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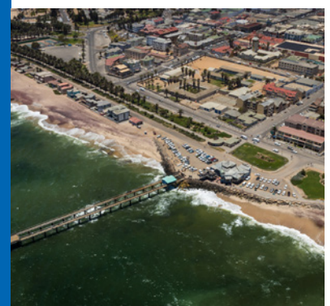
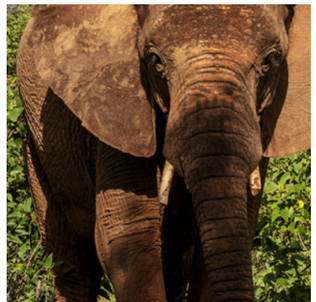
Republic of Namibia
Ministry of Environment, Forestry and Tourism

Second National Integrated State of the Environment Report for Namibia

SEPTEMBER 2021





Preface

I am proud to introduce Namibia's second Integrated State of the Environment Report (ISOER). As part of our collective commitment to conduct systematic analyses and evaluations of the environment, Namibia has prepared an update to the 2004 ISOER. The objective of the ISOER is to communicate credible, timely and accessible information on the current condition of the Namibian environment to a range of stakeholders and decision-makers, as well as the general public.

Namibia's first ISOER made use of the globally recognized Pressure-State-Response (PSR) framework. The 2021 ISOER focuses on environmental indicators drawn from the United Nations Framework for the Development of Environmental Statistics (FDES) and links these to Sustainable Development Goals and Targets. The 2021 ISOER not only covers the subjects of the previous version – such as information on physical, biological and human environments – but incorporates new and recent developments and analyses on cross-cutting issues such as climate change and ecosystem services.

Namibia's commitment to sustainable development broadly, and environmental management in particular, is evident in the provisions of its Constitution as well as in the Government of the Republic of Namibia's ratification of many international environmental agreements since independence. Moving towards the national Vision 2030 requires access to reliable and centralized information on the state of the environment. The 2021 ISOER demonstrates how the country has progressed in managing its natural resources since 2004 while minimising the environmental impacts of wastes and disasters generated by human and economic activity. Based on a core set of indicators, the report highlights environmental performance areas where Namibia is doing well and places a spotlight on areas where the country can perform better. It notes likely factors contributing to environmental change and features society's response to dealing with emerging or ongoing environmental challenges.

Although the 2021 ISOER principally features information about issues of national importance, a number of issues can be better understood at local level. Given that certain topics are only relevant to a specific geographic area in Namibia, rather than the entire country, the report includes a number of local perspectives on issues such as land degradation in the Oshana Region, nature-based tourism in Etosha National Park and Kunene Region and illegal fishing in the Kavango Region. This information, data and visualization in the form of maps, graphs and diagrams, provides crucial inputs and serve as an authoritative reference for policy and decision-makers, resource managers, planners, researchers and students alike.

As the report is prepared to mainly enhance decision-making, its major contribution is the assessment of environmental data availability. There are some areas where datasets are up to date and readily available, however in other areas, there is a need to invest time and resources to gather additional and more recent information. By increasing the availability and visibility of key datasets it will be possible to develop and monitor the implementation of sustainable development strategies, programmes and plans in the future. Furthermore, the 2021 ISOER features priority areas that require urgent and proactive attention to reverse negative trends, whether biophysical or socio-economic. Effecting positive change is possible if there is strong partnership and collective action by stakeholders in the public and private sector. I am confident that Namibians possess the abilities and the resolve to rise to this challenge.

On behalf of the Government of the Republic of Namibia, I wish to express my sincere gratitude to all organizations and individuals who participated in preparing the 2021 ISOER, which has been realised with support from the Biodiversity Management and Climate Change (BMCC) Project and Climate Change and Inclusive Use of Natural Resources (CCIU) Projects of the Deutsche Gesellschaft für Internationale Zusammenarbeit GIZ, implemented on behalf of and in close coordination with the Namibian Ministry of Environment, Forestry and Tourism (MEFT), and funded by the German Federal Ministry for Economic Cooperation and Development (BMZ).

Pohamba Shifeta
Minister of Environment, Forestry and Tourism

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Sossusvlei Desert | Eelco Böhlingk

Purpose of the ISOER

The objective of this Integrated State of the Environment Report (ISOER) is to provide information about the environment, its most important changes over time and across locations, and the main factors that influence them. The ISOER seeks to provide high-quality statistical information to improve knowledge of the environment, support evidence-based policy- and decision-making, and provide information for the general public and specific user groups.

Users of the ISOER include a variety of stakeholders, including:

i. Policy-makers and decision-makers at all levels;
ii. The general public, including media and civil society;
iii. Analysts, researchers and academia; and
iv. International agencies.

Dunes in Namib Desert | JP Desvigne

Stakeholder engagement

The development of the ISOER relied on the identification and engagement of several key stakeholder groups to gather information and data. Key stakeholder input into the draft ISOER was essential, and the chosen platform to gather feedback from various key stakeholders was a workshop. In light of the COVID-19 restrictions, the main stakeholder consultation workshop was held in Windhoek on 11 November 2020 – making use of a combination of in-person meetings and online communication tools. Feedback from workshop participants was captured through the interactive Mentimeter tool. Following the workshop, stakeholders were given time to submit any further comments, and these were used to update the ISOER document. In 2021, two additional stakeholder workshops were conducted with the Sustainable Development Advisory Council (SDAC) on 16 March 2021 and with the Namibian Ministerial Committee on 30 March 2021. Comments were captured during these consultations and members were given additional time to submit any further comments. These were then used to update the ISOER document.

Key Concepts

Adaptation Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Airborne diseases & conditions Airborne diseases and conditions associated with the environment are caused or worsened by exposure to unhealthy levels of pollutants (such as particulate matter (PM), sulphur dioxide (SO^2) or ozone (O^3), usually found in urban settlements and, in particular, in cities with weaker air quality regulations and/or enforcement capabilities.

Annex I Parties The industrialized countries listed in Annex I to the Convention, which committed to returning their greenhouse-gas emissions to 1990 levels by the year 2000 as per Article 4.2 (a) and (b). They have also accepted emissions targets for the period 2008-12 as per Article 3 and Annex B of the Kyoto Protocol. They include the 24 original OECD members, the European Union, and 14 countries with economies in transition. (Croatia, Liechtenstein, Monaco and Slovenia joined Annex 1 at COP-3, and the Czech Republic and Slovakia replaced Czechoslovakia.)

Aquatic resources Comprise fish, crustaceans, molluscs, shellfish, aquatic mammals and other aquatic organisms that are considered to live within the boundaries of the Exclusive Economic Zone (EEZ) of a country throughout their life cycles, including both coastal and inland fisheries. Migrating and straddling fish stocks are considered to belong to a given country during the periods when those stocks inhabit its EEZ.

Biodiversity The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, including diversity within species, between species and of ecosystems. It is also a measure of ecosystem health.

Biological resources Renewable resources that are capable of regeneration through natural (non-managed or managed) processes. Biological resources include timber and aquatic resources, and a range of other animal and plant resources (such as livestock, orchards, crops and wild animals), fungi and bacteria.

Biomass fuels or biofuels A fuel produced from dry organic matter or combustible oils produced by plants. These fuels are considered renewable as long as the vegetation producing them is maintained or replanted, such as firewood, alcohol fermented from sugar, and combustible oils extracted from soy beans. Their use in place of fossil fuels cuts greenhouse gas emissions because the plants that are the fuel sources capture carbon dioxide from the atmosphere.

Biome A biome is a distinct community of plants, animals or fungi that occupy a distinct region. It is often referred to as an ecosystem.

Climate change Climate change is a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is, in addition to natural climate variability, observed over comparable time periods. Climate change occurs through a chain of events and can be observable at all levels, from local to global. Climate process drivers are greenhouse gas (GHG) emissions associated with current production and consumption patterns, which depend heavily on fossil fuels for energy and transportation.

Deforestation Conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 per cent threshold. Deforestation implies the longterm or permanent loss of forest cover and implies transformation into another land use. Such a loss can only be caused and maintained by a continued human-induced or natural perturbation. Deforestation includes areas of forest converted to agriculture, pasture, water reservoirs and urban areas. The term specifically excludes areas where the trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silvicultural measures. From a resource accounting perspective, deforestation is defined by the System of Environmental-Economic Accounting Central Framework as the decrease in the stock of forest and other wooded land due to the complete loss of tree cover and transfer of forest land to other uses (for example, use as agricultural land, land under buildings and roads) or to no identifiable use.

Disasters Unforeseen and often sudden events that cause great damage, destruction and human suffering. They often exceed local response capacities and require external assistance at the national or international level. A disaster is often described as a result of exposure to an extreme event. Depending on their cause, disasters can be both natural and technological.

Driving Force-Pressure-State-Impact-Response (DPSIR) framework An analytical framework that is based on the causal relationship between its D-P-S-I-R components. Driving forces are the socioeconomic and sociocultural forces driving human activities, which increase or mitigate pressures on the environment. Pressures are the stresses that human activities place on the environment. State, or state of the environment, is the condition of the environment. Impacts are the effects of environmental degradation. Responses refer to the responses by society to the environmental situation.

Ecosystem A dynamic system of plant, animal (including humans) and microorganism communities and their non-living physical environment interacting as a functional unit. The basic structural unit of the biosphere, ecosystems are characterized by interdependent interaction between the component species and their physical surroundings. Each ecosystem occupies a space in which macro-scale conditions and interactions are relatively homogenous.

Ecosystem The benefits supplied by the functions of ecosystems and received by humanity.

Emissions Substances released to the environment by establishments and households as a result of production, consumption and accumulation processes.

Energy production Capture, extraction or manufacture of fuels or other energy products in forms which are ready for general consumption. Energy products are produced in a number of ways, depending on the energy source. Total energy production originates from sources that can be classified as non-renewable or renewable. Energy production includes the production of primary and secondary energy. Primary energy refers to energy sources as found in their natural state, as opposed to derived or secondary energy, which is the result of the transformation of primary sources.

Environmental statistics The gradual understanding of environmental issues, and the recognition of the connections among human actions, development, sustainability and human responsibility in these processes. Environmental awareness involves the realization that humans and ecosystems co-exist in a shared environment, which is ultimately the biosphere. Awareness fosters pro-environmental attitudes and predispositions for action and changed behaviour.

Environmental awareness The process of sharing and constructing environmental information and knowledge, as well as information on how humans interact with the environment. Environmental education is carried out through a variety of programmes, including formal and informal education and training, directed towards different audiences. It may be curriculum- and classroom-based or experiential, and may be provided on-site or in community settings by government agencies or NGOs. Environmental education is integral to education for sustainable development.

Environmental health Focuses on how environmental factors and processes impact and change human health. It can be defined as an interdisciplinary field that focuses on analysing the relationship between public health and the environment. From the health perspective, the World Health Organization states that "environmental health addresses all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviours. It encompasses the assessment and control of those environmental factors that can potentially affect health. It is targeted towards preventing disease and creating health-supportive environments."

Environmental indicators Environment statistics that have been selected for their ability to depict important phenomena or dynamics. Environmental indicators are used to synthesize and present complex environment and other statistics in a simple, direct, clear and relevant way.

Environmental regulation & instruments Policy responses to regulate and establish acceptable limits for protecting the environment and human health. It entails both direct regulatory and economic instruments. Direct regulatory instruments include environmental and related laws, standards and limits, as well as their enforcement capacities. These can be described using statistics on regulated pollutants, on licensing systems, on applications for licences, on quotas for biological resource extraction, on budgets and on the number of staff dedicated to enforcement of environmental regulations. Economic instruments may comprise the existence and number of green/environmental taxes, environmental subsidies, eco-labelling and certification, and emission permits.

Environmental resources Naturally occurring living and non-living components of the earth, together constituting the biophysical environment, which may provide benefits to humanity. Environmental resources include natural resources such as sub-soil resources (mineral and energy), soil resources, biological resources and water resources, as well as land. They may be naturally renewable like fish, timber or water, or non-renewable such as minerals.

Extreme events Events that are rare within their statistical reference distribution at a particular location. An extreme event is normally as rare as or rarer than the 10th or 90th percentile.

Global Environment Facility (GEF) The GEF is an independent financial organization that provides grants to developing countries for projects that benefit the global environment and promote sustainable livelihoods in local communities. The Parties to the Convention assigned operation of the financial mechanism to the GEF on an on-going basis, subject to review every four years. The financial mechanism is accountable to the Conference of the Parties (COP).

Greenhouse gases (GHGs) The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_20). Less prevalent – but very powerful – GHGs are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

Groundwater Water that collects in porous layers of underground formations known as aquifers.

Human settlements The totality of the human community, whether people live in large cities, towns or villages. They encompass the human population that resides in a settlement, the physical elements (for example, shelter and infrastructure), services (water, sanitation, waste removal, energy and transport), and the exposure of humans to potentially deleterious environmental conditions.

Intergovernmental Panel on Climate Change (IPCC) Established in 1988 by the World Meteorological Organization and the UN Environment Programme, the IPCC surveys world-wide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the Convention's subsidiary bodies. The IPCC is independent of the Convention.

Land degradation Reduction or loss – in arid, semi-arid and dry sub-humid areas – of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns.

Land use Reflects both the activities undertaken and the institutional arrangements put in place for a given area for the purposes of economic production, or the maintenance and restoration of environmental functions. Land being "used" means the existence of some kind of human activity or management. Consequently, there are areas of land that are "not in use" by human activities.

Elephant crossing | S Gensicke

Multilateral Environmental Agreements (MEAs) MEAs address environmental problems through international cooperation, especially those which have a transboundary nature or are global in scope. For the most relevant MEAs, participant or signatory countries are usually expected to report on progress periodically, either on a mandatory or voluntary basis.

Non-Annex I Parties Refers to countries that have ratified or acceded to the United Nations Framework Convention on Climate Change that are not included in Annex I of the Convention.

Non-governmental organizations (NGOs) Organizations that are not part of a governmental structure. They include environmental groups, research institutions, business groups, and associations of urban and local governments.

Other wooded land (OWL) Land not classified as "forest", which spans more than 0.5 hectares, contains trees higher than 5 metres and a canopy cover of 5-10 per cent (or trees able to reach these thresholds in situ), or has a combined cover of shrubs, bushes and trees above 10 per cent. It does not include land that is predominantly under agricultural or urban land use.

Pollution Is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it, inter alia: less fit for any beneficial purpose for which it may reasonably be expected to be used; or harmful or potentially harmful to the welfare of human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

Renewable resources Captured from sources that replenish themselves. It includes solar (photovoltaic and thermal), hydroelectric, geothermal, tidal action, wave action, marine (non-tidal currents, temperature differences and salinity gradients), wind and biomass energy. All of these are naturally replenished, although their flow may be limited.

Surface water All water that flows over or is stored on the ground's surface, regardless of its salinity levels. Surface water includes water in artificial reservoirs, lakes, rivers and streams, snow, ice and glaciers.

Vulnerability The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, as well as its sensitivity, and its adaptive capacity.

Vulnerable individual/group Individuals/group who may be more likely to be adversely affected by environmental change. Vulnerability considers age, including the elderly and minors, and will include circumstances where they may be separated from their family, the community or other individuals upon which they depend.

Waste Discarded materials that are no longer required by the owner or user.

Waste water Discarded water that is no longer required by the owner or user.

Water resources Freshwater and brackish water, regardless of their quality, in inland water bodies, including surface water, groundwater and soil water.

Abbreviations

AALS	Affirmative Action Loan Scheme
AfDB	African Development Bank
AFOLU	Agriculture, forest and land use
ASF	African Swine Fever
AIDS	Acquired Immunodeficiency Syndrome
BAU	Business as Usual
BCC	Benguela Current Convention
BMCC	Biodiversity Management and Climate Change
BMZ	German Federal Ministry for Economic Cooperation and Development
BUR	Biennal Update Report
CBA	Community-based adaptation
CBD	Convention on Biological Diversity
CBNRM	Community Based Natural Resource Management
CFs	Community Forests
CH_4	Methane
CIMP5	Coupled Model Inter-comparison Project, Phase 5
CO_2	Carbon Dioxide
COP	Conference of the Parties
CoW	City of Windhoek
CRED	Centre for Research on the Epidemiology of Disasters
CSIR	Council for Scientific and Industrial Research
DIWWM	Department of Infrastructure, Water and Waste Management
DEAF	Department of Environmental Affairs and Forestry
DPSIR	Drivers, Pressures, State, Impact and Response
DRFN	Desert Research Foundation of Namibia
DRM	Disaster Risk Management
DWN	Development Workshop Namibia
e	Equivalent
EBSA	Ecologically or Biologically Significant Marine Area
ECB	Electricity Control Board
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIF	Environmental Investment Fund of Namibia
EMA	Environmental Management Act

ENSO	El-Nīno Southern Oscillation
EPI	Environmental Performance Index
ESMAP	Energy Sector Management Assistance Programme
EWS	Early warning systems
FAO	Food and Agriculture Organization of the United Nations
FDES	Framework for the Development of Environment Statistics
FMD	Foot and mouth disease
GCF	Green Climate Fund
GDP	Gross Domestic Product
GED	World Bank's Global Electrification Database
GEF	Global Environmental Facility
GHG	Greenhouse gas
Gg	Gigagram
GWh	Gigawatt hours
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GRN	Government of the Republic of Namibia
GWP	Global Warming Potential
HCRW	Health Care Risk Waste
HFO	Heavy Fuel Oil
HIV	Human Immunodeficiency Virus
HWC	Human-Wildlife Conflict
ICT	Information and Communication Technology
IEA	International Energy Agency
IFM	Integrated Fire Management
ILUP	Integrated Land Use Planning
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent power producer
IPPU	Industrial Processes and Product Use
IRDNC	Integrated Rural Development and Nature Conservation
IRLUPs	Integrated Regional Land Use Plans
ISOER	Integrated State of the Environment Report
ITCZ	Intertropical Convergence Zone
IUCN	International Union for Conservation of Nature
KNP	Kalahari Namib Project

kWh	Kilowatt hour
kWp	Kilowatt peak
LFS	Labour Force Survey
LSD	Lumpy Skin Disease
MAWLR	Ministry of Agriculture, Water and Land Reform
MDGs	Millennium Development Goals
MEAs	Multi-lateral Environmental Agreements
MEFT	Ministry of Environment, Forestry and Tourism
MERS	Middle East Respiratory Syndrome
MFMR	Ministry of Fisheries and Marine Resources
MPI	Multidimensional poverty index
MSP	Marine Spatial Planning
MW	Megawatt
Mt	Metritonne
NAB	Namibian Agronomic Board
NACOMA	Namibian Coast Conservation and Management (Project)
NACSO	Namibian Association of Community Based Natural Resource Management (CBNRM) Support Organizations
NAM-PLACE	Namibia Protected Landscape Conservation Areas (Initiative)
NAP	National Agriculture Policy
NBSAP2	Second National Biodiversity Strategy and Action Plan
NBRI	National Botanical Research Institute
NCCC	National Climate Change Committee
NCCP	National Climate Change Policy
NCCSAP	National Climate Change Strategy and Action Plan
NDP	National Development Plan
NDRMP	National Disaster Risk Management Plan
NFFP	Namibia–Finland Forestry Programme
NGO	Non-Governmental Organization
NHAG	Namibia Housing Action Group
NHE	National Housing Enterprise
NNF	Namibia Nature Foundation
NOAA-AVHRR	National Oceanic & Atmospheric Administration – Advanced Very High-Resolution Radiometer
NPC	National Planning Commission
NSA	Namibian Statistics Agency
NSWMS	National Solid Waste Management Strategy

OIE	The World Organization for Animal Health
ORF	Contagious Pustular Dermatitis
OWL	Other Wooded Land
PJTC	Permanent Joint Technical Commission
RAMSAR	Convention on Wetlands of International Importance Especially as Waterfowl Habitat
RCP6	Representative Concentration Pathways Six
RDRMC	Regional Disaster Risk Management Centre
REFIT	Renewable Energy Feed-In Tariff
SADC	Southern African Development Community
SARS	Severe Acute Respiratory Syndrome
SCP	Sustainable consumption patterns
SDAC	Sustainable Development Advisory Council of Namibia
SDGs	Sustainable Development Goals
SDFN	Shack Dwellers Federation of Namibia
SHPZ	Subtropical High-Pressure Zone
Stats SA	Statistics South Africa
SWM	Solid Waste Management
TAC	Total Allowable Catch
TB	Tuberculosis
TEEBs	The Economics of Ecosystems and Biodiversity
TTCI	Travel and Tourism Competitiveness Index
TZ	Temperate Zone
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNCSD	United Nations Commission on Sustainable Development
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
UNDAF	United Nations Development Assistance Framework
US	United States
USAID	United States Agency for International Development
WASH	Water, sanitation and hygiene
WHO	World Health Organization
WWTP	Wastewater Treatment Plants
WRI	World Resources Institute

Executive summary

Purpose of this report

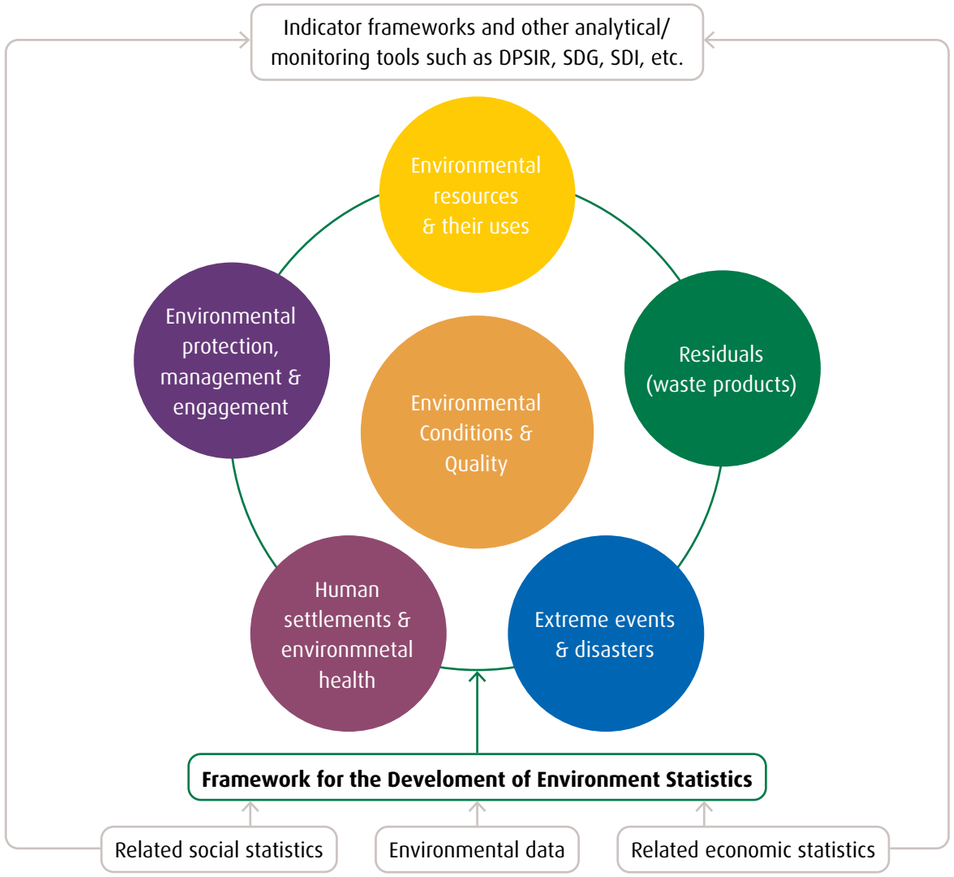
This report is Namibia's second national Integrated State of the Environment Report (ISOER), the first having been prepared in 2004. Commissioned by the Ministry of Environment, Forestry and Tourism (MEFT), the objective of the ISOER is to provide information about the environment, its most important changes over time and across locations, and the main factors that influence them. The ISOER seeks to provide high-quality statistical information to improve knowledge of the environment, to support evidence-based policy- and decision-making, and to inform the general public and specific user groups. It has relied on engagement with several key stakeholder groups for the gathering of information and data. Key stakeholder input into the drafting of the ISOER was also essential to identify key issues of concern, and the chosen platform to gather feedback from various key stakeholders was a workshop.

In preparing a report that aligns with international good practice in environmental reporting and integrates information across a wide spectrum of departments and interest groups – while at the same time providing a clear path of action – MEFT selected to use the Framework for the Development of Environment Statistics (FDES). The FDES was published by the Department of Economic and Social Affairs of the United Nations (UN) Secretariat in 2014. This instrument provides environmental reporting guidelines following a tiered approach, from environmental components and sub-components to individual indicators. It allows for country-specific interpretations and limitations and aligns well with other environmental reporting tools such as the Driver, Pressures, State, Impact and Response (DPSIR) model and Sustainable Development Goals (SDGs) adopted by the UN in 2016. In addition to the FDES, an analysis was conducted of recently published ISOERs of countries that featured thematic topics and issues that were of relevance to Namibia.

The 2021 ISOER provides an update on Namibia's state of the environment since 2004 based on available data and trends; it reports on over 125 indicators, a fourfold increase in the number of indicators used in the 2004 ISOER. It interprets selected indicators from a 'call to action' point of view, noting areas that require attention by country stakeholders. The 2021 ISOER affords decision-makers in all walks of life guidance on what actions could be taken to promote positive trends or address negative movements affecting Namibia's environmental sustainability.

Methodological approach

In developing the 2021 ISOER, several reporting frameworks were used to ensure that data integrity and good practice align with stakeholder needs. The FDES informed the main themes of the report and the DPSIR and SDGs provided the indicator frameworks. The figure below indicates how a focus on potential stakeholder expectations, needs and use of the ISOER informed the reporting approach.



National context

Located on the west coast of Southern Africa, Namibia straddles the Tropic of Capricorn. The country comprises 14 administratively delineated regions and shares common borders with Angola, Zambia, Zimbabwe, Botswana and South Africa. Namibia has a land surface area of 824,268km^2 and a coastline of 1,572km at the Atlantic Ocean to its west, comprising of territorial sea and an exclusive economic zone. Namibia is an active member state of the Southern African Development Community (SADC), a regional inter-governmental organization comprising 16 countries.

Natural borders between Namibia and its neighbouring countries are formed by seven perennial rivers; two are in the north (Kunene and Okavango), four are in the northeast (Zambezi, Kwando, Linyanti and Chobe) and one is in the south (Orange River). Namibia is commonly classified into the following five geographic regions: the Namib Desert in the west; the Great Escarpment; the Central Plateau; the Kalahari Desert in the east; and the Okavango-Caprivi region. The main geographical areas in Namibia include two of the world's largest and most important deserts;

the Kalahari Desert in the east is dominated by stabilized dunes and the Namib Desert in the west comprises a wide range of landscape types. These deserts provide a wide range of unique ecosystems. The Central Plateau, with its Great Escarpment, lies inland of the Namib Desert plains and is the third great landscape unit in Namibia. The Central Plateau runs the length of the country and includes the highest point in Namibia – at Konigstein at an elevation 2,606 metres above sea level. The Atlantic Ocean, with its cold, nutrient-rich Benguela Current, has a significant influence on Namibia's climate, vegetation and marine life.

Rainfall in Namibia is temporally and spatially extremely variable; with annual rainfall ranging from 600mm in the north-east to 25mm in the south-west, Namibia is classified as having extreme water risk. This classification is based on a risk analysis for physical water risks related to quantity and quality as well as water governance. This risk is exacerbated by the impacts of climate change on the region. The impacts and responses to Namibia's water scarcity is highlighted throughout this report. Water is an enabler for growth and development, and as such permeates every aspect of environmental management and reporting.

Namibia gained independence on 21 March 1990 after over a century of colonization and some 40 years of Apartheid. Namibia has a population of approximately 2.5 million, making it one of the least densely populated countries in the world; its population density count is just 3/km^2. Namibia's population growth rate is growing steadily at 2% per year, a trend which is expected to continue. The country is achieving a 4% annual improvement in the global multi-dimensional poverty index, which measures the status of poverty across the world by aggregating data from three dimensions related to the impact of poverty: health, education and standard of living. In spite of the developmental gains and adoption of pro-poor policies, Namibia remains one of the most unequal countries in the world; over 20% of the population is reportedly vulnerable to multi-dimensional poverty. Namibia has achieved notable progress in reducing poverty in recent years, with political stability and sound economic management helping to anchor poverty reduction initiatives.

Since independence, the Namibian government has pursued free-market principles, promoting commercial development and job creation to bring previously disadvantaged citizens into the economic mainstream. Due to its natural mineral riches, Namibia is classified as an upper-middle-income country. It is one of the world's most important diamond exporters, and the fifth largest uranium producer. Agriculture accounts for around 7.2% of the Namibian economy and employs a fifth of the workforce. The country's arid climate and geographic conditions do not favour farming and hence the crop variety is rather limited. Fishing accounts for almost 25% of all activities in the primary sector. Namibia's fauna and its pristine natural environment attracts tourists from all over the world. It is noteworthy that close to 20% of the country's total land mass is protected as parks and conservancies. Nature-based tourism remains a significant contributor to Namibia's economy.

