water quality and inadequate sanitation facilities increase the risk of waterborne diseases such as diarrhoea and cholera. These conditions are particularly severe in rural and underserved communities, where limited infrastructure and healthcare access is already constrained (Government of the Republic of Namibia, 2020).

Malnutrition, a significant health issue in Namibia, is expected to worsen with climate change. Variability in rainfall and extreme weather disrupt agricultural production, leading to food insecurity and affecting the nutritional status of vulnerable populations, particularly children under five. High malnutrition rates not only increase susceptibility to infectious diseases but also impair cognitive and physical development, exacerbating long-term health and economic burdens.

Extreme weather events, such as floods and droughts, threaten to damage healthcare infrastructure, disrupt service delivery, and displace communities. Floods can lead to outbreaks of diseases such as cholera and increase the breeding grounds for mosquitoes. In contrast, droughts can lead to crop failures and water shortages, compounding malnutrition and dehydration issues. These events strain healthcare resources and complicate emergency response efforts, highlighting the need for resilient health systems capable of withstanding climate-related shocks.

The health impacts of climate change also extend to mental health, as communities facing the loss of livelihoods, displacement, and increased mortality rates experience heightened stress and anxiety. This mental health burden is often overlooked but is crucial for comprehensive health planning and response.

Future projections indicate that these climate-related health risks will intensify, necessitating proactive and adaptive strategies to safeguard public health. Enhancing disease surveillance systems to monitor and respond to outbreaks promptly is critical. Strengthening health infrastructure, particularly in vulnerable regions, ensures facilities can withstand extreme weather and continue providing essential services. Promoting sustainable agricultural practices and water management can mitigate food and water security issues, reducing malnutrition and related health problems.

Integrating climate resilience into health policies and planning is essential. This includes training healthcare workers to address climate-related health issues, developing early warning systems for extreme weather events, and investing in research to understand the evolving health impacts of climate change. Collaboration between government agencies, international organizations, and local communities is vital to create comprehensive and effective responses.

Namibia remains committed to improving its healthcare system, service delivery, and resilience to climate change. However, without a specific focus on health and health-related developments, the Namibian population will face new or intensified disease burdens due to the direct and indirect impacts of climate change. Future challenges to the health system could include an increase in local and national epidemics and various outbreaks, which will impose additional demands on the existing health infrastructure.

Therefore, there is an urgent need to adapt and strengthen the resilience of the country’s health system. Namibia is dedicated to enhancing disaster risk management and preparedness, proactively managing forced migrations, improving cholera outbreak and malaria control, and addressing nutrition. These goals will be achieved partly through increased nutrition surveillance and improved staff training for malnutrition prevention and treatment. Additional training for community health workers is essential to provide emergency support and to strengthen transport and communication systems between health facilities. Enhancing water and sanitation systems is imperative, as is improving data collection and management to prepare for climate-induced events and changes.

#### *4.4.5.5 Biodiversity and Tourism*

Namibia, renowned for its vast landscapes and unique ecosystems, boasts a rich tapestry of biodiversity that underpins its thriving tourism sector. The country's diverse habitats range from the Namib Desert's arid expanses to the Zambezi region's lush wetlands (i.e., Caprivi Strip) in the north-eastern part of the country. Figure 4.43 shows Namibia's landscapes in terms of biomes and vegetation types. These landscapes are home to an array of flora and fauna, many of which are endemic. Iconic species such as the desert-adapted elephants, the rare black rhinoceros, and the cheetah thrive within Namibia's borders, drawing nature enthusiasts and wildlife photographers from around the globe.

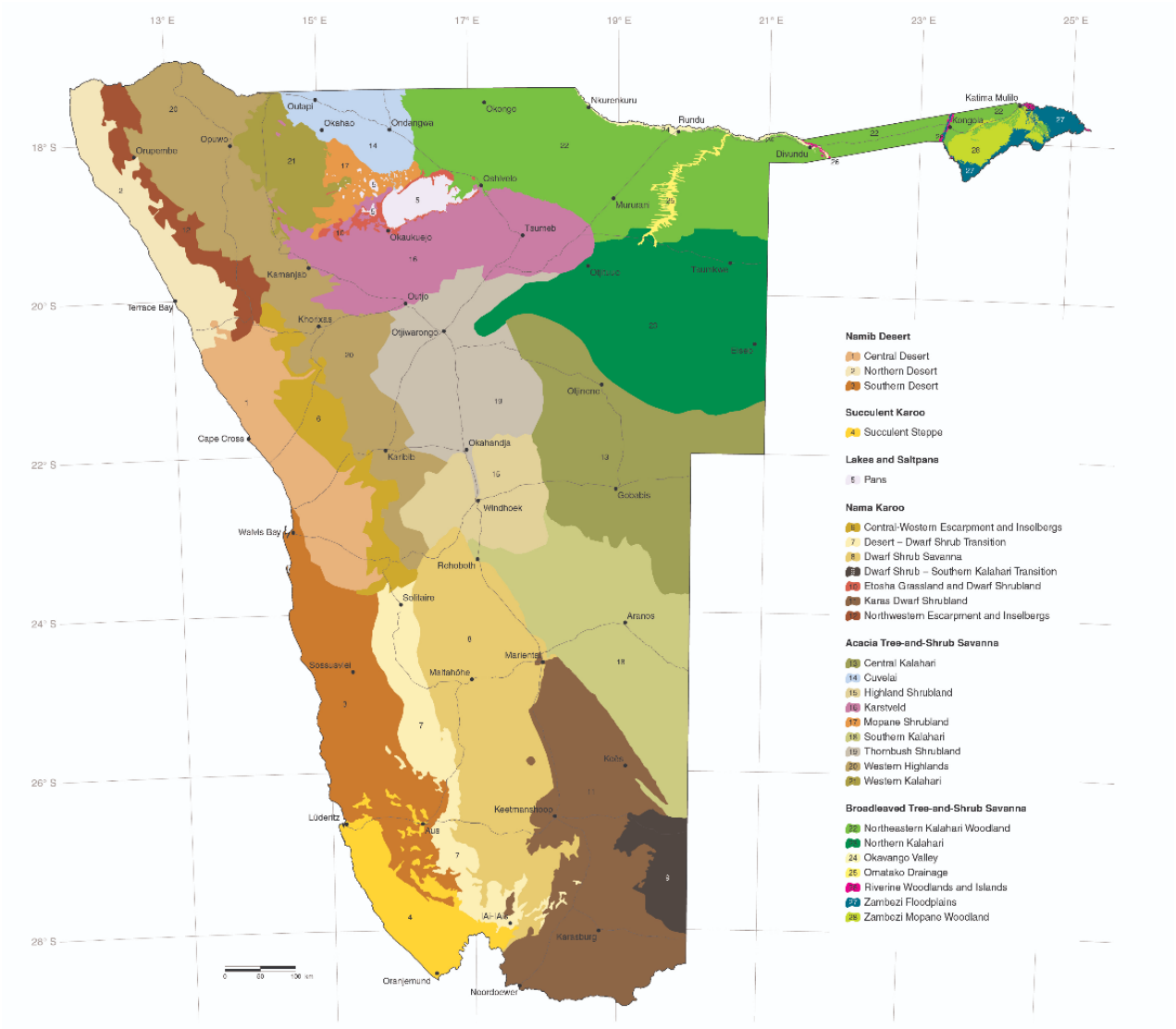



*Figure 4-43. Biomes and vegetation types in Namibia (Source: Atlas of Namibia Team (2023)).*

The Etosha National Park, one of Africa's premier wildlife reserves, and the Namib-Naukluft National Park, encompassing the striking Sossusvlei dunes, are pivotal in promoting ecotourism, a cornerstone of the nation's economy. Moreover, Namibia is one of the few countries in Africa as an internationally recognised "biodiversity hotspot". Namibia's most significant "biodiversity hotspot" is the Sperrgebiet, the restricted diamond mining area in the Succulent Karoo floral kingdom, shared with South Africa. The Succulent Karoo is the world's only arid hotspot. It

constitutes a refuge for an exceptional level of succulent plant diversity, shaped by the winter rainfall and fog of the Southern Namib Desert.

Namibia's unique landscapes and biodiversity support a rapidly developing tourism sector. Tourism has been the fastest-growing economic sector in Namibia in recent decades and one of the most valuable in terms of its contribution to the economy and employment. This is especially important in rural areas where sources of income are limited (Atlas of Namibia Team, 2023). In 2022, the sector directly contributed about 6.9% and 7.9% to national GDP and employment, respectively (MEFT (Ministry of Environment, Forestry, and Tourism), 2022a). Nature landscapes, wildlife, and increasing cultural interest dominate Namibia's tourism products. The Namibian landscape supports a remarkable biodiversity, especially its plant species.

More than 4,500 plant taxa have been recorded, almost 700 of which are endemic to the country and a further 275 of which are Namib Desert endemics. Other areas of concentrated endemic plant species are the Kaokoveld in the northwest, the Otavi highland in the Kalahari basin, the Kavango region in the northeast, the Auas Mountains on the western edge of the central plateau, and the southern Namib.111 The Etosha National Park is the most visited National Park, with 22% of all tourists travelling there and 53% of all holiday tourists (World Bank, 2021). Figure 4.44 shows the estimated value of nature-based tourism in Namibia.

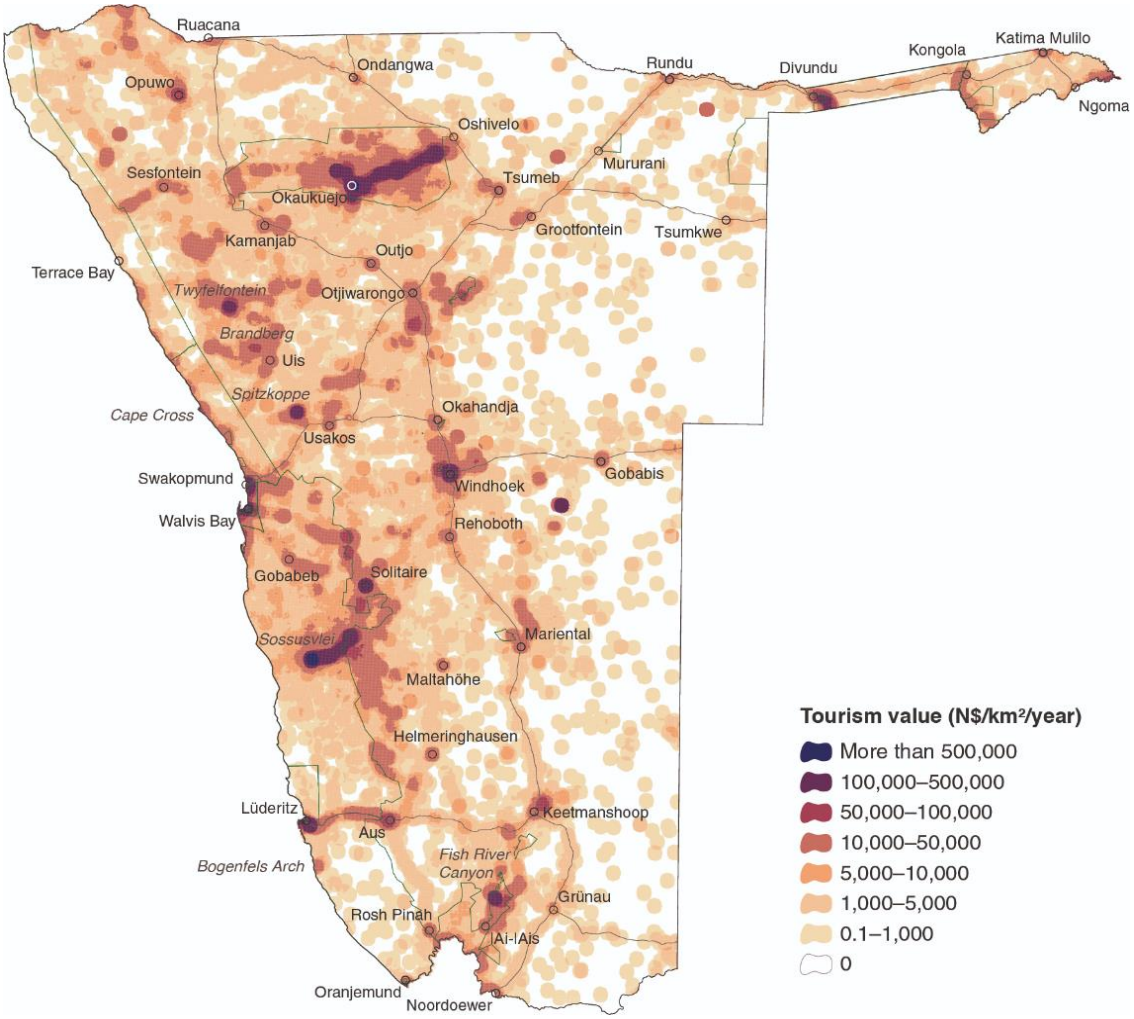



*Figure 4-44. Estimated value of nature-based tourism, 2019 (Source: Atlas of Namibia Team (2023)).*

Another important segment of Namibia's tourism sector is the Community-based Natural Resources Management (CBNRM) Program, a pioneering model for sustainable development that links conservation with socioeconomic growth and significantly enhances the country's tourism sector. Launched in the 1990s, the CBNRM program empowers local communities to manage and benefit directly from their natural resources, fostering a sense of stewardship and incentivizing conservation efforts. Under this program, communal conservancies are established, granting communities rights over wildlife and other natural resources. By 2021, 86 formally gazetted conservancies had spread throughout Namibia's communal land (see Figure 5.45). In total, about 375,569 $km^2$ (i.e., 45.6%) of Namibia is under some form of conservation in 2021. Figure 5.46 shows the trend in Namibia's area under conservation over the period 1975-2021. The rapid increase in community conservancies and forests from the 2000s onwards is attributed to the CBNRM program.

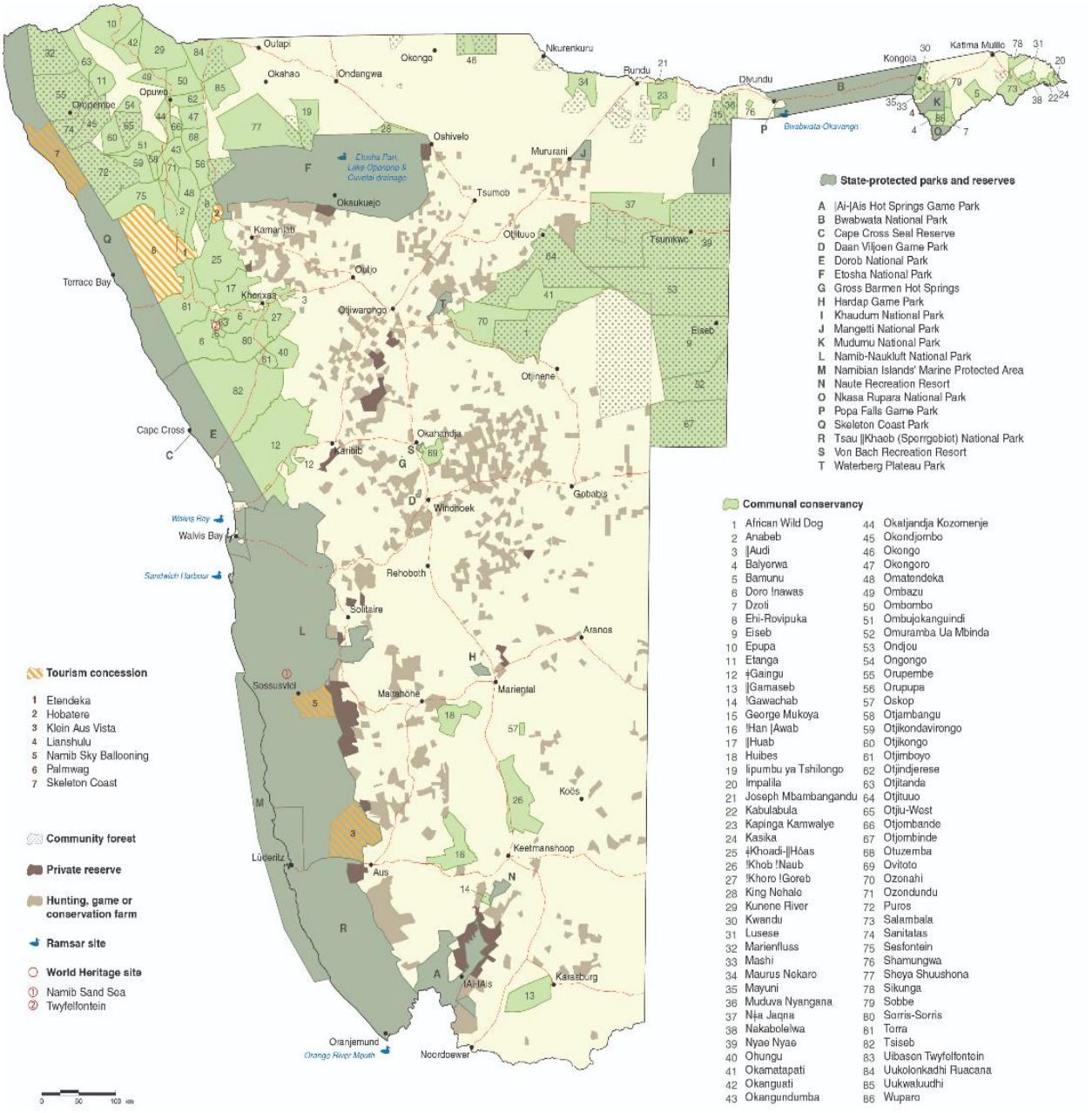



*Figure 4-45. Conservation areas, 2021 (Source: Atlas of Namibia Team (2023))*

The CBNRM program has led to remarkable conservation outcomes, including recovering key species such as the black rhinoceros and the desert-adapted elephants. It has transformed vast landscapes into thriving wildlife habitats. The success of the CBNRM program is integrally tied to Namibia's tourism industry, which is heavily dependent on its rich biodiversity and pristine natural environments. By creating conservancies, communities have become key players in the tourism market, developing eco-lodges, offering guided tours, and participating in wildlife management and anti-poaching activities. This not only generates revenue and employment opportunities for rural populations but also ensures that the benefits of tourism are equitably distributed. Moreover, the program enhances the visitor experience by providing authentic cultural interactions and insights into sustainable living practices.

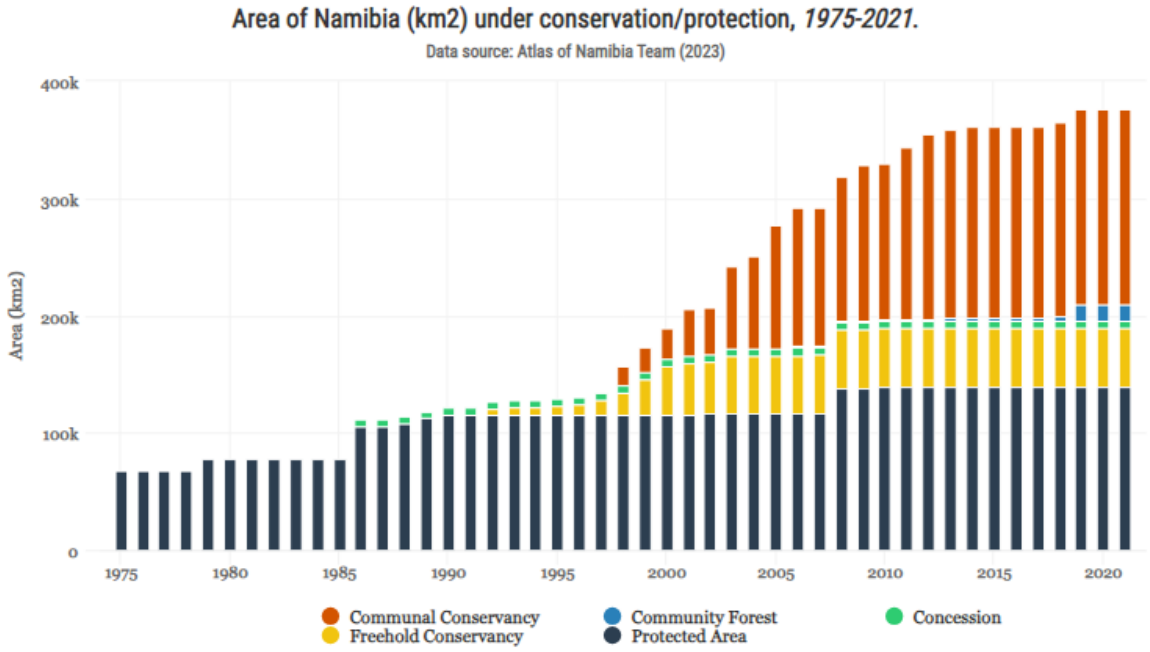



*Figure 4-46. Area of Namibia (km2) under conservation/protection, 1975-2021*

The CBNRM program's emphasis on community involvement and benefit-sharing has proven to be a robust mechanism for enhancing resilience against climate change impacts. By diversifying income sources and improving livelihoods, communities are better equipped to adapt to environmental changes. Additionally, the program's conservation achievements contribute to the stability and health of ecosystems, which are crucial for biodiversity and tourism. Namibia's commitment to CBNRM underscores its innovative approach to integrating conservation and community development, ensuring that tourism growth is sustainable and aligned with preserving its unique natural heritage.

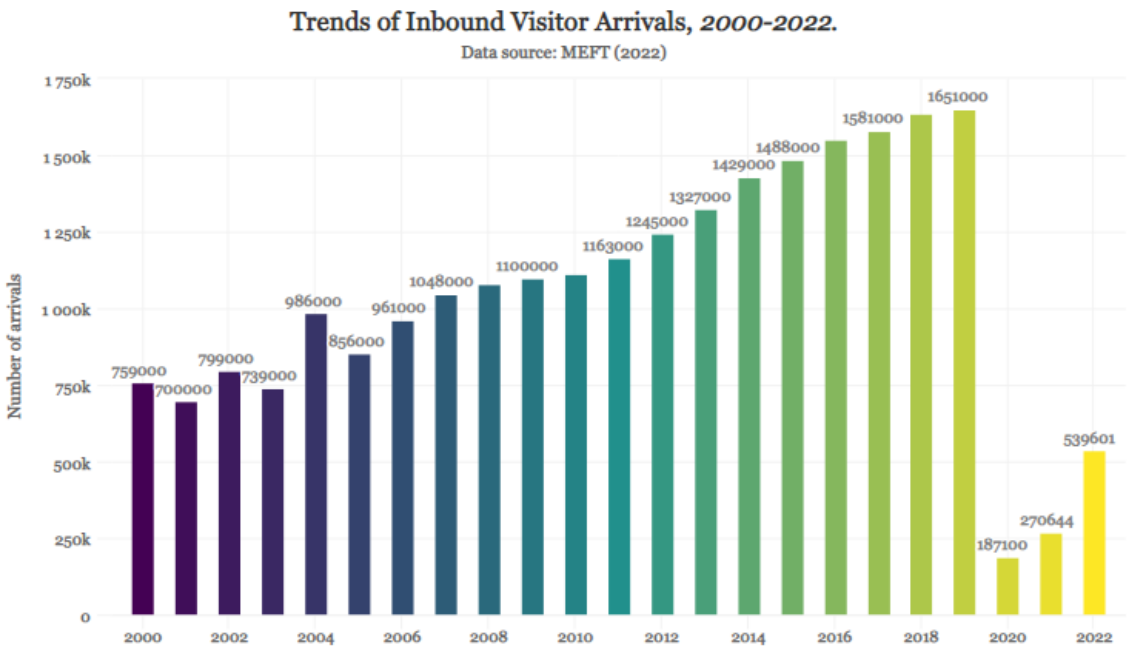



*Figure 4-47. Trends of Inbound Visitor Arrivals, 2000-2022*

International tourist arrivals to Namibia have displayed a consistent upward trajectory since independence, with the highest tourist arrivals of 1,651,000 recorded in 2019 (MEFT (Ministry of Environment, Forestry, and Tourism), 2022b). However, a departure from this trend occurred in 2020 due to the global onset of the devastating COVID-19 pandemic. 2020 witnessed a significant decline of about 89.0 per cent in the number of inbound overnight visitors Figure 4.47. This decline in international arrivals caused significant job losses in the sectors, with countless Namibians losing their main source of income as countless formal and informal businesses in the sector closed. However, a positive shift became visible from 2021 to 2022, signifying a gradual recovery and revival (Figure 4.47). The COVID-19 pandemic highlighted the vulnerability of Namibia's tourism to international arrivals.

Climate is a fundamental resource for tourism in Namibia, dictating the types of activities available and their suitability. There is a paucity of comprehensive assessments on the implications of climate change for Namibia's tourism sector. Existing studies suggest that the current and projected climate change impacts and risks on tourism remain largely uncertain and are primarily derived from the anticipated effects of climate change on biodiversity. Analysing the exposure to climate hazards, the sensitivity, and the adaptive capacity of tourism resources reveals that the northern regions of Namibia are the most susceptible to climate change. Specifically, the Kavango, Kunene, Zambezi, Omaheke, and Omusati regions are identified as highly vulnerable. Notably, Kavango and Kunene are expected to experience an increased vulnerability in their tourism sectors relative to the current situation (Government of the Republic of Namibia, 2020; World Bank, 2021).

Presently, changes in temperature and precipitation patterns are already affecting the distribution and health of key species and ecosystems that attract tourists. The increased frequency and intensity of extreme weather events, such as droughts and heat waves, exacerbate water scarcity and impact wildlife behaviour and habitats, reducing the appeal of natural attractions. Projected climate changes, including rising temperatures, altered rainfall regimes, and sea level rise, are expected to intensify these challenges. The anticipated reduction

in vegetation cover and shifts in species distributions could lead to substantial biodiversity losses, diminishing the unique natural experiences that draw tourists to Namibia (Government of the Republic of Namibia, 2020).

Projections of climate change impacts on biodiversity in Namibia indicate a significant reduction in vegetation cover across the central highlands by the 2050s, with further declines expected by the 2080s. These projections suggest a species loss of 40%-50% by 2050, increasing to 50%-60% by the 2080s. The spatial patterns of this loss will vary considerably. The most significant absolute reductions in plant biodiversity cover are projected for the Kaokoveld region in the extreme northwest and the Kalahari Basin in the southeast, with less significant reductions observed at higher altitudes in the central highlands (Midgley et al., 2005). Additionally, projections indicate that some non-arid areas in Namibia could become more arid. Desert and arid-land shrubs or grasslands are expected to encroach upon the country's grassy and mixed savannah areas. Under non-CO2 fertilization scenarios, arid vegetation is projected to increase by almost 20% by 2050 and up to 43% by 2080. However, with the effects of CO2 fertilization, this expansion will be limited to less than 30% by 2080. The reductions in savannah grasslands in favour of arid grasslands are likely to be more pronounced in Namibia's central highlands and northeastern plains. Furthermore, the frequency of forest fires is expected to rise due to increasing average and extreme temperatures, further impacting biodiversity (Government of the Republic of Namibia, 2020; Mapaure, 2011; World Bank, 2021).

In the desert regions, the impacts of climate change on plant species are expected to vary significantly. Projections indicate local plant extinctions of up to 80% (assuming no migrations) in northeastern and northern Kalahari. In contrast, only about 20% of extinction rates are anticipated in the coastal desert zones. The country's northeastern regions are likely to experience high species turnover, while the western and southwestern areas will see fewer species losses. Endemic plant species, which are more adapted to Namibia's arid and desert conditions, are expected to be less affected by climate change compared to exotic species, with projected losses not exceeding 19% by 2080 (Government of the Republic of Namibia, 2020; World Bank, 2021).