Having grown at an average rate of 5.3% between 2010 and 2015, Namibia's economy entered a recession in 2016 and has since struggled to grow. It has continued to face significant headwinds, with real output contracting by 1.4% in 2019. Severe drought conditions experienced in 2019 constrained agricultural output and led to a sharp decline in harvests. Reduced precipitation also affected the broader Namibian economy through lower electricity generation and water supply, which curtailed industrial production. The COVID-19 pandemic is set to have an unprecedented impact on economic activity throughout Africa, including in Namibia.

Himba woman in Opuwo | Javier Gil

Environmental conditions & quality

Environmental conditions and quality are determined by an interplay of factors through years of evolutionary change and human influence. The Namibian geography is characterized by a wide range of unique physical and biological environments.

Status quo of physical environment

The following points outline the status quo and key trends relating to physical conditions such as atmosphere, climate and weather, hydrographical characteristics, geological information and soil characteristics:

- Current climate change projections indicate that Namibia will likely experience an increase in temperatures by 1.2°C in the south-west and by 2.8°C in the north-east by 2065. This will be accompanied by greater variability in annual rainfall;
- Namibia will reach heat-related stress thresholds such as health impacts sooner than its neighbouring countries;
- The South Benguela current might be more susceptible to the influence of the El-Nĩno Southern Oscillation, causing weaker upwelling cycles possibly affecting marine life;
- Namibia has limited surface water resources available and is heavily reliant on groundwater for water provision to large areas of the country. Its water risk status is compounded by regular droughts and a projected increase in demand for water resources;
- Groundwater quality in Namibia is generally good, although brackish shallow groundwater occurs in densely populated north-central areas. In some rural communities untreated wastewater and increased nitrates due to cattle farming is known to contaminate groundwater; and
- Crop cultivation and livestock farming is practised on over 70% of Namibia's surface area, making the country highly vulnerable to desertification and land degradation.

Responding to changes in the physical environment

The following prominent responses to dealing with changes to physical environmental conditions and quality have been documented:

- Namibia's commitment to reduce Greenhouse Gas (GHG) emissions is articulated in its Intended Nationally Determined Contributions (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC). As a Non-Annex 1 Party to the UNFCCC, Namibia does not have commitment obligations under the Convention but has voluntarily developed INDCs to contribute to climate change mitigation efforts. As a signatory Party to the UNFCCC, Namibia has prepared and submitted four National Communications which includes details on its Nationally Determined Contributions (NDC): The Initial National Communication in 2002; the Second National Communication in 2011; the Third National Communication in 2015 and the fourth National Communication in 2020. Furthermore, Namibia prepared and submitted its NDCs in 2015 and 2021;
- Together with partners, the Namibian Government has taken both a bottom-up and a top-down approach to address water-related challenges at national and regional level. Notably, the MEFT published the Integrated Water Resources Management Plan in 2010 which included a suite of approaches, although implementation is constrained; and
- Namibia subscribes to the United Nations Convention to Combat Desertification (UNCCD), which aims to address degraded areas to increase the amount of usable land in the country and also to ensure sustainability of natural resources in the light of population increases. Namibia is currently in the implementation phase of the Third National Action Programme of the UNCCD that runs from 2014 to 2024.

Status quo of biological environment

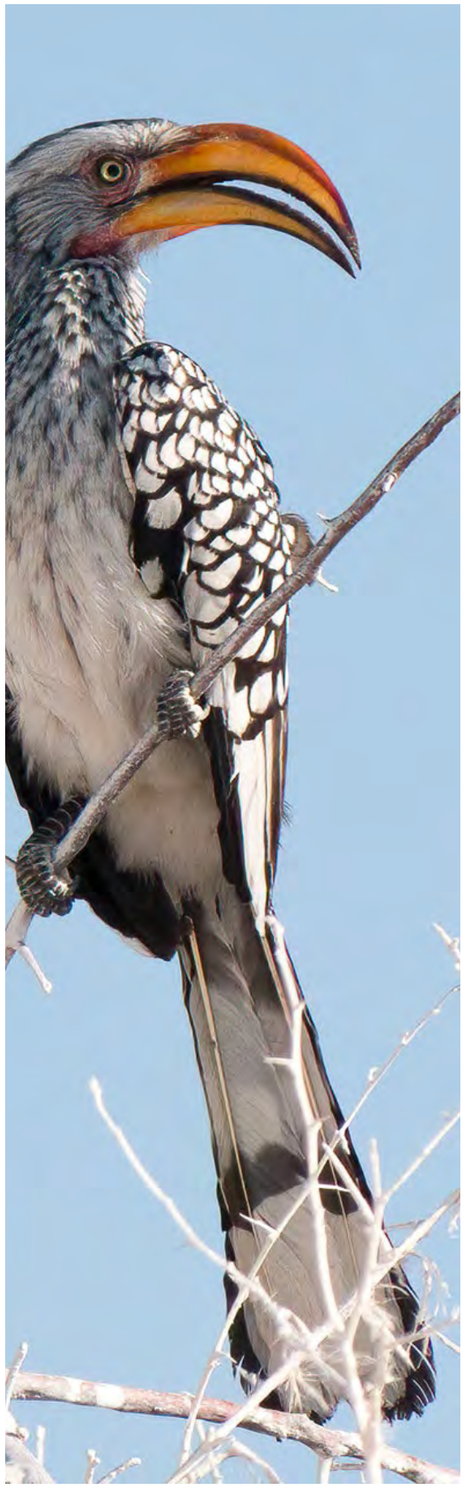
The following status quo and key trends relating to landcover, ecosystems and biodiversity conditions have been noted:

- There has been a reduction in forestland, grassland and croplands while other wooded areas and settlements have increased. These trends can be attributed a variety of factors including population growth, bush encroachment, land degradation and urbanisation as a result of agricultural challenges;
- Over 43% of Namibia's land area is under conservation management, with some 17% of Namibia formally protected within 20 state-run protected areas. Since 2010, there has been a growth in the number of conservancies and community forests;
- The country's terrestrial biodiversity and ecosystems are displaying a decline mainly due to anthropogenic rather than natural influences. Fish and aquatic invertebrate stocks as well as aquatic plants are also threatened by habitat loss and alteration due to off-shore mining and exploration, land-based pollution, invasive species and inconsistencies in the Benguela upwelling system;
- There has been an increase in registered cases of wildlife crimes involving high-value species; and
- There has been a growth in aquaculture with consequent benefits such as improving food security, reducing poverty and creating employment, although it gives rise to a number of environmental impacts that need to be managed.

Responding to changes in the biological environment

The following prominent responses to dealing with changes to biological conditions and quality have been documented:

- Namibia is a signatory of the United Nations Convention on Biological Diversity (UNCBD) and its commitments are managed through the Multi-lateral Environment Agreement (MEA) division of the MEFT. In line with the aims of the UNCBD, the MEFT has set the targets to help protect ecosystems and biodiversity;
- Namibia reports on NDC targets to the UNFCCC that relates to reforestation, land and habitat restoration and wood removal;
- In 2012, Namibia officially recognized the need for introducing marine spatial planning (MSP) as part of the second National Biodiversity Strategy and Action Plan (NBSAP II) and the 2050 Integrated Maritime Strategy of the African Union. In 2014, Namibia prioritized MSP within the framework of the Benguela Current Convention (BCC) together with its regional partners Angola and South Africa. In 2017, Namibia prioritized MSP through its Fifth National Development Plan (NDP 5) as a strategy to implement a Blue Economy governance and management system that sustainably maximizes economic benefits from marine resources and ensures equitable marine wealth distribution to all Namibians;
- Namibia is progressing well with the process of identifying new areas that meet the Ecologically or Biologically Significant Marine Area (EBSA) criteria, and updating the existing recognized EBSAs within the marine space by incorporating new scientific knowledge. The new and updated EBSAs will be fed into the Marine Spatial Planning, with the agreed conservation and management measures in the plan's regulations;
- Under the Red List Project of the National Botanical Research Institute (NBRI), a long-term monitoring programme is in place to monitor population parameters of dwarf succulents over time. NBRI also re-assessed the conservation status of two species, and a further 19 species – which had not been assessed before – were assigned a national status; and
- The MEFT and other law enforcement agencies have intensified security measures in protected areas; the poaching of high value species has declined significantly since reaching a high point in 2016. To strengthen the prosecution of wildlife crimes, the MEFT is working on the new Parks and Wildlife Management Bill.



Hornbill | Dick Hoskins

Environmental resources & their use

Environmental resources are key foundations to human existence on earth. They provide resources on which human existence and quality of life depends, such as shelter, food, health care, infrastructure, transportation, defence and recreation. A lack of these resources will present challenges for society, demanding that they be used sustainably.

Status quo of mineral resources

The following status quo and key trends relating to mineral resource use have been noted:

- Mining remains the biggest primary economic sector in Namibia, directly employing 16,342 individuals and sustaining 114,394 downstream jobs in 2019; this makes up 15.5% of Namibia's employed population. More than half of Namibia's exports are mineral resources, valued at N$31.2 billion in 2019, with diamonds making up the largest share of mineral exports, followed by uranium and metal ores;
- Major overlaps in the location of critically endangered species, rare biodiversity areas and the presence of minerals in Namibia means that biodiversity and ecosystem services can be significantly affected throughout the life of mine. This is due to factors such as land clearance for facilities and infrastructure, pressures linked to mine-induced in-migration and the unintended introduction of invasive species;
- The mining industry has an exceptionally high-water usage rate, consuming over 13,13 Mm^3 in 2018/19 – or 9.9% of NamWater's consumer demand;
- Namibia has 157 registered and likely in excess of 250 abandoned mine sites in total. These sites may pose a serious risk in terms of groundwater and soil contamination and dust pollution; and

- Illegal sand mining has been an increasing challenge in several areas in Namibia over the past decade, especially in the Northern part of the country.

Status quo of energy resources

The following status quo and key trends relating to energy resource use have been noted:

- While electricity production in terms of units into the system has been relatively constant at around 4,500 GWh between 2011 and 2019, the operating cost per customer has doubled – primarily driven by the rising cost of imported electricity;
- Over 50% of the energy supplied to Namibians consists of energy imports from neighbouring southern African countries, highlighting a significant dependency on imported electricity;
- Ruacana hydro-power station provides the bulk of Namibia's power generation capacity. In the light of climate change-induced impacts, especially the uncertainties regarding water supply and rainfall patterns, Namibia is particularly vulnerable to power shortages in the medium- to long-term;
- Oil and gas exploration are planned in northeast Namibia and an EIA is underway for seismic surveys. The exploration license covers the entire Kavango sedimentary basin, an area of approximately 25,341.33km^2;
- Renewable energy as a proportion of Namibia's total energy supply originates from independent power providers (IPPs). Renewable energy consumption has declined from 36% to 28% between 2000 and 2017, driven by growing national demand for electricity that is met by non-renewable energy sources;
- Solar energy has recently begun to supplement Namibia's power supply, making up 6% of the country's energy supply by 2019;
- Namibia has one operating wind farm near Luderitz, which produces 5 MW of power. Approvals have been obtained from government for the construction and operation of four additional wind farms totalling 180 MW production capacity; and
- Through the country's commitments in the Nationally Determined Contribution (NDC), Namibia aims to increase the contribution of renewable energy to total energy supply to 70% by 2030 within the Business as Usual (BAU) scenario (GRN, 2015).

Status quo of land resources

The following status quo and trends relating to land resource use have been noted:

- Overall trends in land ownership in Namibia between 1902 and 2018 show a change in land ownership patterns, with dramatic increases in freehold and communal land post-1964. By 2018, freehold land represented 42% of the land allocation share, followed by communal and state land with 35% and 23% respectively;
- State land is predominantly situated along the Namibian coastline. The northern part of the country is comprised of communal land and the interior is mainly made up of private freehold land;
- Communal land in Namibia provides much of the resident population with a variety of important livelihood resources such as grazing, firewood, building materials and water;
- The majority of agricultural (commercial) land in Namibia belongs to private entities, with previously disadvantaged farm ownership making up 16% of private ownership of commercial agricultural land; and
- There is a lack of daily management of communal land by traditional authorities, leading to overstocking and uncontrolled harvesting of natural resources; this in turn results in higher levels of exploitation and environmental degradation.

Status quo of biological resources

The following status quo and key trends relating to biological resource use have been noted:

- Biological resources contribute extensively to Namibia's economy. Agriculture, forestry and fishing as a whole contributed to 7.3% (N$13.1 billion) of the country's GDP in 2019;
- Agriculture, forestry and fishing play an integral part in the livelihoods of a large portion of the Namibian population. The main source of income for 19.8% of all households is from subsistence farming, 41.6% of these households are situated in rural areas;
- Namibia's fauna and a pristine natural environment forms an integral part of attracting tourists, with tourism spend generating tax income and contributing significantly to the country's foreign exchange reserves;
- There are ongoing incidents of human-wildlife conflicts (HWC), with 1195 head of livestock being killed by wildlife between 2020/21, mainly in the morthern regions of the country;
- Between 2018 and 2019, there has been an increase in wildlife crime registered cases related to high-value species, growing from 115 in 2018 to 174 in 2019; and
- Research indicates that, although major fisheries' yields in the Benguela Current Large Marine Ecosystem (BCLME) are currently much lower than in the past, catches have in general been stable during the past two decades.

Status quo of water resources

The following status quo and trends relating to water resource use have been noted:

- Only 42% of the total water usage is derived from surface water sources, with 38% coming from groundwater abstracted from aquifers;
- Groundwater is mainly used for domestic purposes and livestock watering in rural areas. Many cities and towns are 100% reliant on groundwater, making them vulnerable to impacts on aquifers;
- In 2018/9, the annual consumption of water supplied by NamWater amounted to over 133,1 Mm^3. Severe pressure on the water supply system has resulted in a supply shortfall of 5.23 Mm^3/a, which is projected to grow to 54.75 Mm^3/a by 2050;
- Namibia's central and central northern areas collectively receive about 63% of supplied water compared to the coastal (25.5%) and southern areas (11.5%);
- Water supply at the coast is under pressure due to the development of a number of mines in close proximity, thereby exceeding sustainable yield of this Kuiseb system. This is being offset by development of the establishment of a desalination plant at Vlotzkasbaken;
- The forecast total annual water demand will reach 771.7 Mm^3 by 2030, primarily driven by irrigation that will make up 64.4% of total water usage; and
- Given that Namibia's urban population is set to increase to 2.24 million in 2030, along with rising incomes, urban water demand is projected to increase from 66 Mm^3 to 117.2 million Mm^3/a.

Responding to changes in environmental resources use

The following prominent responses to dealing with changes in resource use have been documented:

- Namibian environmental laws aim to manage resource use. For instance, the Environmental Management Act (EMA), No. 7 of 2007, requires that all ecosystems be provided with sufficient water to meet their ecological needs and that adequate flow is available to sustain water dependent ecosystems. In addition to obtaining groundwater abstraction permits that comply with the purposes and mandates of the EMA, companies also have to comply with water policies such as the Water Resources Management Act of 2013 (WRMA);
- Namibia is currently in the implementation phase of the Third National Action Programme of the UNCCD that runs from 2014 to 2024. The MEFT's action plan is supplemented by several ongoing programmes on land-based approaches that are being supported by international and national organizations;
- The Namibian government has formulated policy to increase the protection of the country's natural resources from mining activities. The 2018 National Policy on Prospecting and Mining in Protected Areas outlines Namibia's policy regarding exploration and mining in protected areas;
- Namibia's energy policy in the recent past has seen a shift towards local renewable energy production of electricity, rather than the largely imported fossil fuel generated electricity. More recently, the National Energy Policy, National IPP Policy and National Renewable Energy Policy have been adopted to support the government's objectives for the energy sector going forward;
- In order to facilitate the gathering of vital land statistics through the various institutions responsible for generating land statistics as administrative records, Namibia has applied integrated land use planning at the regional level through the development of Integrated Regional Land Use Plans (IRLUPs) for its regions;
- Government has published a number of policies and plans focused on agriculture. The agricultural sector features in numerous national plans and strategies, most recently Namibia's fifth National Development Plan (NDP5). The NDP5 is a broad national strategy that sets out the country's development goals from 2017 to 2022. The National Agriculture Policy of 2015 (NAP) emphasizes the objective of increased and sustained agricultural production;
- The country's response to climate change is outlined in the National Climate Change Strategy and Action Plan 2013-2020 (NCCSAP). The NCCSAP acknowledges that the agricultural sector is particularly vulnerable to climate change, with a corresponding risk to food security. The document highlights a number of adaptation and mitigation strategies to reduce the impact and increase the resilience of the agricultural sector to climate change;
- The Namibian government adopted Green Schemes to fund irrigation projects. The Green Scheme programme aims to increase food production through irrigation production. The programme is designed to maximize irrigation opportunities along the maize triangle area of Grootfontein, Tsumeb and Otavi in the Oshikoto and Otjozondjupa regions, as well as North Central and North Eastern regions of Namibia by utilizing the Kunene, Kavango and Zambezi rivers;
- Through the Benguela Current Convention (BCC), Namibia together with Angola and South Africa are focused on ensuring that the shared commercially important fish stocks are jointly monitored, assessed and managed. This is achieved through the implementation of adaptive fisheries management plans for priority shared fish resources, based on an ecosystem approach to fisheries (EAF) principles;
- A significant amount of planning and work has been done by NamWater to improve water infrastructure in Namibia – responding to projected future water demand. NamWater has over 45 water infrastructure development projects underway, which include the rehabilitation of dilapidated water pump stations and distribution canals across the country;
- The country has seen significant policy reform for the water sector, enabling the implementation of a stricter approach to water pricing, water conservation and the development of water re-use and reclamation strategies. These policy reforms are steered by the Integrated Water Resources Management (IWRM) Plan. The Water Resources Management Act, No. 24 of 2004, replaced the Water Act. No 54 of 1956, taking cognizance of the legal requirements to implement the IWRM plan;
- Namibia shares four significant watercourses with neighbouring countries, including the Zambezi, Okavango, Kunene and Orange rivers. To unlock the surface water potential of these rivers, Namibia and its neighbours have established four River Basin Commissions to manage water extraction. Of these, Namibia only has an agreement with Permanent Joint Technical Commission (PJTC) of the Kunene River to increase its

current extraction rate per annum; and

- In response to Namibia's vulnerability to water stress, the Ministry of Agricutlture, Water and Land Reform (MAWLR) has proposed several innovative approaches to increase water security. These include the development of large-scale water desalination plants along Namibia's coastline.

Wastes & their management

Residuals are waste materials that have been discarded after their primary use. These waste materials are usually derived from household, agricultural, construction, industrial and mining activities. Air emissions, wastewater and solid waste pose different environmental and human risks and impacts depending on their volume and composition.

Status quo of waste management

The following status quo and key trends relating to wastes and their management have been noted:

- The aggregated emissions trend indicates that Namibia remained a net GHG sink over the period 1994 to 2014 as the Land category removals exceeded emissions from the other categories;
- In terms of the sectors contributing most to GHG emissions in Namibia, industrial processes and product use (IPPU), agriculture, forest and land use (AFOLU), energy and waste generation all contribute to total emissions;
- The waste sector doubled its emissions over the past 10 years, whereas energy has seen a 121% increase in emissions over the same period – indicating Namibia's growing demand for power;
- Namibia treats wastewater in its most populated and industrialized areas. Treated wastewater is commonly used for irrigation purposes in local fields and gardens;
- As at December 2019, only 75 of the 450 registered wastewater plants in Namibia had a valid permit;
- Namibia has one fully operating landfill site located in Windhoek. The solid waste management in the rest of the country is conducted at waste sites with no proper control or management. It is estimated that approximately 69% of the country's solid waste ends up in open dumps and is generally burned to reduce health risks; and
- Waste management trends between 2001 and 2014 showed there was a general increase in regular collection of waste and waste burning, while irregular waste collection and roadside dumping decreased.

Responding to changes in waste management

The following prominent responses to dealing with wastes have been documented:

- Namibia was one of the first Non-Annex I Parties to prepare a Biennial Update Report (BUR) for the United Nations Framework Convention on Climate Change (UNFCC). To date, Namibia has submitted three BURs and two National GHG Inventory Reports;
- Namibia has implemented minimum quality standards for the discharge of effluent wastewater and is enforcing the 'polluter pays' principle. The Namibia Sanitation Strategy of 2011 has identified the eventual re-use of wastewater for irrigation as a selection criterion for the establishment of sanitation systems;
- An Environmental Clearance Certificate is required to legally operate a mine, under which provision for water management is made. Wastewater treatment plants have been constructed by certain mines to mitigate contamination of ground and surface water resources;
- A Waste Management Strategy (NSWMS) was adopted by the MEFT in 2017 to strengthen the legal, institutional and budgeting framework for solid waste management and to tighten up on standards. This strategy provides a sound framework to deal with solid waste management in the country, but its implementation has been slow; and
- To ensure adequate data and information on waste quantities and practices for planning purposes, the MEFT intends to develop a Namibian system for waste collection that can effectively cover the scope of Namibia.

Extreme events & disasters

In recent decades, increased extreme events have led to more frequent, intense, destructive and deadly natural disasters. Climate change has been identified as a causal factor in this increasing frequency and severity of extreme weather events. As the occurrence and intensity of these natural events and disasters have increased globally, Namibia has like other countries faced greater social and economic impacts.

Status quo of extreme events & disasters

The following status quo and key trends relating to extreme events and disasters have been noted:

- Most common hazards in Namibia with potential to create disasters include floods, droughts, veld fires and human and animal disease outbreaks;
- Projected fluctuations in temperature and precipitation are likely to make extreme events such as droughts and floods more frequent and intense;
- On an annual basis, about 780,000 people (about 31% of the total population) are potentially affected by droughts in Namibia – negatively impacting the GDP by an average of 33%;
- Despite being recognized as a foot and mouth disease (FMD) free zone, Namibia has experienced FMD outbreaks which have been traced to infection originating from neighbouring countries; and
- Namibia has experienced human disease outbreaks in the past that have warranted state intervention. Epidemic-prone diseases in Namibia include malaria and cholera.

Responding to changes in extreme events & disasters

The following prominent responses to extreme events and disaster have been documented:

- Over the past decade, the Namibian Government has collaborated on reforming disaster management approaches. In 2009, the National Disaster Risk Management Policy was approved; it advocated improved capacity for early warning, tracking, monitoring and disseminating information on activities that trigger disaster events;
- Namibia's National Disaster Management System, comprising several committees, minimizes duplication of efforts and optimizes utilization of resources by aligning and integrating roles and responsibilities for disaster risk management; and
- In response to flood events and their associated impacts, the Namibian Government created a multi-pronged policy response to deal with the threats posed by extreme events and natural disasters.

Human settlements & human health

There is a delicate interrelationship between people and the environment, and how they shape and form each other. This is evident when focusing on areas where humans live and work, particularly with regards to living conditions and environmental health.

Status quo of human settlements & human health

The following status quo and key trends relating to human settlements and human health have been noted:

- There has been approximately a 20% increase in national urbanisation in Namibia from 1991 to 2016, with slightly more people (52%) now living in rural areas than in urban settlements. Changes in urbanisation, however, differ across regions;
- Overall national trends indicate that over the past ten years (2001 to 2021): the number of urban citizens using wood and charcoal as their main source of energy for cooking increased; the use of electricity for lighting in urban areas increased slightly the number of people with access to safe water decreased in both rural and urban areas of the country; and the number of people without access to sanitation facilities in urban areas increased;
- Access to safe water is generally high across all regions but there are a number of regions where access in rural areas is relatively low and is not improving at a meaningful rate;
- In 2020, all regions face housing deficits, with the exception of Omusati and Oshana. The greatest need for housing resides in the highly urbanized Khomas and Erongo regions;
- Largely uncontrolled growth of informal settlements occurs in most of the urban areas in Namibia;
- The overall country health indicators show that, despite challenges, Namibia has made gains in improving public health for all citizens. However, tuberculosis remains a significant health challenge and there have been cholera outbreaks in recent years; and
- There has been a progression of recorded Hepatitis E virus (HEV) outbreaks in Namibia, centred mostly in informal settlements with poor water, sanitation and hygiene (WASH) facilities. The COVID-19 pandemic has exposed the inequalities in WASH service provision.

Responding to changes in human settlements & human health

The following prominent responses to changes in human settlements and human health have been documented:

- Supported by the African Development Bank (AfDB), the Namibian Government has made a commitment to reach the universal target of improved sanitation for all by 2030. The AfDB made a grant available to support Namibia's water sector support programme from its Rural Water Supply and Sanitation Initiative Trust Fund. The planned interventions to be completed in 2024 will directly benefit about a million people, with 250,000 indirect beneficiaries, mostly women;
- The Mass Housing Development Programme was set up in 2013 with the aim of building 148 000 affordable houses throughout the country by 2030. Although a number of erven were serviced and houses built, administrative and implementation problems prevented the project from achieving its targets. There are several cooperative partnerships underway to address WASH issues, one being the United Nations Development Partnership Framework (UNPAF) that is currently in its third iteration with the Namibian Government; and
- Nambia's National Disaster Risk Management Plan (NDRMP) (GRN, 2011), provided a basis for Namibia's coordinated response to the COVID-19 pandemic. Responses included declaration of a State of Emergency, COVID-19 response packages and an economic and stimulus relief package.

Community weavers | Ralf Baecker

Testing at Roessing Mine | Ralf Baecker

Environmental protection, management & engagement

A country's engagement in the protection and management of the environment and, therefore, the resources it dedicates to that task, is related to information, awareness and social demand. The level of engagement indicates the country's ability to finance environmental protection activities and participate in international efforts directed at these activities.

Status quo of environmental protection, management & engagement

The following status quo and key trends have been noted:

- A variety of collaborative agreement initiatives between the Namibian Government and National and International Funding Agencies are being used to facilitate social equity and the promotion of sound environmental management, notably the Environmental Investment Fund of Namibia, the Game Products Trust Fund and the Green Climate Fund;
- Nominal biodiversity expenditure within Namibia increased although expenditure is generally greater. Following this, the rate of growth of MEFT biodiversity expenditure started to slow in 2009/10 before turning negative;
- The vast majority of Government expenditure on biodiversity is accounted for by the MEFT, the Ministry of Agriculture, Water and Land Reform (MAWLR) and the Ministry of Fisheries and Marine Resources (MFMR). These three ministries are responsible for more than 90% of total biodiversity expenditure in each year;

- Namibia's total biodiversity expenditure is around N$1 billion per year, which implies that it will need to double the level of investment in biodiversity protection and resource management in order to achieve the targets of the Second National Biodiversity Strategy and Action Plan;
- The apparent dramatic decrease in donor funding post-2014 was caused by the conclusion of major projects that included long-term capital investments. This situation essentially resulted in a return to a more stable level of donor funding. Several donor-funded projects have reportedly commenced implementation in recent years;
- Namibia's development framework is guided by its Vision 2030. Namibia's Green Plan (1992) served it's purpose as a framework for development to secure a safe and healthy environment and a prosperous economy. It recommended strategies to promote sustainable development, and was the stimulus for several ongoing development programmes;
- Over the past decade, government policies have aimed to address ecological diversity and ecosystem functioning as well as focus on improving water and waste management;
- Namibia has entered into over 280 MEAs, including: the Convention on Biological Diversity (CBD), ratified in 1997; the United Nations Framework Convention on Climate Change (UNFCCC), ratified in 1995; the United Nations Convention to Combat Desertification (UNCCD), ratified in 1997; and the United Nations Commission on Sustainable Development (UNCSD);
- Namibia has a fairly strong institutional network of environmental observing systems consisting of several ministries, parastatals and NGOs; and
- In 2019, Namibia published the national Environmental Education (EE) and Education for Sustainable Development (ESD) policies. A high-level ESD Task Force was established in 2019 to assist in mobilizing the necessary financial resources for the implementation of EE and ESD activities through their respective institutions.

Responding to changes in environmental protection, management & engagement

The following prominent responses to environmental protection, management and engagement have been documented:

- In order to address critical environmental challenges faced by Namibia, it has been noted that government will have to work together with stakeholders to mobilize additional resources for biodiversity and conservation;
- Since 2004, Namibia has entered into over 100 MEAs, which demonstrate Namibia's commitment to environmental protection; these can be used to leverage financial assistance for addressing environmental problems;
- Namibia has developed several educational programmes covering a range of issues. It does not, however, currently measure the impact of environmental programmes on awareness and environmental engagement; and
- Given the increasing regularity and severity of natural disasters, a national coordinated and cooperative effort is required to enhance Namibia's capacity to withstand and recover from emergencies and disasters.

Overarching issues

Based on the condition of and trends in Namibia's biophysical and socioeconomic environments, it is possible to highlight a number of overarching and cross-cutting issues.

Ecosystem services

Ecosystem services are defined as benefits that people obtain from the environment. Nature offers these as resources to supports human life and quality of life on earth. Throughout the ISOER, several indicators were used to illustrate

the state of Namibia's use of its natural resources and ecosystem services. It is evident that Namibia's ecosystem services are under pressure, although there have been moves to reduce this impact by creating community forests and establishing conservancies in many regions of the country. Considering land and soil conditions as an indicator of supporting ecosystem services, the human impacts on these natural resources is leading to increased land degradation. As Namibia is still building its environmental indicator monitoring database, it will be prudent to align this database with the emerging research body on ecosystem services reporting. This should be supported by a comprehensive analysis of ecosystem goods and services.