Namibia's coastline extends over 1,500 km and comprises 78% sandy beaches, 16% rocky shores, 4% mixed sandy and rocky shores, and 2% shores backed by lagoons. This coastline is vital for tourism and recreational activities, significantly contributing to the Namibian economy. Key coastal tourist attractions include Sandwich Harbor, the Wreck of the Skeleton Coast, and Walvis Bay Lagoon. However, projected sea level rise and coastal erosion threaten these attractions. Even conservative estimates of sea level rise, ranging from 0.4 m to 1.4 m, could result in the erosion of these key tourist landmarks. Walvis Bay, situated between 1-3 m above sea level in a semi-sheltered bay with an erodible coastline, is particularly vulnerable and could face total inundation. A sea level rise of just 0.3 m, considered virtually certain, would flood substantial areas, while a rise of 1 m would inundate most of the town during high tide (Government of the Republic of Namibia, 2020; World Bank, 2021).

Addressing the current and future climate change impacts and risks requires integrated adaptation strategies that align national tourism policies with climate change objectives. Examples of adaptation strategies, including enhancing sustainable tourism practices, promoting wildlife land use systems, and improving monitoring through a robust national conservancy information system, are critical steps. Furthermore, the Government of the Republic of Namibia (2020) outlines three broad adaptation strategies for the tourism industry: (i) capitalizing on the increasing demand for sustainable tourism as a response to climate

change; (ii) promoting wildlife land use systems to yield better land value compared to other sectors such as agriculture; and enhancing the national conservancy information system to include biodiversity and nature indicators for effective monitoring of climate change adaptation strategies. However, Namibia's national policy on tourism currently does not sufficiently address climate change. Therefore, there is a need to align the national tourism policy with the national climate change policy to ensure that tourism growth strategies are climate-proofed and that development in the sector remains sustainable (Government of the Republic of Namibia, 2020; World Bank, 2021). By fostering resilience within the tourism sector, Namibia can mitigate the adverse effects of climate change, ensuring that tourism remains a viable and sustainable economic driver while preserving its rich natural heritage.

### 4.4.6 Macroeconomic Impacts and Systemic Risks

Climate change profoundly challenges the Namibian economy, affecting overall economic and sectoral performance and other macroeconomic indicators. This section provides an economic perspective on these impacts and risks, focusing on the macroeconomic effects, systemic risks, and potential economic gains from complying with the Paris Climate Accord. Insights presented in this section are primarily drawn from Kompas, Pham, and Che (2018) and a modelling exercise undertaken to prepare this A-BTR to quantify the systemic risk of climate change to the Namibian economy. Kompas et al. (2018) is the most recent study that provides information on the effects of climate change on various economies (including Namibia) and the global economic gains from complying with the Paris Climate Accord. The section proceeds in two subsections. The first subsection uses relevant insights from Kompas et al. (2018) to present the macroeconomic impacts of climate change on the Namibian economy. The subsection also highlights Namibia's potential economic gains from complying with the Paris Climate Agreement. The second subsection presents the Namibian economy's systemic risk of climate change. Insights presented in this subsection are drawn from the climate risk modelling exercise that was done as part of the preparation of the A-BTR.

#### *4.4.6.1 Macroeconomic Impacts*

Climate change poses a significant threat to Namibia's long-term economic prosperity. Rising global temperatures and associated environmental disruptions are projected to adversely impact critical sectors of the Namibian economy, potentially leading to reductions in Gross Domestic Product (GDP) growth and overall economic output. Kompas et al. (2018) provide insights on the macroeconomic impacts of climate change in Namibia. Using a large dimensional and intertemporal computable general equilibrium (CGE) model that accounts for the various effects of global warming (e.g., loss in agricultural productivity, sea level rise, and health effects), Kompas et al. (2018) estimate the impacts of climate change on the real GDP growth and levels for 139 countries (including Namibia), by decade, starting in 2027 to 2097 (i.e., long term). Results from Kompas et al. (2018) relevant to Namibia are presented in Figure 5.48, which shows the annual percentage change (% Change/Year) in Namibia's real GDP by decade up to 2100. From Figure 5.48, potential losses in real GDP are projected to increase from about 0.08% per year in 2027 to about 2.4% by the end of the century (i.e., 2097).

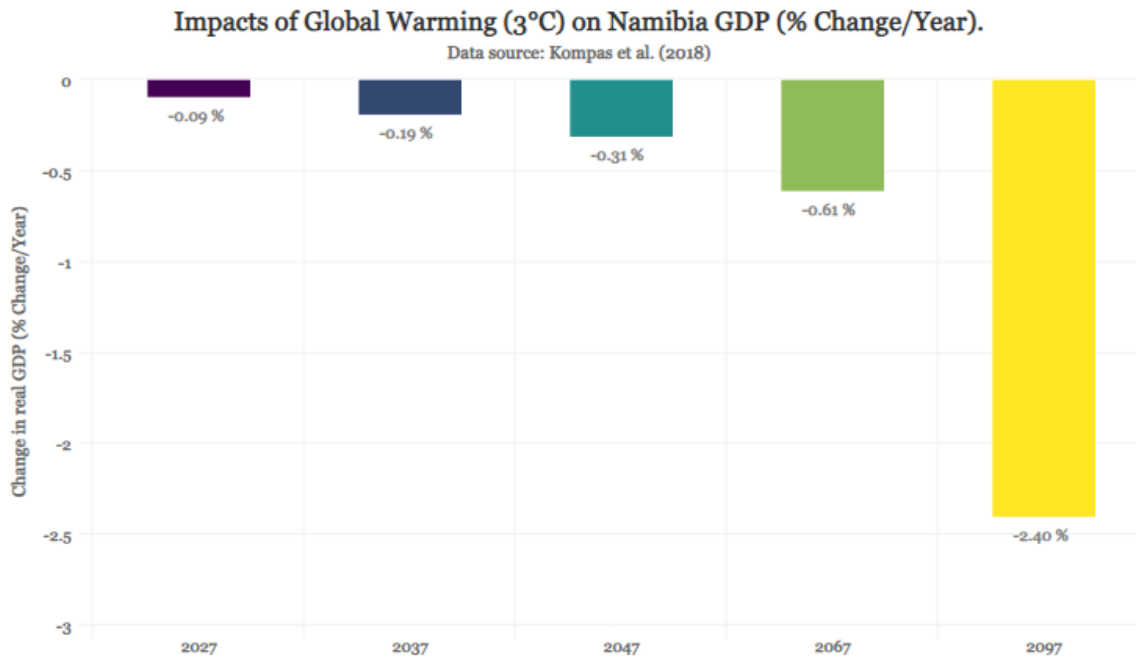



*Figure 4-48. Impacts of Global Warming (3°C) on Namibia GDP (% Change/Year)*

Furthermore, Kompas et al. (2018) also estimate the long-run impacts on real GDP under four global warming scenarios (i.e., 1°C, 2°C, 3°C, and 4°C) corresponding to four Representative Concentration Pathways (RCPs). More specifically, the 1°C scenario corresponds to RCP2.6 and assumes the implementation of more stringent mitigation policies that achieve global warming would increase by about 1°C by 2100. The 2°C scenario corresponds to RCP4.5, reflecting the implementation of the Paris Agreement that achieves global warming increase of about 2°C by 2100. The 3°C scenario corresponds to RCP6 and reflects the implementation of less stringent mitigation policies that would increase global surface temperatures to about 3°C by 2100. Finally, the 4°C scenario corresponds to RCP8.5 and assumes no countervailing action to reduce emissions, increasing global warming to about 3°C by 2100. The results relevant to Namibia are presented in Figure 4.49. The potential long-run losses in Namibia's real GDP, related to climate change, are estimated to range from 0.7% per year under the best-case scenario (i.e., 1°C by 2100) to 3.6% per year under the worst-case scenario (i.e., 4°C by 2100).

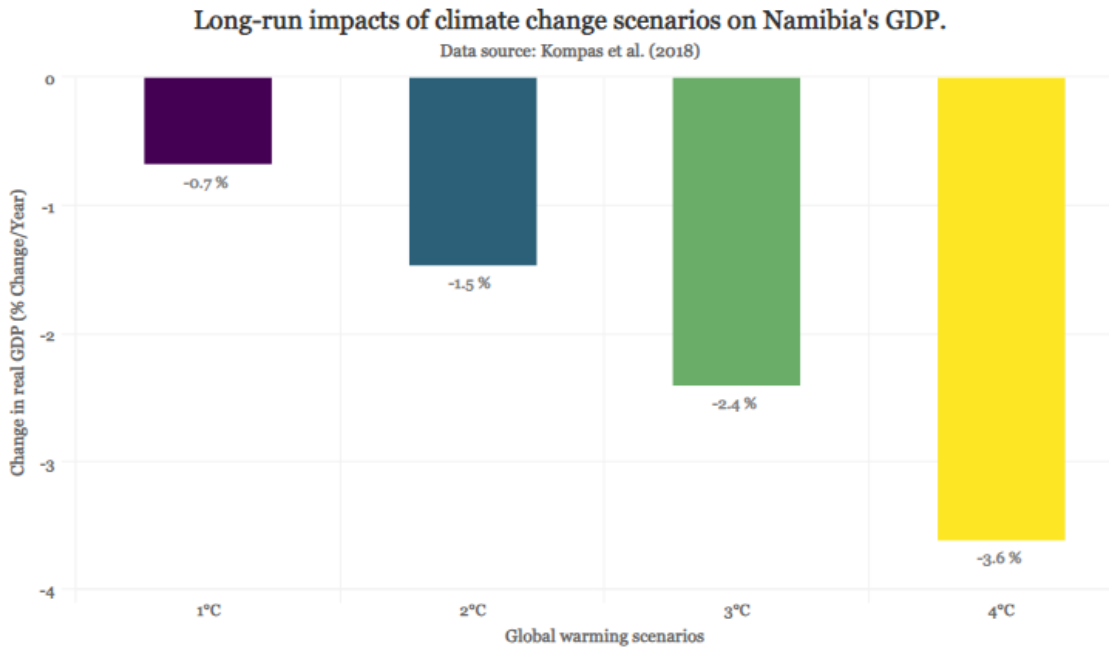



*Figure 4-49. Long-run impacts of global warming scenarios on Namibia's GDP*

The potential gains for Namibia that are associated with complying with the Paris Agreement can be estimated based on the data presented in Figure 4.49. The Paris Accord's achievement implies keeping global warming at roughly 2°C (or RCP4.5) or less. Therefore, the potential economic gains of the Accord can be estimated as the difference in losses between the 4°C, 3°C, and 2°C scenarios. As such, the long-term benefits for Namibia associated with compliance with the Paris Accord range between 0.9% per year and 2.1% per year in avoided real GDP losses.

#### *4.4.6.2 Systemic Risk of Climate Change*

Systemic risk, in the context of climate change, refers to the potential for climate-related events - i.e., variability in temperature and precipitation - to trigger widespread disruptions across various sectors of an economy, leading to cascading failures that amplify the initial impact. Unlike localized or sector-specific risks, systemic risks can destabilize entire economic systems due to the interconnected nature of economic systems. These risks arise from the dependencies and interactions between different sectors, where a shock in one area can propagate through the economy, causing broader economic instability and significant socioeconomic consequences.

A modelling framework that leverages Graph and Markov Chain formalism was used to quantify the systemic risk posed by climate change on the Namibian economy. This approach allows for estimating the likelihood of negative shocks in temperature and precipitation leading to cascading failures across multiple sectors of the economy. Briefly, the modelling framework employs graph formalism to learn a graph representation of the relationship between various sectors of the Namibian economy and climate variables - i.e., temperature and precipitation. Under this graph, nodes represent different economic sectors (e.g., agriculture, tourism, fisheries, infrastructure, health) and climate variables (e.g., temperature and precipitation), and edges represent the conditional dependencies and interactions among these sectors and between these sectors and the climate variables.

The conditional dependencies among the economic sectors and between the economic sectors and climate variables (i.e., temperature (tas) and precipitation (prec)) is shown in Figure 4.50.

The nodes (circles) are the economic sectors and climate variables, and the edges or links reflect the conditional dependencies - i.e., more specifically, normalized partial correlations among the nodes. The graph shown in Figure 4.50 was learned by using percentage changes in real GDP for each economic sector and annual percentage change in climatic variables - i.e., annual average surface air temperature and annual average precipitation - as data inputs into a regularized Gaussian Graphical Model as proposed by Friedman, Hastie, & Tibshirani (2008) and Meinshausen & Bühlmann (2006).

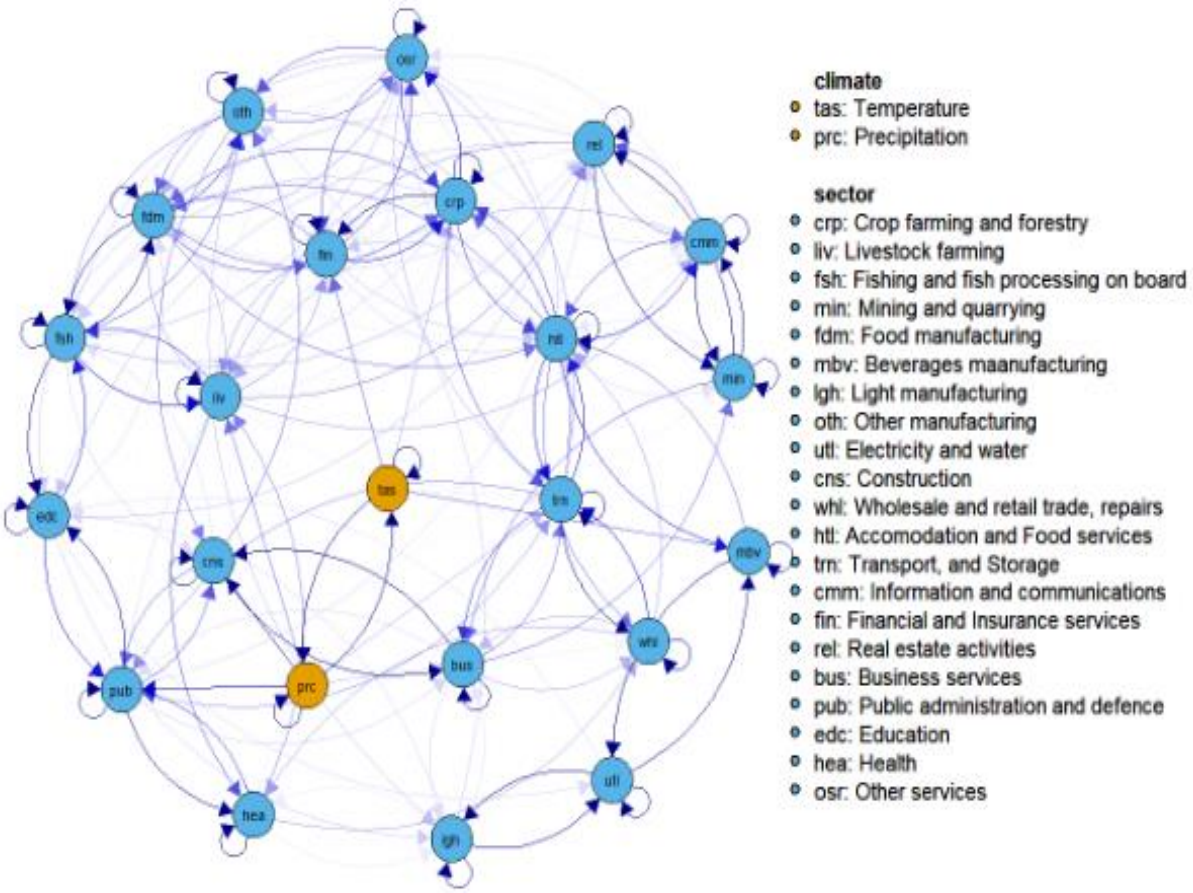



*Figure 4-50. A network of the Namibian Economy showing conditional dependencies between and among economic sectors and climate variables*

**Figure 66: A network of the Namibian Economy showing conditional dependencies between and among economic sectors and climate variables.**

To quantify systemic risk, a Discrete-Time Markov Chain Model (DTMC) was constructed using the learned graph (refer to Figure 4.50) to simulate the propagation of climate-induced shocks through the economy. In this formalism, the state of each sector (node) is determined by the probability of experiencing a negative shock, such as extreme temperature or precipitation events. The graph's adjacency matrix was normalized into a stochastic matrix, capturing the transitional probabilities of the DTMC. This normalization involved adjusting the edge weights of each node so that they range between zero and one. These normalized edge weights represent the propagation of climate-induced shocks from climate nodes (i.e., temperature and precipitation) to other nodes (i.e., sectors of the Namibian economy) in the graph.

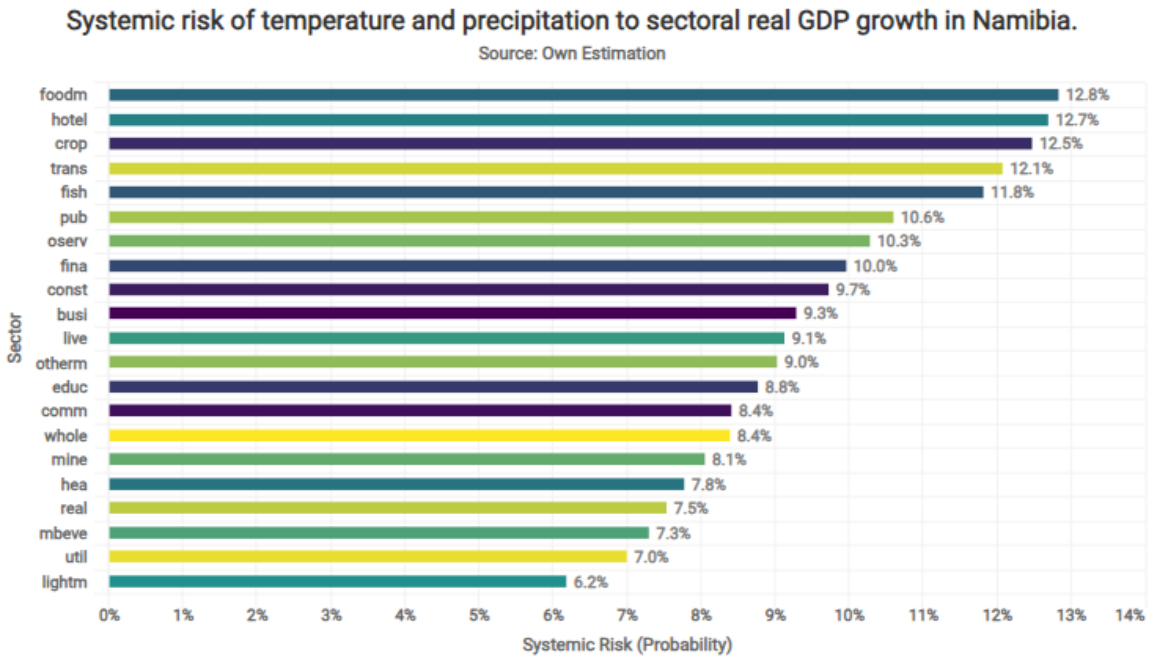



*Figure 4-51. Systemic risk of temperature and precipitation to sectoral real GDP growth in Namibia.*

The estimated systemic risk of extreme temperature and precipitation in various sectors of the Namibian economy is presented in Figure 4.51. Across all the sectors of the Namibian economy, systemic risk ranges between 6% to 12%. This means that the likelihood of extreme temperature and precipitation events causing cascading failures in the Namibian economy is at least 6%. Food manufacturing (foodm), accommodation and food services (hotel), and crop farming and forestry (crop) are the top three sectors with the highest systemic risk. The following is the summary of the main insights from modelling the systemic risk of climate change:

- The food manufacturing sector is highly vulnerable to disruptions in raw material supply caused by extreme weather events. Negative shocks in temperature and precipitation can lead to reduced agricultural output, directly affecting food manufacturing processes. This sector's high interconnectedness with agriculture and retail amplifies the systemic risk.

- The tourism industry, particularly accommodation and food services, is significantly impacted by climate variability. Extreme temperatures and erratic precipitation patterns can deter tourist arrivals and disrupt tourism activities. This reduces revenue from tourism and affects related sectors, such as transportation and local businesses, highlighting the systemic nature of the risk.

- Agriculture, particularly crop farming and forestry, is one of the most climate-sensitive sectors. Extreme weather events like heatwaves, droughts, and heavy rainfall can drastically reduce crop yields and forest productivity. These disruptions have cascading effects on food security, trade, and livelihoods, exacerbating the overall economic impact.

Understanding the systemic risk of climate change on the Namibian economy is crucial for developing effective adaptation and mitigation strategies. The findings of this modelling exercise

underscore the need for comprehensive, cross-sectoral approaches to enhance resilience and reduce vulnerability. These contra vailing actions could include:

- Climate-Resilient Agriculture: Implementing climate-resilient agricultural practices, such as drought-resistant crops, improved irrigation systems, and agroforestry, can help buffer the sector against climate shocks. Supporting smallholder farmers with training and resources is critical to enhancing their adaptive capacity.

- Sustainable Tourism Development: Developing tourism strategies that prioritize sustainability, and resilience can help protect natural attractions and ensure the sector's long-term viability. This includes promoting eco-tourism, enhancing conservation efforts, and investing in climate-resilient infrastructure.

- Strengthening Infrastructure: Investing in resilient infrastructure that can withstand extreme weather events is vital. This includes designing and constructing roads, bridges, and buildings to be more durable and adaptable to changing climate conditions.

- Integrated Water Resource Management: Implementing strategies for sustainable water management is essential to mitigate the risks associated with water scarcity. This includes investment in water-saving technologies, water storage and distribution infrastructure, and policies promoting efficient water use across sectors.

- Cross-Sectoral Coordination: Effective adaptation requires coordination across sectors and governance levels. Establishing mechanisms for integrated planning and decision-making can ensure that adaptation measures are coherent, efficient, and mutually reinforcing.

- Public Health Preparedness: Enhancing public health systems to cope with climate-related health risks is crucial. This involves improving disease surveillance, increasing healthcare capacity, and implementing community health programs to address climate-induced health challenges.

The systemic risk of climate change on the Namibian economy is significant and multifaceted, affecting various sectors through interconnected pathways. We can better understand and quantify these risks by leveraging Graph and Markov Chain formalism, providing valuable insights for policymakers and stakeholders. Proactive and integrated adaptation strategies are essential to enhance resilience, mitigate systemic risks, and ensure sustainable economic development in a changing climate. Integrating climate considerations into economic planning is imperative to safeguard Namibia’s economic stability and ensure the well-being of its population.

#### 4.4.7 Vulnerability to climate risk

Namibia’s population faces significant vulnerability to climate risks. A comprehensive composite index was developed and used to measure climate risk at the household level in Namibia to gain a deeper and more nuanced understanding of this vulnerability. This index called the climate risk index, is built on the index developed and used by the Government of the Republic of Namibia (2020) to measure climate change vulnerability across the constituencies in Namibia. The developed climate risk index is informed by the IPCC’s definition of climate risk, which considers it a function of three components: exposure, sensitivity, and vulnerability to climate-related hazards (Costa et al., 2023; Jarvis et al., 2021; Pachauri et al., 2014; Trisos et al.,

2022). The index is a powerful tool for identifying and quantifying households' risks due to climate change, allowing for targeted adaptation strategies.

The climate risk index is a composite measure that integrates three distinct indices—exposure, sensitivity, and vulnerability. Each of these indices is represented by carefully selected proxy measures that reflect the specific conditions and challenges faced by households in Namibia. Exposure, the first component, refers to the degree to which households are subject to climate-related hazards and is captured by the Aridity Index. The Aridity Index is a robust measure of climate variability, reflecting the frequency and intensity of dry conditions that can severely impact livelihoods, particularly in regions heavily dependent on rain-fed agriculture and water resources.

Sensitivity, the second component, indicates the extent to which households are affected by climate-related events and is proxied by household size. Larger households tend to have more dependents, which can strain resources and reduce the ability to cope with and recover from climate impacts. This makes them more sensitive to climate-related stresses, such as food and water scarcity, exacerbated by climate change.

Vulnerability, the third component, is assessed using the Multidimensional Poverty Index (MPI), which captures a broad spectrum of deprivation that households may experience. The MPI includes factors such as education, health, and living standards, influencing a household's capacity to respond to and recover from climate shocks. Households with higher levels of multidimensional poverty are generally less resilient and more vulnerable to the adverse effects of climate change.

The motivation behind the use of the climate risk index lies in its ability to provide a holistic view of climate risk at the household level, considering not just the physical exposure to climate hazards but also the social and economic factors that affect a household's ability to cope. By integrating these three dimensions—exposure, sensitivity, and vulnerability—the index offers a comprehensive measure that reflects the real-world complexities of climate risk.

The rationale for the selected proxy measures is grounded in their relevance to the Namibian context. The Aridity Index is essential in Namibia, where arid and semi-arid conditions dominate, and water scarcity is a critical issue. Household size is a pertinent measure of sensitivity, as larger households are more likely to experience resource constraints in times of climate stress. The Multidimensional Poverty Index provides a multidimensional view of vulnerability, capturing the intersection of various forms of deprivation that limit households' adaptive capacities.

The climate risk index generated a hotspot map, highlighting the spatial distribution of household climate risk exposure across Namibia's 122 constituencies. This map is a crucial tool for guiding climate change adaptation efforts in Namibia. By identifying areas where households are most at risk, policymakers and stakeholders can prioritize interventions and allocate resources more effectively, ensuring that the most vulnerable populations receive the support they need to build resilience against the impacts of climate change. Additional details about the components of the climate risk index and the climate risk hot-spot map are provided in the following subsections.

#### *4.4.7.1 Exposure to Climate Risk*

Exposure to climate hazards is a key component of the IPCC's climate risk framework and the climate risk index developed for the A-BTR. In this report's climate risk hotspot map, the Aridity Index (AI) is used as a proxy measure of exposure across Namibia's constituencies. The AI is calculated as the ratio between average annual precipitation and average annual potential

evapotranspiration (PET), providing a composite indicator that quantifies the degree of dryness in a particular area. Constituencies with lower AI values are more water-stressed, indicating a higher susceptibility to drought and other climate-related risks.

The AI is a particularly effective proxy for climate hazards because it directly captures moisture availability by reflecting the balance between rainfall and evapotranspiration rate. This makes it a crucial metric for identifying regions exposed to water scarcity, extreme temperatures, low precipitation, and drought—all significant climate hazards threatening agricultural productivity, water resources, and overall economic stability in Namibia. The AI also highlights the variability in climatic conditions, offering a spatially explicit measure of climate risks critical for identifying areas most vulnerable to these hazards. As shown in Figure 4.52, the spatial distribution of AI across Namibia, with constituencies as the unit of analysis, provides valuable insight into the climate risks faced by different regions of the country.