Water fragility

Water insecurity and stress have been discussed at length throughout the ISOER. Over 31 water-related indicators all point to Namibia being at severe water risk. Responses to some of these water-related challenges were discussed in each of the respective chapters and the most salient indicators were included in the action dashboards of each chapter. However, a coordinated response to water security and water risk is urgently needed and all water-related programmes, projects and initiatives should be fast-tracked as a priority.

Climate change mitigation & adaptation

Namibia's second NDC (GRN, 2015) according to Article 4 of the Paris Agreement reflects its continued adherence to the goals of the Paris Agreement to keep the rise in global average temperature well below 2oC above pre-industrial levels.

In 2015 Namibia submitted its NDC with a pledge to reduce its national emissions of GHGs by 89% by 2030. In terms of the fourth communication, Namibia has raised its mitigation ambition from 89% in 2015 to 91% (GRN, 2021).

Namibia commits to reduce its GHG emissions conditionally by 14% (under limited domestic and international support) and towards 77% (with substantial international support) in 2030 compared to the BAU levels (21.996 Mt CO^2 equivalent (e)).

The mitigation contribution from Namibia is in the form of a reduction in GHG emissions compared to a BAU baseline over the period 2015-2030. The updated NDC presents an increase in the ambition of Namibia's commitment to achieving the objective of the Paris Agreement and in line with a path to net-zero emissions by 2050.

Namibia faces constraints and barriers to implementing the 53 specific mitigation measures indicated in its NDC. These include the vast geographic distances, which impact the country's ability to make material changes to its transport sector outside of urban areas – and the feasibility of converting waste to energy.

Namibia developed a National Climate Change Strategy and Action Plan (NCCSAP) 2013-2020 and two themes under mitigation namely: sustainable energy and prioritised low carbon development and transport. Namibia has placed more focus on adaptation that is currently implemented under four key critical themes, that is, food security and sustainable biological resources; sustainable water resources base; human health and wellbeing; and infrastructure development. Namibia has placed more focus on adaptation that is currently implemented under four key critical themes, that is, food security and sustainable biological resources; sustainable water resources base; human health and wellbeing; and infrastructure development.

Awareness raising efforts are a key feature of reaching the goals of Namibia's climate change policy. As such, cross-sectoral and multi-stakeholder initiatives, such as this collaboration, are significant to support education and public awareness for adapting to and mitigating the impacts of climate change and continuing to oversee the implementation of these activities in line with the Harambee Prosperity Plan.

Poverty & environmental health

The impact of inadequate pollution and waste management infrastructure and practices have by and large been disproportionately borne by the poor. There are still major challenges to be faced overcoming past patterns to ensure protection of communities from pollution and exposure to harmful chemicals and pesticides. Insufficient refuse removal services in poverty-stricken areas and rural areas results in accumulation of waste, as well as other environmental health risks. Environmental health problems in poor communities are aggravated by poisonings from pesticides used to control pest infestations due to inadequate waste removal. Environmental responses in the form of policies and regulations are required to ensure the right of the public to healthy and clean environment.

Protecting & managing the natural resource base

Namibia's resources are sensitive to climatic change and human activity. This sensitivity means that these resources are vulnerable to extreme weather events such as droughts and flooding as well as over-exploitation of land, fisheries and biodiversity. Namibia has taken this into account and has committed to managing this through vulnerability assessments and putting disaster risk management systems in place. However, a major challenge that exists within the country is the need to build the capacity within these systems. Greater awareness and education regarding the challenges to protecting and managing Namibia's natural resource base are needed. It is also of utmost importance to establish a nationally cohesive and integrated environmental system of data collection and reporting. This system should be informed by a core set of indicators, many being featured in the 2021 ISOER.

Sustainable consumption & production

There are a number of cross-cutting issues and interlinkages that have relevance to sustainable consumption patterns (SCP). The linkages between resource use and patterns of production as well as societal attitudes and consumption should be noted, while also considering the cumulative effects of unsustainable resource use. Achieving economic growth and sustainable development requires that Namibia urgently reduces its ecological footprint by changing the way goods and resources are produced and consumed. The efficient management of shared natural resources and disposal of toxic waste and pollutants are important to achieving SCP targets for 2030. Stronger governance, information dissemination and financial incentives will positively influence initiatives aimed at SCP implementation.

Roadmap for effecting change

The ISOER highlights areas that require varying forms of management action. Those areas that require urgent and immediate management action should be priorities by all decision-makers in the public and private sector. Public-private sector cooperation will be essential to effectively address the country's pressing challenges. Box 1 provides an overview of immediate, urgent and other management actions required based on the findings presented in this report. Although the Covid 19 pandemic did not impede the collection of data for this ISOER, the collection of indicator data for future reports may be affected and should mitigated. are significant to support education and public awareness for adapting to and mitigating the impacts of climate change and continuing to oversee the implementation of these activities in line with the Harambee Prosperity Plan.

Urgent short term management actions > 5 years	Important medium term management actions 5 - 10 years	CHAPTER	Important long term management actions < 10 years	Important ongoing management actions ∞
• Implement IWRM plan and develop desalination plants. • Continue to apply measures set out in INDCs.	• Continue to develop strategies, plans and programmes in collaboration with UNCBD and UNCCD. • Undertake a grassland assessment to better manage and limit the extent of bush encroachment.	3	• Monitor upwelling changes over time closely and determine impact on marine life.	
• Expand renewable energy sector to reduce reliance on energy imports and fossil fuels. • Continue investments into water supply infrastructure. • Utilize integrated land use planning mechanism to support the promotion of sustainable livestock farming.	• Expand and protect gazetted marine protection areas. • Investigate further means to reduce the reliance on imported energy supply in order to expand the renewable energy production.	4	• Promote low-impact nature-based tourism that supports national programmes and plans for the protection of the environment.	
• Develop an integrated solid waste management database. • Develop and implement strategies to reduce industrial air emissions and land degradation. • Establish a widespread culture of waste minimization and expand recycling systems.	• Prioritise registration monitoring and management of WWTPs.	5	• Improve the implementation of the MAWLR's permitting system for WWTPs to improve compliance.	
• Maintain and monitor disaster management infrastructure country-wide, including integrated database. • Indentify and implement climate-resistant crop farming practices and promote sustainable land management methods. • Regularly update and continue to implement drought response plan.	• Continuously adapt National Disaster Risk Management Policy to increase the country's carrying capacity for potential natural disasters.	6	• Develop a priority-based response to framework including high-level and multi-pronged policies to aid in improving early response approaches.	
• Strengthen WASH infrastructure and services to address weaknesses. • Implementation of national strategies to expand sanitation infrastructure to reach goal of improved sanitation for all by 2030. • Develop and implement programme to lower cost of land subsidize essential services, lower building standards and allow incremental building of houses. • Prepare a work programme to develop national urbanisation strategy for Namibia.	• Improve sanitation infrastructure to reduce risk of Hepatitis E outbreaks. • Improve on advances an investments into malaria management thorugh collaboration with international investment partners.	7	• Continuously invest in the country's health system to improve maternal and infant health	• UNFCC reporting *Continue reporting and follow up with actionable implementation plans related to reported data*
• Proactively identify and source funding for the protection of biodiversity. • Continue strengthening and maintaining governance structures and processes • Develop and implement strategies to reduce air emissions and reduce reliance on fossil-fuel based energy.	• Strengthen regulators capacity to enforce EMA and related regulations. • Strengthen Namibia's implementation of good governance practices that relate to transparency and accountability.	8	• Strengthen the implementation of active MEAs to ensure that cross border environmental protection priorities are addressed.	• Areas under environmental protection: *Improve implementation and enforcement of environmental protection regulations* • Improve environmental data management

Box 1 *Roadmap for effecting change in Namibia's natural environment*

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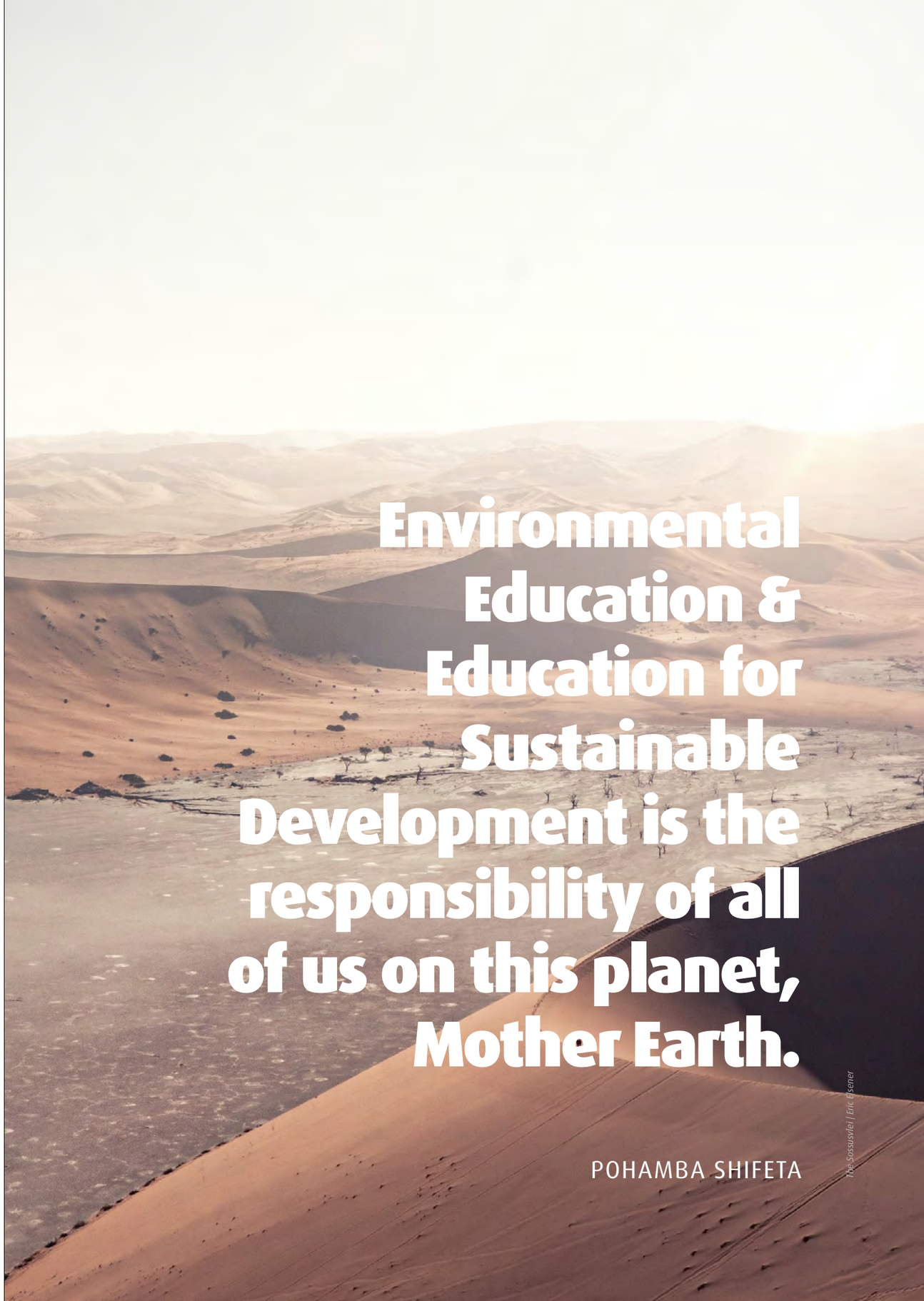


CHAPTER 1

Introduction

The development of the 2021 Integrated State of the Environment Report (ISOER) for Namibia forms part of the implementation of the Biodiversity Management and Climate Change II (BMCC II) and the Climate Change and Inclusive Use of Natural Resources (CCIU) projects, implemented by the Ministry of Environment, Forestry and Tourism (MEFT), in partnership with GIZ, and commissioned and funded by the German Federal Ministry for Economic Cooperation and Development (BMZ).

Himba mother and child | Julia Sadowska

1.1

Background

Namibia's first ISOER was published in 2004 and provided a solid basis from which national reporting on environmental matters could develop (Government of the Republic of Namibia (GRN), 2004). In 2016, the MEFT commissioned an independent critical review of the first ISOER (CSIR, 2016). The purpose of this review was to inform the development of the second ISOER in alignment with available data and international good practice standards. This report draws significantly from the basis provided by both the first ISOER as well as the independent critical analysis.

The international environmental community has seen an exponential growth in the availability of environmental data, accelerated by increasing sophistication of online databases and search engines. Within this context, MEFT commissioned the second Namibian ISOER to determine the current state of natural resources and human systems. While international and national data do not always align, a clearer picture of Namibia's current state of the environment as seen in available data as well as in stakeholder feedback is emerging. A significant amount of time has lapsed since the publication of the first ISOER in 2004; the environmental governance framework has been expanded and landmark projects have been implemented by the MEFT and other stakeholders. The presentation of the 2021 ISOER provides an opportunity for the MEFT to highlight these achievements, identify current challenges and environmental pressures, and share potential new opportunities for promoting sustainable development.

In preparing a report that aligns with international good practice in environmental reporting, integrates information across a wide spectrum of departments and interest groups and, at the same time, provides a clear path of action, the MEFT elected to use the Framework for the Development of Environment Statistics (FDES). The FDES was published by the Department of Economic and Social Affairs of the United Nations (UN) Secretariat (United Nations, 2014). This instrument provides environmental reporting guidelines following a tiered approach, from environmental components and sub-components to individual indicators. It allows for country-specific interpretations and limitations and aligns well with other environmental reporting tools such as the Driver, Pressures, State, Impact and Response (DPSIR) model (Smeets and Wetterings, 1999) and Sustainable Development Goals (SDGs) (United Nations, 2016).

The 2021 ISOER was prepared through a participatory process involving a diverse group of national stakeholders under the guidance of the MEFT. A consultative approach was used to identify and access the most up-to-date data available in Namibia as well as to feature key emerging developmental issues and environmental pressures in the country. The publication of the ISOER signals Namibia's aspiration to make available information pertaining to the environment to decision-makers as well as stakeholders in the public and private sector. The succinct and user-friendly format of the 2021 ISOER enables greater transparency and access by Namibian citizens.

The ISOER is supported by the Sustainable Development Advisory Council of Namibia (SDAC), whose mandate includes promoting cooperation and coordination on environmental issues relating to sustainable development in Namibia. As a signatory to the UN SDGs, Namibia was part of the 2018 voluntary high-level political forum on sustainable development hosted by the UN. The government committed Namibia to integrating the SDGs into its fifth National Development Plan (NDP5), which is informed by the long-term national developmental framework for Namibia, Vision 2030. This report highlights the country's performance in terms of the SDGs and indicates how the current state of the environment is advancing or constraining their achievement (refer to Appendix A).

Namibia's 2004 ISOER provided environmental trends for over thirty indicators across key areas of concern considering the cross-cutting effect of macro-economic, socio-economic, political and cultural factors. The 2021 ISOER provides an update on Namibia's state of the environment since 2004, based on available data and trends, reporting on over 171 indicators, as indicated in Figure 1-1[1]. It interprets selected indicators from a 'call to action' point of view, noting areas that require attention by country stakeholders. It is intended that this report will act as a catalyst for positive change that aids in strengthening Namibia's stewardship of its natural environment.

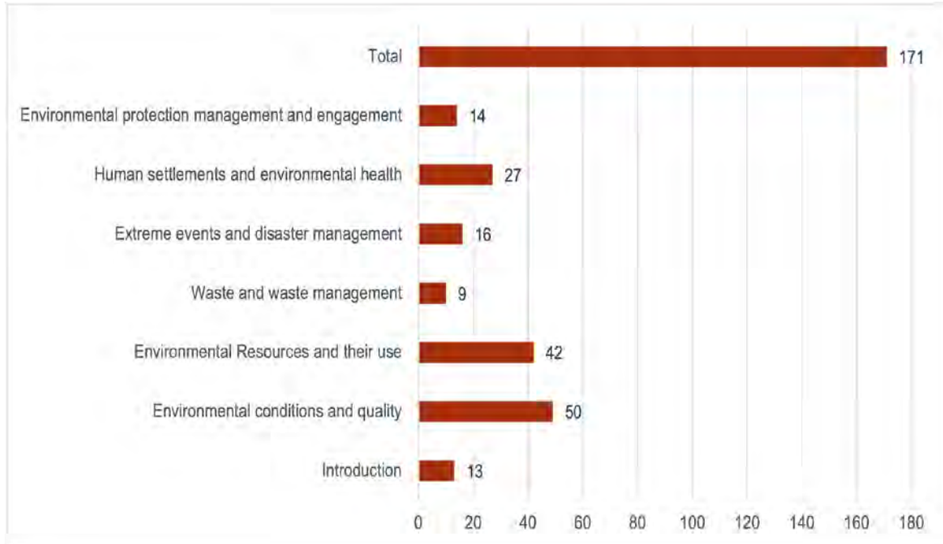


Figure 1-1 *Number of indicators used per ISOER chapter*

[1] Although the Covid 19 pandemic did not impede the collection of data for this ISOER, the collection of indicator data for future reports may be affected and should mitigated.

It is widely acknowledged that environmental sustainability is an essential ingredient in maintaining or improving human development standards. Namibia currently ranks 104th out of 180 countries globally in terms of environmental sustainability, according to the Environmental Performance Index (EPI) published by Yale University (Wendling et al., 2020). On the same index, Namibia is placed in sixth place out of 46 African countries. The EPI reiterates the importance of allocating resources to environmental sustainability by illustrating the relationship between country wealth and environmental sustainability. This implies that, in order to sustainably use natural resources and contribute to human development, Namibia should chart a pathway to improving the protection and management of its natural resources through allocating resources where they are most sorely needed (Wendling et al., 2020). The 2021 ISOER affords decision-makers in all walks of life guidance on what actions could be taken to promote positive trends or address negative movements affecting Namibia's environmental sustainability.

Lighthouse at Swakopmund | Dan Ginwis

1.2

International benchmarking standards

The publication of ISOERs have evolved from being backward-looking and exclusively used as monitoring tools. In recent years, they have been used as authoritative decision-making tools to inform policy, budget allocation and prioritize actions in line with countries' National Development Plans. In terms of conceptual frameworks and content, most international benchmarking tools concur that countries should select relevant environmental issues from a collection of possibilities – as extensively described in international framework tools.

The FDES (United Nations Statistics Division, 2013) was selected to structure the second ISOER report while providing alignment with the SDGs and the commonly used DPSIR framework (provided in Appendix A and B respectively). The following selection criteria were used to determine which of the components, sub-components and indicators recommended by the FDES were incorporated in the second ISOER:

- **Relevance** Certain sub-components of the FDES were not relevant for Namibia, for example tropical forests;
- **Availability of data** Data-mining techniques were used to determine the availability of data with the support of the Compendium of Environmental Statistics (Ministry of Environment, Forestry and Tourism, 2018);
- **Established indicators** Indicators used in the 2004 ISOER were considered against the recommendations of the critical first ISOER analysis report conducted by the Centre for Scientific Research (CSIR) (CSIR, 2016);
- **Current global thematic topic** Certain topics are currently of global importance, such as public health and climate change, and hence should be featured in the report;
- **Current national thematic topic** Certain topics are relevant to only a specific geographic area in Namibia rather than the entire country. A selection of these topics is presented as 'Local Perspectives'; and
- **Relative contribution of the topic to Namibia's Gross Domestic Product (GDP)** Certain topics represent an intricate relationship between the state of the environment and economic sustainability. These were considered relevant for environmental decision-making and included in this report.

In addition to these selection criteria, an analysis was conducted of recently published ISOERs of countries that featured thematic topics and issues that were of relevance to Namibia. The following ISOERs were included in this analysis:

- Tanzania (United Republic of Tanzania, 2019);
- South Africa (Department of Environmental Affairs, 2016); and
- Abu Dhabi (Environment Agency Abu Dhabi, 2017).

Ecosystem services, which represent the integration between human well-being and the benefits or services that nature provides, are integrated into the FDES and addressed in Chapter 8 – providing an integrative overview of Namibia's state of the environment. The FDES incorporates the following main types of ecosystem services that provide for human well-being:

- Provisioning services provide goods and services to people such as food and raw materials;
- Regulating services keep the planet habitable to human beings;
- Supporting services provide a continual cycle of renewal of energy and materials to support living beings; and
- Cultural services provide people with beauty, culturally significant living organisms, natural monuments and wildlife.

Alignment with international frameworks, as well as benchmarking with other countries, strengthened the scientific integrity of the 2021 ISOER and contributed to a comprehensive analysis of Namibia's state of the environment.

New water point in Kunene | Klemens Riha

1.3

Objectives of the report

The second Namibian ISOER has the following objectives:

- Communicate credible, timely and accessible information of the current condition of the environment to decision-makers, as well as the general public;
- Illustrate major trends and pressures and indicate a pathway to intervention and improvement;
- Strengthen the science-policy nexus to guide local, regional and national environmental decision-making;
- Increase the availability and visibility of key datasets for developing and monitoring the implementation of sustainable development strategies, programmes and plans;
- Develop capacity to understand and take action on challenges pertaining to environmental sustainability in a variety of stakeholder groups;
- Highlight environmental performance areas in which Namibia is excelling, and probe areas in which the country can perform better; and
- Facilitate partnerships between institutions and organizations with common goals.

1.4

Methodical approach

In developing the 2021 ISOER, several reporting frameworks were used to ensure that data integrity and good practice align with stakeholder needs. The FDES informed the main themes of the report and the DPSIR and SDGs provided the indicator frameworks. Figure 1-2 indicates how a focus on potential stakeholder expectations, needs and use of the ISOER informed the reporting approach.

The 2021 ISOER was developed with the intention of sharing the results with a wide range of stakeholder groups. These include government ministries, parastatal agencies, non-governmental organizations, academia, the general public, international research institutions and donors. In order to ensure that each stakeholder group's expectations are met, a stakeholder information matrix was developed as presented in Figure 1-3.

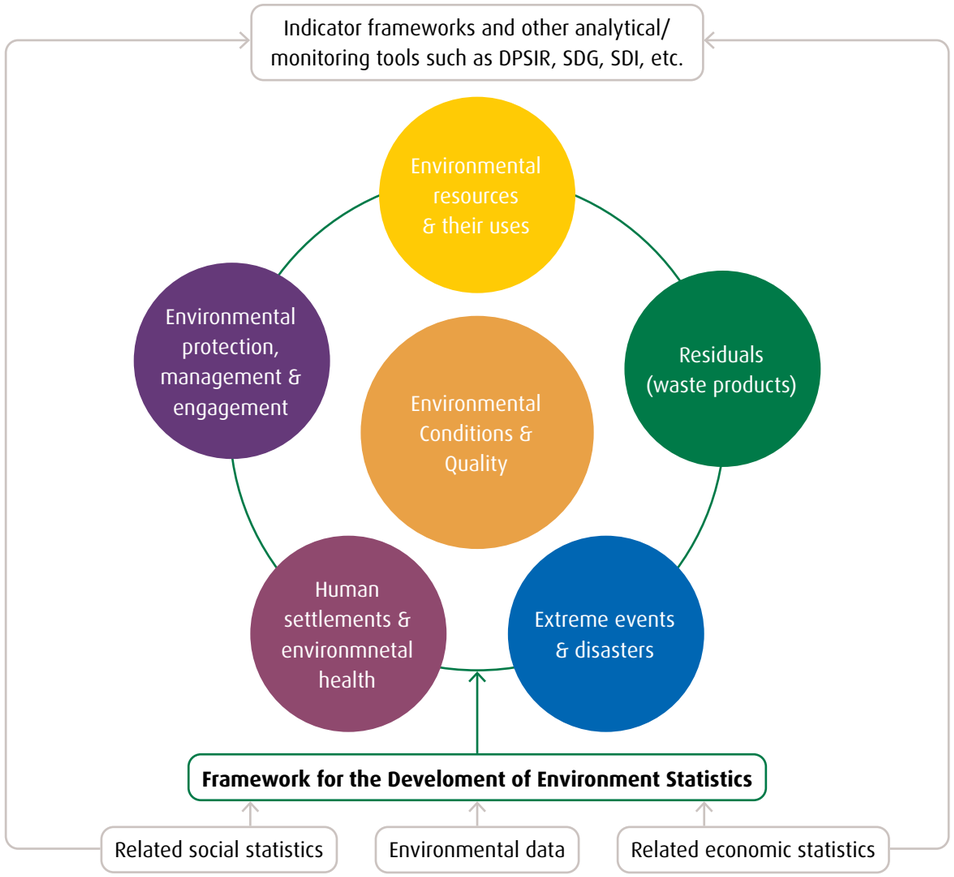


Figure 1-2 *Number of indicators used per ISOER chapter*

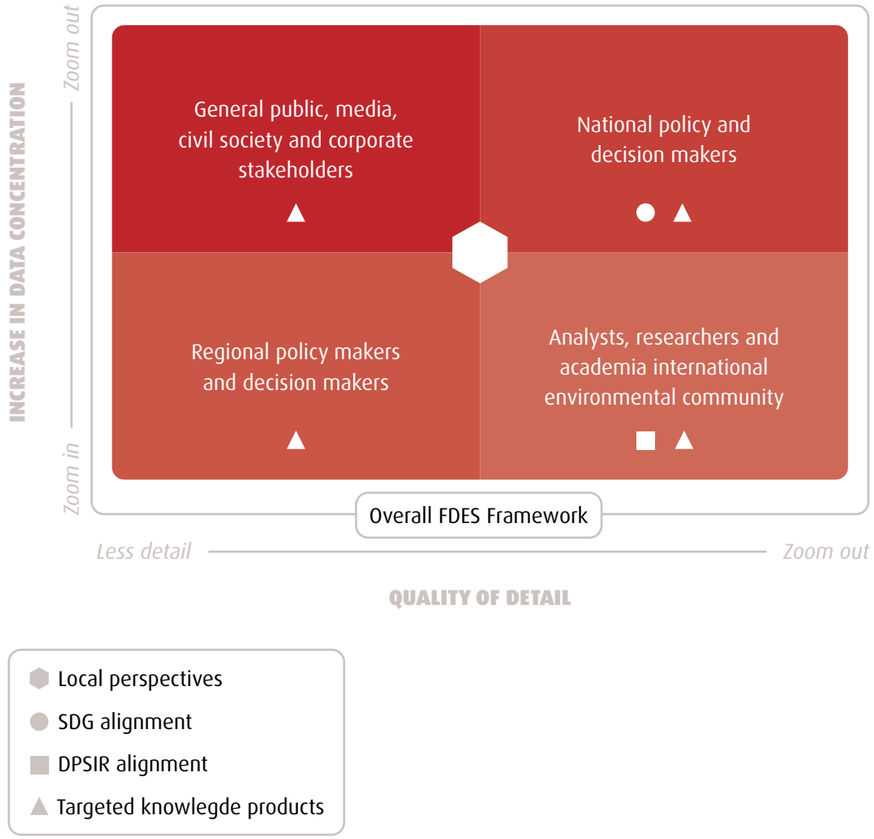


Figure 1-3 *Methodological approach to stakeholder align to data presentation*

1.5

Contextual background of the ISOER

1.5.1

Regional context

Namibia is located on the west coast of Southern Africa, straddling the Tropic of Capricorn. The country comprises 14 administratively delineated regions and shares common borders with Angola, Zambia, Zimbabwe, Botswana and South Africa (Figure 1-4). Namibia has a land surface area of 824,268 km² and a coastline of 1,572 km at the Atlantic Ocean to its west, comprising of territorial sea (12 nautical miles from the Namibian coastline) and exclusive economic zone (200 nautical miles from the coastline) as defined by the United Nations Convention on the Law of the Sea (1982) of approximately 513,015 km² (Mendelsohn et.al, 2002; Goudie and Viles, 2015). Namibia is an active member state of the Southern African Development Community (SADC), a regional inter-governmental organization comprising 16 countries.

Figure 1-4 *Namibia's position within the SADC region*

1.5.2

Biophysical context

Namibia's biophysical context, conditions and quality are discussed in detail in Chapter 2 of this report. This section aims to provide a high-level overview of the biophysical context within which Namibia is situated. Natural borders between Namibia and its neighbouring countries are formed by seven perennial rivers; two are in the north (Kunene and Okavango), four are in the northeast (Zambezi, Kwando, Linyanti and Chobe) and one is in the south (Orange River). Namibia is commonly classified into the following five geographic regions as indicated by Figure 1-5: the Namib Desert in the west; the Great Escarpment; the Central Plateau; the Kalahari Desert in the east; and the Okavango-Zambezi Region.

The main geographical areas in Namibia include two of the largest and most important of the world's great deserts. The Kalahari Desert in the east is dominated by stabilized dunes and the Namib Desert in the west comprises a wide range of landscape types. These deserts provide a wide range of unique ecosystems; the current status of the biodiversity in these ecosystems is discussed in Chapter 2. The Central Plateau, with its Great Escarpment, lies inland of the Namib Desert plains and is the third great landscape unit in Namibia (Mendelsohn et.,al 2002; Goudie and Viles, 2015). The Central Plateau runs the length of the country and includes the highest point in Namibia at Konigstein – which is located at an elevation of 2,606 metres above sea level.