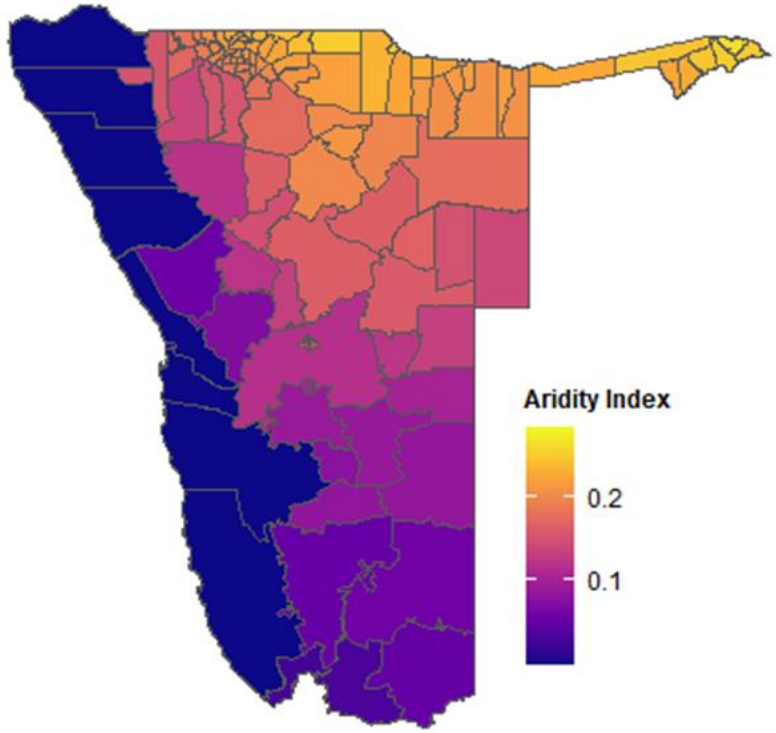



*Figure 4-52. Aridity Index values across constituencies in Namibia*

A global dataset or raster on the Aridity Index (at 30-second grid resolution) from Zomer, Xu, and Trabucco (2022) was used to generate Figure 4.52. The AI values relevant to Namibia range from 0 to 0.27, with areas or constituencies in the country's far northern and northeastern margins generally having the highest values. Typically, AI values are classified into Humid (AI > 0.65), Semi-Humid (0.5 < AI ≤ 0.65), Semi-Arid (0.2 < AI ≤ 0.5), Arid (0.05 < AI ≤ 0.20), and Hyper-Arid (AI ≤ 0.05). Based on this classification, most constituencies are in an arid environment (i.e., AI values range between 0.02 and 0.20), with constituencies along the coastal belt being hyper-arid.

#### *4.4.7.2 Sensitivity to climate risk*

The population was used as a proxy measure of sensitivity to climate hazards at the constituency level. Using population as a proxy measure for sensitivity is highly effective within the IPCC's climate risk framework because it directly relates to the degree to which communities are affected by climate hazards. Populated areas typically have higher concentrations of

infrastructure, economic activities, and social services, all susceptible to climate impacts. A larger population also indicates more people at risk, amplifying the potential for adverse health, economic, and social outcomes. By incorporating population data, the climate risk hotspots map can more accurately reflect the vulnerability of human systems to climate hazards, guiding targeted adaptation and mitigation efforts to protect those most at risk. Using the data from the 2015/2016 Namibia Household Income and Expenditure Survey (NHIES) (Namibia Statistics Agency, 2016), Figure 4.53 shows the number of people across constituencies in Namibia.

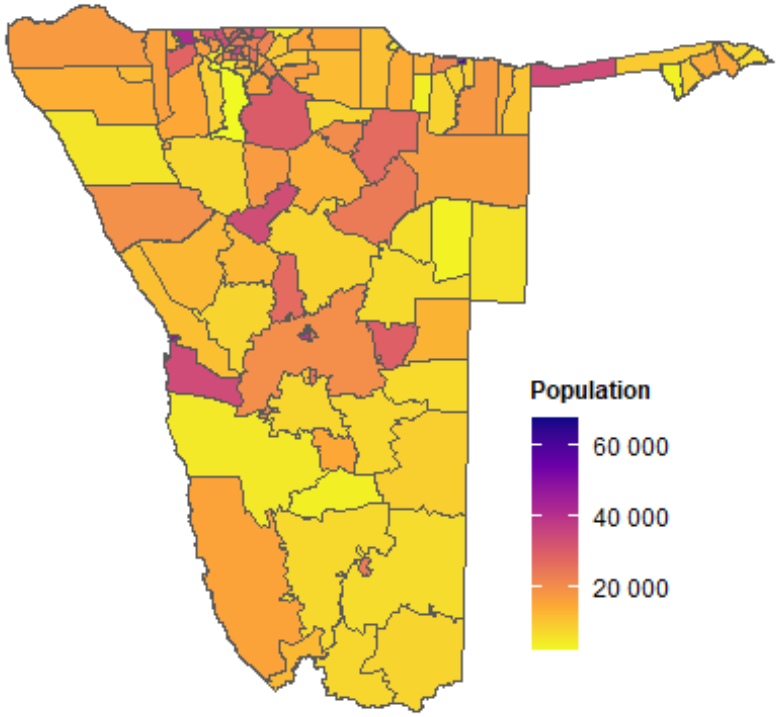



*Figure 4-53. Population across constituencies in Namibia*

Population dynamics at the constituency level exhibit significant variability, with constituencies in urban areas generally having higher population densities compared to those in rural. Most constituencies in the Khomas Region, where the capital city Windhoek is located, are densely populated, reflecting urban migration and concentration of economic activities. Similarly, constituencies in the Erongo Region, particularly those overlapping coastal towns of Swakopmund and Walvis Bay, also have high population densities due to economic opportunities in tourism, fishing, and mining. In contrast, constituencies in northern regions such as Oshana, Omusati, Ohangwena, and Oshikoto have high rural population densities driven by agricultural activities and higher rural community settlements. Within the climate risk framework used to create the hotspots map, constituencies with high populations are deemed highly sensitive to climate hazards.

#### *4.4.7.3 Vulnerability to climate risk*

The multidimensional poverty index (MPI), encompassing deprivations across health, education, and living standards, offers a strong proxy measure for vulnerability to climate risks as defined by the IPCC's framework. Since the IPCC framework highlights the social context of climate risk, the MPI's consideration of these essential dimensions captures a population's limited capacity to cope with and adapt to climate-induced shocks and stresses. Households struggling with

multidimensional poverty likely have weaker access to resources, infrastructure, and social safety nets, leaving them less prepared to handle disruptions caused by climate change, such as extreme weather events, resource scarcity, and livelihood insecurity. Therefore, the MPI serves as a valuable tool for identifying communities most susceptible to the negative consequences of climate change.

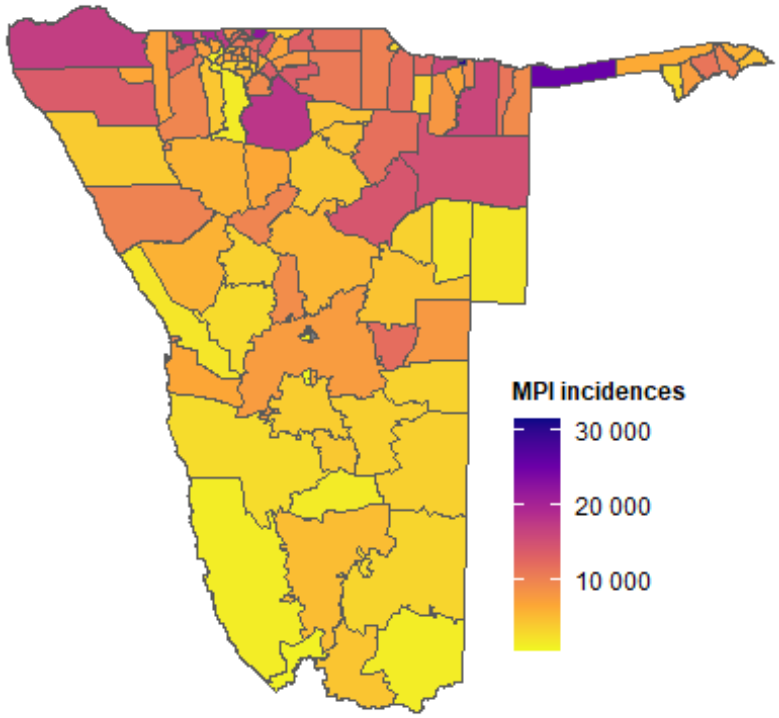



*Figure 4-54. Incidence of multidimensional poverty across the constituency in Namibia.*

Using data from the 2015/2016 NHIES as well as the methodology for estimating MPI developed by the Namibia Statistics Agency (Namibian Statistics Agency, 2021), Figure 4.54 shows the spatial distribution of the incidence of multidimensional poverty across constituencies, i.e., the number of multidimensionally poor people by constituency. The spatial distribution of multidimensional poverty in Namibia exhibits significant regional disparities, with higher concentrations of poverty in constituencies in the northern and northeastern regions, particularly in Kavango East, Kavango West, Zambezi, and Kunene. These areas are characterized by limited access to essential services such as education, healthcare, clean water, and inadequate infrastructure and economic opportunities. Conversely, regions like Khomas and Erongo, encompass urban centres like Windhoek and Swakopmund, show lower multidimensional poverty levels due to better access to services and economic activities. This uneven distribution underscores the heightened vulnerability of impoverished areas to climate risks, as their lack of resources and infrastructure impedes effective adaptation and resilience-building measures, making targeted interventions crucial for equitable climate risk management.

#### *4.4.7.4 Climate Risk Index and Hotspots Map*

The climate risk hotspots map was developed by estimating a climate risk index at the household level, adhering to the IPCC's climate risk framework. This index integrates data on a household's exposure, sensitivity, and vulnerability to climate risk, with specific proxy measures for each element, as alluded to above. The Aridity Index, household size, and the Multidimensional

Poverty Index were used as proxy measures for exposure, sensitivity, and vulnerability, respectively. As already mentioned above, data for the Aridity Index came from Zomer et al. (2022), while household size (i.e., population) and MPI were extracted from the 2015/2016 Namibia Household Income and Expenditure Survey (NHIES). The following score system was used to measure the exposure, sensitivity, and vulnerability as well as the climate risk index of each household in the NHIES:

- Exposure refers to the likelihood of experiencing climate hazards like droughts. The Aridity Index was used as a proxy, with higher scores assigned to households in drier regions (hyper-arid = 3, arid = 2, semi-arid = 1, and humid = 0). The AI threshold for hyper-arid was less than on equal 0.03; 0.03-0.2 for arid, 0.2-0.5 for semi-arid, and above 0.5 for humid.

- Sensitivity: This reflects how household size might influence their ability to cope with climate hazards. Larger households (above the 75th percentile) received a higher score (4) compared to smaller ones (below the 25th percentile, score 1).

- Vulnerability: This represents the household's overall susceptibility to climate impacts. Multidimensional poverty was used as a proxy, with multidimensionally poor households receiving a score of 1 (highly vulnerable) and non-poor households receiving a score of 0.

The resulting exposure, sensitivity, and vulnerability scores were then weighted to reflect their relative importance in determining climate risk. Vulnerability was considered the most significant factor (weight = 0.5), followed by exposure (weight = 0.1) and sensitivity (weight = 0.05). The weighted scores for each household were then summed to create a final climate risk index. This index was then categorized into three risk classes based on percentiles:

- Low Risk (below 25th percentile)

- Medium Risk (between 25th and 50th percentile)

- High Risk (above 50th percentile)

Finally, these risk classes were used to create the climate risk hotspots map. This map visually identifies constituencies where households are concentrated in high or very high-risk categories. Thus, the map highlights constituencies most vulnerable to climate change impacts.

The climate risk hotspots map, generated using the detailed scoring system outlined above, is presented in Figure 5.55. Constituencies shaded in dark purple indicate the highest concentrations of populations vulnerable to climate risks. These areas are characterized by the combined effects of severe aridity, large household sizes, and high levels of multidimensional poverty, making them particularly susceptible to the impacts of climate hazards. The analysis reveals that constituencies with a significant number of vulnerable individuals are predominantly located in Namibia's northern and northeastern regions. These regions are marked by challenging climatic conditions, including prolonged droughts and limited access to essential resources, exacerbating their vulnerability. The spatial distribution highlighted on the map underscores the urgent need for targeted adaptation and resilience-building efforts in these high-risk areas to mitigate the adverse effects of climate change on the most vulnerable communities.

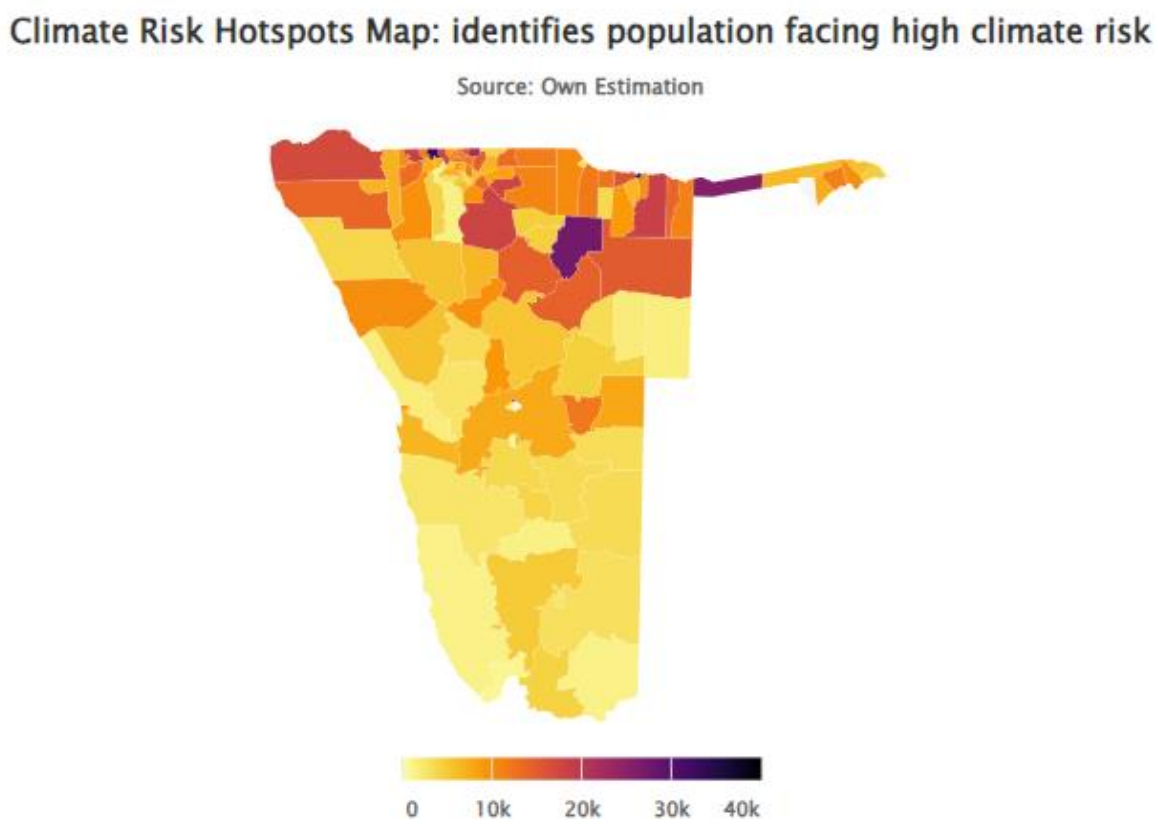



*Figure 4-55. Climate Risk Hotspots Map: identifies population facing high climate risk*

More nuanced insights into the climate risk profile of the Namibian population are illustrated in Figure 4.55. The analysis based on the estimated climate risk index reveals that approximately 45% of Namibia's population is exposed to high climate risk. This significant proportion reflects the substantial vulnerabilities stemming from severe aridity, large household sizes, and multidimensional poverty. Furthermore, 23% of the population is categorized under medium climate risk, indicating moderate susceptibility to climate-related hazards and stressing the need for sustained resilience measures. Meanwhile, 32% of the population faces low climate risk, benefiting from favourable climatic conditions and better socio-economic factors. These percentages provide a comprehensive understanding of the varying degrees of climate risk across the population, highlighting areas where urgent and targeted climate adaptation strategies are essential to mitigate the impacts and enhance the resilience of vulnerable communities.

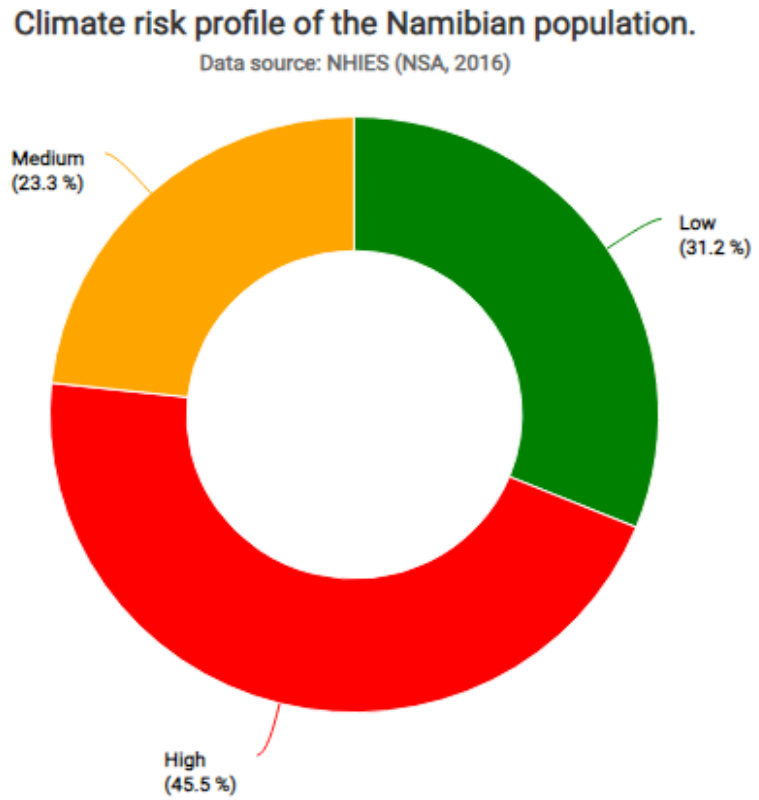



*Figure 4-56. Climate risk profile of the Namibian population*

A regional perspective of the risk of climate hazards to the Namibian population is depicted in Figure 4.57. This analysis reveals that approximately 50% of the population in eight out of the fourteen regions in Namibia are subjected to high climate risk. Notably, the regions of Kavango West, Kavango East, Kunene, and Otjozondjupa exhibit the highest concentrations of populations facing severe climate vulnerabilities. These regions are particularly affected by extreme aridity, substantial household sizes, and significant levels of multidimensional poverty, which collectively exacerbate their susceptibility to climate hazards. The detailed regional breakdown underscores the uneven distribution of climate risk across Namibia, emphasizing the critical need for region-specific climate adaptation strategies to protect and enhance the resilience of the most affected communities.

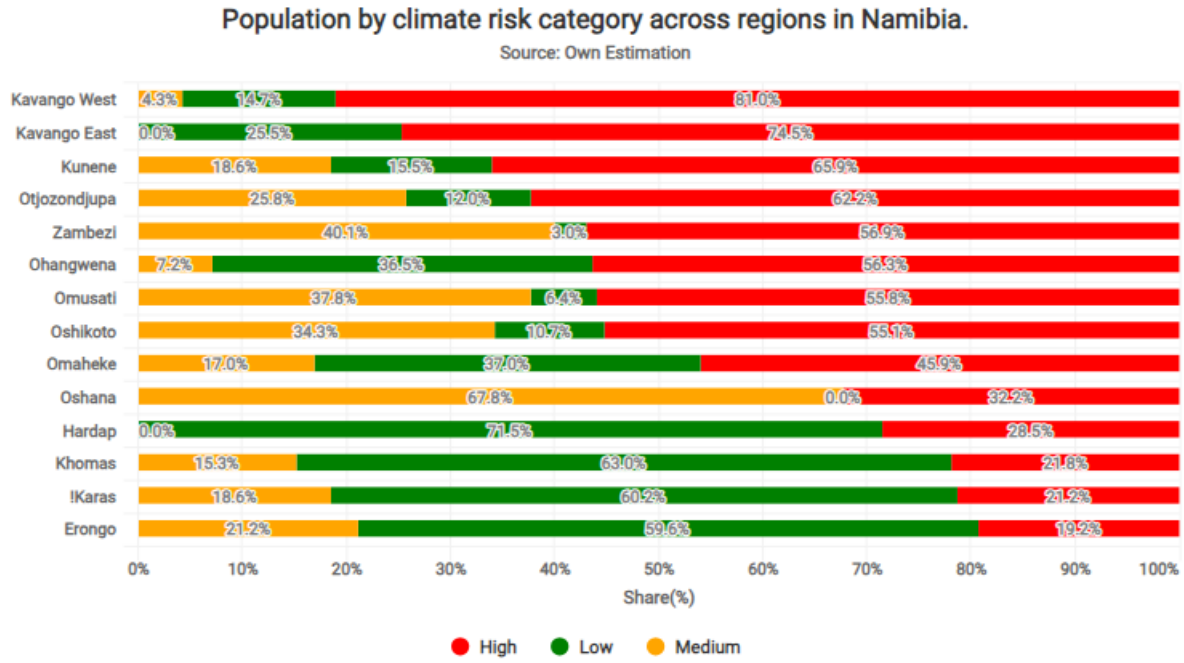



*Figure 4-57. Population by climate risk category across regions in Namibia*

An urban-rural perspective of climate risk in Namibia is presented in Figure 4.58. The analysis indicates a stark contrast in climate risk exposure between rural and urban populations. Approximately 67% of the rural population is subjected to high climate risk, highlighting the acute vulnerabilities faced by these communities. This elevated risk is primarily due to the compounded effects of severe aridity, larger household sizes, and higher levels of multidimensional poverty prevalent in rural areas. In contrast, only 26% of the urban population experiences high climate risk, reflecting better access to resources, infrastructure, and services that mitigate vulnerability in urban settings. This significant disparity underscores the urgent need for targeted interventions to address the heightened climate risks in rural areas, ensuring that adaptation and resilience-building efforts are equitably distributed to protect the most vulnerable populations.

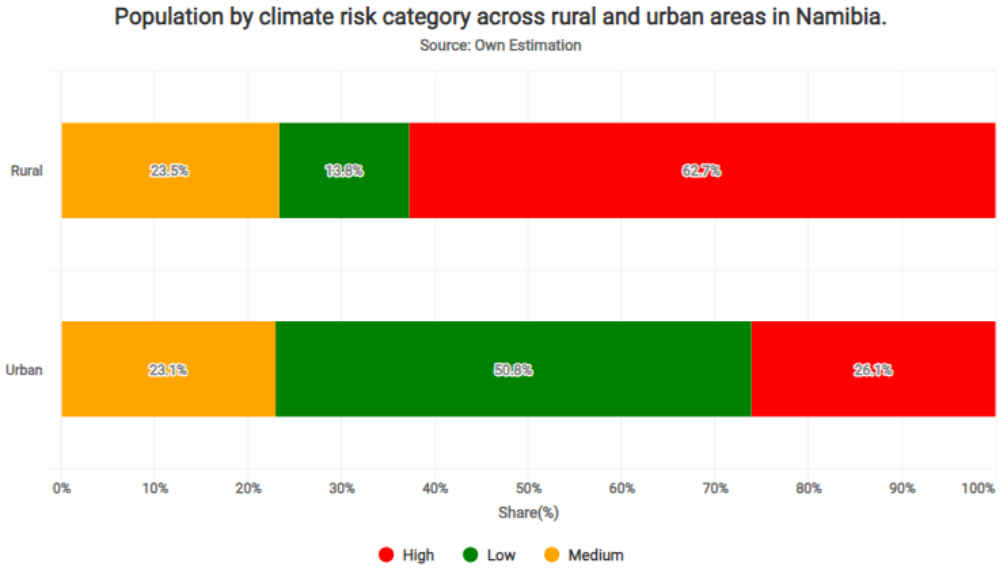



*Figure 4-58. Population by climate risk category across rural and urban areas in Namibia*

Finally, a gender perspective of climate risk in Namibia is presented in Figure 4.59. The analysis reveals insignificant disparities in climate risk across genders, indicating that both men and women are similarly affected by climate hazards. The proportion of the male population facing high climate risk is comparable to that of the female population, underscoring that climate vulnerabilities and exposures do not disproportionately impact one gender. This finding highlights the need for gender-inclusive climate adaptation strategies that address the needs and challenges of all individuals, ensuring that both men and women benefit equitably from efforts to enhance resilience and mitigate climate risks across Namibia.

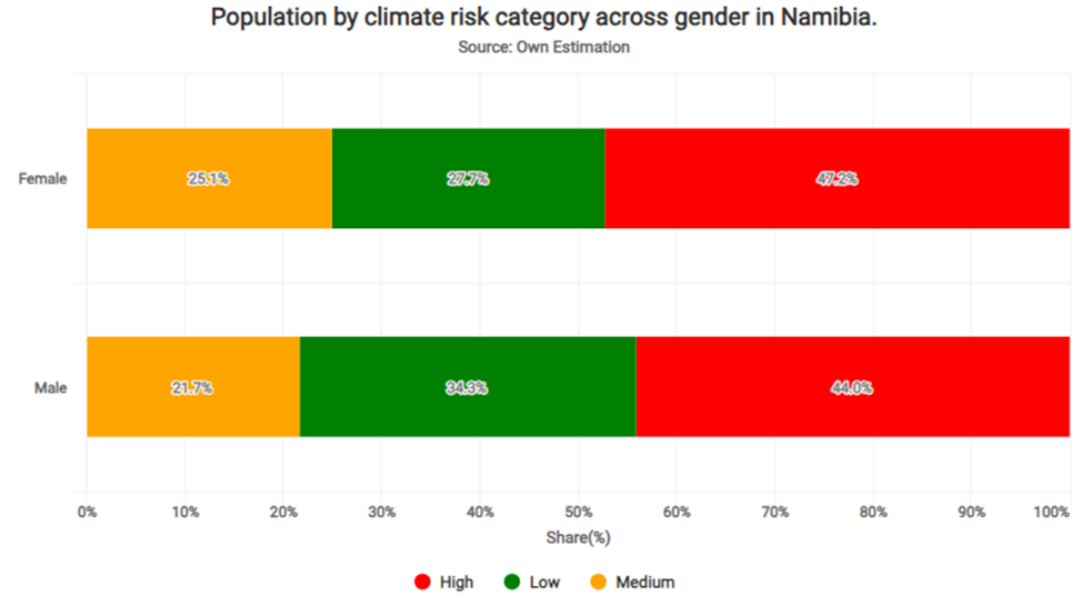



*Figure 4-59. Population by climate risk category across gender in Namibia*

### 4.4.8 Strategic Insights and Way Forward

Namibia faces significant climate change challenges due to rising temperatures, erratic precipitation patterns, and the resulting impacts on its environment, economy, and population. Projections indicate a rise in average temperatures by 1.5 to 3°C by mid-century, exacerbating heatwaves, droughts, and water scarcity. Erratic rainfall further intensifies these issues, impacting agriculture, water resources, tourism, and fisheries. Agriculture is particularly vulnerable, with subsistence farming facing declining yields and increased food insecurity. Similarly, water resources are under stress, requiring improved management to address reduced availability. The tourism and fisheries sectors also face climate-related threats, from biodiversity loss to declining fish stocks, jeopardizing livelihoods and revenue streams.

The cumulative impacts of climate change present macroeconomic challenges, including increased poverty, inequality, and economic instability. High aridity exacerbates water scarcity and desertification risks, especially in hyper-arid regions, while larger households and rural communities are disproportionately vulnerable due to limited resources and higher dependency ratios. Targeted, region-specific strategies are essential to address these vulnerabilities, including investments in resilient infrastructure, sustainable land management, and rural development. Namibia's adaptation strategies must integrate these insights to ensure holistic, inclusive, and regionally nuanced responses, safeguarding its people, ecosystems, and economic stability against climate risks.