Namibia's abundant and unique physical and biological resources, make it a desirable international eco-tourism travel destination. However, what this section shows is that the country's natural resources are finite, and that many of its ecosystems are fragile and prone to degradation and need to be carefully managed.

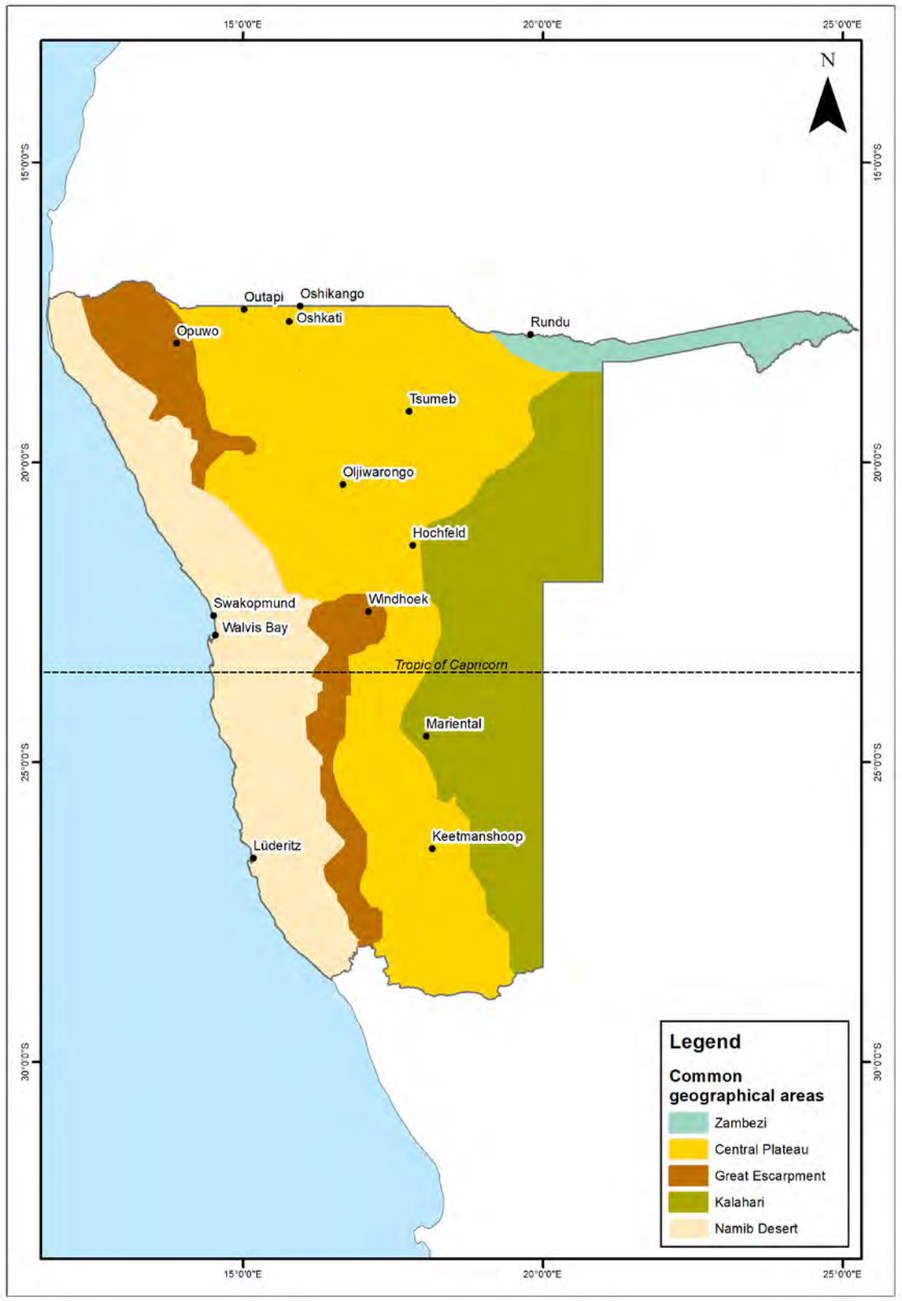


Figure 1-5 *Common geographical areas in Namibia (Namibia Nature Foundation, 2021 forthcoming)*

1.5.3

Socio-political context

Namibia has three major categories of land tenure: commercial farmland with freehold tenure (approximately 44% of the country situated predominantly in the south and centre of Namibia), communal areas which are situated mainly in contiguous blocks in the northern Namibia (approximately 41% of the country) and state land, including conservation areas (approximately 15% of the country) (Mendelsohn et al., 2002; Goudie and Viles, 2015). The Atlantic Ocean with its cold, nutrient-rich Benguela Current has a significant influence on Namibia's climate, vegetation and marine life. The richness and diversity of the country's biodiversity is discussed in Chapter 2 and the country's natural resource utilisation is explored in Chapter 3.

Namibia's unique position in Africa, climatic conditions and geographical areas lead to the country being classified as having extreme water risk by the World Resources Institute (WRI) (WRI, 2020). This classification is based on a risk analysis for physical water risks related to quantity and quality as well as water governance. This risk is exacerbated by the impacts of climate change on the region. The impacts of and responses to Namibia's water scarcity is highlighted throughout this report. Water is an enabler for growth and development, and as such permeates every aspect of environmental management and reporting

Namibia gained independence on 21 March 1990 after over a century of colonization and some 40 years of Apartheid. Namibia has a population of approximately 2.5 million (NSA, 2019; United Nations, 2019), and is one of the least densely populated countries in the world, with a population density count of 3/km². Namibia's population growth rate is growing steadily at 2% per year, a trend which is expected to continue (World Population Review, 2020). Measured between 2006 and 2013, Namibia is achieving a 4% annual improvement on the global multi-dimensional poverty index (MPI). This index measures the status of poverty across the world by aggregating data from three dimensions related to the impact of poverty: health, education and standard of living (United Nations Development Programme and Oxford Poverty and Human Development Initiative, 2020).

Inspite of the developmental gains and adoption of pro-poor policies, Namibia remains one of the most unequal countries in the world. Figure 1-6 indicates the relative decline in Namibia's Gini Coefficient from 2003 to 2018. National aggregated indicators show that even though Namibia is showing a downward trend on the global measurement for inequality (World Bank, 2020a) as indicated in Figure 1-6, the percentage of the population vulnerable to multi-dimensional poverty is currently at 20,3% (United Nations Development Programme and Oxford Poverty and Human Development Initiative, 2020). Namibia has achieved notable progress in reducing poverty, halving the proportion of Namibians living below the national poverty line to 28.7% in 2009/10. In 2015/16, the country further reduced that number to 17.4% (World Bank, 2020b).

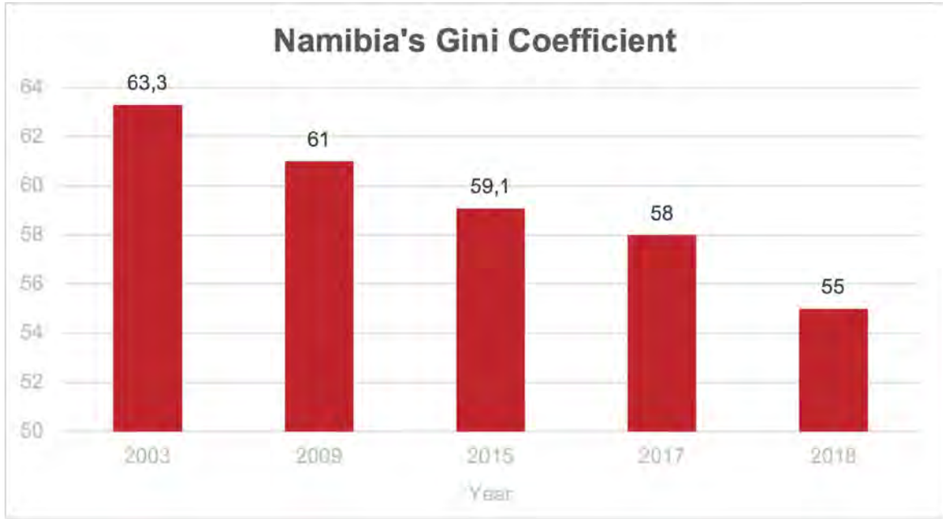


Figure 1-6 *Namibia's Gini Coefficient (World Bank 2020a)*

Executive power is exercised by the government, with the President acting as both chief of state and head of the executive power. The president is elected in a national election every five years. Legislative power is vested in the Parliament, with members being elected every five years on a proportional representation system basis. The National Council is the upper chamber of Parliament and is formed of 26 representatives from all thirteen regions of Namibia – two elected members per region.

Members of the National Council are elected indirectly within Regional Councils, whose elections are based on a first-past-the-post system after every six years (Nordea, 2020).

Namibia also has a network of traditional leadership with 51 recognized traditional authorities, each with their respective leadership councils. These authorities are widely distributed over the whole country and are entrusted with the allocation of communal land and the formulation of customary laws (Vladimir, 2019).

1.5.4

Economic context

Since independence, the Namibian government has pursued free-market principles, promoting commercial development and job creation to bring previously disadvantaged citizens into the economic mainstream. Due to its natural mineral riches, the World Bank has classified Namibia as an upper-middle-income country (World Bank, 2020b).

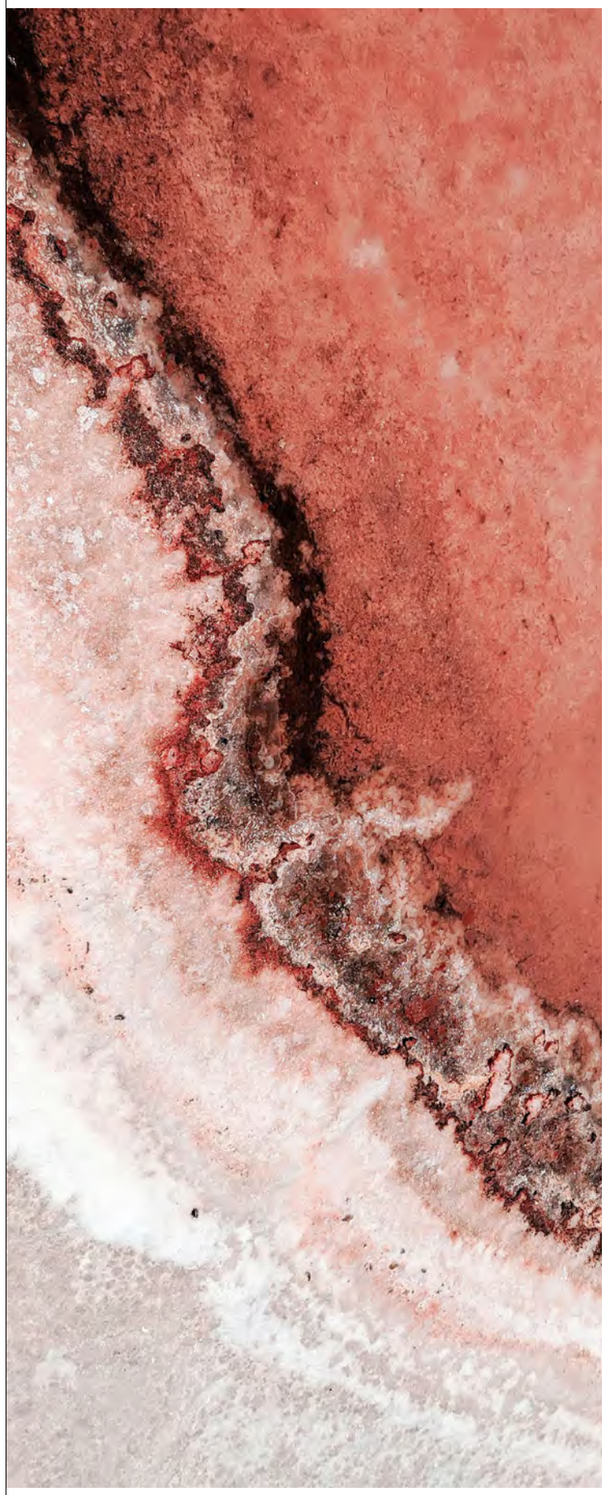
Namibia is one of the world's most important diamond exporters, and the fifth largest uranium producer. Agriculture accounts for around 7.2% of the Namibian economy and employs a fifth of the workforce. The country's arid climate and geographic conditions do not favour farming and hence the crop variety is rather limited. Fishing accounts for almost 25% of all activities in the primary sector (Nordea, 2020).

Political stability and sound economic management have helped anchor poverty reduction. However, this has not yet been translated into job creation, and extreme socio-economic inequalities inherited from the years it was run under an Apartheid system persist, despite generous public spending on social programmes over the past 30 years (World Bank, 2020b).

Having grown at an average 5.3% between 2010 and 2015, Namibia's economy entered a recession in 2016 and has since struggled to grow. Namibia's economy has continued to face significant headwinds, with real output contracting by 1.4% in 2019 (World Bank 2020b). This performance mirrors struggling economic growth in the broader African region, which has recently experienced a slowing of global trade volumes, down from 5.7% in 2017 to 1.1% in 2019. This slowdown affected metals and food, two of Africa's major export commodities (African Union, 2020).

Severe drought conditions experienced in 2019 constrained agricultural output and led to a sharp decline in harvests. The reduced precipitation also affected the broader Namibian economy through lower electricity generation and watersupply, which curtailed industrial production. These developments, along with lower diamond and mineral production caused by reduced global demand and falling prices, have created challenging conditions for national growth (World Bank, 2020b).

The COVID-19 pandemic is set to have an unprecedented impact on economic activity throughout Africa, including in Namibia. The spill-over effect from a global recession, disrupted supply chain and reduced foreign direct investment are expected to lead to an average loss up to 1.5 percentage points on economic growth in Africa in 2020 (African Union, 2020). In Namibia specifically, with its trade largely limited to a few countries and commodities, travel restrictions and lower demand are expected to lead to an economic contraction of 4.8% in 2020. Significant structural and policy reforms will be required for sustainable economic growth (World Bank, 2020b).



Aerial salt shoreline at Walvis Bay | Ali Marwan

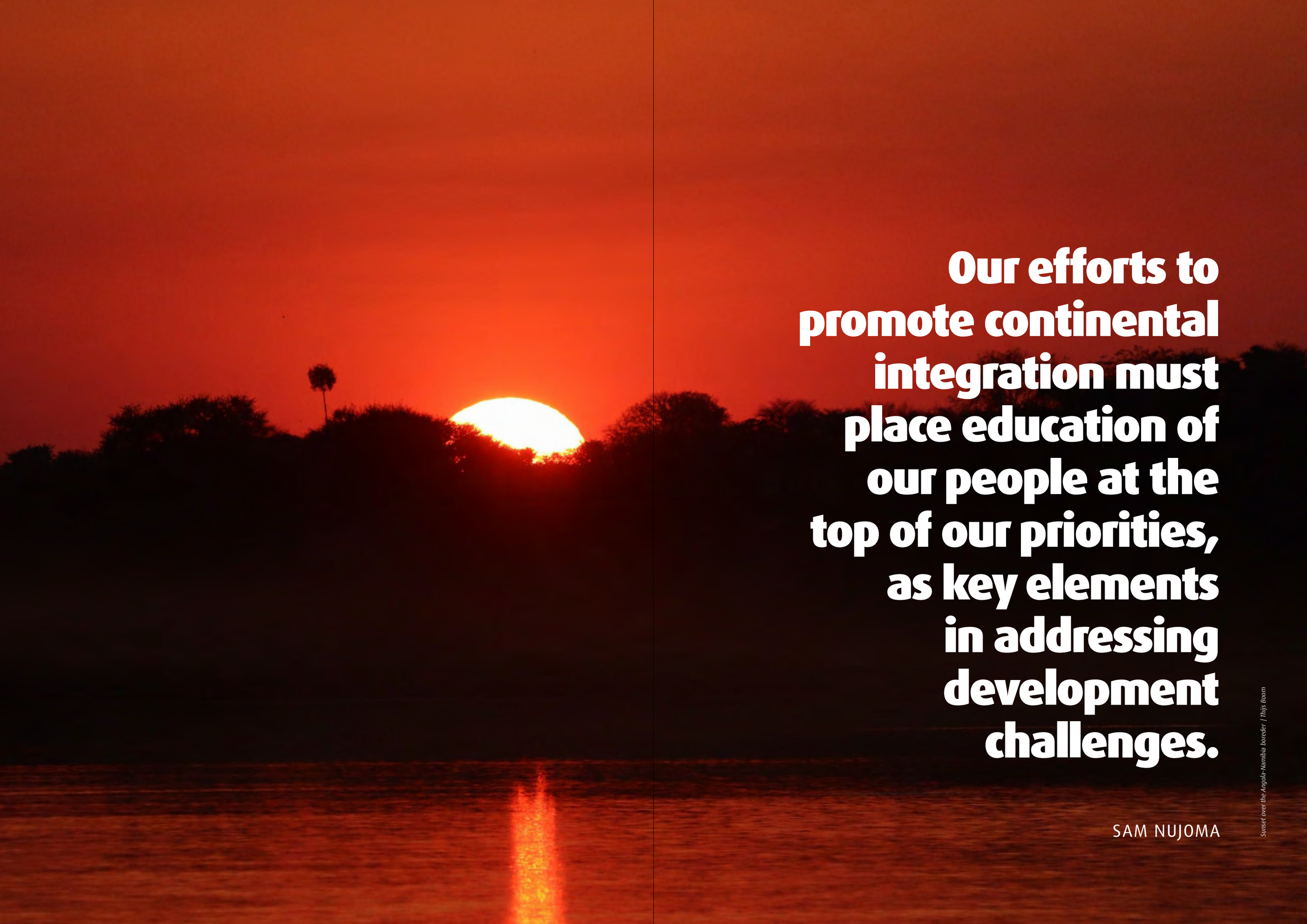
1.6

Structure of the report

Against the backdrop of the international benchmarking and methodological approach to developing the 2021 ISOER, the chapters are structured as follows:

Chapter 1	Introduction;
Chapter 2	Environmental conditions and quality;
Chapter 3	Environmental resources and their use;
Chapter 4	Waste and waste management;
Chapter 5	Extreme events and disasters;
Chapter 6	Human settlements and environmental health;
Chapter 7	Environmental protection, management and engagement;
Chapter 8	Overarching environmental issues; and
Chapter 9	Implications and conclusions.

Where environmental components have relevance to specific localized environmental matters, 'Local Perspective' case studies are presented. In addition, each chapter ends with a collation of indicators which interprets the results presented in the chapter in terms of actions needed to achieve a desired state in the relevant indicators.



Our efforts to promote continental integration must place education of our people at the top of our priorities, as key elements in addressing development challenges.

SAM NUJOMA

Sunset over the Angola-Namibia boreder | Thijs Boom

Dune detail | Birger Strahl

CHAPTER 2

Environmental Conditions & Quality

Environmental conditions and quality are central to the FDES. It provides indicators about the physical, biological and chemical characteristics of the environment and their changes over time. These fundamental conditions are mutually dependent and determine the type, extent, conditions and health of ecosystems. Changes in environmental conditions and quality are caused by natural processes or human activity and might be gradual or rapid. Environmental conditions and quality are divided into physical conditions as well as landcover, ecosystems and biodiversity.

2.1

Introduction

Environmental conditions and quality are determined by an interplay of factors through years of evolutionary change and human influence. The Namibian landscape covers five geographical areas:

- The Central Plateau, which comprises of stable physical conditions;
- The Namib and Kalahari deserts, characterized by extreme, dry climatic conditions; and
- The Escarpment and the Bushveld, which are semi-arid.

Each area is characterized by its own climatic conditions, soil types, regional hydrology, photovoltaic energy potential, and geological and geographical variation. The interior desert environments are characterized by extended periods of drought and extreme floods; the Kalahari Desert extends over three southern African countries: South Africa, Namibia and Botswana (Christelle, 2011). This chapter presents the status quo of environmental conditions in Namibia and highlights impacts and responses.

2.2

Physical conditions - status quo

Status quo refers to the current state of specific environmental conditions relating to physical conditions such as atmosphere, climate and weather, hydrographical characteristics, geological information and soil characteristics. It is informed by how indicators related to these conditions are trending over time. The following 33 indicators are used in this section to report on the current state of the physical environment:

- Average monthly temperature;
- Average monthly rainfall;
- Mean temperature change per year;
- Temp increase in arid areas;
- Annual rainfall variability;
- Annual evaporation in milimeter;
- Evaporation rate;
- Projected change in monthly temperature (2020-2039);
- Projected change in monthly temperature (2040-2059);
- Projected change in monthly precipitation (2020-2039);
- Projected change in monthly precipitation (2040-2059);
- Annual upwelling cycles;
- Trends in seasonal upwelling indices;
- Surface water in Namibia;
- Hydrological cycle;
- Aquifer types, distribution and overall production;
- Total and potential water sources;
- Mean annual flow from perennial rivers on Namibia's border;

- Mean annual flow of ephemeral rivers in interior Namibia;
- Namibian dam levels;
- Number of water level monitoring stations;
- Number of water quality measurement stations;
- Groundwater potential;
- Soil suitable for agriculture;
- Percentage of soil under agriculture;
- Trends in number of rural people living on degraded land;
- Total annual cost of land degradation ;
- Cost of land degradation as a percentage of GDP;
- Cost of land degradation action;
- Cost of land degradation inaction;
- Returns on investment in land degradation;
- Physical water risks; and
- Projected increase in water demand.

2.2.1

Atmosphere, climate & weather

Atmospheric conditions refer to the characteristics of the gaseous layer that surrounds the earth. Long-term patterns in these conditions are referred to as climate and short-term changes are called weather. Atmospheric conditions used to describe climate and weather include temperature, humidity, atmospheric pressure, wind, precipitation and ultraviolet light (Gabrielli, 2019).

Atmospheric conditions

The Intertropical Convergence Zone (ITCZ) brings in moist air from the north, the Subtropical High-Pressure Zone (SHPZ) blows dry cold air against the warm moist air southwards and the Temperate Zone (TZ). The relative position of these climate systems determine how much rainfall the country gets. Namibia is dominated by the SHPZ, resulting in dry windy conditions associated with air from high pressure zones causing warm and dry conditions in the lower levels of the country (Kgabi et al., 2016).

Moisture in the Namibian atmosphere is defined by variation in precipitation with relative wind speed, humidity (the amount of water that air can hold under specific temperatures) and leaf wetness (precipitation and dew). The country is characterized by high evaporation levels with limited rainfall compared to most other countries. Namibia's annual evaporation ranges from 2,600 mm in the north east to 3,700 mm in the central Namibian areas. Evaporation is highest from October to December, when dams in Namibia can lose between 20% and 85% of their water due to evaporation in one season (NamWater, 2020).

Climate

Namibia is characterized by arid and semi-arid climatic zones. Dry conditions persist throughout much of the year, due primarily to the proximity of the Atlantic Ocean and the influence of the cool northward flowing Benguela current that results in persistent high pressure off the coastline (Spear et al., 2018). A rainy season occurs during the summer months (November to April) associated with the southward migration of the ITCZ. Average annual total rainfall varies from approximately 600 mm in the north-east to less than 50 mm in southern and coastal regions. Coastal fog occurs and acts as a vital source of

water for the desert fauna and flora, providing up to five times more water than through rainfall in some coastal regions (GRN, 2015).

Temperature conditions are notably extreme in the interior plateau of the country (30-40°C), with coastal conditions described as moderately cool (15-20°C) (Christelle, 2011).

Annual average temperature & precipitation

Namibia's annual average temperature is characteristic of its arid climate and annual rain cycles. Increased precipitation usually occurs between November and March, when temperatures also rise, as indicated in Figure 2-1. During the winter months, precipitation drops to almost zero and temperatures drop by approximately 10°C.

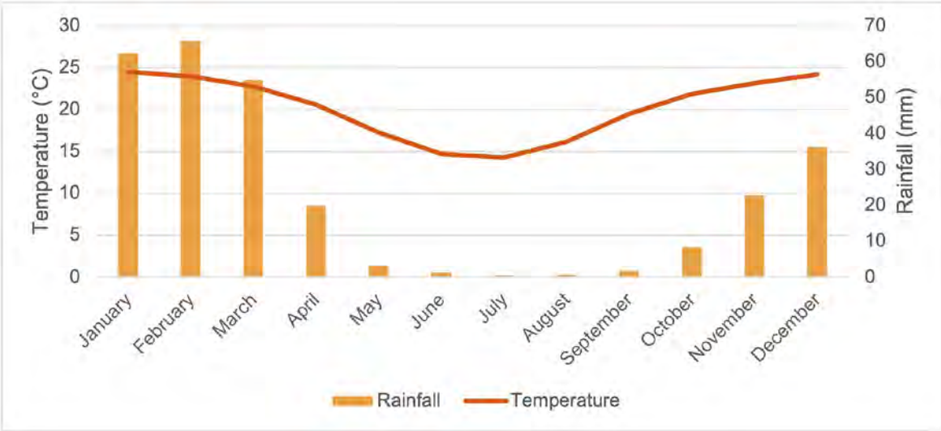


Figure 2-1 *Average monthly temperature and rainfall in Namibia from 1901 to 2016 (World Bank, 2020)*

The aggregated data in Figure 2-1 displays Namibia's annual average temperature and precipitation from 1901 to 2016 and Figure 2-2 illustrates the changes in Namibia's mean average temperature over time since 1960. This gradual rise in mean temperature values is consistent with global rising temperatures. As evident in Figure 2-2, Namibia's mean temperature increased by more than 2°C in the last 60 years. Current climate change projections indicate that Namibia will likely experience an increase in temperatures by 1.2°C in the south-west and by 2.8°C in the north-east by 2065.

This will be accompanied by an overall decrease in annual rainfall (Spear et al., 2018). Evidence points to arid and semi-arid regions in southern Africa being climate change 'hot spots' with accelerated warming expected. Temperature increase per decade (since 1960) in arid and semi-arid regions in southern Africa has been 30% more than in areas with more moderate climates in the same region. This implies that Namibia will reach heat-related stress thresholds with resulting health impacts sooner than its neighbouring countries (Spear et al., 2018).

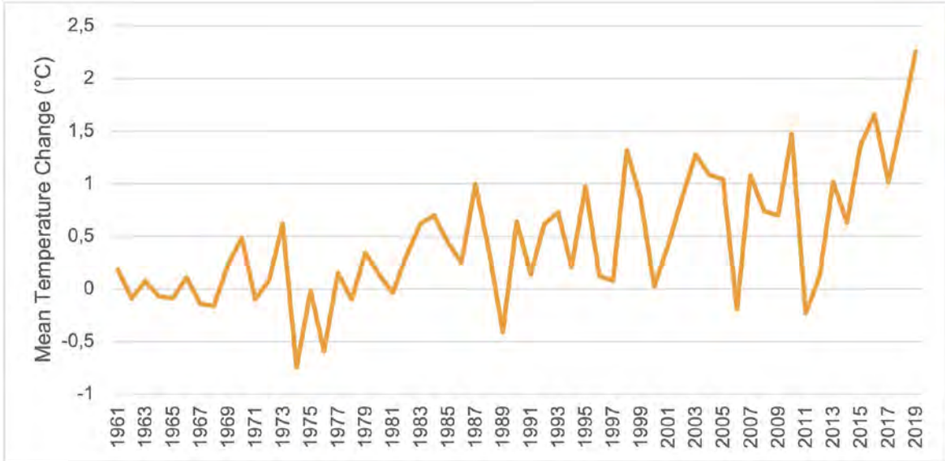


Figure 2-2 *Mean temperature change per year for Namibia (FAO, 2020)*

The Representative Concentration Pathways Six (RCP6) modelling methodology applied to Namibia's mean annual temperature is illustrated in Figure 2-3 and Figure 2-4 for 2020-2039 and 2040-2059 respectively. Using a medium-high emission scenario, median temperature increase projections provide decision-makers with an understanding of what impact greenhouse gas emissions (GHG) might have on Namibia's mean annual temperature. This should be viewed against the commitment of the UNFCCC Paris Agreement in 2015; this aims to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels – and to pursue efforts to limit the temperature increase even further to 1.5°C.

Research is being undertaken to understand the potential impact of temperature increases on the marine environment in the Benguela Current Large Marine Ecosystem (BCLME). Some of the initial findings are featured in Chapter 4. There is a potential for related extreme events and disaster, which are featured in Chapter 5.

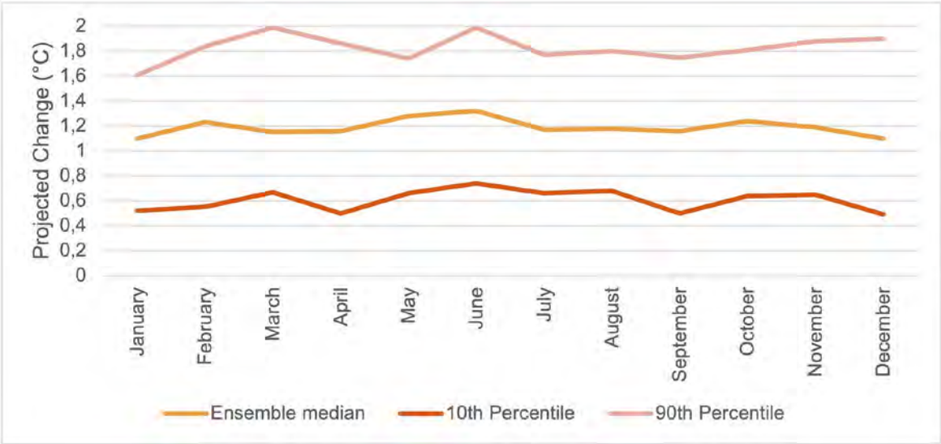


Figure 2-3 *Projected change in monthly temperature for Namibia for 2020 – 2039 (World Bank, 2020)*

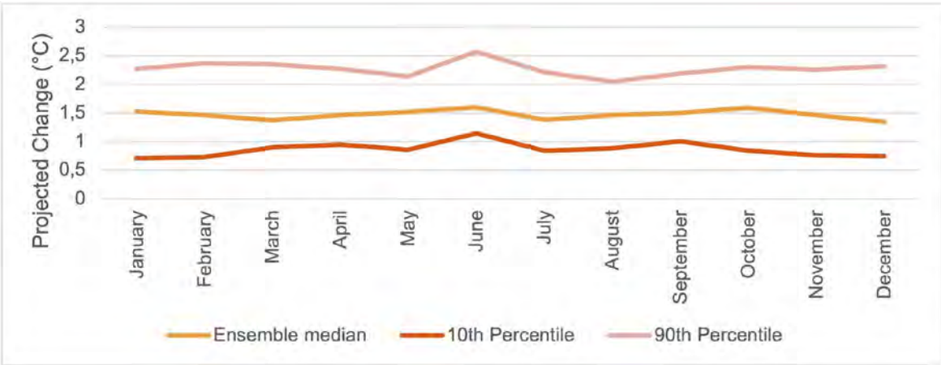


Figure 2-4 *Projected change in monthly temperature for Namibia for 2040 – 2059 (World Bank, 2020)*

In terms of annual rainfall data from 1900 to 2018 over semi-arid regions of Namibia, Botswana and north-west South Africa (New, 2015), there is not a strong trend; instead, the data shows high variability in rainfall data between decades and also between years. Across most climate models, there is consensus that rainfall patterns will change, though not all models indicate a decrease in rainfall. Up to 25% of models indicate increased rainfall, which makes future predictions and preparation difficult. Scientists do, however, agree that rainfall variability will increase and that extreme events (either droughts or floods) will occur with greater frequency (New, 2015). Projections also indicate that some parts of Namibia might be more affected by extreme weather events, lower rainfall and higher temperatures. In this regard, the central and northern regions are more at risk (Spear et al., 2018).

The Representative Concentration Pathways Six (RCP6) modelling methodology applied to Namibia's mean annual precipitation is illustrated in Figure 2-5 and Figure 2-6 for 2020-2039 and 2040-2049 respectively. Using a medium-high emission scenario, this scenario modelling provides decision-makers with an understanding of what impact greenhouse gas (GHG) emissions might have on Namibia's mean annual precipitation. It is evident that rainfall variability projections seem to remain stable for the foreseeable future. Increased evaporation due to increased temperatures might, however, impact the availability of water and lead to increased water stress.

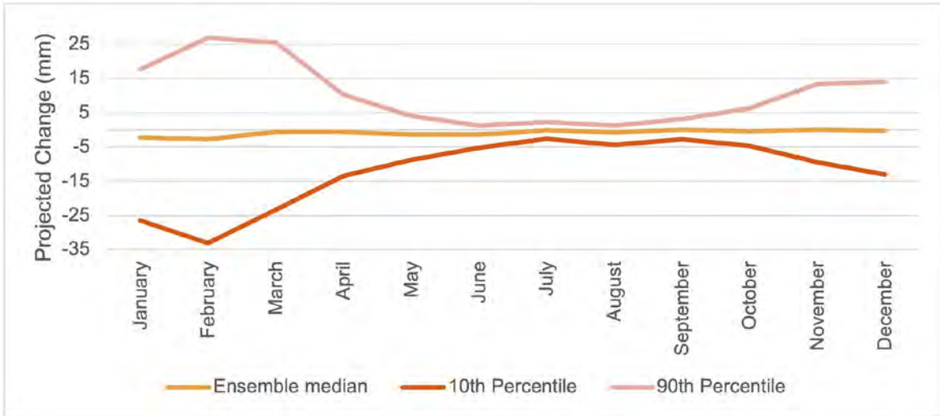


Figure 2-5 *Projected change in monthly precipitation from 2020 to 2039 (World Bank, 2020)*

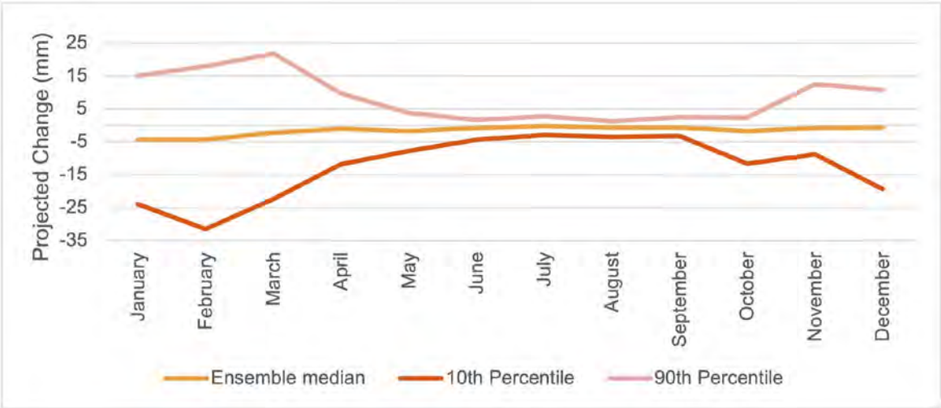


Figure 2-6 *Projected change in monthly precipitation from 2040 to 2059 (World Bank, 2020)*

Changing global temperatures are also affecting the oceans. The spatiotemporal variability of the physical and biological properties of Large Marine Ecosystems (LMEs) are critical indices of the trends and changes in these coastal systems. An assessment of the trends in sea surface temperature (1982–2019) and chlorophyll-a concentrations (1997–2019) for all seven of the African LMEs revealed that, as a whole, almost 99% of all the combined area of African LMEs has warmed (Sweijd and Smit, 2020). The research found rates of sea surface temperature (SST) warming of between 0.11°C/dec (Agulhas LME) and 0.39°C/dec (Mediterranean Sea LME) on average for entire LMEs, and regions with rates of as high as 0.58°C/dec in the Canary Current LME. The study also found that 1.1% of the area of the LMEs had cooling trends in association with upwelling regions found in four of the seven LMEs.

Figure 2-7 depicts the Optimal Interpolation Sea Surface Temperature (OISST) trend between 1981 and 2019 for the African LME. The figure presents spatial distribution of warming and cooling in the respective LMEs , identifying warming 'hotspots' and re-catgorizing the LMEs' sub-regions into 'slow', 'moderate', 'fast' and 'superfast' warming areas – as defined in the Transboundary Waters Assessment Project of the UNECO-IOC and UNEP (2016). Hotspots are observable in southern Africa along the edge of the Agulhas Bank, in the Agulhas Current LME and in the northern Benguela around the Angola-Benguela Frontal Zone in the Bengula Current LME. These changes will need to taken into consideration when assessing ecosystem impacts and effective management responses.

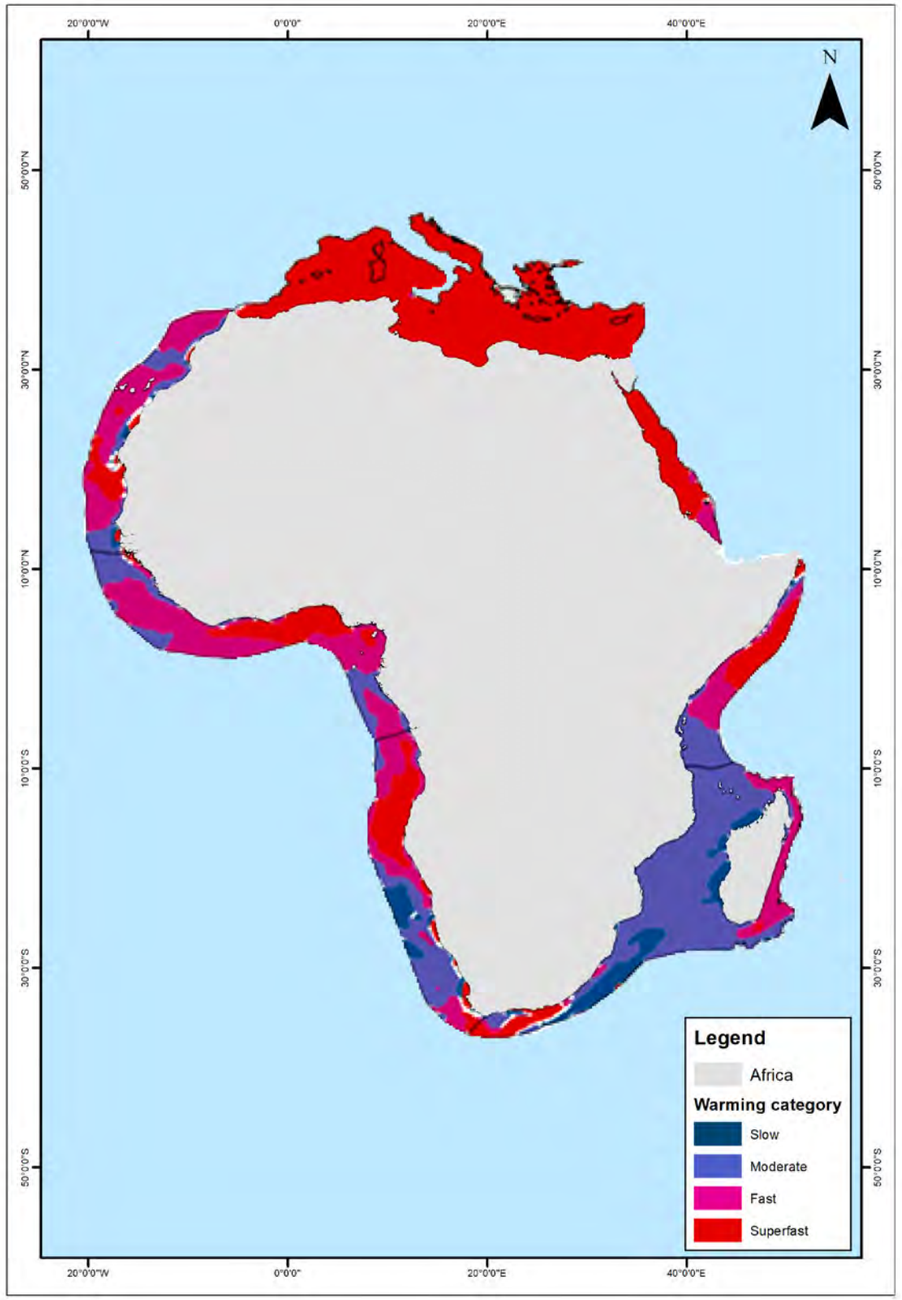


Figure 2-7 *Distribution of categories or warning of within the seven African LMEs (Sweijd and Smit, 2020)*

Seafront in Swakopmund | Grant Durr

Upwelling index

Wind-driven oceanic upwelling results in a complex circulation pattern which helps distribute oxygen and nutrient-rich food in coastal waters. It also assists in diffusing toxins out of the habitats of sea creatures. Coastal upwelling is driven by large-scale atmospheric processes such as temperature, wind and air pressure as well as water depth and movement. Figure 2-8 indicates the annual variability in the North and South Benguela system, with Figure 2-9 showing upwelling trends in the system over a period of 55 years (Black et al., 2017).

Although limited historical climate change impacts on upwelling is evident in this research, Black et al. (2017) note in their analysis of the data presented in Figure 2-8 and Figure 2-9 that the South Benguela current might be more susceptible to the influence of the El-Nīno Southern Oscillation (ENSO). This is causing weaker upwelling cycles and possibly affecting marine life. Seasonal to interannual variability of water mass characteristics and currents on the Namibian shelf has also been identified in research work (Junker et al, 2016).

This hypothesis is supported by recent research indicating that increased coastal sulphur plumes and the resulting impact on marine life is associated with lower-than-usual upwelling indices (Ohde and Dadou, 2018).

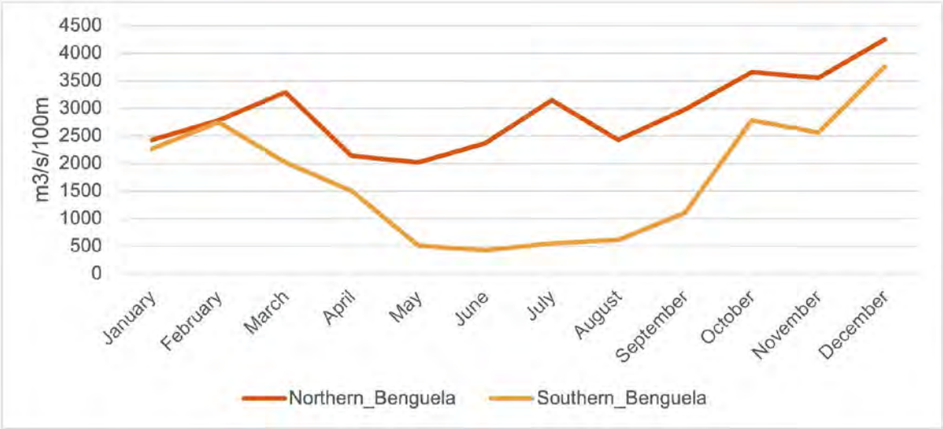


Figure 2-8 *Annual upwelling cycles in the Benguela oceanic system (2014) (Black et al., 2017)*

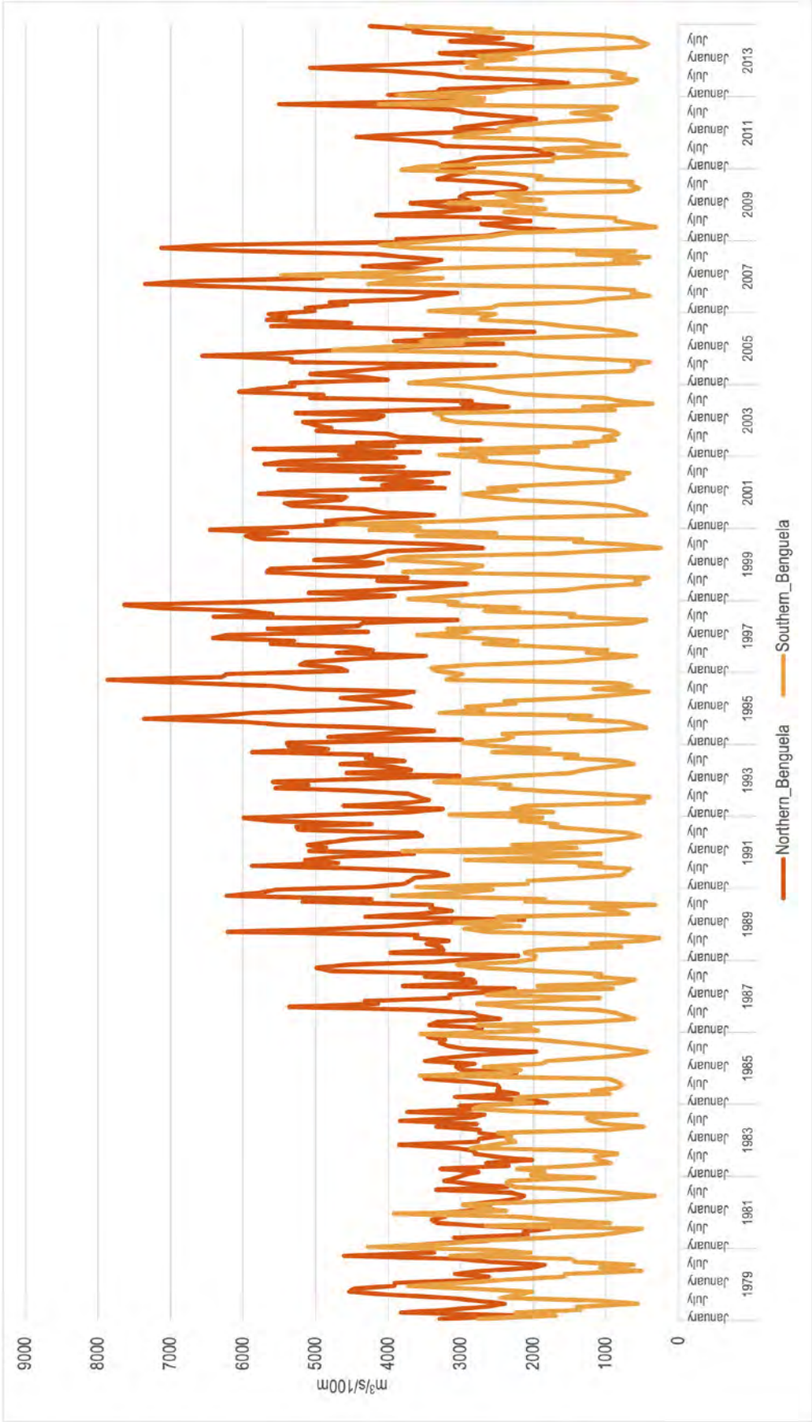


Figure 2-9 *Monthly cumulative upwelling Index for Benguela North and South oceanic systems (1979 to 2013) (Black et al., 2017)*

2.2.2

Hydrographical characteristics

Namibia is divided into twelve main hydrological basins: the Caprivi Strip Basin, the Okovango-Epukiro Basin, the Cuvelai-Etosha Basin, the Otavi Basin, the Northern Namib and Kaokoveld, Brandberg, Erongo and Waterberg Area, the Central Namib Basin, the Hochfeld-Dordabis Basin, the Aroab Basin, Southern Namib and Naukluft, and the Karas Basin (see Figure 2-10). These basins are unique in terms of their geology, geophysical characteristics, hydrogeology and water quality (Christelis and Struckmeier, 2011).

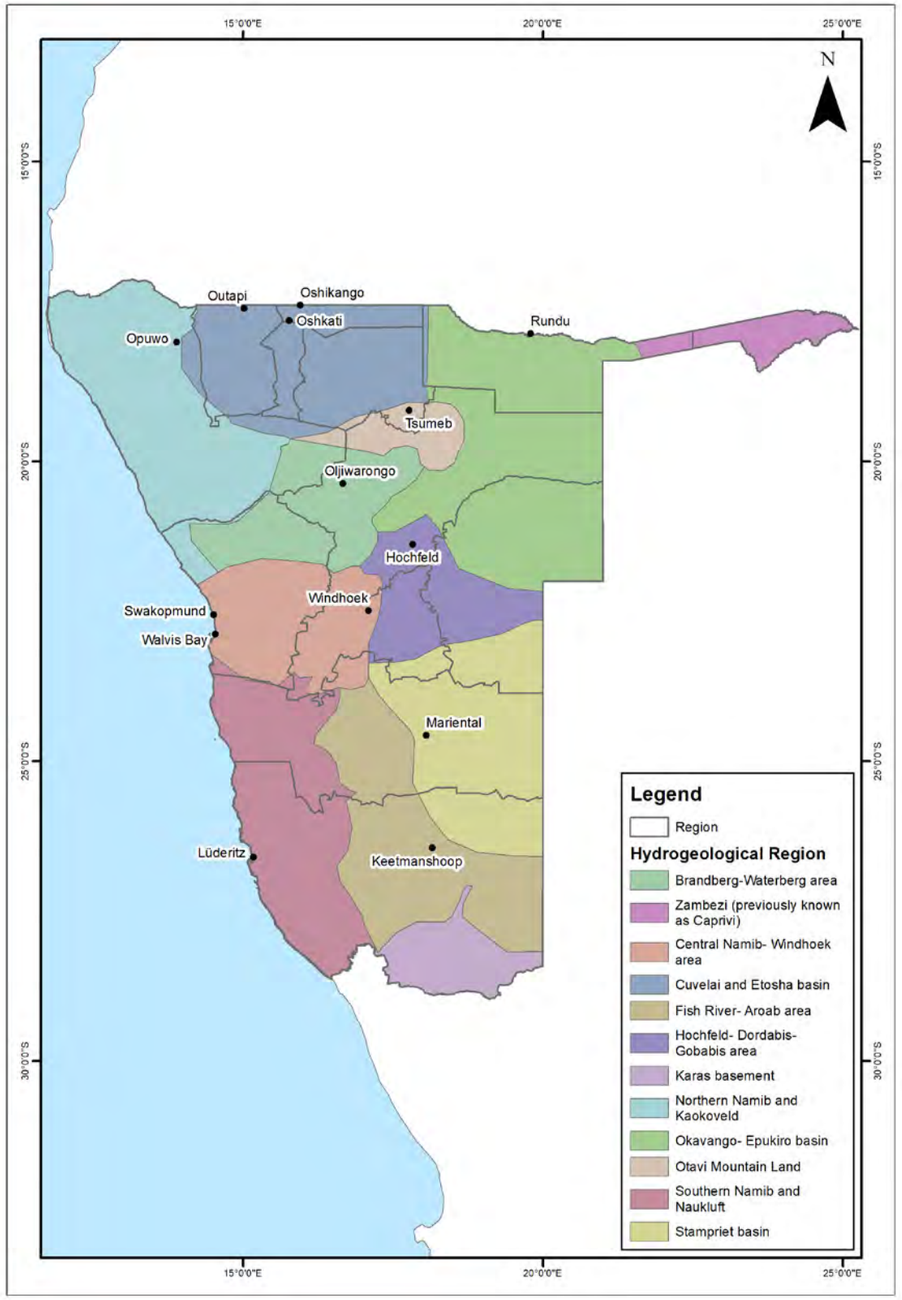


Figure 2-10 *Namibia's catchment basins (Christelis and Struckmeier, 2011)*

Hydrological cycle

The existence and availability of a region's hydrological resources is characterized by the level of precipitation and evaporation, and the ability of soil to contain water (moisture). Precipitation is regarded as the main driver of variability in water balance around the world (Arnell et al, 2018). This variability is defined by changes in rainfall patterns, and catchment capacity to either withhold the amount of surface runoff resulting from excess rainfall (flood events) or limit it (drought events). Evaporation is driven by meteorological controls which vary by environment and the amount of water available. Evaporation includes the vaporization of water from soil, shallow groundwater and water stored in vegetation. Soil plays a role in the availability of water in a region and is influenced by the rate of evaporation, groundwater and surface water (runoff) recharge (Arnell et al., 2018). Figure 2-11 indicates Namibia's current hydrological cycle.

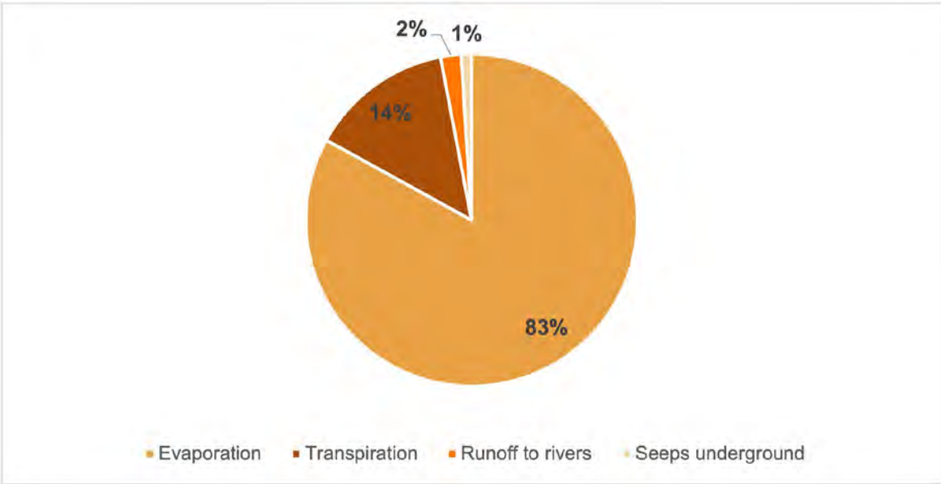


Figure 2-11 *Namibia's hydrological cycle (NamWater, 2020)*

There are limited datasets showing how Namibia's hydrological cycle has changed over time. There is, however, a current research focus on the water cycle dynamics across the African continent. These studies integrate information about ecosystem disturbances and other environmental processes through studying complex interactions between conditions and phenomena such as: biomass burning; landcover and land use; evapotranspiration; drought; desertification; rainfall; soil holding capacity; surface water runoff; and groundwater recharge (Ichoku and Adegoke, 2016).

Of the overall surface water bodies in Namibia, the Okavango River is the largest river system; it covers an area of 23.9% of all water bodies nationally, and is followed in size by the Kunene River basin at 22.1% and the Fish River tributaries of the Orange River (14.7%). There is no single perennial river within the interior; the only perennial rivers are those situated at the borders with other countries. These include the Orange River to the south (bordering South Africa), the Kunene and Kavango rivers to the north-west and north-east (bordering with Angola), and the Kwando-Linyati-Chobe and Zambezi rivers to the far north-east (bordering Zambia, Botswana and partially Zimbabwe) (Christelis and Stuckmeier, 2011).

Surface water resources – quality and quantity

Many of the ephemeral (seasonally flowing) rivers of the Namibian interior are dammed and provide a 95% assured yield of 96 million m^3/year with the application of efficiency improvements. These dams have low safe yields in comparison to their total volume capacity, because of uneven flows over time and high evaporation losses. The main challenge in national water supply is the uneven spatial distribution of water resources, while the lack of water-related infrastructure prevents the distribution of water to where it is needed. Namibia also suffers from regular droughts, the most recent drought occurring in 2019 and further causing instability in water resources (Shikangalah, 2020).

As evident in Table 2-1 Namibia has limited surface water resources available and is heavily reliant on groundwater for water provision to large areas of the country.

Table 2-1 *Available and potentially available water sources in Namibia (MAWLR, 2019)*

Water source	Annual amount of water available with installed capacity (mm³/annum)	Potential amount of water available (total source) (mm³/annum)
Primary sources		
Dams in ephemeral rivers	96	200
Perennial rivers	170	1105
Groundwater	95	360
Secondary sources		
Reclaimed water (Potable use only)	7.5	10
Total	**368.5**	**1675**

NOTE | Uneven spatial distribution not reflected in the table

The potential for extracting higher volumes from perennial rivers is subject to negotiations with the river basin states, notably South Africa in the south as well as Angola and Botswana in the north. The perennial rivers' mean annual flow is presented in Table 2-2 and these are mainly fed from high rainfall areas in these neighbouring countries which have their own water needs to consider. Another complicating factor is the construction of additional infrastructure such as dams and water pipelines, if more water is to be obtained from perennial rivers.

Table 2-2 *Mean annual flow of perennial rivers on Namibia's border (MAWLR, 2019)*

River (million cubic m per/year)	Minimum flow (cubic meters per second)	Minimum flow (cubic m per second)
Zambezi (at Namibia border)	40,000	180
Kwando / Linyati / Chobe	1,500	10
Okavango	10,00	80
Kunene	5,500	< 10
Orange (including Fish)	11,000	10

Namibia's ephemeral rivers flow for short periods in rainy season but could be dry for years during periods of drought. Approximately 2% of precipitation ends up in ephemeral rivers, which makes its water supply highly susceptible to drought. Runoff also depends on land and soil conditions, and is generally better in the central areas of Namibia (MEFT, 2019). Table 2-3 shows the mean annual flow of ephemeral rivers in interior Namibia and emphasizes the interior surface water scarcity for a country as large as Namibia.

Table 2-3 *Mean annual flow of ephemeral rivers in interior Namibia (MEFT, 2019)*

Category	Mean annual flow (million cubic m / year)
Western flowing rivers *Occasionally reaching the Atlantic Ocean*	280
Fish River and other drainage to the Orange River	660
Endoreic (Omatako and Auob/Nossob) drainage	60
Cuvelei oshanas draining into Etosha Pan	200
Direct contribution to Kavango, Kwando, Zambezi Rivers	*Not significant*

Despite the high evaporation rates in Namibia, there are several significant surface water storage dams in the country. These dams have a 95% assured combined yield of approximately 95.3 Mm³/annum. An overview of the dams, their regional groupings and the dam levels as of October 2020 is provided in Table 2-4. Also evident from Table 2-4 is that Namibia's dams are at 44% capacity at the end of the current dry season, and that the central and southern dams contribute the most to overall water availability in Namibia. The MAWLR is responsible for monitoring the quality of surface water and has 46 monitoring points in perennial river systems and 23 points in ephemeral systems installed. An integrated data room for the results of these monitoring activities is under development.