## 4.5 ADAPTATION PRIORITIES, BARRIERS, POLICIES, INSTITUTIONS, AND MAINSTREAMING

### 4.5.1 Adaptation Priority Areas and Planned Adaptation Actions

Namibia's second updated NDC (Government of the Republic of Namibia, 2021) outlines the country's adaptation priority area. It identifies and costs eight (8) priority areas, including cross-cutting issues aimed at establishing or enhancing institutional structures to create an enabling environment for adaptation planning and implementation. The priority areas were selected based on insights, knowledge, and experiences from Namibia's efforts to address climate change and associated development challenges. These are documented in national policy and strategy documents, including:

- Fourth National Communication (NC4) (2020), which includes the Climate Change Vulnerability and Adaptation Assessment Report (V&A Report)
- National Climate Change Policy (NCCP)
- National Climate Change Strategy and Action Plan 2013–2020 (NCCSAP)
- Vision 2030
- National Development Plans (NDPs)
- First and Second Harambee Prosperity Plans

The eight adaptation priority areas comprise 34 measures and 84 actions. These measures and actions align with Namibia's long-term national and sectoral development strategies, as outlined in Vision 2030 and the fifth National Development Plan (NDP5, 2017-2022), as well as sectoral policies and strategies. Namibia is also developing its National Adaptation Plan, which will further guide adaptation within the context of the NDC. The total cost for implementation by 2030 is estimated at USD 6,013 million. Table 4.3 summarises the adaptation priority areas' measures, actions, and costs. The following subsections provide a brief overview of each adaptation priority area.

*Table 4-2. Adaptation priority areas, measures, actions, and costs. (Source: second updated NDC).*

| Priority area | No. of measures | No. of actions | Cost (Mil USD) |
|---|---|---|---|
| Agriculture and Food Security | 9 | 25 | 1,514 |
| Water Resources | 5 | 12 | 3,505 |
| Biodiversity and Ecosystems | 6 | 8 | 371 |
| Fisheries and Aquaculture | 5 | 11 | 85 |
| Health | 3 | 12 | 94 |
| Cross-cutting Issues | 5 | 12 | 162 |
| Infrastructure | 2 | 3 | 258 |
| Coastal Zone | 1 | 1 | 24 |

| Priority area | No. of measures | No. of actions | Cost (Mil USD) |
|---|---|---|---|
| Total | 36 | 84 | 6,013 |

#### *4.5.1.1 Agriculture and Food Security*

Agriculture and food security are crucial adaptation priority areas for Namibia, considering their vital role in people's livelihoods. Despite a modest national GDP contribution, agriculture directly impacts 70% of the population, with nearly half (48%) of rural households relying on subsistence farming (Namibia's Fifth National Development Plan, NDP5). This priority area addresses these vulnerabilities by focusing on nine key measures and 25 specific actions to strengthen Namibia's food security. The total estimated cost for these measures is USD 1,514 million. The following are the measures under this priority area:

- Improvement of livestock disease control, prevention and treatment, including facilities
- Development of climate-resilient livestock species
- Improve fodder production and create fodder banks
- Value chain development of agricultural products
- Upgrading of soft and hard infrastructure for improved monitoring of climate impacts on agricultural production system
- Promote conservation and organic agricultural practices
- Improve support to enhance adaptation to CC through better-adapted crops, crop husbandry practices, alternate crops
- Introduce new technologies to enhance/maintain crop productivity
- Diversify from traditional crops to perennials

#### *4.5.1.2 Water Resources*

Due to Namibia's existing water scarcity challenges, water resources were identified as a critical adaptation priority area. Limited water availability significantly hinders socio-economic development. Scientific evidence strongly suggests that climate change will exacerbate these water scarcity issues. This priority area focuses on the following five key measures, encompassing twelve specific actions, with a total estimated cost of USD 3,505 million:

- Integrated Water Resources Management Plan
- Water Infrastructure Development, Maintenance and Rehabilitation
- Water recycling
- Establishment and restoration of riparian buffers
- Desalination

#### *4.5.1.3 Biodiversity and Ecosystems*

Healthy ecosystems are crucial for Namibian communities and contribute significantly to the national economy. However, these biodiverse ecosystems are vulnerable to climate change impacts, particularly rising temperatures and reduced rainfall. To address this challenge, Namibia prioritizes ecosystem adaptation, focusing on the following six key measures, encompassing eight specific actions, at an estimated cost of USD 371 million:

- Sustainable land management
- Management of State Protected Areas
- Environmental Management
- Fire management plans
- Green spaces and urban corridors
- Adaptive management of fragile natural habitats (karoo, wetlands, and desert)

#### *4.5.1.4 Fisheries and Aquaculture*

Fisheries and aquaculture play a significant economic role in Namibia, contributing to employment, export earnings, and GDP. They also empower women through participation in the value chain. However, climate change has reduced productivity in recent years. Namibia prioritizes fisheries adaptation through five key measures and eleven specific actions to address this challenge. These actions aim to enhance resilience within the blue economy, a potential engine for sustainable growth. The total estimated cost for these measures is USD 85 million. The following are the measures under this priority area:

- Support Sustainable use of fisheries resources by local communities
- Adaptive management and protection of aquatic ecosystems/biodiversity
- Develop Mariculture within the blue economy
- Strengthen Aquatic food systems
- Building Climate Change resilience in both marine and freshwater fishing and aquaculture communities

#### *4.5.1.5 Health*

Namibia faces significant health vulnerabilities due to climate change. Projected climate shifts, including changes in temperature, rainfall patterns, and extreme weather events, can directly and indirectly impact human health. These impacts range from water quality and availability issues to malnutrition, vector-borne disease transmission, and heat stress. To address these challenges, Namibia prioritizes health adaptation through three key measures encompassing twelve specific actions. These actions focus on strengthening health facilities and improving disease monitoring and management. The total estimated cost for these measures is USD 94 million. The following are the measures under this priority area:

- Health security.
- Eradication of malaria.

- Improve disease management.

#### *4.5.1.6 Cross-cutting Issues*

Extreme weather events, particularly floods and droughts, threaten Namibia's vulnerable populations and economic stability. Data since 1980 reveals over 25 occurrences of these events, resulting in tragic losses – over 500 lives and economic damages exceeding USD 215 million, impacting over 3.2 million people. To bolster resilience against these climate extremes, Namibia prioritizes five cross-cutting adaptation measures encompassing twelve specific actions. These urgent actions aim to prevent future devastation and losses. The total estimated cost for these measures is USD 162 million. The following are the measures under this priority area:

- Disaster risk management
- Education, training and public awareness
- Research and systematic observation
- Land planning
- Gender mainstreaming

#### *4.5.1.7 Infrastructure*

Climate change significantly threatens Namibia's infrastructure, potentially hindering development progress. To address these risks, Namibia prioritizes infrastructure adaptation through two key measures encompassing three specific actions. The total estimated cost for these measures is USD 258 million. The measures under this priority area are:

- National infrastructure: undertake a national study to define the vulnerability of infrastructure and enable more informed decisions for planning adaptation
- Road infrastructure: upgrade 100 km of roads that are usually flooded and built drains to evacuate rainwater and prevent flooding of roads

### 4.5.2 Adaptation Gaps and Barriers

Adaptation gaps refer to the difference between the climate change adaptation measures needed to reduce vulnerability adequately and the actual measures implemented. These gaps can occur due to insufficient funding, technology, knowledge, or capacity to adapt to climate change impacts effectively. Adaptation measures often fail to address the full scope of climate risks, leaving populations, ecosystems, or infrastructure inadequately protected. Figure 4.60 highlights critical adaptation gaps in Namibia based on national documents such as the Updated NDC, Fourth National Communication, and the National Adaptation Communication. The visual emphasizes critical areas like human capacity, vulnerability studies, access to technology, financial resources, and more, representing some of the significant challenges faced in implementing effective climate change adaptation measures. The adaptation gaps highlighted in Figure 4.60 are elaborated in detail below.

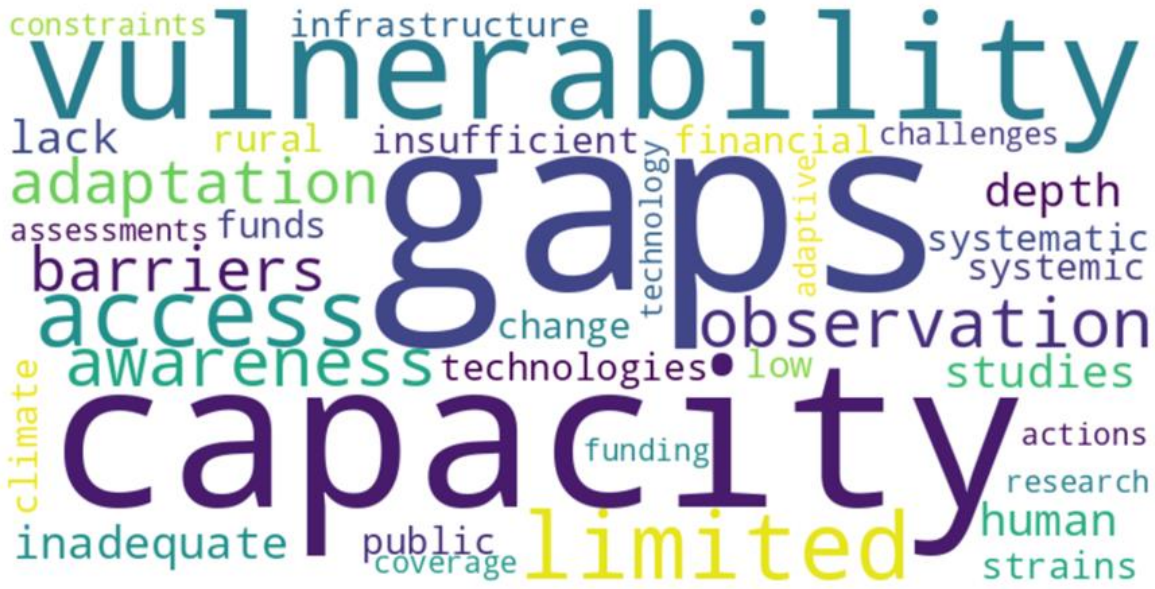



*Figure 4-60. Identified adaptation gaps in Namibia*

On the other hand, adaptation barriers hinder the planning, implementation, or scaling of adaptation efforts. These barriers can be institutional (e.g., weak governance, lack of coordination), financial (e.g., insufficient funding), social (e.g., lack of public awareness or engagement), or technological (e.g., limited access to adaptation technologies). Overcoming these barriers is essential for closing adaptation gaps and ensuring that adaptation efforts are effective and sustainable in reducing climate vulnerabilities. The following sections present key adaptation gaps and barriers in Namibia, which are highlighted in Namibia's Adaptation Communication (MEFT, 2021) as well as in other studies like Crawford & Terton (2016), Crawford & Terton (2016), and Davies et al. (2020). Figure 4.61 highlights critical adaptation barriers in Namibia, based on key national documents such as the Updated NDC, Fourth National Communication, and the National Adaptation Communication. Key barriers like lack of coordination, conflicting programme implementation, limited institutional capacity, and insufficient evidence base are emphasized. The barriers highlighted in Figure 5.60 are elaborated in detail below.


*Figure 4-61. Main adaptation barriers in Namibia*

#### *4.5.2.1 Adaptation Gaps*

Namibia faces several recurring adaptation gaps that hinder implementing climate change adaptation actions effectively. One of the most pressing gaps is inadequate human capacity, which limits the ability to design, implement, and monitor adaptation initiatives across various sectors. This shortfall is evident in the scarcity of trained personnel, technical expertise, and institutional knowledge, which constrains the development of climate-resilient policies and the execution of projects at both local and national levels (Crawford & Terton, 2016; MEFT, 2021).

Another key gap is the lack of in-depth vulnerability studies. While some vulnerability assessments have been conducted, they often lack the granularity and detail required to fully understand how different regions, ecosystems, and communities are affected by climate change. Adaptation efforts may not be well-targeted or effective without a comprehensive understanding of the specific vulnerabilities, leading to inefficient resource allocation and missed opportunities to mitigate risks (Crawford & Terton, 2016; MEFT, 2021).

Limited access to the latest technologies further exacerbates the challenges in implementing climate adaptation. Advanced technologies, such as climate-resilient agricultural techniques, early warning systems, and water conservation innovations, are essential for enhancing Namibia's adaptive capacity. However, these technologies are often costly or unavailable, particularly in rural areas, which hinders the country's ability to respond to climate-induced challenges like droughts, floods, and changing rainfall patterns (Crawford & Terton, 2016; Davies et al., 2020; MEFT, 2021).

Namibia also struggles with limited coverage for systematic observation, crucial for tracking climate trends, monitoring environmental changes, and predicting future climate impacts. Inadequate meteorological, hydrological, and environmental monitoring infrastructure results in data gaps, compromising the accuracy of climate models and risk assessments. This limitation affects timely decision-making and reduces the effectiveness of climate adaptation planning (Crawford & Terton, 2016; Davies et al., 2020; MEFT, 2021; World Bank, 2021).

Another significant gap is the relatively low awareness among a large population segment about climate change impacts and adaptation strategies. Many communities, particularly in rural

areas, are unaware of the risks they face or the adaptation measures available. This lack of awareness hampers efforts to mobilize local-level adaptation actions, critical for addressing localized climate vulnerabilities, such as water scarcity or agricultural risks (Crawford & Terton, 2016; Davies et al., 2020; MEFT, 2021).

Finally, insufficient funding remains a persistent barrier to addressing these adaptation gaps and barriers. Namibia's limited financial resources restrict the ability to scale up adaptation efforts, invest in human capacity building, implement systematic observation systems, and deploy the latest technologies. Additionally, sectors already strained by climate change, such as agriculture and water resources, are often the least equipped to address these challenges without substantial financial support, leaving critical adaptation needs unmet. Closing these financial gaps is essential for enabling the country to embark on robust adaptation efforts that enhance resilience to climate change across all sectors (Brown & Amuntenya, 2021; Crawford & Terton, 2016; Davies et al., 2020; MEFT, 2021; World Bank, 2021).

#### *4.5.2.2 Adaptation Barriers*

Namibia faces several key adaptation barriers that hinder effective climate change adaptation efforts. One major barrier is the lack of coordination and conflicting programme implementation. Different government ministries, agencies, and stakeholders often work in silos, resulting in overlapping mandates and fragmented implementation of climate adaptation programs. This lack of coordination leads to inefficiencies and missed opportunities for synergies across sectors that could strengthen adaptation efforts. Conflicting priorities or misaligned timelines between development and adaptation programs exacerbate this challenge, making it difficult to execute comprehensive and integrated adaptation strategies.

Another critical barrier is framing climate change as an environmental issue. This narrow focus overlooks the broader socio-economic dimensions of climate change, such as its impact on health, food security, livelihoods, and infrastructure. By treating climate change solely as an environmental concern, adaptation efforts fail to engage key sectors like agriculture, water, and energy, which are critical to resilience. Broadening the framing to encompass its multi-sectoral nature would encourage a more holistic and inclusive approach to adaptation planning.

The lack of access to information is another significant barrier. Decision-makers and local communities often lack timely, accurate, and relevant data on climate risks and vulnerabilities. This information gap prevents effective adaptation planning and reduces the ability of stakeholders to make informed decisions. Without access to climate projections, risk assessments, or early warning systems, communities remain vulnerable to climate shocks, unable to prepare adequately for future impacts.

Namibia also faces challenges related to the lack of effective decentralization and limited institutional capacity at the local level. While climate change impacts are felt most acutely at the community level, local governments and institutions often lack the resources, knowledge, and authority to implement adaptation measures. The centralization of decision-making powers limits the ability of local authorities to respond quickly and effectively to local climate risks. Strengthening local capacities and decentralizing adaptation responsibilities would empower communities to take ownership of their resilience-building efforts.

A major barrier to successful adaptation is the reactive approach versus long-term planning. Many adaptation actions in Namibia are taken in response to immediate climate disasters, such as droughts or floods, rather than being incorporated into long-term development plans. This

short-term, crisis-driven response reduces the overall resilience of communities and ecosystems, as it does not allow for strategic investments in sustainable adaptation infrastructure or practices. Transitioning from a reactive to a proactive and forward-looking approach is critical for building long-term resilience.

Lastly, there is insufficient evidence on the benefits of adaptation versus costs. Without clear, quantifiable evidence demonstrating the economic, social, and environmental benefits of adaptation actions, it becomes difficult to justify the significant investments required. This lack of evidence undermines efforts to prioritize adaptation measures in national budgets and development plans, as decision-makers are reluctant to allocate resources without seeing tangible returns on investment. Improving the evidence base on the cost-effectiveness and long-term gains of adaptation is essential for securing political and financial support for climate-resilient development.

### 4.5.3 Adaptation Design and Planning Process

Namibia's adaptation design and planning process is built on a solid foundation of scientific research, institutional coordination, and community involvement. This ensures that adaptation actions are well-targeted, practical, and capable of addressing the country's climate challenges. The integration of national policies with local needs and the emphasis on sustainability and inclusivity make Namibia's approach to adaptation both forward-looking and resilient.

This section highlights the adaptation design and planning process in Namibia. It is structured around two key issues: the design elements of Namibia's adaptation actions, as indicated in the Updated NDC, and the adaptation planning process, focusing on institutional arrangements for adaptation. Each of these issues is elaborated in the following sections.

#### *4.5.3.1 Design of Adaptation Actions*

Namibia's adaptation actions in the Updated Nationally Determined Contribution (NDC) are designed and selected through a systematic and participatory approach, aligning with the country's national development priorities, climate vulnerability assessments, and international commitments under the Paris Agreement. Below is an overview of how these actions are designed and selected:

- Alignment with National Development and Climate Policies: Namibia's adaptation actions align closely with the country's overarching development policies, such as Vision 2030, the Fifth National Development Plan (NDP5), and the Harambee Prosperity Plan. These policies emphasize sustainable development, poverty reduction, and improved resilience to climate change. The Updated NDC also draws from Namibia's National Climate Change Policy, National Climate Change Strategy and Action Plan, and the National Adaptation Framework, ensuring that the adaptation actions complement broader national goals.

- Vulnerability and Risk Assessments: Adaptation actions are informed by vulnerability and risk assessments conducted across sectors, regions, and communities. Namibia has undertaken several studies identifying climate-sensitive sectors and regions, such as agriculture, water resources, and coastal areas. These assessments have highlighted key vulnerabilities to climate change impacts, such as droughts, floods, and rising sea levels, allowing Namibia to prioritize actions that address the most pressing risks. The climate

risk index and other analytical tools help identify geographic areas and sectors most needing adaptation interventions.

- Sectoral Focus and Prioritization: The adaptation actions are sector-specific, focusing on the most vulnerable to climate change. The Updated NDC identifies eight priority areas: agriculture and food security, water resources, biodiversity and ecosystems, fisheries and aquaculture, health, infrastructure, and cross-cutting issues.

- Stakeholder Engagement and Participatory Approach: The selection of adaptation actions is built on a participatory and inclusive process. Key stakeholders, including government ministries, local authorities, civil society organizations, academic institutions, and the private sector, are involved in the planning and prioritising of adaptation measures. This approach ensures that adaptation actions reflect the needs and priorities of vulnerable communities and sectors, fostering ownership and sustainability of the interventions. Additionally, community-based adaptation measures, particularly in rural areas, are integrated to enhance local resilience.

- Use of Scientific and Traditional Knowledge: Namibia's adaptation planning incorporates scientific research and traditional knowledge. Scientific studies on climate change impacts, such as changes in rainfall patterns and temperature increases, guide the technical aspects of the adaptation actions. Simultaneously, traditional knowledge, particularly in rural communities, is used to inform sustainable practices in agriculture, water management, and disaster risk reduction.

- Institutional and Policy Coordination: Namibia ensures that adaptation actions are integrated into existing institutional frameworks and policies, promoting coordination among ministries and government agencies responsible for agriculture, water, environment, and disaster risk management. The NCRC and other inter-sectoral platforms are key in aligning adaptation efforts across sectors, ensuring coherence in planning and implementation.

- Funding and Resource Mobilization: Namibia's adaptation actions are selected based on the availability of financial resources and the country's ability to attract international climate finance. The NDC outlines key adaptation priorities requiring domestic funding, such as government budgets, international mechanisms like the Green Climate Fund (GCF) and bilateral partners. Adaptation actions that are deemed cost-effective and have the potential to leverage additional funding are prioritized.

- Monitoring, Reporting, and Learning: The Updated NDC includes a robust framework for monitoring and reporting on the progress of adaptation actions. This framework ensures that Namibia can track the effectiveness of its interventions, allowing for course corrections where necessary. The lessons learned from implementing adaptation actions are fed into the design process, enabling continuous improvement in resilience-building efforts.

- Sustainable and Nature-based Solutions: Namibia prioritizes sustainable and nature-based solutions in its adaptation actions. These include reforestation, wetland

restoration, and ecosystem-based adaptation strategies that reduce vulnerability to climate risks and enhance biodiversity and carbon sequestration. Such solutions are critical in enhancing the adaptive capacity of communities while promoting environmental conservation.

- Gender-sensitive and Inclusive Adaptation: Namibia's NDC recognizes the differentiated impacts of climate change on vulnerable groups, particularly women, children, and marginalized communities. Therefore, the adaptation actions are designed to be gender-sensitive and inclusive, ensuring that adaptation measures promote equity and do not exacerbate existing vulnerabilities.

#### *4.5.3.2 Institutional Arrangements for Adaptation*

Namibia's institutional arrangements reflect a multi-stakeholder approach to climate change adaptation. However, there are clear gaps, particularly at the local level and in private sector involvement, that need to be addressed to ensure comprehensive and inclusive adaptation efforts.

Namibia's institutional arrangements for climate change adaptation are designed to ensure coordinated action across multiple sectors and levels of government. The Cabinet of Namibia is responsible for national policy development, including climate change-related ones. Namibia has established the National Committee on the Rio Conventions (NCRC) to facilitate climate-related policy implementation. This committee combines the work of the three Rio Conventions—the UN Framework Convention on Climate Change, the UN Convention on Biological Diversity, and the UN Convention to Combat Desertification—under a single structure to streamline efforts and ensure more effective coordination.

The Ministry of Environment, Forestry, and Tourism (MEFT) leads the implementation of climate change policies through its Climate Change Unit, which is part of the Directorate of Environmental Affairs and Forestry. The MEFT serves as Namibia's National Focal Point (NFP) for the UN Framework Convention on Climate Change and is also the Nationally Designated Authority (NDA) to the Green Climate Fund (GCF), facilitating access to international climate finance.

The NCRC reports to the Parliamentary Standing Committee on Natural Resources and Economics, which advises the Cabinet on climate change policy matters. The NCRC's membership includes various institutions, including key government ministries, financial institutions, academic bodies, local authorities, and international organizations. These members provide expertise and collaborate on cross-cutting climate adaptation issues. Some prominent members are the Ministry of Agriculture, Water and Land Reform, Mines and Energy, the National Planning Commission, and the Namibia Meteorological Service. International organizations like the United Nations Development Programme (UNDP) and the Food and Agriculture Organization (FAO) are also part of this committee.

While national-level coordination is strong, challenges remain at the sub-national level, where no formal structures are dedicated to adaptation planning. Some Disaster Risk Management Committees have been established in certain regions, and there are ongoing discussions, led by the University of Namibia, about expanding these structures to include climate change planning. Civil society organizations (CSOs) have played a significant role in adaptation, particularly through projects related to food security, water access, and natural resource management, even though these efforts are not always labelled as climate change initiatives.

Private sector engagement in adaptation efforts is still limited, though some development banks, like Agribank, offer specific loans to support farmers in activities such as bush encroachment control. Several private sector entities also run corporate social responsibility projects focused on biodiversity conservation, drought relief, and low-cost housing. However, a more structured and formal approach to private sector participation in climate adaptation is needed to enhance resilience across various sectors.

### 4.5.4 Adaptation Mainstreaming

Namibia has proactively addressed climate change through its commitment to international agreements and developing national strategies prioritising climate change adaptation. The Republic of Namibia ratified the United Nations Framework Convention on Climate Change (UNFCCC) as a Non-Annex I Party in 1995, acknowledging the global need for collective action on climate issues. In 2016, Namibia ratified the Paris Agreement, strengthening its dedication to combating climate change. As part of its obligations under the UNFCCC, Namibia has prepared and submitted key national reports, including four National Communications (NCs), four Biennial Update Reports (BURs), two Nationally Determined Contributions (NDCs), and one Adaptation Communication. These documents lay the groundwork for the country's climate actions, focusing on mitigation and adaptation.

#### *4.5.4.1 Adaptation as a Priority in National Policy*

The importance of adaptation has been consistently emphasized in Namibia's climate policy, particularly in the updated NDC and the first National Adaptation Communication. These documents commit Namibia to developing a comprehensive National Adaptation Plan (NAP), which will serve as a strategic blueprint for enhancing the country's resilience to climate impacts. The NAP will help identify and prioritize adaptation actions across key sectors, integrate adaptation into national planning processes, and ensure the country is prepared for immediate and long-term climate risks.

#### *4.5.4.2 Key Policies and Strategic Interventions*

Several national policies, strategies, and plans have been developed to guide Namibia's adaptation efforts. These documents outline the country's broad strategic priorities and approach to addressing climate change impacts. Below is a summary of policy and regulatory frameworks that guide climate change adaptation actions in Namibia:

- Namibian Constitution (1990): Commits the state to the maintenance of Namibia's ecosystems, essential ecological processes, and biological diversity and to use living natural resources sustainably for the benefit of present and future generations.

- Namibia's updated Nationally Determined Contribution (2021): Namibia's adaptation component identifies key vulnerable sectors, including water resources, agriculture, forestry, coastal zones, tourism, health, and disaster risk management, with an estimated investment of USD 1.72 billion required. While 43 prioritized adaptation actions are outlined, the document lacks specific details on implementation activities. It also highlights cross-cutting issues like gender, youth involvement, and private-sector engagement. The National Adaptation Plan (NAP) will guide the implementation of these actions.

- Namibia's Adaptation Communication (2021) (AdCom): Emphasizes the importance of climate change adaptation to ensure the welfare of its people, reduce risks, and build

resilience. Key challenges include inadequate human capacity, lack of detailed vulnerability studies, limited technology access, insufficient systematic observation, low public awareness, and insufficient funding. The document summarizes vulnerability and risk information from the 2019 V&A report and highlights sector-based actions and financial needs from the updated NDC. It prioritizes adaptation measures in agriculture, water resources, coastal zones, tourism, health, and disaster risk management, though these sectors are not fully aligned with the NDC.

- Fourth National Communication (2020): Outlines the projected climate-driven impacts on the country for the mid-and end-century. The NC4 includes a Climate Change Vulnerability and Adaptation Assessment (CCVAA) Report, which provides trends and projections for climate change in Namibia based on a literature review. It provides a vulnerability and risk assessment of key sectors and identifies broad activities to boost resilience based on literature, interviews and expert opinions. It also develops a National Climate Change Vulnerability Index and applies it to constituencies across Namibia.

- First Technology Needs Assessment (2005): Focuses on technology for adaptation, recognizing its likely status as a carbon sink and vulnerability to climate change. Key sectors prioritized for technological needs include food and agriculture, water, environment and tourism, energy, and industry. The emphasis is on integrating capacity building, awareness, research, and hard technology into adaptation projects.

- National Policy on Climate Change (NPCC) (2011): The policy framework provides a comprehensive national strategy for developing, implementing, monitoring, and evaluating climate change adaptation activities in Namibia. It had five key objectives: to develop and implement appropriate strategies and actions that will lower the vulnerability of Namibians and various sectors to the impacts of climate change; to integrate climate change effectively into existing policy, institutional and development frameworks in recognition of the cross-cutting nature of climate change; to enhance capacities and synergies at local, regional and national levels and at individual, institutional and systemic levels to ensure successful implementation of climate change response activities; to provide through Government, secure and adequate funding resources for the effective adaptation and mitigation investments to climate change and associated activities; and to facilitate climate proof development to reduce the magnitude and extent of impacts of climate change.