Table 2-4 *Namibian dam levels as at 12 October 2020 (NamWater, 2020)*

	Dam name	Capacity mm³	Present volume mm³	% of full capacity
Central	Swakoppoort Dam	63.5	48.4	76.1
	Von Bach Dam	47.5	39	82
	Omatako Dam	43.5	13	30.5
Windhoek	Friedenau Dam	7	2.9	42.4
	Goreangab Dam	4	3.2	88.3
	Otjivero Main Dam	10	4.7	49
Gobabis Dams	Otjivero Silt Dam	8	-	-
	Tilda Viljoen Dam	1	0.3	27.1
	Daan Viljoen Dam	0.5	0.1	28.2
Southern Namibian Dams	Hardap Dam	294.6	96.5	32.7
	Naute Dam	83.6	63.3	75.7
	Oanob Dam	34.5	29.1	84.2
	Bondels Dam	1.1	0.05	4.8
Other	Olushandja Dam	45.7	6.8	15
	Omaruru Delta Dam	35.2	*Empty*	-
	Omatjenne Dam	5.1	*Empty*	-
	Total	**684.8**	**307.35**	**49%**

Groundwater resources

Namibia has eight main aquifers contributing to the overall 95 Mm³/annum that is currently utilized. These aquifers are Karst' Otjiwarongo, Omaruru Delta (OMDEL), Lower Kuiseb, Windhoek, Stampriet, Koichab and Ohangwena II. As indicated in Figure 2-12, several of these aquifers have further abstraction potential, provided that the correct infrastructure is installed at scale to ensure that water is transported to the water-stressed parts of the country. Groundwater quality in Namibia is generally good, although brackish shallow groundwater occurs in densely populated north central areas. In some rural communities, untreated wastewater and increased nitrates due to cattle farming cause contamination of groundwater (British Geological Society, 2020).

Groundwater monitoring is the responsibility of the MAWLR's Geohydrology division. The department has 660 water level monitoring boreholes across the country, utilising automatic data loggers with daily to weekly measurements. It also measures water quality at 50 boreholes. This monitoring system is currently being improved. Eventually, data collation will take place in a National Groundwater Database (GROWAS) (British Geological Society, 2020).

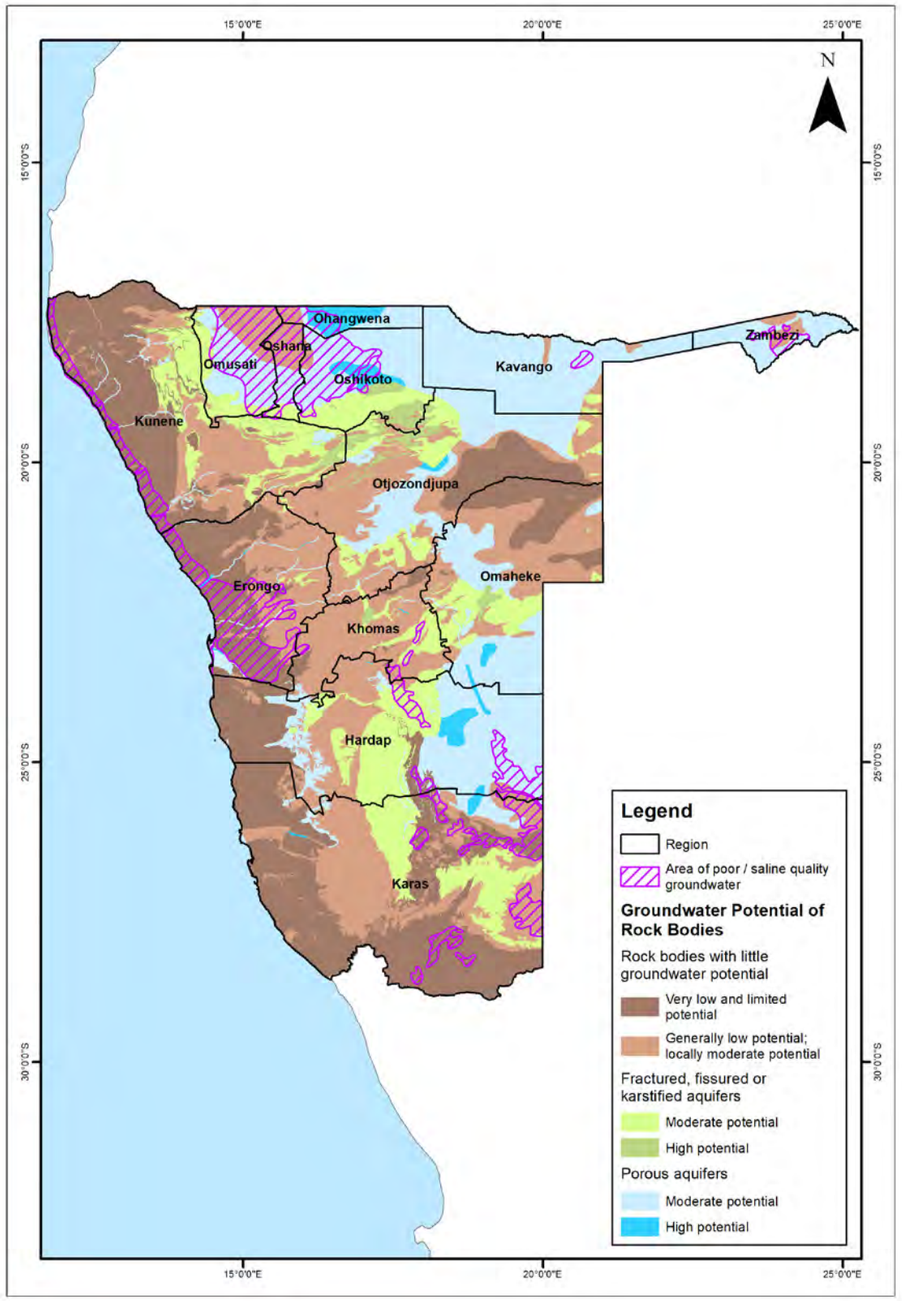


Figure 2-12 *Groundwater potential in different rock types in Namibia (Christelis and Stuckmeier, 2011)*

2.2.3

Geographical information

The country mostly comprises of metamorphic rocks ranging from deformed gneisses, amphibolites, meta-sediments and associated intrusive rocks of Paleoproterozoic age (2200 to 1800 Mega annum), to the Namaqualand Metamorphic complex of the Mesoproterozoic age (1800 to 1000 Ma) overlain by the Neoproterozoic Damara Orogen (800 to 500 Ma), which is covered by sediments of the Kalahari Sequence (Figure 2-13). Regional geological bedrock formations cover 46% of the Namibia's surface area. A variation in lithologies and hydrogeological characteristics has resulted in the abundance of unconsolidated to semi-consolidated sand, gravel and calcrete that comprise the Kalahari and Namib deserts (Christelis and Struckmeier, 2011). The mineralogy of Namibia's lithology is evidenced in the many mineral deposits; the significance of the country's mineral resources is discussed in Chapter 3.

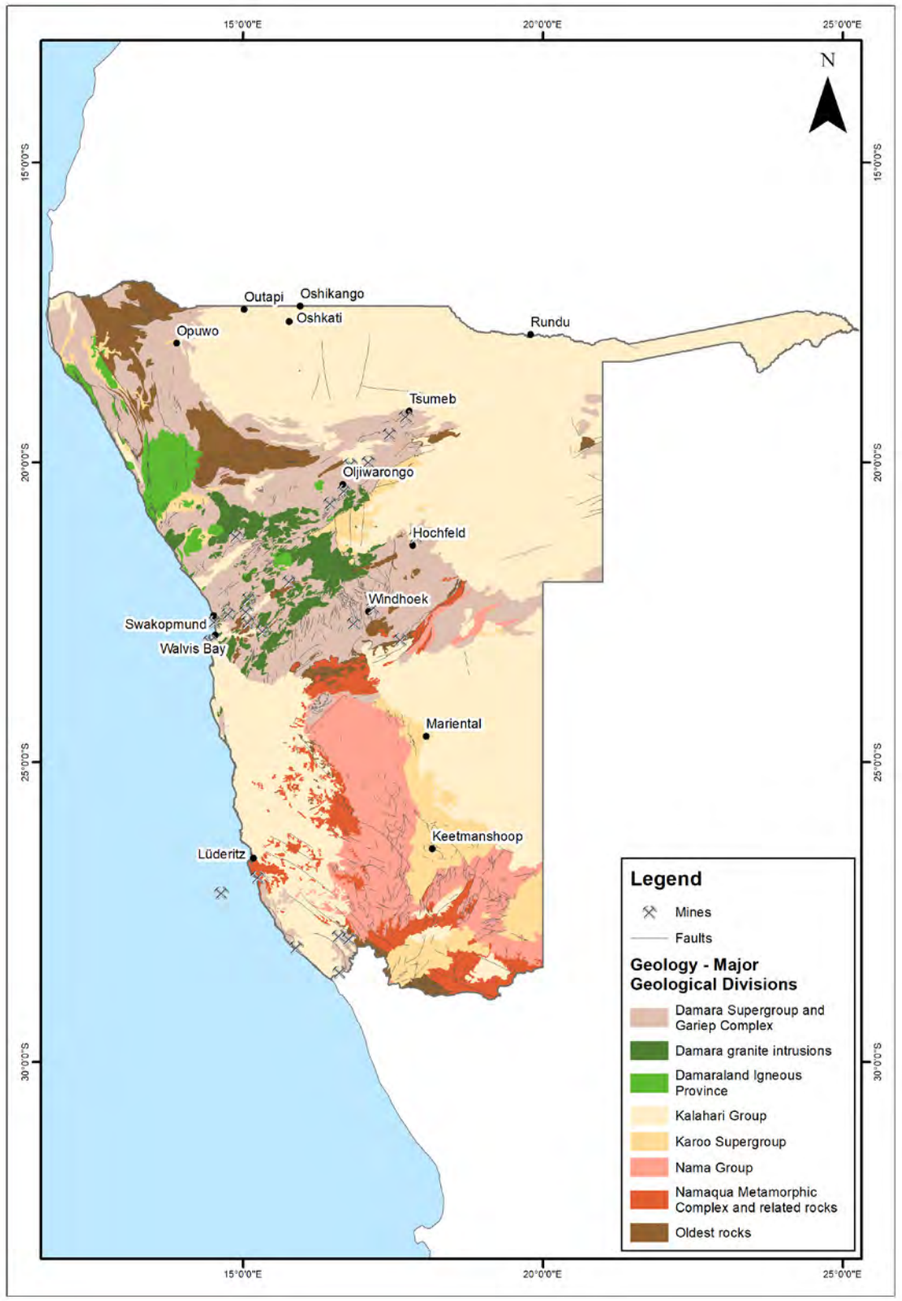


Figure 2-13 *Simplified geological map of Namibia (Geological Survey of Namibia, 2011)*

2.2.4

Soil characteristics

Over 70% of Namibia's surface is dominated by sandy soils and is highly susceptible to erosion, making soil stewardship generally very difficult. Namibia is an arid country with limited agricultural potential (illustrated in Figure 2-14), but its population practices extensive agricultural activities despite the challenges. It is estimated that crop cultivation and livestock farming occurs on approximately 71% of the land, making the country highly vulnerable to desertification and land degradation (Mendelsohn, 2006). Between 2000 and 2010, the number of rural people living on degraded agricultural land decreased 31.6%. This shift is not due to the restoration of degraded land, but rather to the rural communities rapidly moving to cities as land in Namibia becomes increasingly unsuitable for agricultural activities (Global Mechanism of the UNCCD, 2018).

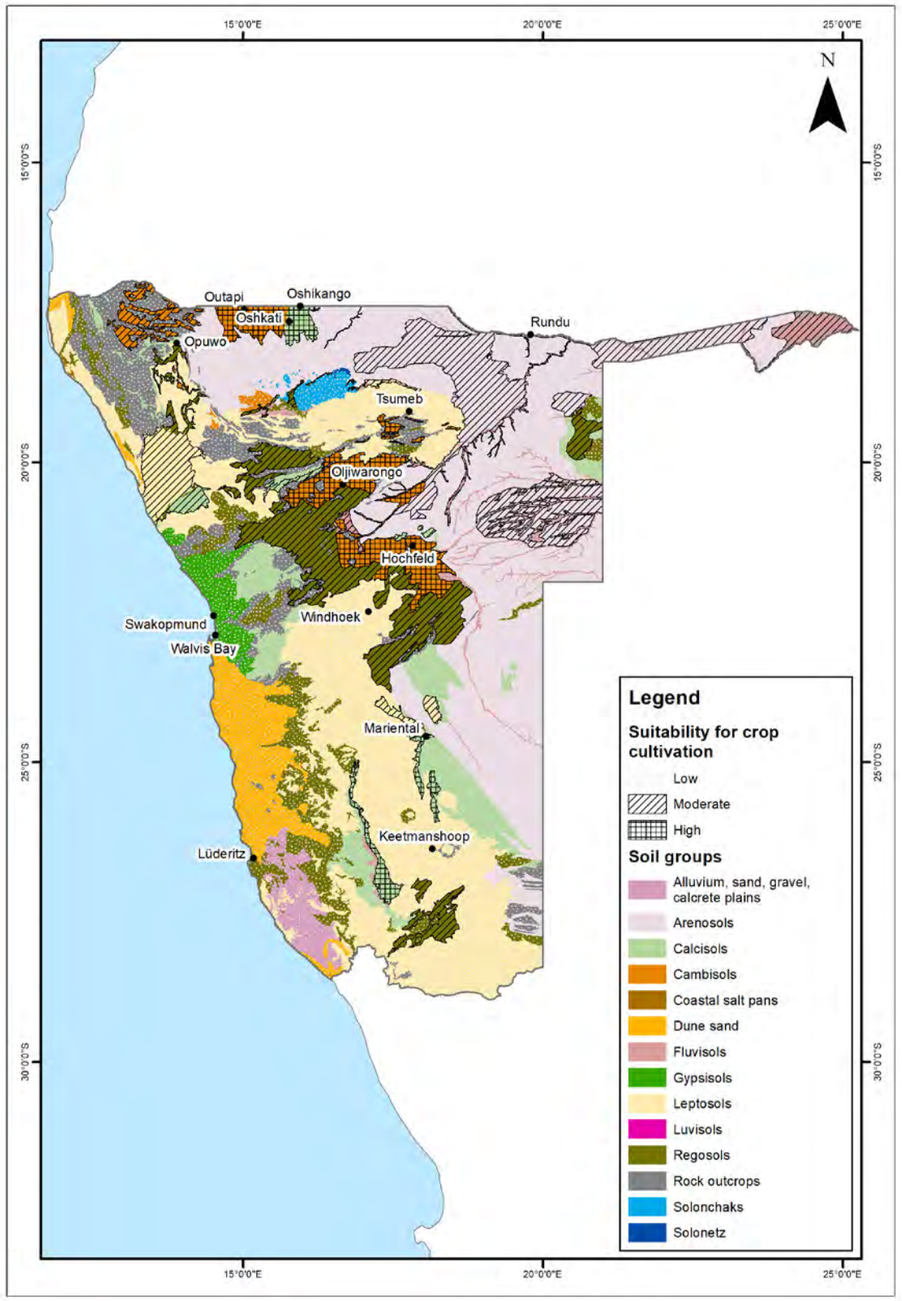


Figure 2-14 *Relative suitability of soil types for agriculture (MEFT, 2003)*

Several initiatives have been implemented over the past decade to quantify the scale of soil and land degradation in Namibia. Agencies at various levels of governmental – as well as NGOsorganization, universities and development agencies – have been collecting data about the status of land. Due to a lack of coordination, however, data could not be readily compared and collated – as different standards of collection and definitions of types of areas were used (Mariathasan et al., 2019). To address this issue and work towards reporting accurately on land degradation over time, the Namibian Statistics Agency (NSA) convened a Technical Working Group to develop a national land cover classification system for Namibia.

Once the classification system is gazetted and regulations are issued, role players can integrate and collate data to complete an accurate national land cover map and track changes over time (Bezuidenhout, 2019).

The global economic cost of land degradation has received significant attention in recent years. In its 2018 report, the Global Mechanism of the United Nations Convention to Combat Desertification sites the economic indicators of land degradation in Namibia (Table 2-5). With a total annual cost of USD1,6 billion, it is evident that urgent action is needed in Namibia to combat desertification and restore high potential areas.

Table 2-5 *Economic indicators for land degradation in Namibia (Global Mechanism of the UNCCD, 2018)*

Indicator	Cost in USD
Total annual cost of land degradation (base year 2007)	1.6bn
Cost of land degradation as a % of GDP	19%
Cost of action (30-year planning horizon)	29.2bn
Cost of inaction (30-year planning horizon)	107.4bn
Returns on action against land degradation per dollar invested	4 USD

Drought landscape in Namibia | Peter Burdon

2.3

Physical conditions - challenges & responses

This section highlights the most prominent challenges and responses pertaining to physical environmental conditions and quality, and the responses that have been implemented. It also highlights selected opportunities that might be imbedded in the environmental challenges Namibia is facing. A recommended way forward is presented at the end of Chapter 2.

2.3.1

Extreme weather events

Several factors contribute to the growing challenges associated with the impacts of climate change. While the probable temperature increase in Namibia is confirmed by several climate change models, the rainfall variability is uncertain. There seems to be consensus about the increase in extreme weather events due to climate change impacts (New, 2015). Responses to these challenges can be viewed on two levels: climate change mitigation, and climate change adaptation.

Climate change mitigation measures include efforts to reduce the amount of Greenhouse gas (GHG) emitted nationally and focus on minimising the main cause of climate change. Namibia's commitment to reduce GHG emissions is articulated in its Intended Nationally Determined Contributions (INDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) (GRN, 2015), including its Nationally Determined Contributions (NDC) as part of the four National Communications to the UNFCCC. As a Non-Annex 1 Party to the UNFCCC, Namibia does not have commitment obligations under the Convention. Namibia has voluntarily developed NDCs to contribute to climate change mitigation efforts. Considering Namibia's constraints to implementing the NDCs, significant external funding will be required to build the systems, institutions and human capacityrequired, as well as green technology development and other mitigation commitments (GRN, 2015). Namibia has committed 10% of the funds for this initiative but is still in multilateral discussions with climate donors regarding the remaining 90%.

The Paris Agreement (Article 4, paragraph 2) requires each party to prepare, communicate and maintain successive NDCs that it intends to achieve. Parties are expectd to pursue domestic mitigation measures, with the aim of

achieving the objectives of such contributions. As a party to the Paris Agreement, Namibia is presently preparing NDCs to demonstrate its efforts to reduce national emissions and adapt to the impacts of climate change.

Namibia is already experiencing more frequent occurrence of extreme weather events and their associated impacts such as drought, floods, veldfires and land degradation. In line with the FDES reporting methodology, these impacts and their associated responses are discussed at length in Chapter 5.

2.3.2

Water risk & management

As a water-scarce country with the added complexity of significantly uneven distribution of water resources, Namibia is considered to be at extreme water risk. The World Resources Institute's Aqueduct Water Atlas (WRI, 2020) assessed Namibia's physical water quantity risk using seven parameters. These were: baseline water stress; water depletion; inter-annual variability; inter-seasonal variability; groundwater table decline; riverine flood risk; coastal flood risk; and drought risk. This assessment showed that, with exception of pockets of land situated next to cross-border perineal rivers, the majority of Namibia is classified as displaying a extremely high water risk (Figure 2-15).

In terms of Namibia's future water needs, its water risk status is compounded by a projected increase in demand for water resources. The WRI (2020) projects Namibia's future water needs (up to 2040) within a 'business as usual'[2] scenario to increase between 1.2 to 1.4 times in most of the country's regions (WRI, 2020) (Figure 2-16). From these projections, it is evident that Namibia is already facing a severe water crisis, which will only worsen in the immediate future.

[2] The "business as usual" scenario represents a world with stable economic development and steadily rising global carbon emissions, with CO2 concentrations reaching ~1370 ppm by 2100 and global mean temperatures increasing by 2.6–4.8°C relative to 1986–2005 levels.

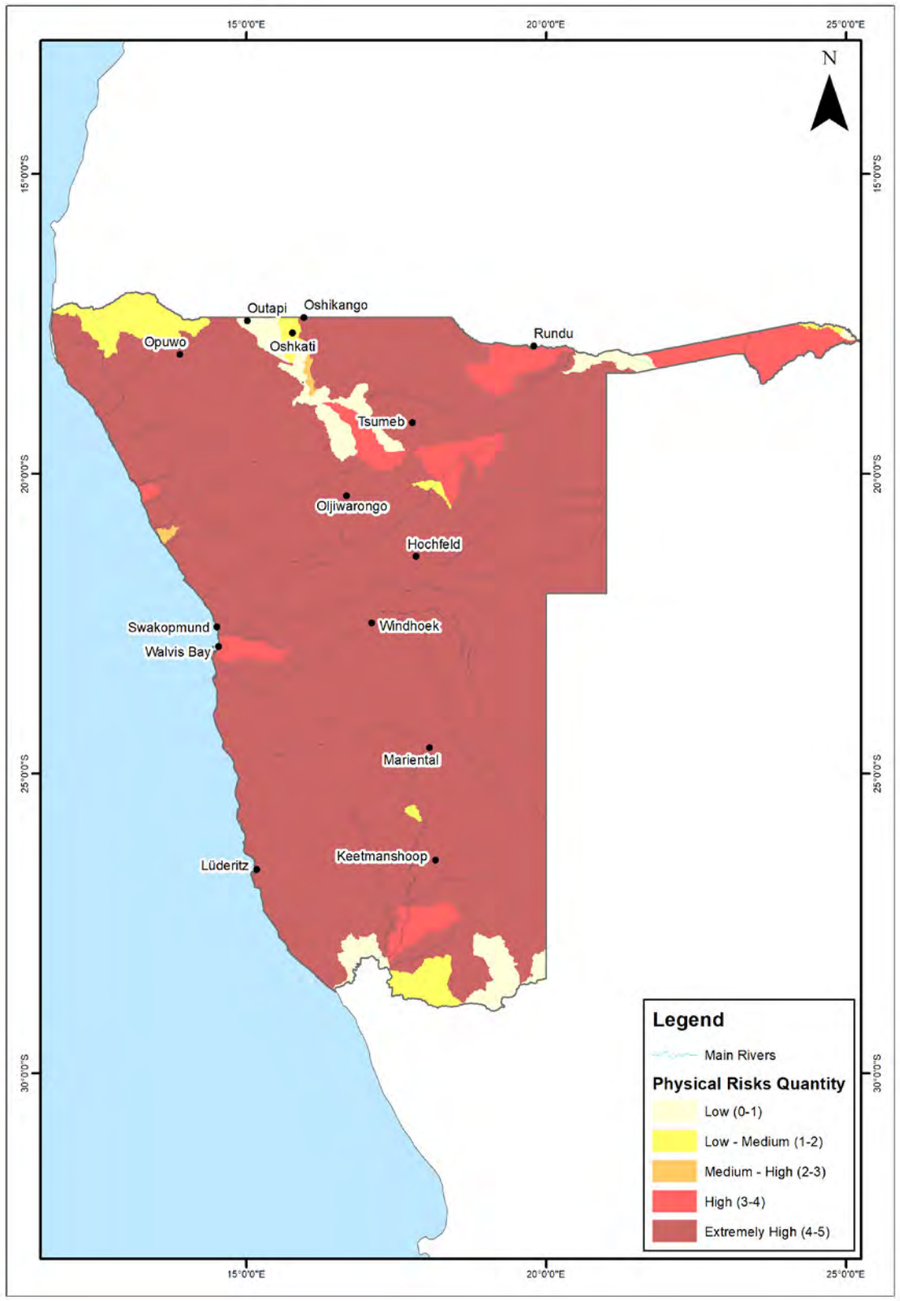


Figure 2-15 *Namibia's physical water risk – quantity (WRI, 2020)*

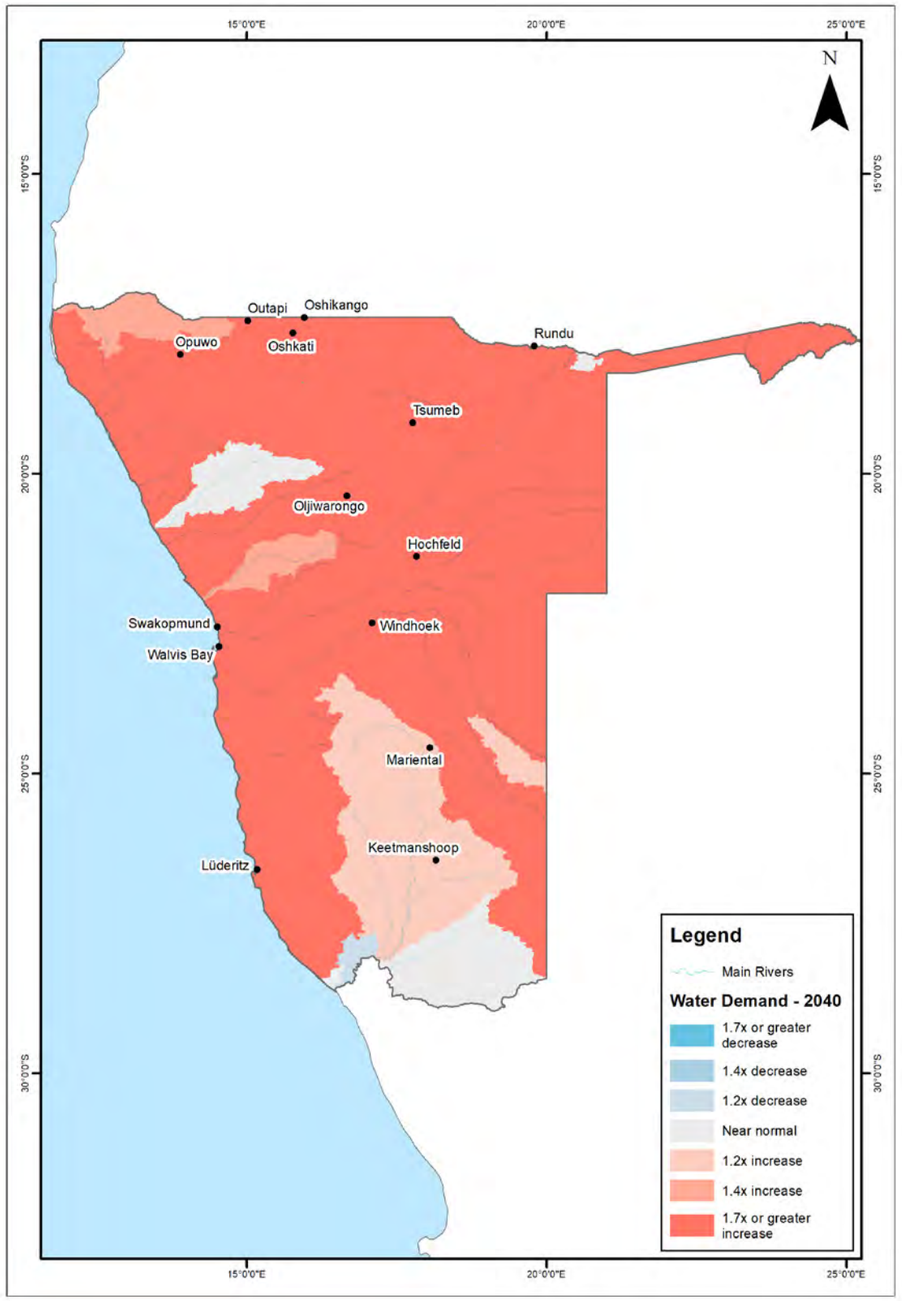


Figure 2-16 *Projected increase in water demand by 2040 (WRI, 2020)*

The Namibian government has worked consistently over the last decade to improve water management in the country. Together with partners, it has taken both a bottom-up and a top-down approach to address water-related challenges at national and regional level. Notably, the MEFT published the Integrated Water Resources Management Plan (MEFT, 2010) which included a suite of approaches (Figure 2-17). Each of these approaches has a detailed management plan, which has been implemented to various levels of success. The major challenges to IWRMP implementation include a lack of funding, fragmentation between government departments responsible for different aspects of planning, and a lack of capacity to implement the plan at scale across regions.

In addition to the Government's continuous effort to plan for sustained water availability, several other role players are also working towards increased water security in Namibia. Table 2-6 provides a sample of other stakeholder's efforts to support the Government in its efforts towards sustainable water for all Namibians.

Figure 2-17 *Approaches to sustaining water availability in Namibia (MEFT, 2010)*

Table 2-6 *Economic indicators for land degradation in Namibia (Global Mechanism of the UNCCD, 2018)*

Stakeholder group	Partner name	Type of approach
Academic researchers	University of Namibia – various water related topics	Water management and innovation
Non-governmental organizations	Southern African Development Community Groundwater Management Institute (SADC-GMI)	Groundwater management capacity building and mapping
International donors	Namibia water sector support programme African Development Bank (AfDB)	Water infrastructure

2.3.3

Land degradation

Multiple factors play a role in desertification and land degradation in Namibia; Figure 2-18 demonstrates the interconnectedness of several of these factors. Several socio-economic, natural and institutional factors are exacerbated by the impacts of climate change and the increase in extreme weather events that Namibia is experiencing (refer to Chapter 4).

Figure 2-18 *Factors contributing to and perpetuating environmental degradation in Namibia (adapted from Vision 2030)*

As discussed in the status quo discussion on soil and land (Section 2.2.4), more coherent information about soil erosion and land degradation is needed – as well as mechanisms for role player alignment. Namibia subscribes to the United Nations Convention to Combat Desertification (UNCCD), which aims to address degraded areas to increase the amount of usable land in the country and to also ensure sustainability of natural resources in the light of population growth. Namibia is currently in the implementation phase of the Third National Action Programme of the UNCCD that runs from 2014 to 2024.