- National Disaster Risk Management Plan (NDRMP) (2011): Was developed in response to the 2009 National Disaster Risk Management Policy. It provides guidance for disaster management across national, regional, and local governments, businesses, community leaders, and civil society. The plan standardizes disaster prevention, preparedness, response, and recovery operations. Both the NDC and the Adaptation Communication (AdCom) include actions related to Disaster Risk Management (DRM).

In addition to the climate change related policies and regulatory frameworks above, adaptation to climate change has been mainstreamed and included in various development policies and strategies. The following are some of the development policies and strategies that have mainstreamed climate change adaptation:

- Vision 2030: Namibia's long-term development plan is being implemented through a series of 5-year National Development Plans (NDP). NDP5 (2017-2022) addresses the collaboration with regional neighbours on common environmental challenges such as droughts to advance adaptation and resilience across the regions. It also aims to increase climate finance and sets some targets for environmental protection, access to water, and agriculture. Although these targets will contribute to adaptation, they have not been developed from a climate change adaptation lens.

- Second Harambee Prosperity Plan (HPPII) (2021-2025): This is a complementary accelerating tool to the NDPs, allowing for flexibility in the Namibian planning system by fast-tracking development in areas where progress is insufficient and incorporating new development opportunities and addressing challenges that emerge following the formulation of the NDPs. The HPPII recognises climate change as one of the threats to gains achieved in socioeconomic development but focuses on mitigation aspects, for example, the role of the private sector in developing the blue economy through investment in the synthetic fuels industry, including green hydrogen.

- Third National Programme for the Implementation of the UNCCD: This programme recognises synergies with adaptation efforts and includes an output on the publication of climate change scenarios and risks for Namibia and their implications on local adaptation needs (Outcome 1).

- Second National Biodiversity Strategy and Action Plan (NBSAP2): Target 9 of the NBSAP2 aims to identify ecosystems most vulnerable to climate change and their anthropogenic pressures by 2016. By 2018, appropriate adaptation measures should be developed and implemented in priority areas. Key Performance Indicators identified include a report on the vulnerability of Namibian ecosystems to climate change and associated anthropogenic pressures and an evaluation of the implementation of appropriate measures. In addition, Strategic Initiative 2.6.1 sets out to undertake vulnerability assessments and develop relevant adaptation measures to enhance the climate change resilience of priority ecosystems by 2018.

- National Agriculture Policy: This policy respects and mainstreams national and international protocols and conventions dealing with climate change and adaptation and promotes measures that ensure that agricultural production adapts to a changing environment.

- Community-Based Natural Resource Management (CBNRM): A key strategic aim of the CBNRM Policy is "to enable communities to engage in environmental and natural resource monitoring collectively and in mitigation and adaptation to climate change". A specific objective under education and knowledge aims "to promote climate change adaptation knowledge and formidable skills".

- Communication, Education and Public Awareness Strategy (CEPA) 2019 - 2030: In 2019, the Ministry of Environment, Forestry and Tourism developed a CEPA strategy, whose first Strategic Priority is to raise awareness of Climate Change. It proposes communicating the necessity of climate change adaptation in school curricula and civil servants training.

It also targets increased awareness of climate change impacts and adaptation measures among rural households, aiming at having 30% of them aware of adaptation measures by 2022.

#### *4.5.4.3 National Adaptation Plan (NAP) Process*

The NAP process in Namibia is rooted in several key baseline assessments and reports. One of the main baselines is the Vulnerability Assessment, submitted as part of Namibia's Fourth Communication to the UNFCCC. This assessment provides a detailed analysis of Namibia's vulnerabilities to climate change, focusing on agriculture, water resources, health, and infrastructure sectors. The first Adaptation Communication, recently submitted to the UNFCCC, offers a comprehensive overview of Namibia's adaptation priorities, challenges, and gaps. Namibia's revised NDC also plays a critical role in shaping the NAP by outlining national targets and adaptation priorities for sectors most vulnerable to climate impacts.

#### *4.5.4.4 Institutional Context*

Namibia's institutional framework for adaptation is robust and multi-sectoral, ensuring that climate change is integrated into national development planning. The Ministry of Environment, Forestry, and Tourism (MEFT) is the lead agency responsible for coordinating climate change actions, including adaptation. The MEFT works closely with other ministries such as Agriculture, Water and Land Reform, Health and Social Services, and Mines and Energy, as well as with local governments, civil society organizations, and the private sector.

A key institution in Namibia's adaptation governance is the National Committee on the Rio Conventions (NCRC), which was established to oversee the implementation of the three Rio Conventions, including the UNFCCC. The NCRC coordinates adaptation efforts across sectors and ensures that national policies align with international climate agreements. It reports directly to the Parliamentary Standing Committee on Natural Resources and Economics, which guides the Cabinet on climate change matters.

#### *4.5.4.5 Cross-Sectoral Coordination and Challenges*

While Namibia has made significant progress in laying the groundwork for climate adaptation, several challenges remain. There is still a need for improved cross-sectoral coordination to ensure that climate adaptation is effectively mainstreamed across all levels of government. Furthermore, limited financial resources and human capacity, particularly at the local level, hinder the implementation of adaptation measures. These barriers are recognized in the country's NDC and Adaptation Communication, and efforts are underway to address them through international climate finance mechanisms like the Green Climate Fund (GCF).

#### *4.5.4.6 Moving Forward*

Namibia's adaptation planning and policy landscape reflects a commitment to resilience in climate change. However, the successful implementation of these plans will require continued support from national stakeholders and international partners. The NAP will be a crucial tool for guiding these efforts, helping Namibia to prioritize adaptation actions, secure funding, and build institutional capacity to address climate risks effectively.

### 4.5.5 Conclusion

While Namibia has established a robust framework for climate change adaptation, ongoing efforts must focus on overcoming identified barriers, ensuring detailed planning and implementation, and aligning actions with national development objectives to foster a resilient and sustainable future.

This chapter has provided an overview of Namibia's adaptation strategies, revealing critical insights into the country's response to climate change, emphasizing its priority areas, barriers to progress, planned actions, and alignment with national development priorities. Below are the main key insights in the chapter

Priority Areas for Adaptation: Namibia has identified several priority sectors vulnerable to climate change, including water resources, agriculture, forestry, coastal zones, tourism, health, and disaster risk management. These sectors are essential for maintaining the population's well-being and the economy's sustainability. The prioritization reflects an understanding of the multifaceted impacts of climate change on natural resources and public health.

Barriers to Progress: Despite the clear priority areas, significant barriers hinder progress in adaptation efforts. Key challenges include inadequate human capacity, limited access to information and technologies, insufficient funding, and a lack of coordinated governance structures. Additionally, the framing of climate change primarily as an environmental issue rather than a cross-cutting developmental challenge restricts the integration of climate adaptation into broader policy frameworks.

Planned Adaptation Actions: Namibia's adaptation actions are outlined in various national documents, including the Updated Nationally Determined Contributions (NDC) and the National Adaptation Communication (AdCom). These documents specify 43 prioritized adaptation actions with associated timelines, accountable ministries, and links to the Sustainable Development Goals (SDGs). However, detailed activities to achieve these actions are less defined, indicating a need for more specific implementation plans.

Design and Selection of Adaptation Actions: The design and selection process for adaptation actions in Namibia incorporates extensive stakeholder consultations and relies on existing vulnerability assessments and national strategies. The government emphasizes the importance of integrating climate change into existing policies and development frameworks to ensure that adaptation measures are holistic and sustainable. By addressing gaps in knowledge and capacity, Namibia aims to create a comprehensive approach to adaptation.

Alignment with National Development Priorities: Namibia's planned adaptation actions are closely aligned with its national development priorities, focusing on enhancing resilience, promoting sustainable livelihoods, and improving resource management. The government recognizes that effective adaptation is essential for addressing climate risks and achieving broader developmental goals, such as poverty reduction and social equity.

## 4.6 ADAPTATION PROGRESS AND MANAGEMENT

### 4.6.1 Introduction

This chapter uses the MPGs to thoroughly examine climate change adaptation implementation progress and management in Namibia, focusing on the adaptation priorities discussed in the previous chapter. It seeks to answer two core questions with their associated supplementary questions. The core question is: What is the implementation status of the planned adaptation actions? The supplementary question to this core question is how much of Namibia's adaptation programme has had international support, and how effective have the supported actions been? The second core question is, what are the impacts and outcomes of adaptation actions that have been implemented? This core question has two supplementary questions: How effective and sustainable have these implemented adaptation actions been, and how replicable are they?

Moreover, what are the capacities, capabilities, and characteristics of Namibia's Monitoring and Evaluation System for adaptation? To address these questions, the chapter proceeds with two main sections, focusing on adaptation implementation progress (addressing the first core question) and adaptation management (addressing the second core question).

### 4.6.2 Adaptation Implementation Progress

Namibia, as a climate-vulnerable country, has made significant strides in designing and planning adaptation actions to address the impacts of climate change. The recent Updated NDC (Government of the Republic of Namibia, 2021) outlines Namibia's key adaptation priorities and the necessary measures to strengthen its resilience across critical sectors such as agriculture, water resources, forestry, coastal zones, tourism, health, and disaster risk management. However, as Namibia has only recently designed these adaptation actions, implementing the planned measures is still in its early stages. This section assesses the implementation status, the role of international support, and the effectiveness, sustainability, and replicability of the adaptation actions undertaken thus far.

### 4.6.3 Implementation Status of Planned Adaptation Actions

Namibia's Updated NDC identifies 43 prioritised adaptation actions across key sectors. These actions are critical for enhancing the country's capacity to cope with the adverse effects of climate change. Despite the ambitious planning, the implementation of these adaptation measures is still at a nascent stage. Several of the identified actions are in the initial phases of development, with emphasis on project conceptualization, capacity-building, policy formulation, and establishing the institutional frameworks necessary for long-term adaptation. For instance, the MEFT, as a National Designated Authority, has received GCF Readiness Funding to improve capacity and strengthen the governance framework around climate change issues in Namibia. Furthermore, Namibia has received funding from GCF to develop its National Adaptation Plan (Green Climate Fund, 2023).

Some early progress has been observed in sectors such as agriculture, water resources, and ecosystem and biodiversity. Pilot projects aimed at enhancing drought resilience and improving water resource management have been initiated, but these are primarily small-scale and localized efforts. The primary focus of completed or ongoing adaptation projects has been developing strategies and policies that will enable the full-scale implementation of the actions outlined in the NDC. Notable examples include the ongoing efforts to mainstream climate change adaptation into Namibia's agricultural policies and practices and community-based water management projects that aim to address water scarcity issues exacerbated by climate change. Table 5.4 highlights some of the completed or ongoing adaptation projects. It shows the project's name, funders, costs, implementers, and description of project aims.

*Table 4-3. Some of the completed or ongoing adaptation projects*

| Project | Funder, cost, and implementers | Description |
|---|---|---|
| PIMS 4711: Scaling up community resilience to climate variability and climate change in | Funded by GEF; Total cost: US$ 23,217,263.00; Implementation: UNDP, MEFT, MAWLR | The SCORE project was implemented in seven northern regions of Namibia, namely Oshana, Omusati, Ohangwena, Oshikoto, Kunene, Kavango West and Kavango East. These regions are regularly and increasingly threatened by extreme weather events such |

| Project | Funder, cost, and implementers | Description |
|---|---|---|
| Northern Namibia (SCORE) (2014 – 2019) | | as floods, which cause damage to infrastructure and agricultural productivity, as well as severe droughts. The combined effect of these natural disasters is detrimental to people's livelihoods, including their health status. |
| FP023: Climate Resilient Agriculture in three of the Vulnerable Extreme northern crop-growing regions (CRAVE) (2017 – 2022) | Funded by GCF; Total Cost US$10 million; Implementation: MAWLR, EIF | The project aimed to strengthen the adaptive capacity of 4000 households to climate change and reduce their vulnerability to droughts and floods, with 80% of these households being women-led and children from 75 schools in Northern Namibia. The project's desired outcomes include (1) Smallholder adaptive capacity for climate-resilient agricultural practices strengthened (2) Reducing vulnerability to droughts and floods, and (3) Mainstreaming climate change into national agricultural strategy/sectoral policy, including budgetary adjustments for replication and scaling up. |
| Bush Control and Biomass Utilisation (BCBU) (2018 – 2021) | Funded by: BMZ; Total Cost: US$ 10 Million; implementation: GIZ, MAWLR, MEFT | Bush encroachment on pastureland is causing massive economic and ecological damage in Namibia. This affects 30 to 45 million hectares, more than 30 per cent of Namibia's land area. The most significant consequences of bush encroachment are reduced carrying capacity of affected rangeland and reduced groundwater recharge and biodiversity through habitat loss. All of these have been exacerbated by a changing climate, and through BCBU, adaptation and resilience to climate change will be promoted. The project promoted the sustainable thinning of encroacher bushes to restore the landscape and ecosystem services and use the removed biomass in various value chains. |
| Biodiversity Management and Climate Change (2017 - 2020). | Funded by BMZ; Total Cost EUR 6,061,428; Implementation: GIZ, MEFT | This project ensured a coherent implementation of biodiversity and climate change-related policies, strategies, and practices by the Ministry of Environment and Tourism in cooperation with other ministries and non-governmental actors, which |

| Project | Funder, cost, and implementers | Description |
|---|---|---|
| | | increasingly contributed to diversifying and securing the livelihoods of local users of natural resources. |
| Pilot rural desalination plants using renewable power and membrane technology | Adaptation Fund US$ 4,999,674; Implemented by: DRFN, Nam Water | The project's objective is to pilot the treatment by reverse osmosis (RO) of poor-quality local groundwater to a level that complies with the national standards for drinking water, using sun and wind energy to power the process. The project will result in improved resilience of vulnerable communities and groups to climate change impact, specifically to a decrease in the chemical water quality of existing groundwater sources. In addition, the project will also serve to increase the capacity of government agencies to integrate climate change adaptation considerations into water supply planning and policy processes. |
| Enhancing Climate Change Resilience in the Benguela Current Fisheries System (2015-2019, extended to 2023) | Funded by: GEF; Total cost (LDCF/SCCF allocation): US$4 725 000; Co-financing total cost: USD19 166 000; Implemented by: FAO, BCC | The objective is to build resilience and reduce the vulnerability to climate variability and change of the marine fisheries and mariculture sectors within the BCLME by strengthening adaptive capacity and implementing participatory and integrated strategies to ensure food and livelihood security. |
| Capacity-building Initiative for Transparency (CBIT) Project | Funded by: GEF; Total cost: USD 1.100.000; Implemented by: UNDP | The main objective of this project is to enhance Namibia's institutional and technical capacities to establish a comprehensive Transparency Framework for Measurement, Reporting and Verification (MRV) of climate actions and to report on NDC implementation under the Paris Agreement. The project also aims to support Namibia to overcome the challenges resulting from the full implementation of the PA and the enhanced transparency framework. |
| Climate Change and Inclusive Use of Natural Resources (CCIU) | Funded by: BMZ and EU; Total cost: EUR12,670,000; Implemented by: GIZ | The project aims to contribute to a more equitable use of natural resources, and to increase the resilience of especially rural and vulnerable households by improving good governance and strengthening institutional |

| Project | Funder, cost, and implementers | Description |
|---|---|---|
| | | capacities, inclusive valorisation of natural resources, strengthening institutional framework and capacities of MEFT, and enabling relevant stakeholders to implement the NDCs for Namibia. |
| Investment Plan for the Integrated Ecosystems Management in Namibia. | Funded by the Climate Investment Funds; Total cost: USD500,000; Implemented by AfDB-MEFT | The project is in the context of the landscape approach and focused on developing an investment plan for integrated ecosystem management around the nature-people-climate nexus. The project aims to contribute to climate change adaptation efforts while generating multiple benefits for mitigation through nature-based solutions |
| Strengthening Namibia's Forest and Veld Fire Detection, Monitoring and Response System | Funded by: UNDP Seoul Policy Centre-SDG Partnerships; Total cost: USD75,000; Implemented by: UNDP and MEFT | The project aims to strengthen Namibia's institutions and foster international and cross-sectoral collaboration to implement forest and veld fire management plans effectively. |
| Strengthening and building the resilience of Namibia's peri-urban communities to climate change through climate-smart agricultural production, access to solar technologies, climate information and early warning | Funded by: Government of Japan; Total cost: USD1,030,039; Implemented by: UNDP-MEFT | The project aims to support peri-urban communities through increased access to solar technologies linked to backyard gardens and contribute towards implementing the NDC targeting 100 households with 60% female-headed households. This is in response to food insecurity created by droughts and the effect of the COVID-19 pandemic on the economic sectors of Namibia. The project includes agri-photovoltaic technologies, climate-smart agriculture practices suited for peri-urban areas, and market linkages through electric mobility. |

However, many planned adaptation actions have yet to transition into the active implementation phase. Key barriers such as limited financial resources, inadequate institutional capacity, and the need for stronger coordination between sectors have slowed the pace of implementation. Additionally, many of the proposed actions, such as those focused on coastal zone management and health, depend on developing detailed implementation plans and acquiring sufficient funding before they can move forward.

#### *4.6.3.1 International Support for Namibia's Adaptation Programme*

International support has been crucial to Namibia's adaptation efforts, given its reliance on external funding and technical assistance to achieve its climate goals (see the second column in

(Table 5.4). Much of the adaptation programme outlined in the Updated NDC is contingent upon international financial support, which Namibia has actively sought through multilateral climate funds such as the Green Climate Fund (GCF)c, Global Environmental Facility (GEF), and the Adaptation Fund.

Several adaptation projects in Namibia have received international support, most notably in the agriculture, water sectors, biodiversity and ecosystems (see Table 5.4). For example, the GCF has provided funding for initiatives to improve water access in drought-prone areas and enhance agricultural, biodiversity, and ecosystem resilience to climate variability. These projects have focused on building infrastructure, such as water harvesting systems, introducing climate-smart agricultural practices, and leveraging nature-based solutions to address current and future climate change impacts. International support has also been directed towards capacity-building initiatives, helping to strengthen the institutional and technical capacity required to design, implement, and report on Namibia's adaptation actions.

While the international support received so far has been instrumental in jump-starting Namibia's adaptation programme, the level of support has not yet matched the scale of the country's adaptation needs. Namibia's Updated NDC estimates that a total of USD 1.72 billion is required for adaptation actions between 2021 and 2030, with a large portion of this funding expected to come from international sources. However, funding flows have been slow, and a substantial gap remains between the financial resources needed and those currently available. As a result, many planned adaptation actions are either delayed or in the planning phase, awaiting sufficient funding to be fully implemented.

#### *4.6.3.2 Impacts and Outcomes of Implemented Adaptation Actions*

The impacts of Namibia's adaptation actions are still emerging, given that many of the projects are in the early stages of implementation. However, initial outcomes from some pilot projects provide insights into the potential long-term benefits of these actions.

In agriculture, climate-smart farming practices introduced through internationally supported projects have shown promise in improving crop yields and enhancing food security in areas affected by drought. For instance, introducing drought-resistant crops and conservation agriculture techniques has helped farmers reduce their vulnerability to changing rainfall patterns. Similarly, water management projects have improved water access for rural communities, particularly in regions prone to prolonged dry periods.

In the disaster risk management sector, Namibia has begun integrating climate adaptation measures into its disaster preparedness frameworks. This includes improving early warning systems and enhancing the capacity of local governments to respond to climate-related disasters. Although these efforts are still in the early stages, they have the potential to significantly reduce the human and economic costs of climate-related disasters in the future.

However, it is important to note that these impacts are limited in scope and primarily confined to pilot or localized projects. Scaling up these initial successes to a national level will require increased funding, stronger coordination among sectors, and continued international support.

#### *4.6.3.3 Effectiveness, Sustainability, and Replicability of Implemented Actions*

The adaptation actions implemented in Namibia have demonstrated varying effectiveness and sustainability. The actions have proven effective locally in agriculture, water management, biodiversity and ecosystems, particularly in building resilience to drought and improving resource management. The introduction of climate-smart practices in agriculture has shown

that adaptive measures can significantly enhance productivity and reduce vulnerability to climate shocks. Furthermore, Community-based Natural resource management has improved biodiversity and ecosystem management, enhancing their resilience to climate change impacts.

Sustainability remains a key concern, however. Many of the pilot projects implemented so far have relied heavily on external funding and technical assistance. Ensuring the long-term sustainability of these actions will require building local capacity, securing long-term funding, and integrating adaptation measures into national and sub-national policies. Moreover, local ownership of adaptation actions will be essential to their continued success beyond the project lifecycle.

The replicability of these actions is also an important consideration. While many of the early adaptation measures have been implemented at a small scale, their success indicates potential for replication in other parts of Namibia. However, replicability will depend on the availability of resources, institutional capacity, and effective knowledge sharing among communities and government agencies.

### 4.6.4 Adaptation Monitoring and Evaluation System

While Namibia's M&E system for adaptation is still in its early stages, the country has laid the groundwork for tracking and evaluating the progress of its adaptation actions. With continued investment in capacity building, data infrastructure, and stakeholder engagement, Namibia's M&E system has the potential to become a robust tool for ensuring the effective implementation of its adaptation strategy.

Namibia has made significant progress in identifying and prioritizing adaptation actions in its Updated Nationally Determined Contribution (NDC). These actions address the country's vulnerability to climate change impacts across key sectors such as agriculture, water resources, coastal zones, health, and disaster risk management. However, the monitoring and evaluation (M&E) system for adaptation actions is still in the developmental stage, given that many of these actions have only recently been designed. This overview focuses on the capacities, capabilities, and characteristics of Namibia's M&E system for adaptation while emphasizing that the system is not yet fully operationalized.

#### *4.6.4.1 Capacities and Capabilities of Namibia's M&E System for Adaptation*

Namibia's approach to monitoring and evaluating its adaptation actions is still evolving. The M&E system is designed to track progress toward achieving the goals in the Updated NDC and ensure that adaptation measures are implemented effectively across various sectors. While some foundational elements of the M&E system have been established, Namibia faces challenges in capacity and capability to operationalize the system fully. These challenges are related to institutional coordination, data availability, and technical expertise.

- Institutional Coordination and Governance: Namibia's M&E system for adaptation is managed under the broader climate change governance structure led by the Ministry of Environment, Forestry and Tourism (MEFT). The MEFT, through its Climate Change Unit, serves as the national coordinating body for adaptation actions. The system is intended to integrate the efforts of various ministries, sectors, and stakeholders, including civil society and the private sector. Key institutions such as the National Planning Commission (NPC) and sectoral ministries are also involved in data collection and reporting. Although Namibia has made strides in establishing institutional frameworks, effective coordination between these entities remains challenging. The cross-cutting

nature of climate adaptation actions requires strong collaboration across ministries, sectors, and levels of government. The current capacity of some institutions to monitor and evaluate adaptation actions is limited, which hinders the timely collection of data and reporting on adaptation outcomes. Strengthening institutional capacity and ensuring better alignment between national and sub-national institutions are essential for fully operationalising the M&E system.

- Technical Expertise and Resources: The successful implementation of Namibia's M&E system for adaptation requires technical expertise in data collection, analysis, and reporting. However, Namibia faces a shortage of qualified personnel with the necessary skills to design, implement, and maintain an effective M&E system. Building local expertise and enhancing technical capacity are critical to ensure Namibia can effectively track its adaptation progress. In response to these gaps, Namibia has started efforts to build the technical capacity of relevant institutions through workshops, training programs, and collaborations with international organizations. International support and capacity-building initiatives from development partners have also played a significant role in helping Namibia enhance its technical capabilities. However, more investment is needed to ensure that Namibia's M&E system can operate independently and sustainably.

- Data Collection and Reporting: The collection of reliable, accurate, and timely data is essential for monitoring the progress of adaptation actions. Namibia's M&E system faces challenges in this area, particularly regarding data availability, quality, and consistency. Many adaptation actions identified in the Updated NDC require detailed, sector-specific data to measure effectiveness. However, Namibia's current data collection infrastructure is underdeveloped, especially in water management, agriculture, and disaster risk management. To address this, Namibia is improving its national data collection systems, including enhancing climate observation networks and integrating data collection efforts across different ministries. This involves upgrading meteorological stations, improving agricultural and environmental monitoring systems, and promoting satellite-based tools for better data accuracy. While these efforts are underway, significant progress is still needed to ensure Namibia has the data infrastructure necessary to support its M&E system.

#### *4.6.4.2 Characteristics of Namibia's M&E System for Adaptation*

Although Namibia's M&E system for adaptation is still in its early stages, several key characteristics define its approach to tracking and evaluating adaptation actions. These characteristics include:

- Outcome-Oriented: Namibia's M&E system is designed to be outcome-oriented, focusing on the measurable impacts and results of adaptation actions. The system seeks to evaluate the implementation of adaptation measures and their effectiveness in reducing vulnerability to climate change and improving resilience across different sectors. For example, the system would track indicators such as crop yields, water usage efficiency, and the reduction in climate-related agricultural losses in the agriculture sector. The emphasis on outcomes is essential for ensuring that Namibia's adaptation efforts lead to tangible improvements in climate resilience. However, given the

challenges in data collection and institutional coordination, the country has yet to fully develop the indicators and metrics required to track these outcomes comprehensively.

- Cross-Sectoral and Inclusive: The M&E system for adaptation is cross-sectoral, covering a wide range of sectors such as agriculture, water, health, and coastal management. It aims to integrate climate change considerations into national and sectoral policies and plans, ensuring that adaptation is mainstreamed across all levels of governance. The system also involves various stakeholders, including civil society organizations, the private sector, and local communities. By ensuring broad participation in the M&E process, Namibia aims to promote inclusivity and enhance the effectiveness of adaptation actions. Engaging local communities and vulnerable populations in the monitoring process is particularly important for ensuring that adaptation measures are equitable and address the needs of those most affected by climate change.

- Aligned with International Standards: Namibia's M&E system for adaptation is being designed in alignment with international climate frameworks, such as the Paris Agreement and the UNFCCC. The country's reporting on adaptation actions is linked to its obligations under the UNFCCC, including preparing National Communications, Biennial Update Reports (BURs), and Adaptation Communications (AdComs). By aligning its M&E system with international standards, Namibia ensures it can track its progress in a way that is consistent with global climate reporting requirements. However, while the system is designed to be aligned with international standards, its full operationalization depends on building the capacity and resources needed to consistently meet these standards.

#### *4.6.4.3 Moving Forward: Operationalizing Namibia's Adaptation M&E System*

As Namibia continues to implement the adaptation actions outlined in its Updated NDC, the full operationalization of its M&E system will be crucial for tracking progress and ensuring accountability. The M&E system will need to be strengthened in several key areas:

- Capacity Building: Namibia must invest in building the capacity of its institutions and technical staff to design, implement, and maintain an effective M&E system. This includes providing training on data collection and analysis, enhancing institutional coordination, and ensuring that sufficient resources are allocated for M&E activities.

- Data Infrastructure: Improving the availability and quality of climate-related data is essential for the effective functioning of the M&E system. Namibia will need to enhance its data collection infrastructure, including meteorological stations, agricultural monitoring systems, and disaster risk management networks.

- Stakeholder Engagement: Ensuring that all relevant stakeholders, including local communities and vulnerable populations, are involved in the M&E process will be critical for promoting inclusivity and ensuring that adaptation actions address the needs of those most affected by climate change.

- International Support: Given Namibia's financial and technical constraints, continued international support will be vital for developing and operationalising its adaptation M&E system. Support from multilateral climate funds, international organizations, and

development partners will help Namibia build the necessary capacity and resources to implement an effective M&E system.

Namibia's adaptation efforts are off to a promising start, but the implementation of the actions and operationalisation of the M&E system needs further development. Strengthening institutional capacities, enhancing data collection, and securing continued international support will be essential to achieving the country's adaptation goals, ensuring resilience against climate change impacts, and improving the livelihoods of vulnerable populations.

Moving forward, Namibia aims to align its adaptation efforts through its National Adaptation Plan (NAP), which will streamline funding, strengthen governance, and enhance institutional capacity. The NAP will also ensure integration with international commitments and broader development goals. While challenges such as securing adequate funding persist, Namibia's proactive approach underscores its commitment to building a climate-resilient future for its population, ecosystems, and economy.

# 5 RESEARCH AND SYSTEMIC OBSERVATION, EDUCATION, TRAINING AND PUBLIC AWARENESS, GENDER, YOUTH AND JUST TRANSITION

## 5.1 INTRODUCTION

Namibia's climate action framework emphasizes three interconnected pillars: Research and Systemic Observation, Education, Training, and Public Awareness, and Gender, Youth, and Just Transition. Together, these pillars underpin the country's efforts to build climate resilience and sustainable development.

Namibia's national observational networks, supported by regional collaborations like SASSCAL and international partners such as the IPCC and GCOS, collect and analyse critical climate data to guide evidence-based policies (SASSCAL, 2023; IPCC, 2023). These efforts focus on addressing challenges like desertification, water resource management, and biodiversity conservation (Namibia's Updated NDC, 2023).

Education and public awareness are key drivers of Namibia's climate agenda. Climate-focused curricula, community outreach programs, and campaigns like "Green Namibia" equip citizens with the knowledge and skills to adopt sustainable practices, fostering a culture of resilience (MEFT, 2023; NDC ISAP - Cross-cutting, 2023). Training programs, particularly in sustainable agriculture and water management, empower rural communities to adapt to climate variability (MEFT, 2023).

Inclusivity is central to Namibia's approach, with initiatives like the Namibia Youth for Climate Action (NYCA) and gender-responsive policies enhancing participation in climate action (EIF, 2023; Ministry of Gender Equality and Child Welfare, 2023). The Just Transition Framework supports communities transitioning from carbon-intensive industries, providing green skills training and economic opportunities (TVET, 2023).

By integrating research, education, and inclusivity, Namibia demonstrates a holistic and equitable approach to climate action, positioning itself as a leader in sustainable development.

## 5.2 RESEARCH AND SYSTEMIC OBSERVATION

Namibia's climate research framework is grounded in a commitment to understanding climate dynamics, managing environmental risks, and crafting policies that promote resilience. Through systematic data collection and analysis, Namibia addresses critical challenges, such as water scarcity, biodiversity loss, and land degradation. This chapter provides an in-depth look at Namibia's national observational networks, regional studies, international collaborations, and their implications for sustainable policy and adaptation strategies.

### 5.2.1 National Observational Networks

Namibia's national observational network is the backbone of its climate research efforts, providing vital data that captures long-term climate trends. This network is a collaborative effort led by the Namibia Meteorological Service (NMS) and the Ministry of Environment, Forestry, and Tourism (MEFT), with contributions from local research institutions and private organizations. The network comprises over 150 meteorological stations strategically located across Namibia's ecological zones, from the hyper-arid Namib Desert to the wetter northern regions. These

stations measure parameters such as temperature, precipitation, atmospheric pressure, humidity, and solar radiation. Advanced automated weather stations, introduced in 2018, enable real-time data collection, allowing for a more immediate response to weather events. Since implementation, the data coverage has improved significantly, providing granular insights into microclimatic conditions across the country.

In Namibia's coastal and desert areas, specialized sensors measure sand and dust transport, which affect local climate and air quality. This data has proven essential in understanding desertification and informing policies to mitigate dust storms that impact agriculture and human health. The observational network's coverage extends to remote areas, where mobile stations measure seasonal river flows in ephemeral rivers—crucial for understanding water availability and guiding community-based water management efforts.

### 5.2.2 Regional and Sectoral Studies

Namibia's climate research extends beyond national borders through regional and sectoral studies under frameworks like the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL). Through SASSCAL, Namibia collaborates with neighbouring countries to address shared climate challenges, including drought, desertification, and biodiversity loss.

#### *5.2.2.1 Desertification and Land Degradation Studies*

Desertification poses one of the most significant threats to Namibia's ecosystems and economy, affecting over 20% of arable land. Collaborative research funded by the Green Climate Fund (GCF) and supported by SASSCAL has focused on mapping desertification hotspots and assessing the impacts of climate variability on soil health and vegetation cover. For instance, recent studies identified severe soil degradation in the northwestern Kunene region, where increased temperatures and erratic rainfall patterns have reduced agricultural productivity and increased vulnerability to food insecurity.

The research has led to practical recommendations, such as promoting sustainable grazing practices, introducing soil conservation techniques, and supporting community-driven land management projects. Pilot projects in the Kunene and Erongo regions have shown promising results, with soil stabilization observed in 80% of project areas. These successes underscore the role of scientific research in informing and validating Namibia's Sustainable Land Management (SLM) policy framework.

#### *5.2.2.2 Water Resource Management*

Namibia's water resources are highly vulnerable to climate variability, as approximately 83% of the country's land is classified as arid or semi-arid. Regional studies with SASSCAL have focused on understanding groundwater dynamics and the recharge potential of Namibia's aquifers. Advanced hydrological models have been developed to assess groundwater availability under various climate scenarios, incorporating data from real-time river gauges and remote sensing.

In partnership with the Ministry of Agriculture, Water, and Land Reform (MAWLR), Namibia is piloting water-saving irrigation technologies, such as drip and deficit irrigation, in the Omusati and Oshana regions. These studies show a potential water-use efficiency increase of up to 35% compared to traditional irrigation methods. The positive outcomes have spurred the expansion of water-saving technologies across Namibia, ensuring more sustainable agricultural practices in water-scarce areas.

### 5.2.3 International Collaborations

Namibia's climate research benefits from strategic international partnerships, facilitating access to advanced tools, methodologies, and expertise. Key partnerships with organizations like the Food and Agriculture Organization (FAO), United Nations Environment Programme (UNEP), and the Intergovernmental Panel on Climate Change (IPCC) ensure that Namibia's data collection aligns with global standards and that findings are comparable internationally.

#### *5.2.3.1 National Greenhouse Gas Inventory System*

The National Greenhouse Gas Inventory System, developed in collaboration with the FAO and UNEP, provides a comprehensive platform for monitoring emissions across Namibia's key sectors: energy, agriculture, forestry, and waste management. Using satellite data, Geographic Information Systems (GIS), and ground-based measurements, the inventory system offers a precise, real-time overview of emissions sources.

This system allows Namibia to conduct sector-specific emission analysis, identifying hotspots and opportunities for mitigation. For example, data from the agriculture sector revealed methane emissions from livestock as a significant contributor to Namibia's overall emissions profile. Based on these findings, Namibia has developed targeted methane reduction programs, including improved livestock feeding practices and manure management, resulting in an estimated 15% reduction in methane emissions from pilot farms in the Otjozondjupa region.

#### *5.2.3.2 Collaboration with Global Climate Observing System (GCOS) and IPCC*

Through the Global Climate Observing System (GCOS) and the IPCC, Namibia receives technical assistance for developing climate models that predict regional impacts under various emission scenarios. Figure 5.1 flowchart illustrates the collaborative structure underpinning these partnerships, showing how data integration efforts from organizations like for example FAO, UNEP, GCOS, and IPCC contribute to Namibia's climate monitoring framework under the AFOLU sector. The GCOS partnership, in particular, has enabled Namibia to enhance the quality of data collected from satellite and ground-based observation networks, ensuring greater accuracy in climate modelling and forecasting (NDC ISAP - Cross-cutting, 2023).

Advanced climate models developed with IPCC support have been used to simulate future temperature and rainfall trends in Namibia, indicating potential increases in extreme weather events, such as intense droughts and heatwaves. These projections guide adaptation strategies by identifying vulnerable sectors like agriculture and water resources, prioritizing resilience planning in at-risk communities. The collaboration with UNEP and FAO further strengthens Namibia's monitoring capacity by providing infrastructure and technical resources that enhance data coverage and reliability across ecological zones (Namibia's Updated NDC, 2023).

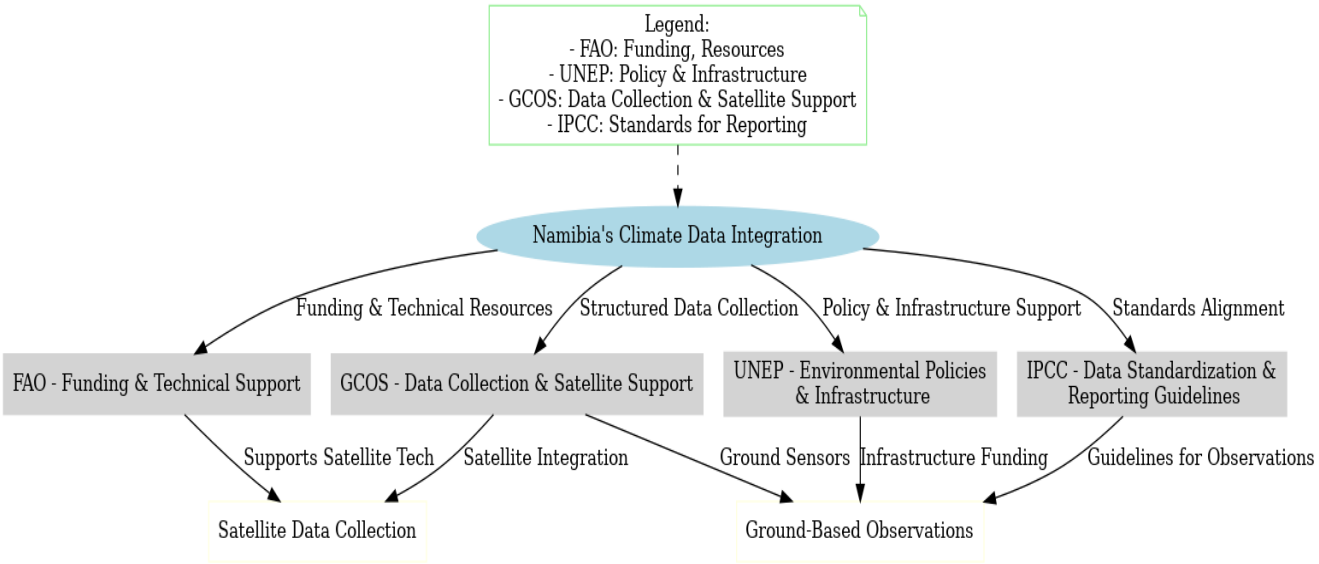



*Figure 5-1. Collaborative Structure of Namibia's Climate Data Integration Partnerships under afolu.*

*Source: Namibia's Updated Nationally Determined Contribution (NDC), 2023; NDC ISAP - Cross-cutting, 2023.*

### 5.2.4 Key Findings and Case Studies

Systematic observation and research have provided Namibia with key findings that shape its policy responses to climate impacts. The following case studies illustrate significant insights gained through Namibia's climate observation and monitoring efforts:

#### *5.2.4.1 Drought and Agricultural Resilience*

Studies show that Namibia's frequency of droughts has increased over the past 20 years, with severe droughts occurring in 2013, 2016, and 2019. These droughts have severely impacted crop production, with losses estimated at $2 billion annually during peak drought years. Research conducted in collaboration with local universities and SASSCAL has focused on enhancing drought resilience through conservation agriculture techniques, such as minimum tillage and crop rotation.

In pilot areas within the Kunene and Omaheke regions, conservation agriculture practices have improved crop yields by 30% in drought years, providing stable food supplies and income for local farmers. This success has led to the government scaling up these practices as part of its Climate Resilient Agriculture Network, a program that targets 10,000 farmers over the next decade.

#### *5.2.4.2 Biodiversity and Ecosystem Shifts*

Namibia's observational data has documented shifts in the distribution of key wildlife species due to rising temperatures and habitat changes. For example, the Namibian Elephant Project, a collaboration between MEFT and international conservation organizations, monitors the migration patterns of elephants in response to water scarcity. Data shows that elephant herds are migrating to previously unused areas, increasing human-wildlife conflict as they venture closer to villages.

To mitigate these conflicts, Namibia has initiated community-based conservation programs and established migration corridors that guide elephants away from residential areas. These

conservation corridors have reduced crop damage by 40% in affected communities, demonstrating the impact of data-driven conservation initiatives.

### 5.2.5 Implications for Climate Adaptation and Policy

The research and monitoring conducted by Namibia's networks and partnerships have directly informed a range of policy decisions, particularly those focused on climate adaptation.

#### *5.2.5.1 Water Resource Management*

Insights from groundwater studies have underscored the need for integrated water resource management (IWRM) strategies. The Water Resources Management Act (2013) has integrated recommendations from these studies, establishing protocols for sustainable water use in agriculture and urban planning. In drought-prone areas, the government has introduced policies that encourage water harvesting and restrict groundwater extraction to protect aquifers.

The adoption of the "Water Wise Namibia" campaign has increased awareness of water-saving techniques among citizens and businesses, leading to a 25% reduction in water consumption in urban centres. Moreover, data-driven water policies have improved access to clean water for rural communities, reducing dependency on water trucking during dry seasons.

#### *5.2.5.2 Energy Policy and Renewable Expansion*

Climate data analysis has revealed the increasing energy demands associated with rising temperatures, which places stress on Namibia's conventional energy systems. Recognizing the potential for renewable energy, Namibia's NDC includes ambitious goals for solar and wind energy, supported by detailed climate data on solar irradiance levels and wind speeds. Namibia's Renewable Energy Plan, launched in 2021, prioritizes areas with optimal conditions for solar farms, such as the Karas and Hardap regions, to ensure maximum efficiency and cost-effectiveness.

### 5.2.6 Future Directions in Climate Research and Monitoring

Namibia's forward-looking climate strategy involves expanding its research capabilities to adapt to emerging climate challenges. As illustrated in Figure 5.2, planned infrastructure and technology investments prioritize a centralized climate data repository that consolidates information from multiple sectors, enhancing access for policymakers, researchers, and the public (NDC ISAP - Cross-cutting, 2023). This repository, alongside Namibia's exploration of artificial intelligence (AI) for climate data analysis, supports advanced climate risk modelling and improved early warning systems.

To bolster observational coverage, Namibia plans to expand its network of weather stations, with a particular focus on under-monitored areas in northeastern regions where seasonal flooding poses recurrent challenges. The investment also includes the adoption of drones and remote sensing technologies, which will provide detailed ecosystem monitoring, especially in remote and protected areas.

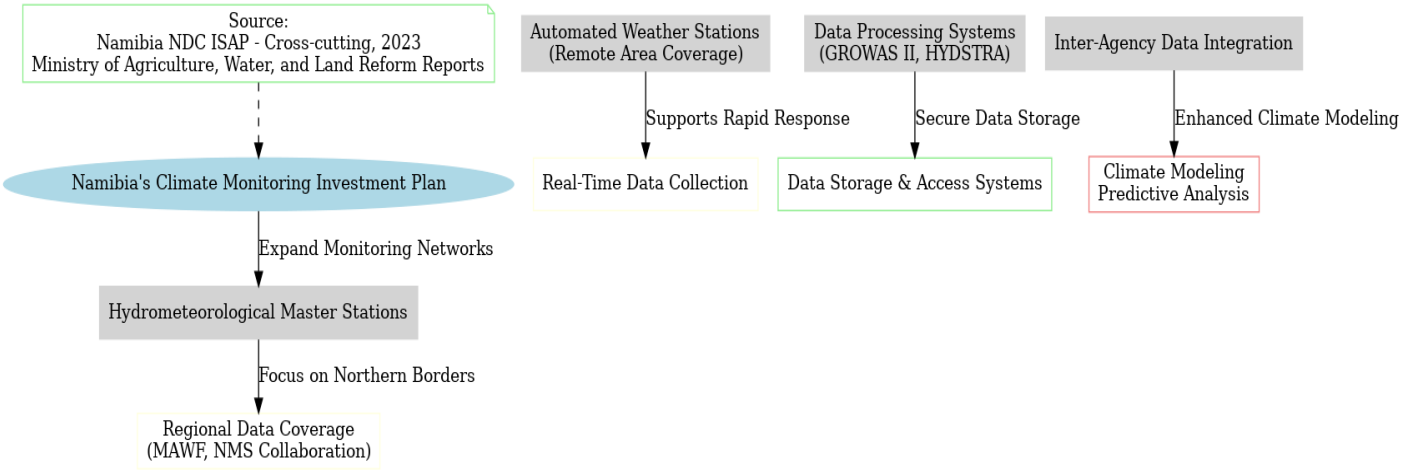



*Figure 5-2. Planned Infrastructure and Technology Investments in Namibia's Climate Monitoring System.*

## 5.3 Education, Training, and Public Awareness

Namibia has embraced education, training, and public awareness as cornerstones in its fight against climate change. Through a range of initiatives targeting students, farmers, professionals, and the general public, the country is fostering a culture of environmental stewardship, equipping communities to face climate challenges, and building a workforce skilled in sustainable practices. These efforts encompass formal education, vocational training, and community outreach programs that seek to create a well-informed and resilient society. This chapter delves into Namibia's comprehensive strategy for enhancing climate literacy and engagement, detailing each initiative's objectives, structure, and impact.

### 5.3.1 Educational Initiatives in Climate Change

Namibia's integration of climate change education into the National Curriculum represents a critical step in building climate awareness from an early age. Recognizing the need for a future workforce that understands and values sustainability, the Ministry of Education, Arts and Culture, in collaboration with the Ministry of Environment, Forestry and Tourism (MEFT), has developed a series of climate modules designed for primary and secondary students. This initiative aims to equip young Namibians with knowledge and skills that promote environmental responsibility and inspire climate action.

#### *5.3.1.1 Climate Change Curriculum Development and Implementation*

Namibia has successfully integrated climate education within its national curriculum, impacting over 200 schools and reaching approximately 70,000 students (Figure 5.3). This initiative, supported by MEAC and aligned with Namibia's Nationally Determined Contributions (NDCs), ensures that students are equipped with essential knowledge on climate resilience and sustainable practices .

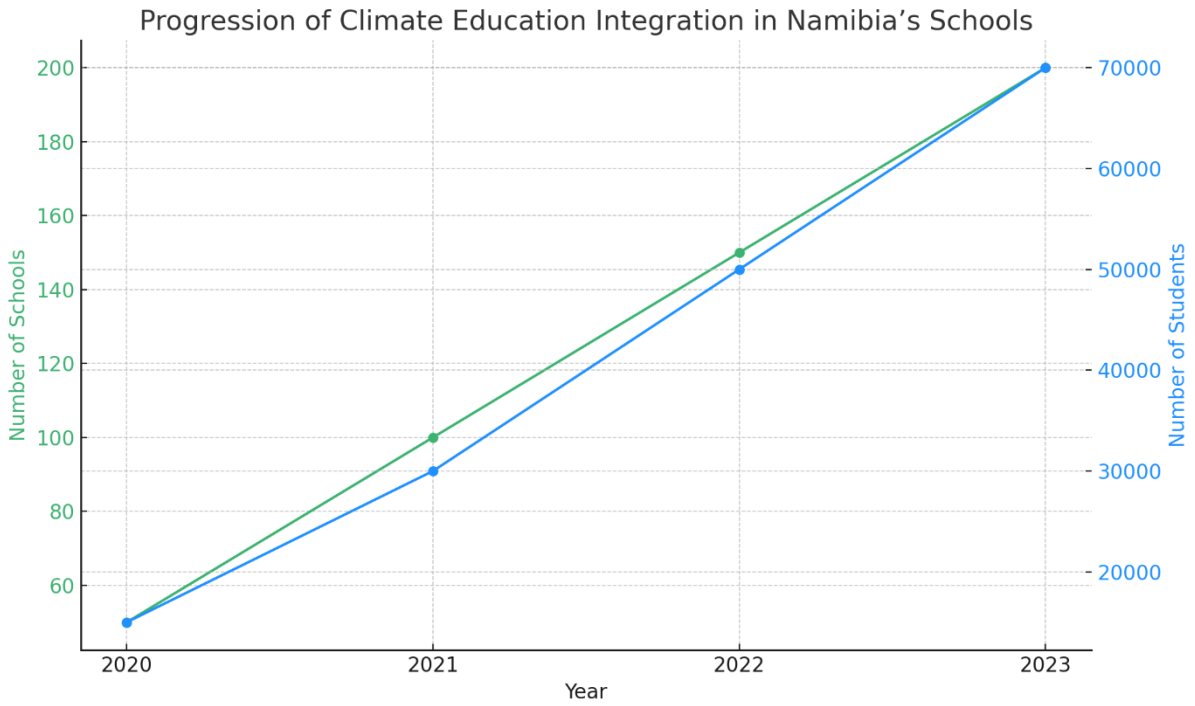



*Figure 5-3. Progression of Climate Education Integration in Namibia's Schools*

*Source: NDC ISAP - Cross-cutting, 2023*

The climate change modules introduced across Namibia's schools are tailored to different education levels, ensuring that topics are appropriate and comprehensible for each age group. For primary school students, lessons focus on introducing fundamental concepts, such as the basics of weather and climate, the causes and impacts of climate change, and the importance of protecting natural resources. Through stories, illustrations, and interactive activities, younger students engage with these topics in a way that encourages curiosity and empathy for the environment.

In secondary schools, the curriculum delves deeper into climate science, exploring subjects like greenhouse gases, renewable energy, biodiversity, and sustainable resource management. Students analyse case studies specific to Namibia, such as the impact of droughts on agriculture and the consequences of desertification in the Namib Desert. By focusing on national examples, the curriculum reinforces the local relevance of climate change, helping students understand how global phenomena directly affect their lives and communities. As of 2023, these modules are part of the standard curriculum in over 200 schools, reaching approximately 70,000 students annually (Figure 5.3).

To ensure effective delivery, teachers across Namibia undergo specialized training that equips them with the knowledge and pedagogical skills needed to teach climate concepts. These training sessions, often conducted as workshops by MEFT and environmental education organizations, provide educators with resources like simulation models, climate change teaching kits, and guides on incorporating climate change topics into various subjects.

#### *5.3.1.2 Extracurricular Environmental Clubs and Youth-Led Initiatives*

Beyond classroom instruction, many Namibian schools have launched environmental clubs where students participate in hands-on activities that reinforce sustainable practices. These clubs, run by students and supported by school staff, engage members in activities such as tree

planting, recycling drives, and local clean-up events. By participating in these clubs, students develop a sense of environmental stewardship and gain practical experience in managing small-scale sustainability projects.

One prominent project emerging from these clubs is the "One Student, One Tree" initiative, which encourages students to plant and nurture a tree each year. Launched in 2019, this project has resulted in the planting of over 10,000 trees, mainly in regions vulnerable to desertification. Students involved in the project are responsible for tracking the growth of their trees, monitoring soil moisture, and learning about native plant species. This hands-on experience has fostered a sense of ownership among students, empowering them to act as ambassadors for environmental conservation in their communities.

Environmental clubs often collaborate with local NGOs and government programs, enabling them to access additional resources and expertise. Through these partnerships, students have organized community events such as workshops on sustainable agriculture and water conservation. The clubs have become influential within schools and communities, promoting sustainability beyond the classroom and inspiring students to continue environmental advocacy into adulthood.

### 5.3.2 Training Programs for Climate Resilience

Namibia's climate training programs are designed to build skills in adaptive practices, particularly among farmers and rural communities who are most affected by climate variability. These programs offer practical training in sustainable agriculture, water management, and renewable energy, addressing both immediate adaptation needs and long-term resilience.

#### *5.3.2.1 Climate Resilient Agriculture Network and Sustainable Farming*

The Climate Resilient Agriculture Network has trained farmers in drought-resistant agricultural practices and sustainable land management. As shown in the bar chart, two projects the Climate Resilient Agriculture in the three Vulnerable Extreme (CRAVE) and Farming for Resilience (F4R) have steadily increased its reach, with a growing number of farmers trained annually (Figure 5). This progression underscores the network's expanding impact on Namibia's agricultural sector.

The programs, initiated by MEFT in partnership with the Ministry of Agriculture, Water, and Land Reform, equips farmers with resources and knowledge to reduce vulnerability to climate extremes, particularly in drought-prone regions such as Omusati and Oshana. Through this network, over 5,000 farmers have adopted sustainable practices like conservation tillage and crop rotation. There has been a positive impact of these techniques on crop yields, with farmers reporting an approximately 30% increase in productivity after adopting climate resilience agriculture methods. This improvement is crucial for maintaining agricultural resilience amid water scarcity and unpredictable weather patterns.

In addition to individual training, climate resilience agriculture projects encourage the formation of farmer cooperatives, facilitating collective resource management and knowledge sharing. These cooperatives strengthen resilience by enabling farmers to share best practices, invest in equipment, and pool resources. Climate resilience agriculture's success has led to plans for expansion, with new modules on sustainable livestock management and soil restoration expected in the coming years.

#### *5.3.2.2 Water Management Training and Community Resource Governance*

Effective water management is essential for Namibia's resilience, given the country's arid climate and limited water availability. MEFT has developed comprehensive water management training programs that teach techniques such as rainwater harvesting, efficient irrigation, and soil moisture management. These programs target both individual farmers and community leaders who play a role in local water governance.

The rainwater harvesting training, for instance, provides step-by-step instructions on building and maintaining low-cost water collection systems. Farmers and households are trained to install gutter-based systems and water tanks that capture rainwater, which can then be used during dry periods. These systems are particularly beneficial for remote areas that rely on sporadic rainfall as their primary water source.

In rural areas, MEFT has established community-based water management groups, where local leaders are trained in water resource governance and conservation. Leaders who complete the training serve as resource persons for their communities, teaching water-saving techniques and ensuring that households adhere to local water management policies. By decentralizing water management, Namibia has empowered communities to maintain local water security, reducing reliance on government water deliveries during droughts.

### 5.3.3 Public Awareness Campaigns

Raising public awareness on climate change and sustainability is a central element of Namibia's climate strategy. Through nationwide campaigns, MEFT aims to educate citizens on reducing carbon footprints, practicing conservation, and supporting community-based environmental initiatives. These campaigns have expanded over recent years, leveraging digital platforms and local partnerships to maximize reach and impact.

#### *5.3.3.1 The "Green Namibia" Campaign for Sustainable Lifestyles*

The "Green Namibia" campaign is a multi-channel public awareness initiative launched to promote sustainable practices and climate-friendly behaviours among Namibians of all ages. This campaign employs social media, television, radio, and print media to reach diverse audiences, with a focus on encouraging energy conservation, waste reduction, and water-saving habits.

In 2023, "Green Namibia" partnered with youth organizations, local influencers, and popular media personalities to amplify its message, reaching an estimated one million Namibians through social media alone. The campaign also created a series of interactive resources, such as an online carbon footprint calculator that helps individuals assess their environmental impact and provides personalized tips for reducing it. These resources are widely used by schools, workplaces, and local governments as part of environmental education and outreach efforts.

"Green Namibia" has shown significant success in urban centres like Windhoek and Swakopmund, where recycling rates and household energy savings have increased by an average of 15% since the campaign began. The initiative has become a model for other public awareness efforts, demonstrating how targeted messaging and digital engagement can lead to meaningful behavioural changes on a large scale.

#### *5.3.3.2 Community Clean-Up and Conservation Days*

Namibia's Community Clean-Up and Conservation Days are organized annually to encourage hands-on community participation in environmental protection. These events involve citizens,

local businesses, and government agencies in cleaning public spaces, restoring natural habitats, and planting trees. Each year, thousands of Namibians participate in clean-up activities that remove waste from parks, riverbanks, and urban areas, collectively collecting hundreds of tons of waste.