The MEFT's action plan is supplemented by several ongoing programmes on land-based approaches, supported by international and national organizations. These include projects such as Sustainable Management of Namibia's Forested Lands, Disaster Risk Management Support for Agropastoral Communities in Northern Namibia, and Community Climate Change Resilience Support funded by a consortium of international donors (Global Mechanism of the UNCCD, 2018).

Local perspectives

Land degradation in the Oshana Region

1. The Oshana Region is made up of 8.8% poor and 29.4% extremely poor inhabitants. The main source of income in the region is: farming (36%); wages and salaries (32%); business and non-farming (13%); pensions (12%); cash remittances (5%); and other incomes (2.8%). Unemployment is currently at 1% while the HIV/AIDS prevalence was 29% in 2016. The majority of the population is rurally based living on communal land.

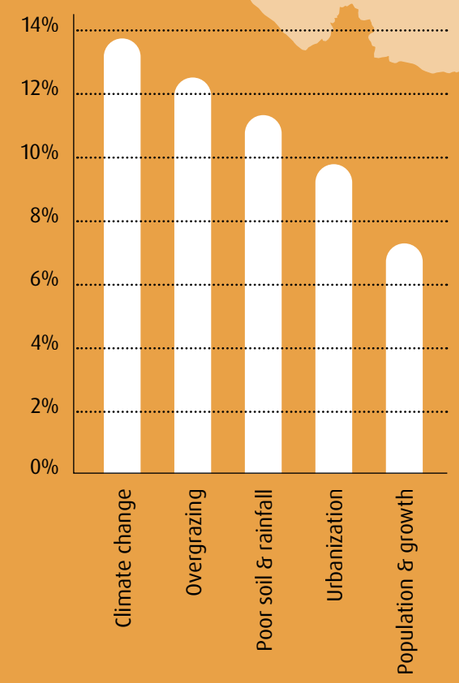
2. Desertification is perceived by the community to be the leading type of land degradation (31%). Community members viewed land degradation mainly as soil erosion (24%) and the loss of soil structure (22%). In terms of perceptions, climate change and overgrazing were the leading causes of land degradation (see graph).

3. Based on a survey conducted in 2019, 75% of community members noted that they had witnessed land degradation in within their community. Further anecdotal evidence revealed that it is becoming an everyday phenomenon, especially when related to illegal sand mining.

4. Even though the respondents did not see sand mining as an important cause of land degradation, it is a growing problem in the region. National government has identified it as a problem attempting to halt illegal mining, seizing illegally mined sand, while also engaging with traditional authorities to address the problem.

75%
the percentage of community members that have noted the presence of land degradation in their local communities.

Perceptions about the cause of land degradation



Source Content adapted from Hamunyela (2019)

2.4

Land cover, ecosystems & biodiversity

Land cover is defined by the Food and Agricultural Organization (FAO) (2005) as the observed (bio) physical cover on the earth's surface. Changes in land cover are the result of natural processes, human activities and changes in land use. Land areas provide space for natural ecosystems, human and domestic animal habitats, and human activities. As land is a finite resource, the expansion of human activities can encroach on the space natural ecosystems need to thrive, reducing their capacity to yield ecosystem services for both humans and other living beings (Global Mechanism of the UNCCD, 2018).

Ecosystems are distinct communities of plants, animals or fungi that occupy a specific region. There are two types of ecosystems: terrestrial and aquatic. Terrestrial ecosystems are found only on land – including forests, deserts, grasslands, tundra and taiga – while aquatic ecosystems are found in waterbodies (United Nations, 2017). Despite its arid climate, Namibia holds a remarkable variety of species, habitats and ecosystems – ranging from deserts to subtropical wetlands and savannas. The country's terrestrial and marine ecosystems are the basis of livelihood for most of the Namibian population (MEFT, 2014a).

2.4.1

Land cover, ecosystems & biodiversity - status quo

Status quo refers to the current state of specific environmental conditions. It is informed by how indicators related to landcover, ecosystems and biodiversity are trending over time. The following 17 indicators are used in this section to report on the current state of the biological environment:

- Land tenure distribution;
- Landcover change in Namibia;
- Percentage of land under conservation management;
- Increase in community forests;
- Number and location of Namibia's community forests in 2018;
- Areas under various kinds of conservation management;
- Terrestrial biomes;
- Namibia's coastal environment;
- Contributions to the protection of major biomes;
- Terrestrial and marine protected areas;

Landscape of Namibian ecosystem | Eric Deschaintre

- Number of species and level of endemism;
- Human wildlife conflict incidents per annum;
- Regional distribution of wildlife crimes;
- Livestock census;
- Fingerling and fish production;
- Status of marine life; and
- Status of fresh-water fish.

Land cover

Across the globe, the expansion and intensification of human land use in recent decades is causing major changes in biodiversity (Global Mechanism of the UNCCD, 2018). These changes are also evident in Namibia. There are three general land tenure classifications in Namibia: communal, freehold and state land (Namibia Nature Foundation, 2021 forthcoming). The Nambian Statistics Agency found that freehold agricultural (commercial) land accounts for 39,728,364 ha (48% of the total) followed by communal land at 28,720,443 ha (35%) and state land at 13,906,437 ha (17%). Of the total state land, parks and restricted areas accounts for 13,111,193 ha (16%) – of which an area of 8,095,000 ha (67% of parks and restricted areas) is land covered by the Namib Desert; the Etosha National Park covers most of the remaining 5,016,193 ha (NSA, 2018).

Figure 2-19 presents spatial data on land tenure distribution drawn from the Namibian Atlas that is currently under development.

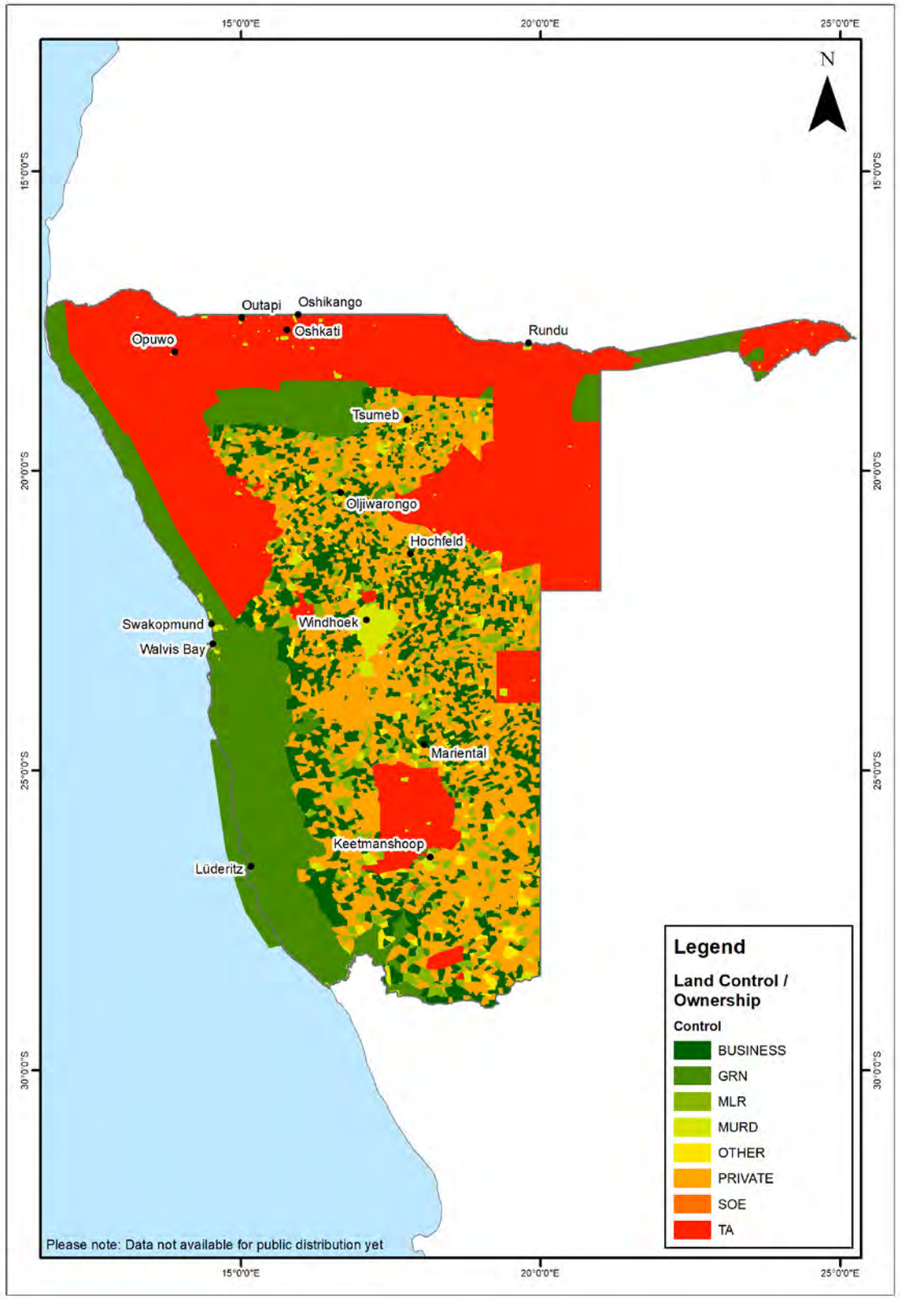


Figure 2-19 *Land tenure distritribution in Namibia (Namibia Nature Foundation, 2021 forthcoming)*

All land within the Namibian territory has been classified under six Intergovernmental Panel on Climate Change (IPCC) land categories, including forest land, cropland, grassland, wetlands, settlements and other land (IPCC, 2003). Forests are divided into two sub-categories; forestland and other wooded land (OWL), which include woodlands, shrubland and savannah.

FOREST COVER

Forest cover maps have been produced for each region of Namibia. The spatial pattern of forest cover is broadly as expected, showing forest cover mostly limited to the north and east of the country (Figure 2-20). False positives were noted on steep slopes, and in locations of seasonal inundation. Mapped areas indicate 85% of Namibia's forest area is found in the north and eastern regions of Kavango East, Kavango West, Ohangwena and Zambezi. Forest cover maps appeared less reliable in southern and western regions of Namibia, where forest area is limited, and false positives dominate the forest class.

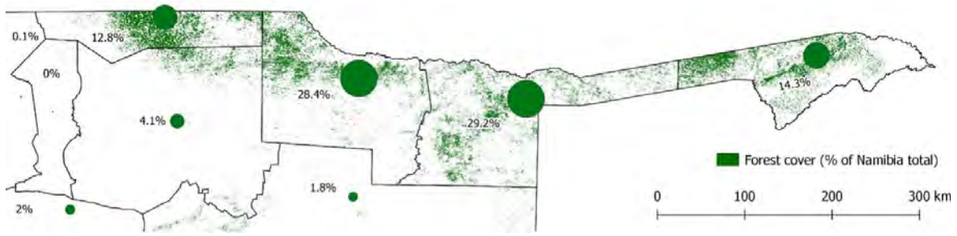
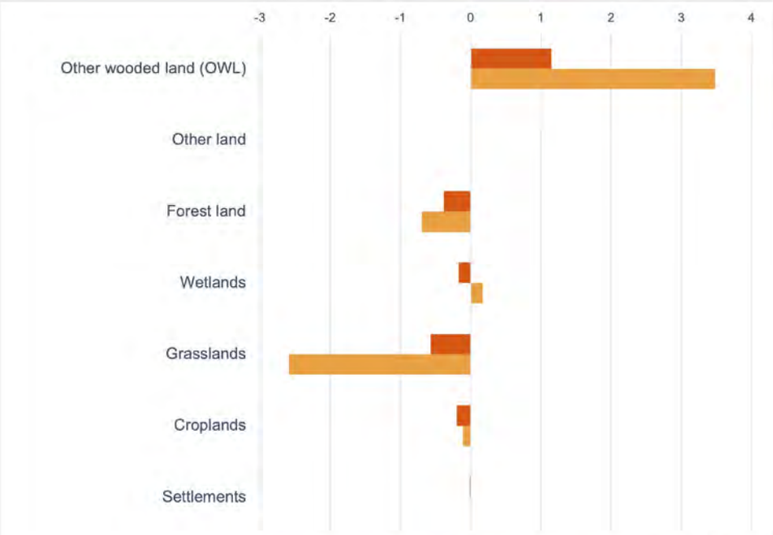


Figure 2-20 *Forest cover map for Namibia, showing the concentration of forest cover in the North and East of Namibia (Directorate of Forestry)*

LAND COVER CHANGES

Figure 2-21 indicates how landcover changed from 2001 to 2015. A reduction in forest land, grassland and croplands are noted while other wooded areas and settlements have increased. These trends can be attributed a variety of factors including population growth, land degradation and urbanisation as a result of agricultural challenges.



	Settlements	Croplands	Grasslands	Wetlands	Forest land	Other land	Other wooded land (OWL)
Percentage change over time 2010-2015	-0,01	-0,2	-0,57	-0,17	-0,38	0	1,15
Percentage change over time 2001-2010	0	-0,11	-2,59	0,17	-0,7	0	3,48

Figure 2-21 *Landcover change in Namibia from 2001 – 2015 (MEFT, 2015)*

As indicated in Figure 2-21, Namibia has witnessed a constant woody biomass accumulation in its forest land and OWL from natural regeneration and more rapidly from the encroachment by both indigenous and alien species. Over the past three decades, invasion by indigenous and exotic species have accelerated to become a serious challenge. Grassland and croplands have been most affected by this phenomenon, which has resulted in a decrease in the carrying capacity of rangelands, thus posing a threat to the sustainability of the livestock industry. The decrease in cropland is due to a number of factors including the migration of the rural population to urban areas, a higher purchasing power for a more varied food basket, improved yields from better crop husbandry practices and the impact of climate change including a higher climate variability. Grassland has decreased due to bush encroachment, which is defined as the invasion and/or thickening of aggressive undesired woody species, resulting in an imbalance of the grass to bush ratio, a decrease in biodiversity, and a decrease in carrying capacity (De Klerk, 2014).

There are a number of unpublished reports on bush encroachment in Namibia; however, a holistic overview of problems and benefits is lacking. One recently published article by Shikangalah and Mapani (2020) provides the results of a review of secondary data sources, drawn mostly from various literature sources not in the public domain. It noted that over 45 million hectares of agricultural land in Namibia are affected, effectively lowering agricultural potential. The phenomenon has led to decreased biodiversity, as well as degradation of the functions and structures of ecological ecosystems. Encroachers include species such as *Senegalia erubescens, Senegalia fleckii, Vachellia nilotica, Vachellia luederitzii, Vachellia reficiens, Colophospermum mopane, Rhigozum trichotomum, Terminalia prunioides, Terminalia sericea, Senegalia mellifera* and *Dichrostachys cinereal.* Although the process poses many challenges that lead to long lasting rangeland

degradation, through de-bushing it is providing many value chains that are useful to livelihoods; as a drought resilience solution to the meat industry, for instance, it is contributing to the country's economy. However, de-bushing could negatively impact the environment if not managed in a controlled and sustainable manner (Shikangalah and Mapani, 2020).

A recent study on community perceptions regarding degradation has been conducted in semi-arid rangeland in Kunene Region (Inman et al, 2020). The study showed that herder perception matched with the vegetation attributes for areas of high and moderate degradation where *Colophospernum mopane*, a known encroacher species across Namibia, was the dominant species. Often areas of low degradation which had *Pechuel-loeschea leubnitziae*, a known indicator of degradation, were not perceived as degraded. This highlights the current and future threats to conservation management aimed at combating land degradation.

CONSERVATION MANAGEMENT

Almost half of Namibia (43.87% of the land area), is under conservation management. The first conservancies were registered in 1998 and the first community forests in 2006 (Namibian Association of CBNRM Support Organizations, 2018). The establishment and management of both conservancies and community forests are intended to provide communities with opportunities to realize a livelihood from natural resources. This approach to community-based natural resource management is regulated by the Forest Act of 2001. The use of conservancies and community forests and its associated challenges are discussed in Chapter 3.

Since 2010, there has been significant growth in the number of community forests in the country, as indicated in Figure 2-22, and the area covered by community forests doubled to over 3,000 km² in 2013 from 1,486 km² in 2010.

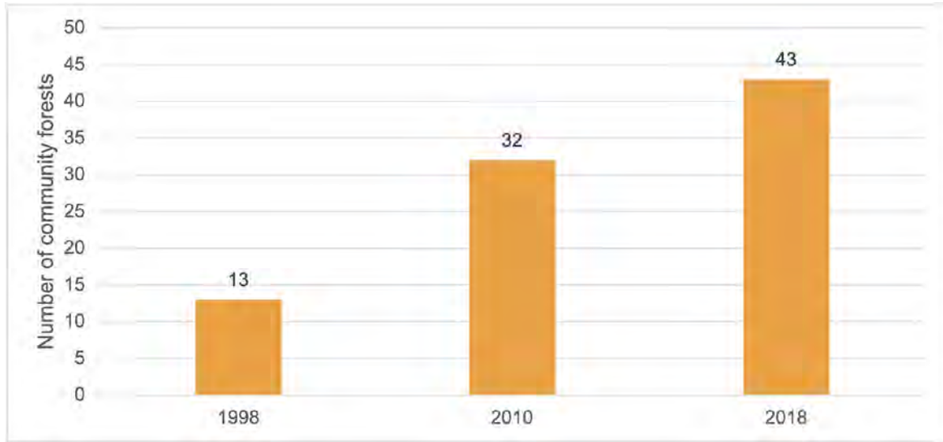


Table 2-22 *Increase in community forests in Namibia (MEFT, 2018)*

In 2018, an additional 10 new community forests were gazetted, bringing the total number of gazetted community forests to 43. This increase is indicated in Figure 2-23 and brought the total area for community forests submitted for gazettement from 5.67 million ha to 8.79 million ha in 2018 (MEFT, 2018). Research is needed to determine whether community forests have had a positive or negative impact in terms of biodiversity, and how this land cover differs compared to the areas that are not community forests.

Feedback from stakeholders during the drafting of the ISOER highlighted that a community forest had been established in the Omaheke Region near Epukiro since the MEFT study was undertaken. It was also noted that some community forests – especially in the Kavango Region – had been compromized by leaseholds and were not functional.

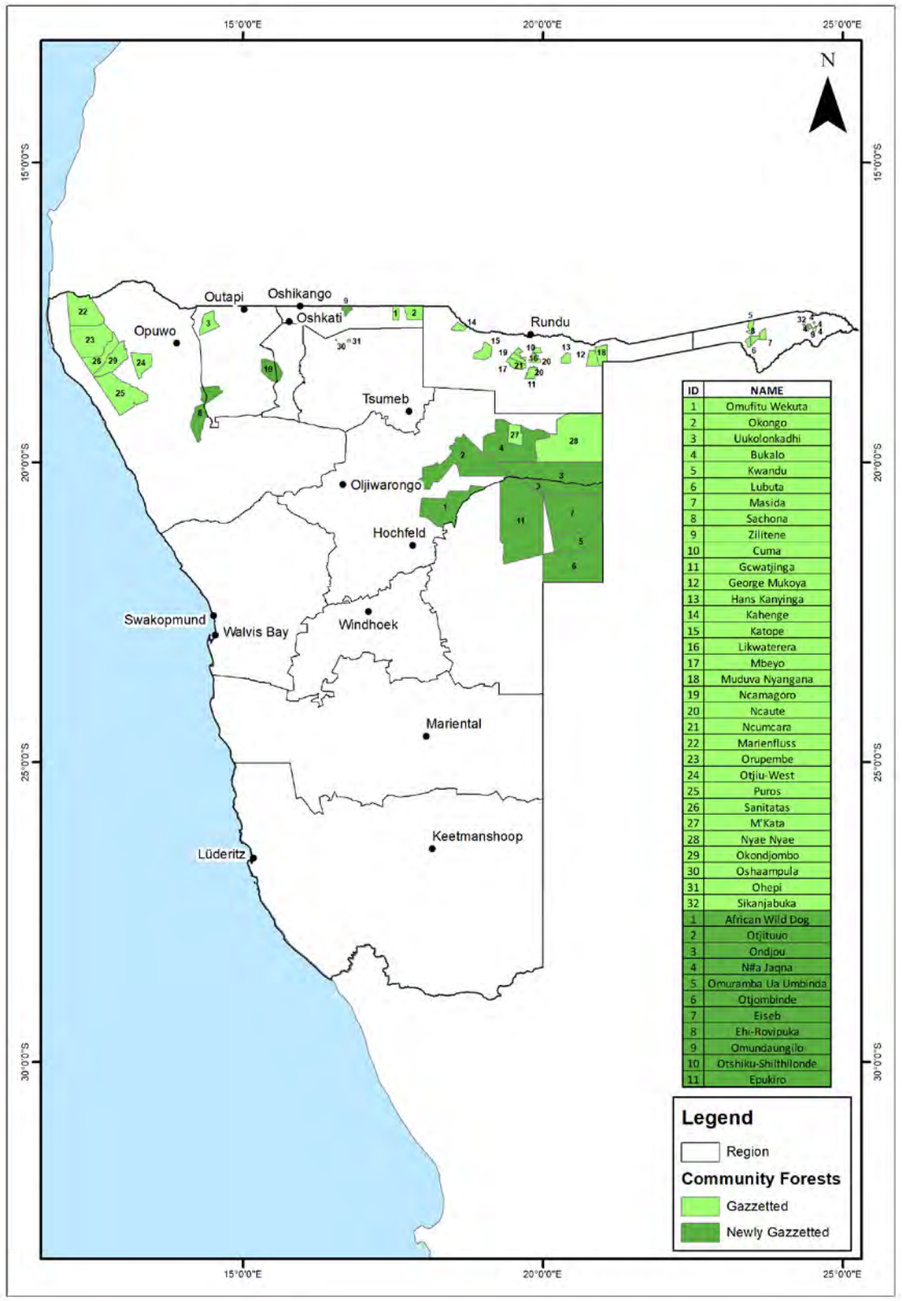


Figure 2-23 *Projected increase in water demand by 2040 (WRI, 2020)*

Ecosystems

Ecosystems can be broadly defined as a community of organisms, together with their physical environment, viewed as a system of interacting and interdependent relationships (United Nations, 2017).

Terrestrial ecosystems

As indicated in Figure 2-24, Namibia is classified into 29 vegetation zones and six terrestrial biomes which include the Namibia Desert, Nama Karoo, Succulent Karoo, Acacia Savanna, Broad-leafed Savanna, and Lakes and Salt Pans.

Each biome is affected to a different extent by land uses such as rangeland farming, agriculture, wildlife production, tourism and recreation, mining and urban development (MEFT, 2014a). The Namib Desert is one of the oldest deserts in the world and this habitat was granted World Heritage status by the International Union for the Conservation of Nature in 2013.

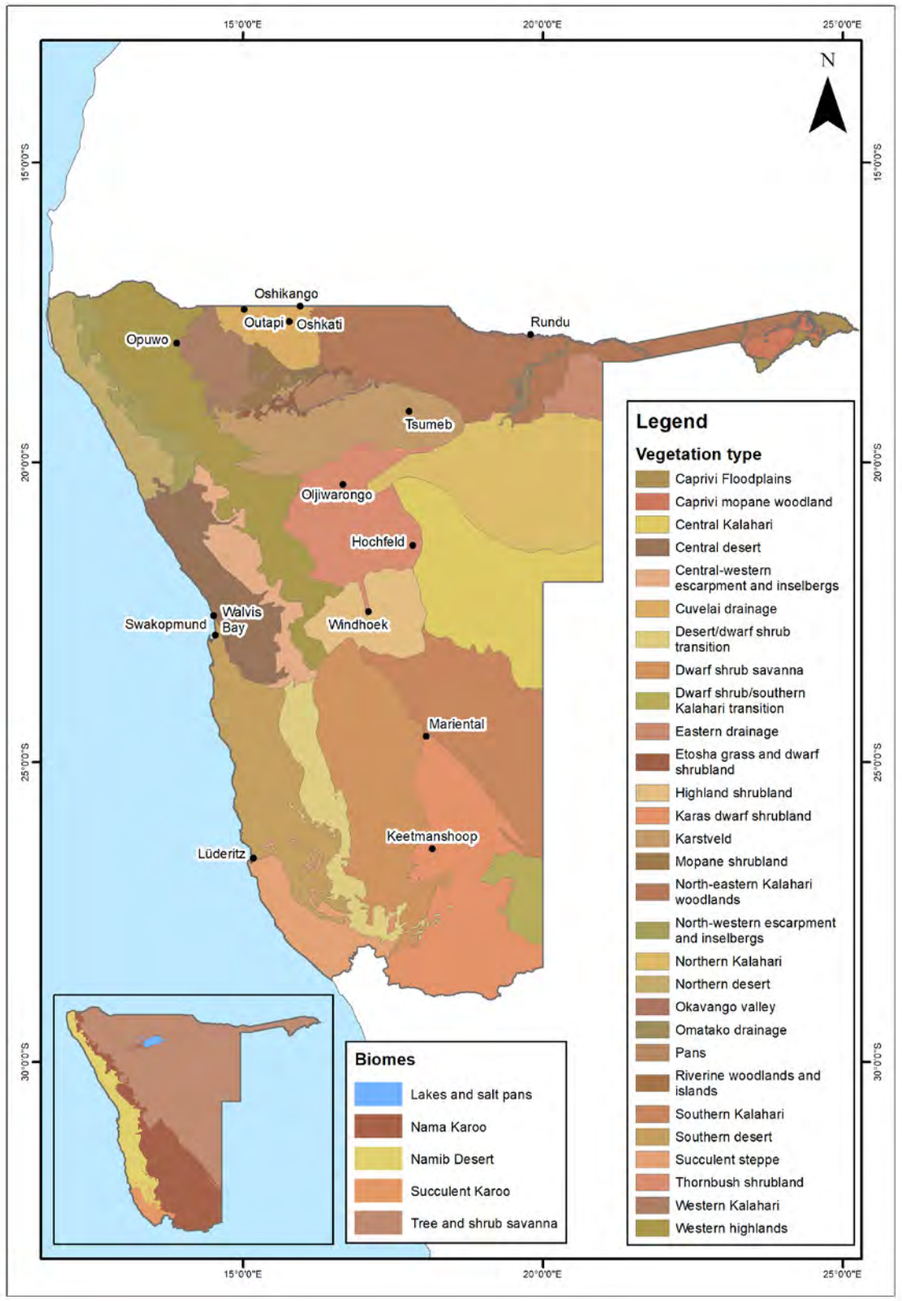


Figure 2-24 *Terrestrial biomes and vegetation types in Namibia (MEFT, 2014a)*

Stretching for over 1,570 km, Namibia's coastline displays exceptionally high biological productivity. The country's coastal zones consist of 78% sandy beaches, 16% rocky shores and 4% mixed sand and rocky shores, with lagoons making up only 2% of the shore (MEFT, 2020) (Figure 2-25). The marine ecosystems off Namibia's coast are influenced by the cold Benguela Current System, which produces a nutrient-rich upwelling system. This system supports some of the highest concentrations of marine life in the world and hosts multiple habitats including the littoral, shelf and abyssal zones, islands, lagoons and estuaries (MEFT, 2020). There are several islands situated off Namibia's southern coast. Perennial rivers empty into the ocean on the country's northern and southern boundaries and stormwater from 10 major ephemeral rivers occasionally reach the sea along Namibia's northern coast. The coastline has four important bays and inlets: Lüderitz; Walvis Bay (the only deep-water port); Swakopmund; and Henties Bay (MEFT, 2020).

In addition to Namibia's marine wealth, Namibia also has wetland systems. Wetlands are defined as land or areas such as marshes or swamps that are covered intermittently with shallow water or are saturated with moisture (RAMSAR, 2016). Wetland systems in Namibia include marine, estuarine, riverine, lacustrine and palustrine systems, which occupy less than 5% of land cover and are among Namibia's most threatened ecosystems. Due to Namibia's high level of aridity, wetlands are a critical refuge for biodiversity and a provider of essential ecosystem services (MEFT, 2020).