The Conservation Days also include educational workshops on waste management, recycling, and the benefits of biodiversity. Participants are educated on the ecological impacts of litter and the importance of conserving local wildlife habitats. In 2023 alone, over 200 community events were organized nationwide, and more than 300 tons of waste were removed. The program's impact goes beyond environmental clean-up, fostering a sense of community responsibility and pride in local natural spaces.

Additionally, Community Clean-Up and Conservation Days have strengthened partnerships between local conservation organizations and municipal governments. These partnerships provide resources such as recycling bins, collection trucks, and educational materials, ensuring the program's sustainability. Local businesses have also begun sponsoring these events, providing funding and manpower, which enhances the scope and reach of clean-up efforts.

### 5.3.4 Impacts of Education, Training, and Public Awareness Programs

The cumulative impact of Namibia's climate education, training, and public awareness initiatives is profound, driving positive change across multiple sectors and fostering a society that is better equipped to handle climate-related challenges.

#### *5.3.4.1 Quantifiable Outcomes in Climate Literacy and Community Resilience*

Data collected by the Ministry of Education reveals that students who participate in climate-focused education programs exhibit a 40% improvement in climate knowledge, with many showing an increased willingness to engage in sustainable practices. Surveys conducted in schools indicate that students involved in environmental clubs or climate-related extracurricular activities are more likely to advocate for sustainable behaviours within their communities, extending the program's impact beyond school grounds.

In agriculture, the Climate Resilient Agriculture Network has delivered notable improvements in crop stability and resilience among participating farmers. According to evaluations by MEFT, 80% of farmers trained through CRAN have reported higher crop yields and income stability during drought years. These improvements underscore the effectiveness of adaptive training programs in building resilience among rural populations, providing them with tools to respond to climate pressures independently.

#### *5.3.4.2 Long-Term Shifts in Public Behaviour and Environmental Engagement*

Namibia's public awareness campaigns have generated observable shifts in public attitudes toward sustainability, especially in urban areas where campaigns like "Green Namibia" have achieved high engagement. Municipal reports indicate that waste reduction and recycling practices have become more common, with cities like Windhoek reporting a 15% decrease in waste management costs due to improved recycling rates.

The positive reception of Community Clean-Up and Conservation Days has also reinforced community solidarity and environmental responsibility. The increase in volunteer participation reflects a growing commitment among Namibians to preserve their natural environment, creating a culture that prioritizes ecological health and sustainability. These campaigns have

demonstrated that public awareness efforts can catalyse lasting behavioural change, enhancing Namibia's resilience at both the individual and community levels.

### 5.3.5 Future Directions in Education, Training, and Public Awareness

Namibia's education and public awareness strategy is evolving to meet the country's emerging climate challenges. In the coming years, the government plans to broaden climate education to cover advanced topics in renewable energy, climate policy, and sustainable economics at the secondary and tertiary levels. These additions will prepare students for careers in green industries, supporting Namibia's transition to a low-carbon economy.

MEFT is also exploring partnerships with international organizations to expand vocational training programs in climate-smart technologies. Proposed programs will offer skills training in areas like solar panel installation, green building techniques, and sustainable urban planning. By equipping citizens with technical skills relevant to a low-emission future, Namibia aims to strengthen its workforce and create economic opportunities within the context of climate resilience.

## 5.4 GENDER, YOUTH, AND JUST TRANSITION

Namibia's climate action framework recognizes that sustainable progress cannot be achieved without inclusive participation. By prioritizing gender equity, youth engagement, and a just transition, Namibia is fostering a resilient society that values equal opportunities, environmental stewardship, and economic fairness. This chapter provides an in-depth look at Namibia's initiatives in these areas, highlighting the roles of youth, gender-responsive policies, and transition strategies aimed at creating a more sustainable, equitable future for all.

### 5.4.1 Youth Engagement in Climate Action

Namibia places a strong emphasis on involving its youth in climate action, recognizing the transformative potential young people bring to the nation's environmental goals. Through programs that promote leadership, advocacy, and hands-on environmental projects, Namibia is cultivating a generation that is both environmentally conscious and empowered to contribute to climate resilience.

#### *5.4.1.1 Namibia Youth for Climate Action (NYCA)*

Namibia Youth for Climate Action (NYCA) was established in 2021 to enable young people across the country to take an active role in combating climate change. Supported by the Ministry of Environment, Forestry, and Tourism (MEFT) and funded by the Environmental Investment Fund (EIF), NYCA serves as a national network through which youth can organize, lead, and participate in environmental projects that directly benefit their communities.

One of NYCA's flagship projects addresses plastic waste management in urban centres and coastal regions, where pollution impacts both human health and biodiversity. Youth-led teams in Windhoek, Swakopmund, and Walvis Bay organize regular clean-up events, establish recycling stations, and conduct educational workshops on the dangers of plastic pollution and the importance of waste reduction. This project has significantly reduced plastic waste by approximately 15% annually in these areas, demonstrating the effectiveness of youth-led interventions in achieving tangible environmental improvements. In addition to environmental benefits, the initiative has created approximately 100 part-time jobs for young people, contributing to economic empowerment by offering skills and employment in waste management, recycling, and community outreach.

Beyond waste management, NYCA's members are actively involved in tree-planting campaigns, water conservation projects, and renewable energy awareness activities. These projects not only address immediate environmental issues but also help develop skills in project management, teamwork, and community organizing, preparing young Namibians for leadership roles in future climate initiatives.

### 5.4.2 Youth Leadership in Climate Advocacy and Policy

To enhance youth representation in climate policy, Namibia has developed training programs focused on building climate leadership skills among young people. Through partnerships with the National Youth Council, MEFT, and international organizations, young leaders participate in workshops that teach them about climate governance, sustainable development frameworks, and Namibia's Nationally Determined Contributions (NDCs). This training prepares youth to engage with policymakers, represent their communities in national climate forums, and advocate for climate issues within their regions.

Young leaders trained through these programs have begun participating in local and national policy discussions, acting as advocates for sustainable practices within their communities and advising on issues such as renewable energy, water conservation, and sustainable agriculture. In 2022, the government established the Namibia Youth Climate Council, a body comprised of youth representatives who provide input on climate strategies and review policy proposals from a youth perspective. This council ensures that young people's insights and aspirations are incorporated into Namibia's climate policy, fostering a collaborative approach to national climate action.

### 5.4.3 Gender-Inclusive Climate Policies

Gender inclusivity is a cornerstone of Namibia's climate policies. The country's climate strategy acknowledges that women, especially in rural areas, are among the most affected by climate impacts but are also essential agents of change. Namibia's gender-responsive policies aim to empower women through climate adaptation projects, vocational training, and leadership roles, ensuring equitable participation across all sectors.

#### *5.4.3.1 Women's Role in Community-Based Climate Adaptation*

Women's participation in community-based climate adaptation has grown significantly, thanks to partnerships between the Ministry of Gender Equality and Child Welfare and international NGOs. These partnerships have led to the establishment of women-led cooperatives and initiatives that focus on sustainable resource management, climate-smart agriculture, and renewable energy solutions. Currently, women manage approximately 40% of Namibia's community-based adaptation projects, a testament to the emphasis placed on gender-responsive climate action.

In the Kavango and Kunene regions, where communities face severe droughts, women-led groups are implementing water conservation techniques such as rainwater harvesting, greywater recycling, and soil moisture retention practices. These groups have introduced water-efficient farming systems that improve crop yields while conserving water, enabling households to maintain food security despite irregular rainfall. This approach has not only strengthened community resilience but has also reduced the time women spend collecting water, giving them more time for educational, economic, and family pursuits.

Women's cooperatives also focus on diversifying income sources to reduce climate-related vulnerabilities. By producing and selling climate-resilient crops, such as drought-resistant millet

and cassava, and developing small-scale agro-processing businesses, these cooperatives have contributed to household income stability. The increased economic empowerment has given women a stronger voice in community decisions, enabling them to advocate for sustainable practices and lead local climate adaptation efforts.

#### *5.4.3.2 Gender-Responsive Training and Capacity Building*

Namibia's climate strategy includes targeted training programs that equip women with skills relevant to sustainable industries. In partnership with international development agencies, Namibia offers courses in climate-smart agriculture, renewable energy, and eco-friendly manufacturing. These programs have allowed women to gain technical expertise in areas such as solar panel installation, organic farming, and sustainable forestry, providing them with access to new income-generating opportunities that are both environmentally and economically sustainable.

A notable example of these efforts is the "Women in Renewable Energy"[43] initiative, which trains women from rural areas as solar technicians and installers. This program, funded by MEFT and the Green Climate Fund (GCF), provides hands-on training in solar technology, allowing women to set up solar-powered energy systems for homes, schools, and businesses. Participants who complete the program often start their own solar installation businesses or work as technicians in their communities, contributing to energy access while reducing reliance on fossil fuels.

The impact of this program extends beyond income generation, as it fosters a sense of agency among women and challenges traditional gender roles. Women in these programs report greater confidence and involvement in community decisions, particularly regarding environmental and energy issues. By integrating gender-focused training into its climate strategy, Namibia is building a skilled workforce that supports both gender equity and environmental resilience.

### 5.4.4 Just Transition Framework

Namibia's Just Transition Framework is an essential part of its commitment to a low-carbon economy. The framework provides a structured approach to moving away from carbon-intensive industries in a way that supports workers and communities impacted by these changes. By focusing on retraining, economic diversification, and green job creation, Namibia aims to create a fair transition that benefits the environment and society.

#### *5.4.4.1 Economic Diversification and Green Skills Training*

Namibia's approach to economic diversification is underpinned by the "Green Skills for All" initiative, which offers retraining programs for workers affected by the decline of carbon-intensive industries like mining and heavy manufacturing. This program, developed in collaboration with Namibia's Technical and Vocational Education and Training (TVET) centres, provides training in areas such as solar energy installation, organic agriculture, and sustainable construction. By equipping individuals with skills suited to Namibia's green economy, the initiative reduces unemployment while meeting the growing demand for green jobs.

One significant outcome of the Green Skills for All program is the retraining of former mine workers in the Erongo region, where the mining industry has historically been a major employer. These workers are now trained in renewable energy installation, including solar panel maintenance and wind turbine assembly. Many participants have secured employment with renewable energy companies, while others have established small businesses that provide

[43] Women in Renewable Energy

energy solutions to rural communities. This transition from mining to renewable energy aligns with Namibia's NDC targets for carbon reduction and creates sustainable income opportunities for affected workers.

In addition to individual training, Namibia's government is working with industry leaders to establish renewable energy hubs in regions transitioning away from traditional industries. These hubs serve as centres for skill development, innovation, and employment, contributing to the national green economy while ensuring that communities previously reliant on fossil fuels can adapt to new economic realities.

#### *5.4.4.2 Support Systems for Workers and Communities in Transition*

Namibia's Just Transition Framework includes a range of support systems to ensure that workers and communities have the resources needed to adapt to a green economy. The framework provides financial assistance, counselling, and job placement services to help individuals and families manage the economic shift. Workers enrolled in retraining programs receive stipends to support their families during the transition, and job placement services connect them with employment opportunities in renewable energy, eco-tourism, and conservation.

The government has also introduced initiatives to support the economic revitalization of communities impacted by industry shifts. In regions where mines or carbon-intensive factories are closing, the government invests in renewable energy projects, conservation programs, and sustainable agriculture initiatives that create new jobs and stabilize the local economy. Solar farms and wind energy installations, for instance, not only offer employment but also provide communities with a stable, renewable power source, supporting Namibia's goals for energy access and sustainability.

### 5.4.5 Case Studies and Success Stories

Namibia's efforts to integrate gender equity, youth involvement, and a just transition in climate action have led to transformative projects that demonstrate the impact of inclusive climate policies. These case studies offer insight into how targeted initiatives create real change for individuals and communities.

#### *5.4.5.1 Youth-Led Plastic Waste Management in Swakopmund*

In Swakopmund, a youth-led initiative under NYCA has successfully reduced plastic waste through a community-centred approach. The project involves frequent beach clean-ups, the establishment of recycling stations, and workshops that educate residents on plastic pollution. The team has also worked with local businesses to reduce single-use plastic consumption, creating a community-driven waste management model.

Since its inception, the project has reduced plastic waste by 20% on Swakopmund's beaches, protecting marine life and enhancing the area's appeal to tourists. Additionally, the initiative has generated part-time jobs for local youth, contributing to their economic empowerment while equipping them with skills in waste management and community organization. Similar projects in Swakopmund include the youth initiative "Project Shine".

#### *5.4.5.2 Women's Water Management Cooperative in Kavango*

In the drought-prone Kavango region, a women-led cooperative focused on sustainable water management has improved water security for hundreds of households. The cooperative, supported by the Ministry of Gender Equality and Child Welfare, teaches members to use water-efficient farming techniques, rainwater harvesting, and soil moisture retention practices. These

techniques have enabled the cooperative to boost local agricultural productivity and reduce reliance on external water sources.

This initiative has significantly improved the livelihoods of participating women, enhancing food security and reducing the need for long-distance water collection. The cooperative also serves as a model for other communities, showcasing how gender-inclusive projects can address resource challenges while empowering women.

### 5.4.6 Future Directions and Strategic Goals

As Namibia continues to develop its climate strategy, the government is committed to expanding its gender, youth, and just transition initiatives. Plans include increasing women's participation in renewable energy sectors, with a goal to train 1,000 women as solar technicians by 2030. The expansion of NYCA will also provide more resources for youth-led climate projects, enabling young people to assume greater roles in advocacy, innovation, and community engagement.

For the just transition, Namibia is exploring partnerships with international development organizations to secure funding for additional green job training and renewable energy infrastructure. The government aims to establish renewable energy hubs in communities transitioning away from fossil fuels, providing resources for sustainable economic development.

# 6 INFORMATION ON FINANCIAL, TECHNOLOGY DEVELOPMENT AND TRANSFER AND CAPACITY-BUILDING SUPPORT NEEDED AND RECEIVED

## 6.1 INTRODUCTION

This chapter provides a detailed assessment of the financial, technical, and capacity-building support received, required, and utilized by Namibia in its efforts to meet the objectives of the Paris Agreement and its Nationally Determined Contributions (NDCs). The chapter is structured to align with the reporting requirements under the Enhanced Transparency Framework (ETF), highlighting the crucial role of international collaboration in addressing climate change challenges.

Namibia's commitments under the Paris Agreement require significant resources to implement mitigation and adaptation actions effectively. This chapter outlines the financial resources mobilized through bilateral and multilateral channels, the type of support received, and the contribution of this support to national and international climate goals. It also identifies key gaps, barriers to accessing additional funding, and areas requiring capacity-building to strengthen Namibia’s ability to meet its transparency and climate action obligations.

Special emphasis is placed on the alignment of support with Namibia's NDC targets for both mitigation and adaptation. The chapter also captures Namibia’s progress in technology transfer and capacity-building, showcasing successful initiatives while recognizing the need for further enhancements to address evolving challenges.

By providing comprehensive data on financial flows, technological support, and capacity-building efforts, this chapter seeks to enhance transparency and foster international confidence in Namibia’s commitment to addressing climate change. It also serves as a foundational guide for stakeholders and partners to understand the nation’s priorities, challenges, and opportunities for collaboration.

## 6.2 UNDERLYING ASSUMPTIONS, DEFINITIONS AND METHODOLOGIES

The conversion rate adopted for reporting is 18 NAD to one USD.

Amount of support needed based on the First NDC updated version is estimated at 9,052 USD for mitigation and 6,013 Million USD for adaptation. Of the 15,065 M USD, 13,558.5 M USD (90%) is conditional on international support.

The reporting year is 2022 for the 2030 timeframe.

During the period 2017 to 2022, 44.42 M USD came from multilateral sources and 89.77 M USD from bilateral partners. Of these 45.14 M USD were grants, 2.65 M USD technical assistance, 3.71 M USD concessional loan and 82.68 M USD a mix of grant and concessional loan. It is not yet possible to identify specific sources for support needed. Work is under way to develop the methods and tools for assessing public funding for climate action.

Information on whether support is committed, received or needed is provided in the appropriate tables at the end of this chapter.

The status of supported activities relative to whether planned, ongoing or completed is given in the appropriate tables at the end of this chapter. Namibia has 52 planned actions for the 2030 time horizon, 3 ongoing and 8 completed projects as at 2022. Information on the status of the supported activity (planned, ongoing or completed) is provided in the appropriate set of tables at the end of this chapter.

Information on the channel (bilateral, regional or multilateral) is provided in the appropriate tables at the end of this chapter.

Information on the type of support (mitigation, adaptation or cross-cutting) is provided in the appropriate tables at the end of this chapter.

Information on the financial instrument (grant, concessional loan, non- concessional loan, equity, guarantee or other) is provided in the appropriate tables at the end of this chapter.

Energy, IPPU, Agriculture, LULUCF and Waste for mitigation and Agriculture and Food Security, Water Resources, Biodiversity and Ecosystems, Fisheries and Aquaculture, Health, Cross-cutting issues, Infrastructure and Coastal zone for adaptation. Information on the sectors and subsectors is provided in the appropriate set of tables at the end of this chapter.

Support needed and received contributes to implement mitigation actions towards meeting Article 2 of the PA and adaptation actions to increase the resilience of the country to climate change impacts. Mitigation actions will lead to reduction of emissions and increased removals to lower the carbon footprint of the country. The end result of the combined mitigation and adaptation actions will assist the global community in combating global warming and its impacts through sustainable development initiatives. End results will be better air quality, improved livelihood, green job creation and improved quality of livelihood among others. Information on the use, impact and estimated results of the support needed and received is provided in the appropriate set of tables at the end of this chapter.

Thirty-nine (75%) of the actions identified for support contributes to technology development and transfer, and capacity building. Information on support as contributing to technology development and transfer and capacity-building is provided in the appropriate set of tables at the end of this chapter.

All efforts have been made to avoid double counting in reporting information on support needed and received for the implementation of Article 13 of the Paris Agreement and transparency-related activities, including for transparency-related capacity-building, when reporting such information separately from other information on support needed and received. To facilitate sharing of information under the different items, the projects, actions or measures have been provided in relation to each item individually.

## 6.3 Information on financial support needed by developing country Parties under Article 9 of the Paris Agreement

### 6.3.1 International finance, including existing barriers

Sectors Namibia wishes to attract international finance for mitigation are Energy - Energy Industries (Solar, Biomass, Wind and Hydro), Transport (Road and Rail), Commercial and Institutional (Solar), Residential (Solar, Biomass), Agriculture Solar), Fishing (Green hydrogen), Cement production, Nin Energy product Use and Refrigeration and Air conditioning under IPPU,

Livestock under Agriculture, Forestland, Grassland, Cropland and Settlements under LULUCF and Solid Waste Disposal, Incineration and open Burning, and Wastewater Treatment and Discharge under Waste.

Regarding adaptation, the sectors are Agriculture (Livestock and Crops), Water Resources, Biodiversity and Ecosystems, Fisheries and Aquaculture, Health, Cross-cutting issues, Infrastructure and Coastal zone.

Barriers to attracting international finance are lack of detailed project documents, low readiness of national stakeholders to spearhead project implementation, Unavailability of funds for the unconditional part, Weak framework for project implementation and limited knowledge on some key technologies to be developed and transferred.

### 6.3.2 Contribution of support to the NDC and long-term goals of the Paris Agreement

Support needed will lead to mitigation of 11.902 Mt $CO_2$ e through the reduction of 7.669 Mt $CO_2$ e of emissions and increase removals by 4.213 Mt $CO_2$ e. The adaptation measures will increase the resilience of the country to climate change impacts.

Information on Title (of activity, programme or project); Programme/project description; Estimated amount (in domestic currency and in United States dollars); Expected time frame; Expected financial instrument (grant, concessional loan, non-concessional loan, equity, guarantee or other); Type of support (mitigation, adaptation or cross-cutting); Sector and subsector; Whether the activity will contribute to technology development and transfer and/or capacity-building, if relevant; Whether the activity is anchored in a national strategy and/or an NDC; Expected use, impact and estimated results is given in Table 1 at the end of this chapter.

## 6.4 Information on financial support received by developing country Parties under Article 9 of the Paris Agreement

Information on Title (of activity, programme or project); Programme/project description; Channel; Recipient entity; Implementing entity; Amount received (in domestic currency and in United States dollars); Time frame; Financial instrument (grant, concessional loan, non-concessional loan, equity, guarantee or other); Status (committed or received); Sector and subsector; Type of support (mitigation, adaptation or cross-cutting); Whether the activity has contributed to technology development and transfer and/or capacity-building; Status of activity (planned, ongoing or completed); Use, impact and estimated results is provided in Table 2 at the end of this chapter.

## 6.5 Information on technology development and transfer support needed by developing country Parties under Article 10 of the Paris Agreement

### 6.5.1 Plans, needs and priorities related to technology development and transfer, including those identified in technology needs assessments

Namibia conducted a Technology Needs Assessment which informed the development of a Technology Action Plan (TAP) in 2005 (MEFT, 2005). This plan has not been revisited since then and this exercise is now most urgent to enhance the country's capacity to implement its NDC to meet its obligations to the PA. The 2005 TNA identified and prioritized 25 technologies, both hard and soft, for implementation to support the deployment of mitigation and adaptation actions. Out of these technologies, a higher number of technologies privileged adaptation to mitigation.

However, new needs have emerged since 2005, given the dynamic situation and the dangerous increase in anthropogenic emissions, the worsening of the vulnerability of developing countries and the inadequate adaptation which is straining sustainable development. Key technology needs that have emerged in the last few years are production of green hydrogen, generation of electricity from biomass, electric vehicles, generation of electricity from wind for mitigation and adaptation technologies for the coastal zone, infrastructure, water resources, natural ecosystems and conservation agriculture. It is of utmost importance to conduct another TNA and develop a TAP when updating the NDC in 2025.

### 6.5.2 Technology development and transfer related needs for the enhancement of endogenous capacities and technologies.

Information on the Title (of activity, programme or project); Programme/project description; Type of support (mitigation, adaptation or cross-cutting); Type of technology; Expected time frame; Sector and Expected use, impact and estimated results is given in Table 3 at the end of this chapter.

## 6.6 Information on technology development and transfer support received by developing country Parties under Article 10 of the Paris Agreement

### 6.6.1 Case studies, including key success and failure stories

Out of the 25 technologies identified in 2005, some have been implemented with different level of success. Key successful technology transfers are Rural electrification R&D – PV mini grid, solar water heaters, energy-efficient cooking techniques, efficient stoves, and charcoal kilns, energy efficiency in public institutions, inland aquaculture, developing efficient and productive aquaculture techniques. Some others have been successful to a lower degree and no record of failure stories has been recorded up to now.

### 6.6.2 Contribution of support to technology development and transfer

Technology development and transfer have not been realised on a stand-alone basis. Most of the time, they are embedded with financial support. This approach has produced good results and should be pursued while not neglecting the development and transfer of key ones such as green hydrogen production and use for various activities in replacement of fossil fuels.

### 6.6.3 Stage of the technology cycle supported, including research and development, demonstration, deployment, diffusion and transfer of technology

Experience demonstrates that almost all technologies transferred were beyond the development stage. That is well developed, and proven technologies are usually successfully transferred provided that there is a capacity building component accompanying the demonstration, deployment and diffusion process. Research and development are not overlooked but requires resources that are not readily available for implementation. Research and development should be encouraged through the provision of appropriate support through academic partners/research institutes and training institutions for sustainability and enhanced deployment.

Information on the Title (of activity, programme or project); Programme/project description; Type of technology; Time frame; Recipient entity; Implementing entity; Type of support (mitigation,

adaptation or cross-cutting); Sector; Status of activity (planned, ongoing or completed) and Use, impact and estimated results are provided in Table 4 at the end of this chapter.

## 6.7 Information on capacity-building support needed by developing country Parties under Article 11 of the Paris Agreement

### 6.7.1 Approach Namibia seeks to take to enhance capacity-building support

Namibia has adopted a multi-pronged approach to enhance capacity building support. In addition to support provided through the decisions of the COP, namely the enabling activities for the preparation of national reports to the UNFCCC and the CBIT process, Namibia has and will continue to explore other possibilities from other multilateral organizations such as UNDP, UNEP and others. Namibia will continue to seek support from other bilateral partners, private trusts and organizations. Other avenues are through the initiatives of the UNFCCC, the GSP global and regional platforms and peer exchanges between countries of the region.

### 6.7.2 Country-specific capacity-building needs, constraints and gaps

Capacity building needs are very wide and relates to mitigation and adaptation while being closely linked with technology development and transfer. Without underscoring mitigation and adaptation, Namibia also needs capacity building on cross-cutting issues such as gender mainstreaming in climate actions through the development plans, knowledge management including dissemination and sharing of transparent products, research and development on climate change issues and raising awareness of the population on the PA and its requirements for action. More details on the national capacity building needs are provided in Table 5 at the end of this chapter.

### 6.7.3 Processes for enhancing public awareness, public participation and access to information in relation to capacity-building.

The best process for enhancing public awareness, public participation and access to information relating to capacity building is to engage stakeholders in a gender sensitive all-inclusive manner. Given the size of the territory, the literacy level, poverty situation and accessibility to information technologies to consult media, it is recommendable that consultation be done physically by deploying local experts trained to do that exercise. As this exercise is costly and time-consuming, Namibia counts of the support of development partners to undertake a new National Capacity Self-Assessment (NCSA), namely after the NDC updating exercise.

Information on the Title (of activity, programme or project); Programme/project description; Expected time frame; Type of support (mitigation, adaptation or cross-cutting) and Expected use, impact and estimated results are provided in the set of tables at the end of this chapter.

## 6.8 Information on capacity-building support received by developing country Parties under Article 11 of the Paris Agreement

### 6.8.1 Case studies, including key success and failure stories

Due to the unavailability of an appropriate system to track information on capacity building and the obsoleteness of the NCSA conducted nearly 2 decades ago and not revisited, it is difficult to identify success stories and failures. However, at least one key success which is more recent has been recorded. This is the capacity of national experts of the TWG on the GHG inventory through the enabling activities of the GEF that has led to at least 6 nationals able now to compile

sectoral inventories. Capacity built following the completion of the CBIT1 project is still to be fully assessed during the implementation of the BTR2 and combined BTR3/NC6 project when knowledge gained on the tools and other transparent reporting processes will be fully rolled out.

The CBIT1 project was a success as it enabled Namibia to develop tools for data collection for the GHG inventory, tracking of NDC mitigation actions and support needed and received, including capacity building, performing the KCA with and without LULUCF, undertaking QA/QC as per the IPCC guidelines and creation of a web portal for transparency reporting.

Support received through the Initiative for Climate Action Transparency (ICAT) project addressed the Regulatory Framework and Stakeholder Engagement.

### 6.8.2 How support received has enhanced a Party's capacity

Support received through the GEF on past enabling activities and the CBIT projects has definitely raised the capacity of institutions and national stakeholders. This has enhanced their participation in the TWGs with regard to transparent data collection for reporting according to the ETF of the PA, namely for the compilation of the GHG inventory, tracking of NDC mitigation actions, and support needed and received as well as monitoring of NDC adaptation actions.

Support received from the GEF for the first round of CBIT funding enhanced Namibia's capacity through the provision of tools for data collection for the GHG inventory, tracking of NDC mitigation actions and support needed and received, including capacity building, performing the KCA with and without LULUCF, undertaking QA/QC as per the IPCC guidelines and provision of a web portal for facilitating transparent reporting.

The Initiative for Climate Action Transparency (ICAT) enabled Namibia to better understand the existing challenges on the Regulatory Framework, improved Stakeholder Engagement.

The Climate Promise II project laid out a Framework for projections of emissions and key NDC tracking indicators in selected sectors, enhanced the country's capacity to assess impact of selected policies and measures and provided a framework for tracking NDC actions of the energy sector.

### 6.8.3 Capacity-building support received at the national

Capacity building support has been received under the CBIT, combined BTR1/NC5, ICAT projects, and UNFCCC initiatives on reporting in accordance with the ETF of the PA.

Information on the Title (of activity, programme or project); Programme/project description; Implementing entity; Recipient entity; Type of support (mitigation, adaptation or cross-cutting); Time frame; Status of activity (planned, ongoing or completed) and Use, impact and estimated results are provided in Table 6.1 at the end of this chapter.

*Table 6-1. Capacity-Building Support Received by Namibia Under Article 11 of the Paris Agreement*

| Title of Activity/Project | Programme/Project Description | Implementing Entity | Recipient Entity | Type of Support | Time Frame | Status | Use, Impact, and Estimated Results |
|---|---|---|---|---|---|---|---|
| CBIT1 - Capacity Building Initiative for Transparency | Developed tools for data collection, tracking of NDC mitigation actions, support needed/received, QA/QC, and transparency web portal. | GEF/UNDP | Namibia | Cross-cutting | 2018-2021 | Completed | Enhanced GHG inventory capacity, tools for NDC tracking, and QA/QC as per IPCC guidelines. Improved transparency in reporting under ETF of the Paris Agreement. |
| Combined BTR1/NC5 Project | Supported the preparation of the first BTR and fifth NC in accordance with ETF requirements. | MEFT | Namibia | Cross-cutting | 2024- | Ongoing | Strengthened national capacity to meet ETF requirements, develop integrated reports, and improve stakeholder coordination. |
| Initiative for Climate Action Transparency (ICAT) | Addressed challenges in regulatory frameworks, stakeholder engagement. | UNEP/ICAT | Namibia | Cross-cutting | 2024- | Ongoing | Enhanced understanding of coordination between institutions to track progress in implementing climate projects and improved stakeholder engagement. |
| UNFCCC Capacity- | Provided training for the preparation of national GHG | UNFCCC | Namibia | Cross-cutting | Ongoing | Ongoing | Improved understanding of transparency frameworks and capacity building in monitoring, |

| Title of Activity/Project | Programme/Project Description | Implementing Entity | Recipient Entity | Type of Support | Time Frame | Status | Use, Impact, and Estimated Results |
|---|---|---|---|---|---|---|---|
| Building Program | inventories and NDC tracking, with a focus on compliance with transparency requirements of the Paris Agreement. | | | | | | reporting, and verifying climate actions. |
| Climate Promise II | Developed frameworks for emissions projections, tracking key NDC indicators in the energy sector, and assessing policy impacts. | UNDP | Namibia | Mitigation/Adaptation | 2021-2023 | Completed | Strengthened capacity to project emissions, track NDC actions in energy, and evaluate the impacts of policies and measures on climate goals. |

## 6.9 INFORMATION ON SUPPORT NEEDED AND RECEIVED BY DEVELOPING COUNTRY PARTIES FOR THE IMPLEMENTATION OF ARTICLE 13 OF THE PARIS AGREEMENT AND TRANSPARENCY-RELATED ACTIVITIES, INCLUDING FOR TRANSPARENCY-RELATED CAPACITY-BUILDING

### 6.9.1 Overview of Namibia's Financial Support under Article 9 of the Paris Agreement

Namibia remains committed to mobilizing and utilizing financial resources effectively to achieve its climate action goals, as outlined in its Nationally Determined Contributions (NDCs). Financial support for Namibia emphasizes not only the leveraging of public finance but also mechanisms to mobilize private investment.

During the reporting period, Namibia has focused on securing international support for projects addressing renewable energy expansion, sustainable agriculture, water resources management, and climate adaptation. Public financial support has been facilitated through collaborations with multilateral institutions like the Green Climate Fund (GCF) and Global Environment Facility (GEF), which provided grants and concessional loans. In addition, bilateral partnerships with countries such as Germany, through GIZ and KfW, and the European Union under the GCCA+ initiative, have significantly contributed to funding large-scale renewable energy projects and climate-resilient infrastructure.

Namibia's climate finance strategy emphasizes enabling frameworks for private sector participation. Through regulatory reforms and incentives, the country has attracted investments in renewable energy, particularly solar and wind projects, as well as sustainable agricultural practices and water-efficient technologies. Over the reporting period, private finance mobilized through co-financing schemes contributed significantly to the energy sector.

Capacity building has also been a priority for Namibia to ensure effective access and utilization of international climate finance. This includes organizing training workshops and study tours to enhance the capacity of local entities in accessing funds like the GCF. Additionally, efforts to strengthen Monitoring, Reporting, and Verification (MRV) systems have been undertaken to ensure accountability and transparency in the use of climate finance.

These combined efforts underline Namibia's dedication to utilizing financial support to achieve its climate resilience and mitigation objectives effectively.

### 6.9.2 Institutional Arrangements for Financial Support

Namibia has established a robust institutional framework to facilitate the mobilization, management, and utilization of financial resources for climate action under its Nationally Determined Contributions (NDCs). These arrangements ensure coordination, transparency, and accountability in accessing and deploying financial support from domestic and international sources.

The Ministry of Environment, Forestry and Tourism (MEFT) serves as the primary coordinating entity for climate finance in Namibia. It oversees the implementation of climate-related projects and ensures alignment with national priorities and NDC commitments. The MEFT also acts as the National Designated Authority (NDA) for the Green Climate Fund (GCF), enabling Namibia to directly engage with the GCF and access funding.

The Environmental Investment Fund (EIF) plays a critical role as a national climate finance institution. The EIF is mandated to mobilize and manage climate finance from multilateral and bilateral sources and facilitate the financing of climate projects in sectors such as renewable energy, agriculture, and water resources. It also supports small- and medium-scale projects through grants and loans.

Namibia's National Planning Commission (NPC) ensures that climate finance strategies are integrated into broader national development plans. The NPC coordinates with sectoral ministries to prioritize funding for projects that align with national socio-economic and environmental goals.

The Ministry of Finance works closely with the MEFT and other stakeholders to ensure the efficient management of financial resources. It is responsible for negotiating international funding agreements, managing concessional loans and grants, and ensuring compliance with financial accountability standards.

To enhance stakeholder coordination, Namibia has established inter-ministerial committees and technical working groups. These platforms facilitate collaboration among sectoral ministries, local governments, civil society organizations, and private sector stakeholders, ensuring a participatory approach to climate finance decision-making.

Additionally, Namibia has developed a Monitoring, Reporting, and Verification (MRV) framework to track the use of climate finance and measure the impact of funded projects. This system ensures transparency and accountability while providing critical data to inform future funding decisions and strategies.

Overall, Namibia’s institutional arrangements for financial support are designed to maximize the effective use of climate finance, mobilize additional resources, and build the country’s capacity to implement sustainable and impactful climate actions. These arrangements reflect Namibia's commitment to achieving its NDC targets while fostering resilience and sustainable development.

### 6.9.3 Mitigation-Related Needs for Support by Sector

Namibia requires substantial financial, technological, and capacity-building support across key sectors to implement its mitigation strategies effectively and achieve its NDC targets. Below is a sector-specific breakdown of mitigation-related needs, including financial figures and statistics based on Namibia’s national plans and climate strategies:

#### *6.9.3.1 Energy Sector*

The energy sector is responsible for a significant portion of Namibia’s emissions. Transitioning to renewable energy and increasing energy efficiency are key mitigation strategies.

- **Total Cost:** USD 7.678 billion.
- **Mitigation Potential:** 3.613 Mt $CO_2e$, representing 57% of BAU scenario emissions.
- **Key Measures:** Includes substituting fossil fuels with renewables, increasing energy efficiency, and transitioning to clean energy technologies. Specific projects like the Anixas II and Omburu PV plants are central to this effort.

#### *6.9.3.2 Agriculture, Forestry, and Other Land Use (AFOLU)*

The AFOLU sector has the largest mitigation potential due to its capacity for carbon sequestration and reduction of emissions.

- **Total Cost:** USD 857 million.
- **Mitigation Potential:** 8.062 Mt $CO_2e$, comprising 67% of the national mitigation potential.
- **Key Measures:** Includes bush thinning, conservation agriculture, and restoration of degraded lands to improve soil carbon sequestration and reduce methane emissions from livestock.

#### *6.9.3.3 Industrial Processes and Product Use (IPPU)*

Industries require support to transition to energy-efficient production methods and low-carbon technologies.

- **Total Cost:** USD 180 million.
- **Mitigation Potential:** 0.113 Mt $CO_2e$.
- **Key Measures:** Focus on adopting clean industrial technologies and improving energy efficiency in manufacturing processes.

#### *6.9.3.4 Waste Sector*

Emissions from waste can be reduced through methane capture, recycling, and waste-to-energy projects.

- **Total Cost:** USD 499 million.
- **Mitigation Potential:** 0.115 Mt $CO_2e$.
- **Key Measures:** Implementation of waste management facilities, recycling initiatives, and methane recovery systems at landfills.

#### *6.9.3.5 Total Financial Need:*

The total estimated cost for implementing all mitigation measures across sectors is **USD 9.05 billion**, of which a majority is conditional on international support.

#### *6.9.3.6 Support Required:*

Namibia seeks international assistance to:

- Finance renewable energy projects and grid upgrades.
- Transfer technology for carbon sequestration and methane capture.
- Build capacity for Monitoring, Reporting, and Verification (MRV) systems.
- Provide technical expertise for implementing energy-efficient technologies and sustainable agricultural practices.

These figures and priorities reflect Namibia's commitment to achieving its mitigation targets and contributing to global climate goals.

### 6.9.4 Adaptation-Related Needs by Sector

Namibia's adaptation needs are significant given its vulnerability to climate change impacts such as persistent droughts, erratic rainfall, and floods. The updated figures and priorities for adaptation-related needs are detailed below based on Namibia's Second Updated NDC (2023).

#### *6.9.4.1 Agriculture and Food Security*

- **Total Cost:** USD 1.51 billion.
- **Key Needs:**
    - Implementation of conservation agriculture to improve soil health and productivity.
    - Development of climate-resilient crop varieties and livestock breeds.
    - Enhanced water management systems for irrigation.
    - Capacity building for farmers on sustainable agricultural practices.

#### *6.9.4.2 Water Resources*

- **Total Cost:** USD 3.51 billion.
- **Key Needs:**
    - Development of water storage infrastructure to improve supply reliability.
    - Installation of renewable energy-powered water pumps and desalination plants.
    - Improved water efficiency in urban and rural supply systems.
    - Measures to protect groundwater resources from overexploitation.

#### *6.9.4.3 Biodiversity and Ecosystems*

- **Total Cost:** USD 371 million.
- **Key Needs:**
    - Conservation and restoration of ecosystems, including riparian and savanna regions.
    - Protection of biodiversity hotspots through community-managed conservancies.
    - Combatting invasive species that threaten ecosystems.

#### *6.9.4.4 Fisheries and Aquaculture*

- **Total Cost:** USD 85 million.
- **Key Needs:**
    - Development of sustainable aquaculture practices.
    - Strengthening the resilience of coastal fisheries to climate variability.
    - Implementation of monitoring systems for fish stock management.

#### *6.9.4.5 Health*

- **Total Cost:** USD 94 million.
- **Key Needs:**
    - Development of early warning systems for climate-sensitive diseases.
    - Infrastructure to prevent and respond to health emergencies, including heat waves and vector-borne diseases.
    - Community health outreach programs for vulnerable populations.

#### *6.9.4.6 Cross-Cutting Issues*

- **Total Cost:** USD 162 million.
- **Key Needs:**
    - Strengthening institutional frameworks for adaptation planning and implementation.
    - Integration of gender-sensitive approaches in adaptation measures.
    - Capacity building for local governments and community-based organizations.

#### *6.9.4.7 Infrastructure*

- **Total Cost:** USD 258 million.
- **Key Needs:**
    - Climate-resilient infrastructure for transportation, energy, and housing.
    - Retrofitting existing structures to withstand extreme weather events.
    - Development of flood and drought management infrastructure.

#### *6.9.4.8 Coastal Zone*

- **Total Cost:** USD 24 million.
- **Key Needs:**
    - Protection of coastal infrastructure from sea-level rise and storm surges.

- Restoration of other natural buffers against coastal erosion.
- Development of climate-resilient tourism strategies.

#### *6.9.4.9 Total Financial Need:*

The total cost for implementing adaptation measures across all sectors is **USD 6.01 billion**, of which 90% is conditional on international support.

#### *6.9.4.10 Support Required:*

Namibia seeks support in the following areas:

- **Financial:** Grants and concessional loans to fund large-scale adaptation projects.
- **Technological:** Access to advanced water management technologies, climate-resilient crop varieties, and renewable energy solutions.
- **Capacity Building:** Training and community outreach to build local resilience, particularly among women and marginalized groups.
- **Research and Development:** Climate risk assessments and feasibility studies to guide adaptation planning.

Namibia's adaptation measures are critical for enhancing the resilience of its population and ecosystems, contributing to sustainable development in a changing climate.

### 6.9.5 Support needed

Namibia requires significant financial, technological, and capacity-building support to achieve the ambitious targets outlined in its Nationally Determined Contributions (NDCs) under the Paris Agreement. The country faces constraints in scaling up mitigation and adaptation activities due to limited domestic financial resources and technical expertise, particularly in the sectors of renewable energy, agriculture, water management, and climate-resilient infrastructure.

Financially, Namibia needs enhanced access to concessional loans, grants, and innovative funding mechanisms from international entities such as the Green Climate Fund (GCF), Global Environment Facility (GEF), and bilateral donor agencies. These funds are critical for scaling renewable energy projects, expanding conservation agriculture practices, and developing resilient water systems. Additional funding is also necessary for strengthening Namibia's climate monitoring systems and enhancing disaster risk reduction efforts.

Technological support is essential for implementing state-of-the-art renewable energy systems, advanced water-saving technologies, and climate-smart agricultural practices. Namibia seeks access to technology transfer programs and expertise from global leaders to integrate innovative solutions into its climate action plans. The country also requires support in developing local capacity to manage, operate, and maintain such technologies.

Capacity-building efforts are pivotal for Namibia to improve the effectiveness of its climate interventions. Training and knowledge-sharing programs are needed to build local expertise in areas such as Monitoring, Reporting, and Verification (MRV), climate finance access, and

sustainable project implementation. Namibia also emphasizes the need for support in engaging local communities to ensure that climate actions are inclusive and responsive to the needs of its most vulnerable populations.

In summary, Namibia requires a combination of financial, technological, and capacity-building support to address existing gaps and accelerate the implementation of its climate actions, ensuring progress toward achieving its NDC goals and contributing to global climate resilience and sustainability.

### 6.9.6 Support received

Namibia has successfully mobilized financial, technological, and capacity-building support from various international and bilateral sources to advance its climate action goals under its Nationally Determined Contributions (NDCs). The country has benefitted from partnerships with global financial mechanisms, development agencies, and bilateral agreements to implement projects across key sectors such as renewable energy, agriculture, water resources, and climate resilience.

Financial support has been received through multilateral funding mechanisms like the Green Climate Fund (GCF) and Global Environment Facility (GEF). These funds have been critical in financing renewable energy projects, enhancing agricultural sustainability, and implementing water management strategies. For example, concessional loans and grants facilitated the development of large-scale solar and wind projects that are central to Namibia's transition to a low-carbon economy.

Bilateral collaborations with partners such as Germany, through GIZ and KfW, and the European Union, under the GCCA+ initiative, have provided significant financial and technical assistance. These partnerships have supported the implementation of climate-smart projects and the development of resilient infrastructure, particularly in rural and vulnerable communities.

On the technological front, Namibia has received support to adopt advanced renewable energy systems, including grid integration of solar and wind energy, and water-saving technologies to enhance agricultural productivity and water security. Collaborative efforts have enabled the transfer of expertise and tools to improve efficiency in these sectors.

Capacity-building initiatives have also been a major component of the support received. Training programs and workshops have strengthened Namibia’s institutional capacity to access international climate finance and improve the Monitoring, Reporting, and Verification (MRV) of climate actions. Support for community engagement programs has enhanced local participation and ownership of climate initiatives, ensuring that actions are inclusive and sustainable.

The support received has played a vital role in enabling Namibia to address its climate challenges and make tangible progress in meeting its NDC targets. Continued international collaboration and support will remain critical for scaling up these efforts and achieving long-term climate resilience.

# REFERENCES


EEA. *EMEP/EEA Air Pollutant Emission Inventory Guidebook 2023: Technical Guidance to Prepare National Emission Inventories*. Copahagen, Denmark: European Environmental Agency, 2023. https://www.eea.europa.eu/publications/emep-eea-guidebook-2023.

Eggleston, H S, M K Buendia, L, T Ngara, and K Tanabe. "2006 IPCC Guidelines for National Greenhouse Gas Inventories." Japan, 2006. http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm.

IPCC. "2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories — IPCC," 2019. https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/.

MEFT. "Namibia's Second Updated Nationally Determined Contribution." Windhoek, Namibia, 2023.

———. "Namibia's Updated Nationally Determined Contribution." Windhoek, Namibia, 2021. https://unfccc.int/sites/default/files/NDC/2022-06/Namibia%27s Updated NDC_ FINAL 25 July 2021.pdf.

———. "National Policy on Climate Change for Namibia," 2013.

MEFT. "Intended Nationally Determined Contributions (INDC) of The Republic of Namibia to the United Nations Framework Convention on Climate Change." Windhoek. Namibia, 2015. https://www.meft.gov.na/files/files/Intended Nationally Determined Contributions (INDC) of Namibia to the UNFCCC 2015.pdf.

———. "Namibia's National GHG Inventory Report." Windhoek, Namibia, 2014. https://unfccc.int/sites/default/files/resource/60298351_Namibia-BUR3-1-Namibia-NIR3-Final Version-Part2-2018-10-21 %28annexes%29.pdf?download.

NACSO. "State of Community Conservation in Namibia - Annual Report 2017." Windhoek, Namibia, 2017. https://www.nacso.org.na/sites/default/files/State of Community Conservation book web_2017.pdf.

Namibia, Republic of. "First Biennial Update." Windhoek, Namibia, 2014.

———. "Fourth Biennial Update Report of the Republic of Namibia under the United Nations Framework Convention on Climate Change." Windhoek, Namibia, 2021.

———. "Initial National Communication to the United Nations Framework Convention on Climate Change." Windhoek, Namibia, 2002.

———. "Namibia's Fourth National Communication to the United Nations Framework Convention on Climate Change." Windhoek, 2020.

———. "National GHG Inventory Report NIR 3." Windhoek, Namibia, 2018.

———. "Second Biennial Update Report (BUR2) of the Republic of Namibia." Windhoek, Namibia, 2016.

———. "Second National Communication to the United Nations Framework Convention on Climate Change for the Republic of Namibia." Windhoek, Namibia, 2011.

———. "Third Biennial Update Report (BUR3) to the United Nations Framework Convention on

Climate Change," 2018.

———. "Third National Communication to the United Nations Framework Convention on Climate Change for the Republic of Namibia." Windhoek, Namibia, 2015.

NPC. "Namibia's 5th National Development Plan (NDP 5)," 2017.

NSA. "Agriculture and Fishing Indicators Statistical Bulletin." Windhoek. Namibia, 2023. https://nsa.org.na/wp-content/uploads/2024/07/Agriculture-and-fishing-indicators-Statistical-Bulletin-–-First-Quarter-2023-.pdf.

———. "Annual National Accounts 2023." Windhoek, Namibia, 2023. https://nsa.org.na/wp-content/uploads/2024/08/ANNUAL-NATIONAL-ACCOUNTS-2023-report.pdf.

NTB. "Annual Report 2015/16 Namibia Tourism Board." Windhoek, Namibia, 2016. https://visitnamibia.com.na/wp-content/uploads/2022/03/Annual-Report-2015_16.pdf.

Republic of Namibia. "Namibia's NDC UPDATE." Windhoek, Namibia, 2021. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwidm5SPtLqEAxWzUkEAHR2qAn0QFnoECBEQAQ&url=https%3A%2F%2Fclimatepromise.undp.org%2Fwhat-we-do%2Fwhere-we-work%2Fnamibia&usg=AOvVaw0ZgL8nA2R46St78fedIXNi&opi=89978449.

UNFCCC. "Decision 18/CMA.1 Modalities, Procedures and Guidelines for the Transparency Framework for Action and Support Referred to in Article 13 of the Paris Agreement (FCCC/PA/CMA/2018/3/Add.2)," 2018. https://unfccc.int/resource/tet/0/00mpg.pdf.

V., Konrad-Adenauer-Stiftung e. The Harambee Prosperity Plan II (2021-2025) (2020).

# ANNEXES TO THE BTR

## ANNEX 1: COMMON REPORTING TABLES FOR THE ELECTRONIC REPORTING OF THE NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES

The Common Reporting Tables (CRT) for electronic reporting of the National Inventory Document (NID) will be submitted after Namibia finalizes and submits its National Inventory Document to the United Nations Framework Convention on Climate Change (UNFCCC). The submission timeline for the NID is pending, and the CRT will follow once it is confirmed that the greenhouse gas emission and removal data from the NID can be accurately integrated and reported using the electronic reporting tools designated for CRT preparation.

## ANNEX 2: COMMON TABULAR FORMATS ON INFORMATION NECESSARY TO TRACK PROGRESS

Please refer to the following URL for the common tabular format of Namibia's 1st BTR:

Link to be provided later after finalisation

## ANNEX 3: ASSUMPTIONS AND METHODS USED TO CALCULATE THE EXPECTED IMPACTS OF POLICIES AND MEASURES

This annex outlines the assumptions and methodologies utilized in estimating the impacts of policies and measures (PaMs) implemented under Namibia's Biennial Transparency Report (BTR) and National Communication (NC). The estimation process aligns with international guidelines such as the IPCC Guidelines for National Greenhouse Gas Inventories and UNFCCC transparency requirements.

### 1. Objectives

The primary objectives of assessing the impacts of PaMs are to:

- Quantify expected reductions in greenhouse gas (GHG) emissions.
- Understand co-benefits, including economic, social, and environmental outcomes.
- Provide transparency and support decision-making processes regarding future mitigation strategies.

### 2. Key Assumptions

The impact of policies and measures was calculated based on the following assumptions:

#### 2.1. Baseline Scenario

- **Definition**: A Business-as-Usual (BAU) scenario, which assumes no additional policies or measures beyond those implemented by 2020.
- **Key Assumptions**:
    - Population and GDP growth follow trends reported by Namibia Statistics Agency.
    - No significant technological advancements beyond those projected in the baseline.
    - Historical emission trends remain consistent.

#### 2.2. Mitigation Scenarios

- **Definition**: Scenarios incorporating the effects of PaMs, aligned with Namibia's NDC targets.
- **Key Assumptions**:
    - Adoption rates for renewable energy technologies, electric vehicles, and energy efficiency measures.
    - Improved land-use practices, including afforestation and reduced deforestation.
    - Implementation of waste management reforms.

### 3. Methodologies

The methodologies used for calculating impacts are sector-specific and adhere to IPCC Guidelines.

#### 3.1. Energy Sector

- **Model Used**: LEAP (Long-range Energy Alternatives Planning System).
- **Approach**:
    - Emission reductions were calculated based on energy savings from efficiency measures and shifts to renewable energy sources.
    - Emission factors for electricity generation were sourced from IPCC 2006 Guidelines.
    - Key metrics: carbon intensity ($tCO_2$/MWh), energy efficiency improvement percentages.

#### 3.2. AFOLU (Agriculture, Forestry, and Other Land Use)

- **Model Used**: AFOLU Carbon Calculator.
- **Approach**:
    - Land-use data and emission factors were combined to estimate GHG removals and emissions.
    - Impact of sustainable farming practices, reforestation, and forest conservation was included.
    - Key metrics: carbon sequestration rates ($tCO_2$/ha/year), avoided deforestation areas.

#### 3.3. Industrial Processes and Product Use (IPPU)

- **Model Used**: Custom IPPU Model.
- **Approach**:
    - Process-specific emission factors were applied to production data for key industries (e.g., cement, refrigeration).
    - Mitigation measures such as the adoption of low-emission technologies were modeled.
    - Key metrics: emissions per unit of product ($tCO_2$/unit).

#### 3.4. Waste Sector

- **Model Used**: Waste Model.
- **Approach**:
    - Methane emissions from landfills were estimated using first-order decay models.

- The impact of policies promoting recycling and composting was integrated.
- Key metrics: waste generation rates, methane generation potential ($tCH_4/t$).

**4. Data Sources**

- **National Data**:
  - Namibia Statistics Agency for population and economic indicators.
  - Ministry of Environment, Forestry, and Tourism for sector-specific policies.
- **International Data**:
  - IPCC Emission Factor Database.
  - Global databases for technology benchmarks and emission factors.

**5. Sensitivity Analysis**

Sensitivity analysis was conducted to test the robustness of results under varying assumptions:

- High and low population growth rates.
- Variations in technology adoption rates.
- Differing land-use change trajectories.

**6. Reporting and Uncertainty**

The results of these calculations are presented with an associated uncertainty range, determined using Monte Carlo simulations where applicable. This approach ensures that estimates are robust and transparent.

**7. Limitations and Improvements**

- **Limitations**:
  - Limited granularity in activity data for some sectors.
  - Challenges in quantifying indirect impacts of certain PaMs.
- **Planned Improvements**:
  - Enhancing data collection frameworks for agriculture and waste sectors.
  - Increasing the use of advanced modelling tools for cross-sectoral analysis.

## ANNEX 4: MODELLING SYSTEMS FOR PROJECTIONS

The modelling systems used in this reporting form a critical component of Namibia's efforts to meet the Enhanced Transparency Framework requirements under the Paris Agreement. By employing internationally recognized tools and methodologies, Namibia ensures the credibility and transparency of its GHG projections, providing a solid foundation for tracking progress toward its climate commitments.

| Modelling Tool | Application | Used in |
|---|---|---|
| **GACMO** | Energy sector projections including electricity, transport, and industrial fuel combustion, Projecting methane emissions from waste disposal, wastewater treatment, and incineration. | BTR and NC |
| **AFOLU Carbon Calculator** | Estimating emissions and removals in agriculture, forestry, and other land use. | BTR and NC |
| **IPPU Model** | Tracking emissions from industrial processes and product use. | BTR and NC |
| **GIS-based Land-Use Models** | Analysing spatial data for land-use change and its impact on emissions. | Planned for future use in BTR and NC |

## ANNEX 5: MODALITIES, PROCEDURES AND GUIDELINES

This Report includes BTR chapters which follow the requirements according to decision 18/CMA.1261, which sets out the modalities, procedures and guidelines (MPGs) for the transparency framework for action and support referred to in Article 13 of the Paris Agreement. As the various chapters of the BTR directly reference specific paragraphs of the MPGs, for the reader's convenience, this annex provides an overview of where in this BTR the specific MPGs are discussed The full description of the MPG's can be found on the UNFCCC website: https://unfccc.int/resource/tet/0/00mpg.pdf

**MPG References in the BTR**

| MPG Paragraph Reference | Topic/Requirement | Location in BTR |
|---|---|---|
| **Paragraph 74** | GHG Inventory | Chapter 3, Section 3.1 |
| **Paragraph 75** | Tracking Progress of NDC | Chapter 4, Section 4.2 |
| **Paragraph 76** | Support Needed and Received | Chapter 5, Section 5.1 |
| **Paragraph 77** | Adaptation Reporting | Chapter 6, Section 6.3 |
| **Paragraph 78** | Mitigation Policies and Measures | Chapter 7, Section 7.4 |
| **Paragraph 79** | Information on Climate Impacts | Chapter 8, Section 8.2 |
| **Paragraph 80** | Projections | Chapter 9, Section 9.1 |
| **Paragraph 81** | Capacity Building | Chapter 10, Section 10.5 |