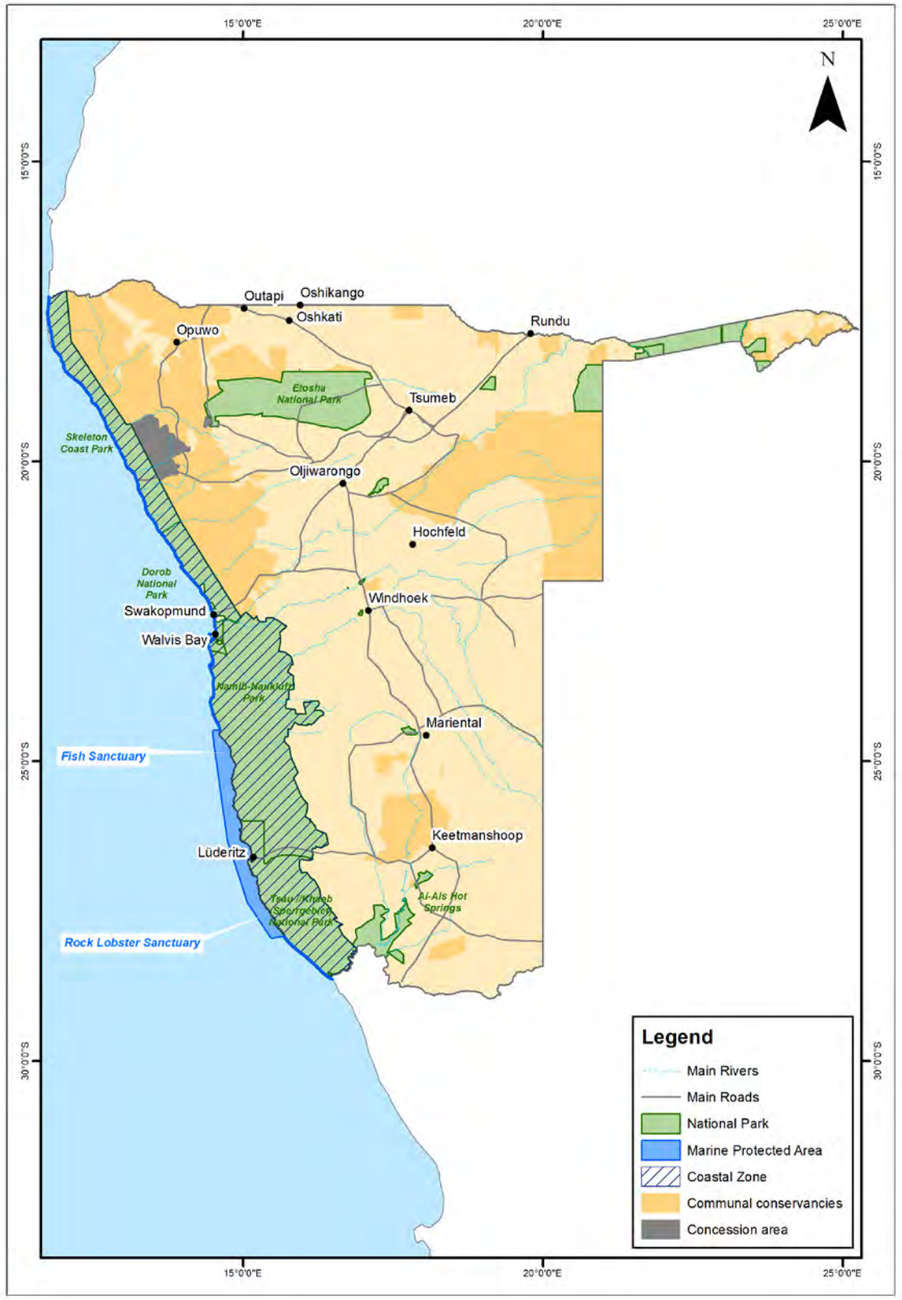


Figure 2-25 *Namibian coastal environment (GRN, 2011)*

Conservation & protected areas

Namibia has a proud heritage of conservation, which is recognized internationally. Namibia's system of national protected areas provides the core protection for the country's most important habitats and species of national and global significance. The protected areas network expanded by 28,983 km² (or 8.8%) from 2010 to 2013, with the bulk of this leading to an increase in coverage of the acacia savannah and broad-leafed savannah biomes (Namibian Association of CBNRM Support Organizations, 2018).

Figure 2-26 features a map of areas that fall within the protected areas network in Namibia. As indicated in Table 2-7, approximately 17% of Namibia is formally protected within 20 state-run protected areas. The protected areas network contributes significant value to Namibia's economy as it underpins the tourism industry – which is the second largest contributor to national income and the fastest growing economic sector (Lentley and Turpie, 2018).

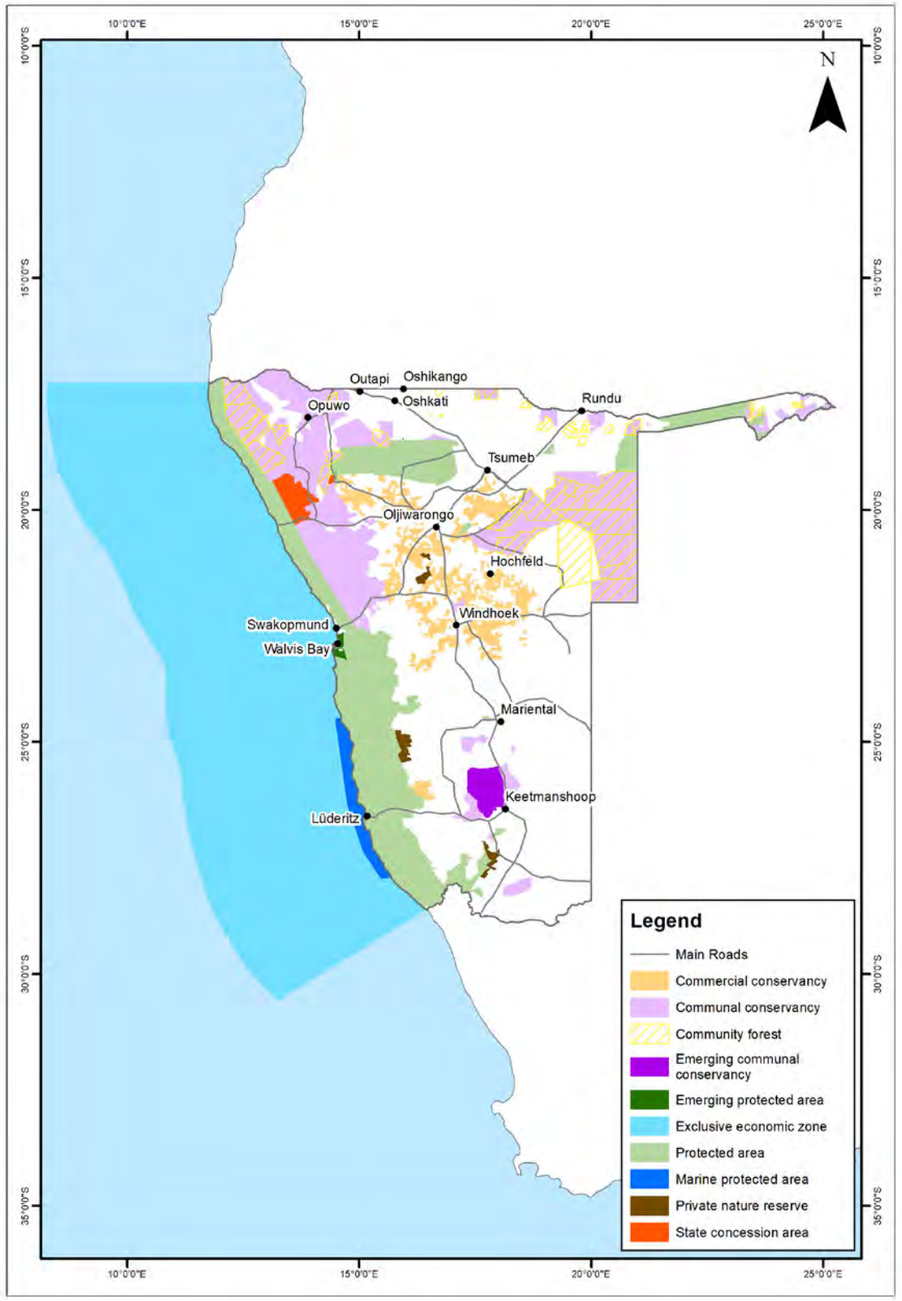


Figure 2-26 *Areas under various kinds of conservation management in Namibia (Lentley and Turpie 2018)*

Since the establishment of the first conservancy in 1998, Namibia has reported 59 gazetted conservancies on communal land, covering an area of more than 120 000 km²; this marks an increase of 163,151 km² of total land and 83 communal conservancies by the end of 2017. This area, combined with land covered by state protected areas (16.8%), tourism concessions (0.8%) and freehold conservancies (6.1%), brought the total land surface in Namibia covered by sustainable resource management and biodiversity objectives to 43.8% (Namibian Association of CBNRM Support Organizations, 2018). This represents 52.9% of all communal land in Namibia and 19.8% of Namibia's total land area. Table 2-7 provides a breakdown of the various biomes, habitats and areas and indicates their respective contribution to the protection of major biomes types and wetlands in the country.

Table 2-7 *Contributions to the protection of major biomes vegetation and wetlands in Namibia (Namibian Association of CBNRM Support Organizations, 2018)*

Habitat, biome or area	Communal conservancies	Community forests outside conservancies	Concession areas	State protected areas	Total coverage
Lakes and dams	15.6%	*not available*	*not available*	12.6%	29.6%
Oshanas and flood plains	33.4%	*not available*	*not available*	8.6%	42.0%
Pans	3.1%	*not available*	*not available*	77.8%	80.9%
Perennial rivers	33.8%	*not available*	*not available*	20.8%	54.6%
Ephemeral rivers	25.3%	*not available*	1.6%	11.1%	44.8%
Nama Karoo	14.6%	*not available*	1.4%	5.0%	22.0%
Namib Desert	13.9%	*not available*	3.2%	75.7%	93.4%
Succulent Karoo	*not available*	*not available*	*not available*	90.5%	90.5%
Acacia Savanna	19.5%	*not available*	0.2%	4.5%	37.6%
Broad-leafed Savanna	33.5%	2.1%	*not available*	8.8%	5.6%
Total area of Namibia	**19.8%**	**0.4%**	**0.8%**	**16.8%**	**43.9%**

Protected areas also cover Namibia's entire coastline, stretching from the Orange River mouth in the south (bordering South Africa) to the Kunene River mouth in the north (bordering Angola). The country's first marine protected area was established in 2009, stretching 400 km along the coast and 30 km offshore, incorporating 10 islands. There are four coastal wetlands in Namibia, which comprise extensive mud flats and shallow marine and estuarine

habitats; they provide important feeding and breeding grounds to a large number of migratory birds, wading birds and seabirds. Of the four coastal wetlands, three are listed as Wetlands of International Importance along the coast of Namibia. The Walvis Bay Wetland supports more than 100,000 birds and is recognized as the most important wetland in terms of bird diversity in southern Africa.

The wetland at Sandwich Harbour supports up to 315,000 birds of 115 species, making it southern Africa's single most important coastal wetland for migratory and resident birds. The Orange River Mouth is the sixth richest coastal wetland in southern Africa in terms of bird abundance and a total of 64 wetland species have been recorded here. Supporting at least 72 species of wetland birds, the Kunene River mouth is the second richest coastal wetland for birds in Namibia. In addition, Nile Soft-Shelled Terrapins and Green Turtles have been found at the Kunene River mouth and Nile Crocodiles, Nile Monitors and five endemic fish species have been recorded in the estuary itself (MEFT, 2020).

Table 2-8 *Namibia's terrestrial and marine protected areas (Lentley and Turpie, 2018)*

Name	Area (km²)	Name	Area (km²)
Desert Parks	**Desert Parks**	**Small game parks and recreational areas**	
1. Namibnaukluft Park	49,768	**13.Popa Game Park**	0,25
2. Skeleton Coast Park	16,390	**14. Hardap Recreation Resort**	252
3. National West Coast Recreational Area (National Park)	7,800	**15. Daan Viljoen Game Park**	40
4. Sperrgebiet National Park	22,000	**16.Von Bach Recreation Resort**	43
5. /Ai-/Ais Hot Springs / Huns Mountains	4,611	**17.Gross-Barmen Hot Springs**	1
Less developed Wildlife parks		**18.Naute Recreation Resort**	225
7. Nkasa Rupara National Park (formerly) Mamili National Park	320	**19. South West Nature Reserve**	0,12
8. Bwabwata National Park	6,274	**20.Cape Cross Seal Reserve**	60
9. Mangetti National Park	420		
10. Khaudum National Park	3,842	**Walvis Bay**	
Developed Wildlife Parks		**Sandwich Harbour**	
11. Etosha National Park	22,935	**Orange River Mouth**	
12. Game Park and Mahango Game Reserve			

Biodiversity

Biodiversity refers to the variability among living organisms in terrestrial, marine and other aquatic ecosystems (United Nations, 1992). Biodiversity provides humans with food, medicine, fuel and other essentials, including water and climate regulatory services – vital assets for the well-being of people and economic growth of a country (MEFT, 2010). Alteration of the integrity of biodiversity at any level impairs the well-being of both humans and wildlife.

Globally, biodiversity loss is identified to be a major threat that is affecting – and will continue to affect – nature's well-being. It consequently impacts human survival and economic nourishment on the globe if no mitigation measures are taken.

Table 2-9 *Number of species in Namibia and their level of endemism*

Taxonomic groups	Number of described species in Namibia	% of species endemic to Namibia
Reptiles	254	28%
Insects	6,421	24%
Plants	4,334	17%
Amphibians	50	12%
Arachnids	618	11%
Fish	114	8%
Mammals	229	7%
Birds	676	2%

TERRESTRIAL

Namibia is one of the few dryland countries in the world with internationally recognized biodiversity hotspots. The most significant of these is the Tsau||Khaeb (formerly Sperrgebiet), situated in the Succulent Karoo floral kingdom in southern Namibia. This hotspot area has a unique biodiversity of terrestrial and marine species. The second hotspot is the rugged Namib Escarpment, which is part of Africa's great western escarpment, and is an area of particularly high endemism. Only a few species are endemic to the more tropical areas of north-eastern Namibia, while areas of high endemism are mainly concentrated in the arid and semi-arid west, central and southern parts of the country (Namibian Association of CBNRM Support Organizations, 2018)

ENDANGERED & VULNERABLE SPECIES

The International Union for Conservation of Nature (IUCN) Red List is a critical indicator of the health of the world's biodiversity that informs and catalyses action for biodiversity conservation and policy change; this makes it vital to protecting the natural resources needed to survive. The IUCN Red List is used to inform decisions taken by Multilateral Environmental Agreements and Goal 15 of the United Nations Sustainable Development Goals (SDGs).

In Namibia, land use change caused by natural and anthropogenic factors has placed pressure on ecosystems and habitats, placing several species on the IUCN Red List. These include plants (e.g. Aloe ramosissima), birds (e.g. African Black Oystercatcher), reptiles (e.g. Berger's Cape Tortoise), amphibians (e.g. Desert Dew Frog) and mamals (e.g. Black Rhinceros). Fourteen species are in the 'Critically Endangered' category, 35 are 'Endangered' and 83 are 'Vulnerable'. There is recognition that major gaps exist with respect to woody and non-woody plant species in large parts of the country. Of the red list species, 37.4% are terrestrial ecosystems and 20.4% are located in inland water ecosystems (IUCN, 2020).

HUMAN-WILDLIFE CONFLICT

Human-wildlife conflict (HWC), manifesting in the killing of livestock, loss of crops, damage to property and loss of life, occurs throughout Namibia on communal as well as freehold land and involves a variety of species. Most of the northern regions of Namibia display high incidents of HWC, which is aligned with the higher denisties of wildlife and people. HWC was shown to have a high impact on rural households especially those in hotspots such as close to protected areas where wildlife numbers are higher (Jones and Barnes, 2006).

HWC data for the period of April 2020 to March 2021 (MEFT, 2020/2021), shows that 1195 head of livestock were lost across the country (compared to 1422 in 2019/2020), with Kunene Region being the worst affected. Of the livestock kills, the three largest groupings were goats (499), cattle (455) and sheep (118). Kunene Region reported 24% of the losses followed by the regions of Omusati, Otjozondjupa, Oshikoto and Kavango East (10-12% each) (Figure 2-27). (The Ohangwena, Khomas, Omaheke, Hardap and //Kharas regions had a combined total of 50 cases (4%). Lions are the worst culprits and accounted for 33% of the losses, with leopards (18%), hyenas (17%) and wild dogs (10%) also causing a lot of livestock losses.

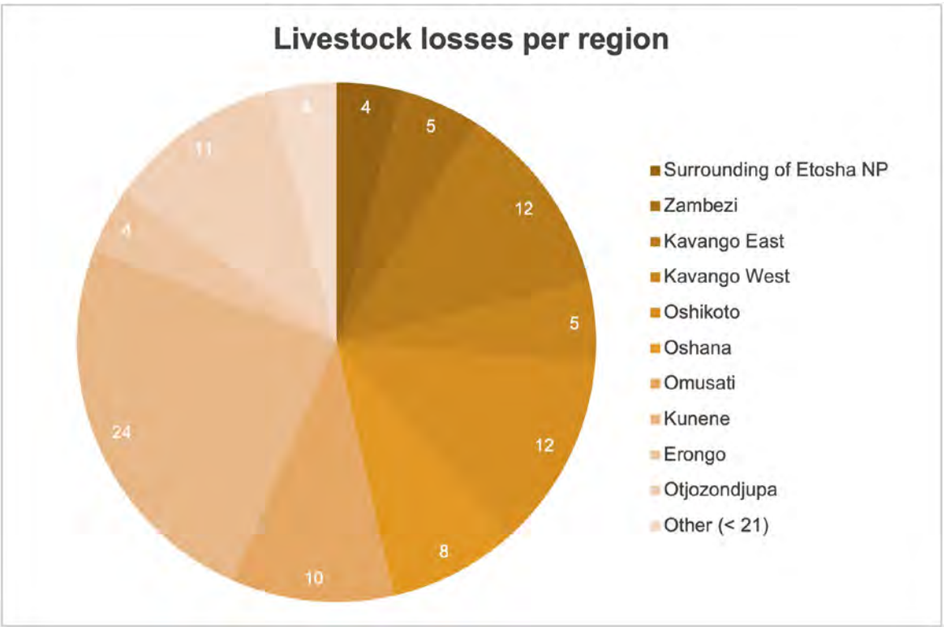
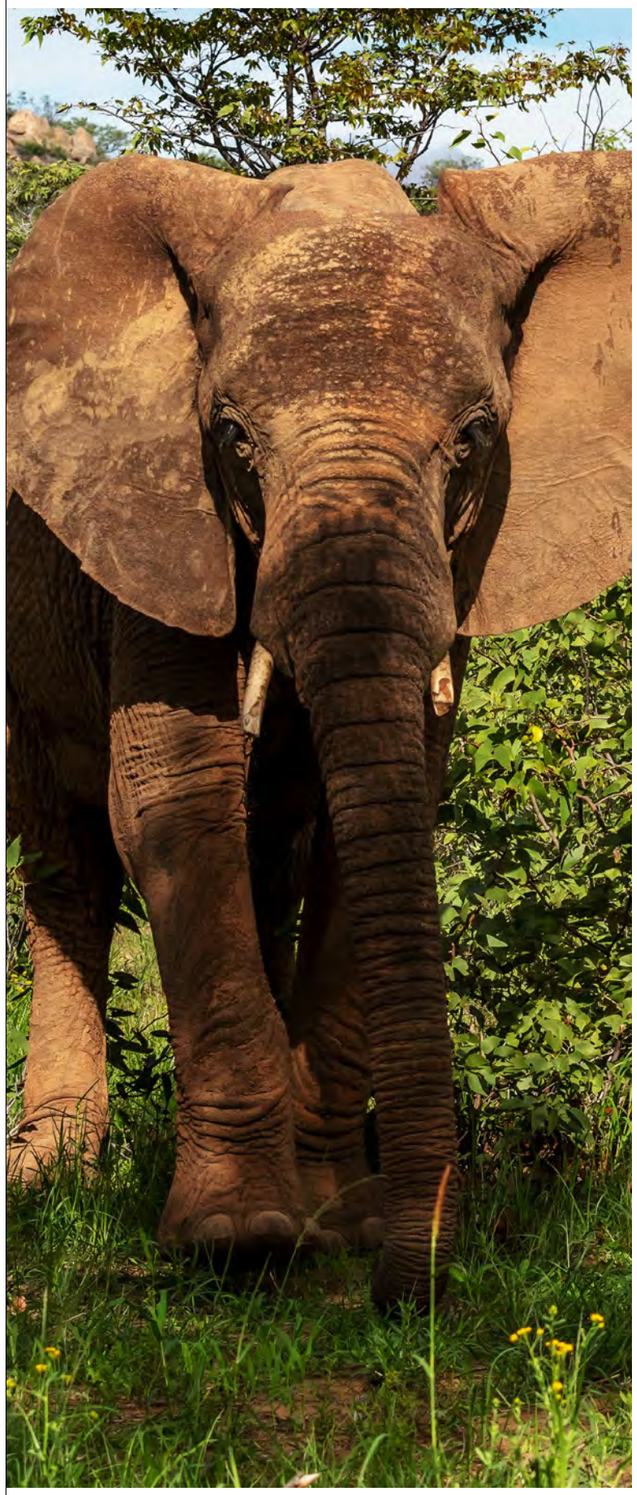


Figure 2-27 *Livestock losses per region (MEFT, 2020/2021)*

Nearly 660 hectares of crop fields were destroyed by various wildlife species compared to nearly 1,600 hectares in 2019/2020. Kavango West and Kunene are the two regions that were the worst affected, and elephants were mainly responsible for crop destruction. Several problem causing animals were destroyed by MEFT staff or the affected party. During 2020/2021, a total of 134 problem animals were destroyed compared to 84 problem animals in 2019/2020, an increase that may possibly be attributed to drought conditions. Eight people lost their lives to wildlife during the year (seven to crocodile and one to elephant) in Zambezi and Kavango East and West Regions. Furthermore, fourty-one people were injured by wildlife, mainly due to leopards (14), hippos (7), crocodiles (7) and lions (3). Wildlife also cause damage to property, such as fences, buildings, water tanks and pipes, reservoirs and so forth. Several reports were received about property damaged, mainly by elephants. In southern regions baboons also cause damage (MEFT, 2020/2021).

WILDLIFE CRIME

Wildlife crime remains a severe threat to Namibia's economy and biodiversity, as well as to local livelihoods. A large number of wildlife crime cases are related to poaching for meat, mainly affecting antelope. While all wildlife crime cases are treated as serious, data is collected related to the following high-value species: elephant, rhinoceroses (black and white rhino combined) and pangolin. Rhinos currently represent the most valuable and sought-after wildlife crime target. Of the all registered cases in 2019, pangolin was by far the most-targeted high-value species, representing 21% of all cases. These are often trafficked alive and can be rehabilitated if seized alive. Elephant cases make up a significant percentage (12%) and usually consist of ivory seizures. Rhino cases make up 7% of the total; many are pre-emptive cases where the animals can be saved (Namibian Parks and Wildlife, 2019).



Elephant in Etosha National Park | Alan J. Hendry

According to the Namibian Chamber of Environment (NCE), elephants were most notably increasing in population numbers, after a 50 year decline due to the increase in the demand for ivory. The African Savanah Elephant was recently classified under the endangered species group by the Union for the Conservation of Nature (IUCN). The most recent elephant census was undertaken during 2014 and 2015 as part of the Great Elephant Census (GEC). The census revealed an increase in the elephant population by approximately 4,305 (Thomson, 2021). The increase was also coupled by the decrease in the rate of poaching, recent statistics indicated an 85% decline in the number of elephants poached from 2014 (78 elephants poached) to 2020 (11 elephants poached) (Shikongo, 2021).

Between 2018 and 2019, there has been an increase in wildlife crime registered cases related to high-value species, growing from 115 in 2018 to 174 in 2019.

Figure 2-28 provides a regional distribution of wildlife crimes across the country. The map shows that the highest incidence of wildlife crimes is in the central, eastern and north-eastern parts of Namibia. The highest number of incidents were recorded in the Otjozondjupa Region. Low wildlife densities and fewer high-value species explain the low prevalence of wildlife crime in the south.According to the Namibian Chamber of Environment (NCE), elephants were most notably increasing in population numbers, after a 50 year decline due to the increase in the demand for ivory. The African Savanah Elephant was recently classified under the endangered species group by the Union for the Conservation of Nature (IUCN). The most recent elephant census was undertaken during 2014 and 2015 as part of the Great Elephant Census (GEC). The census revealed an increase in the elephant population by approximately 4,305 (Thomson, 2021). The increase was also coupled by the decrease in the rate of poaching, recent statistics indicated an 85% decline in the number of elephants poached from 2014 (78 elephants poached) to 2020 (11 elephants poached) (Shikongo, 2021).

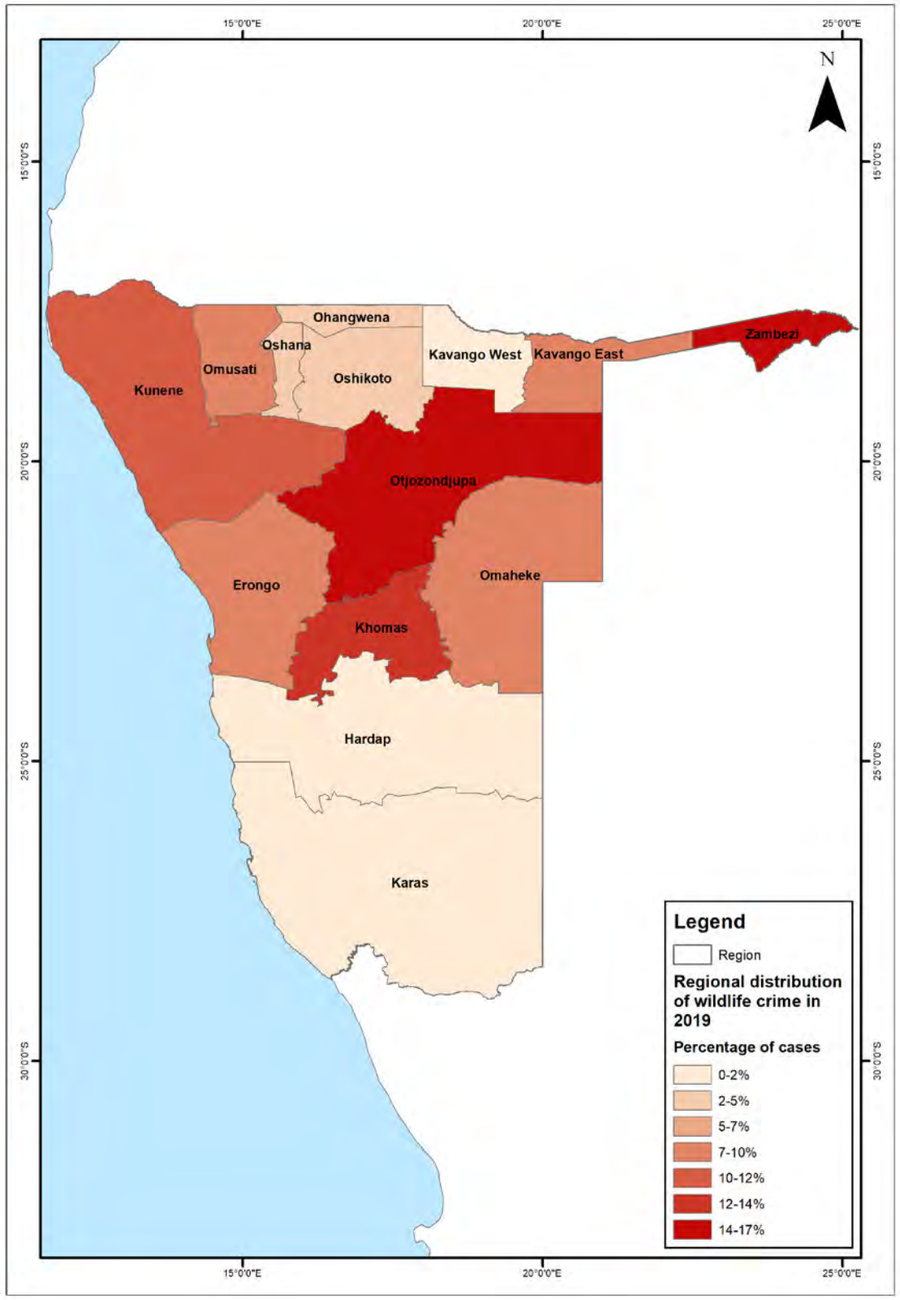


Figure 2-28 *Regional distribution of wildlife crime in Namibia in 2019 (Namibian Parks and Wildlife, 2019)*

Within the realm of biodiversity, genetic diversity refers to the diversity (or genetic variability) within species. Namibia's plant and animal genetic resources are particularly important for the sustainable development of Namibia's agriculture industry and to improve food security, especially given the predicted impacts of climate change on the agriculture sector (MEFT, 2014b).

The country's genetic diversity seems to be declining in natural ecosystems as well as in livestock production systems, except poultry (Table 2-10). Indigenous breeds of livestock and crops have been replaced to a large extent by exotic breeds and crops, which are often poorly adapted to Namibia's harsh farming environment. There has been a gradual increase in the total number of human-wildlife conflict incidents in conservancies, where livestock attacks increased considerably in 2017 (Namibian Association of CBNRM Support Organizations, 2018).

Table 2-10 *Livestock Census Summary for 2014 and 2015 (NSA, 2015)*

Species	2014	2015	% change
Cattle	2,882,489	2,777,545	-4%
Sheep	2,044,156	1,973,393	-3%
Goats	1,892,439	1,868,535	-1%
Horses	55,241	47,151	-15%
Donkeys	159,028	148,859	-6%
Pigs	68,710	62,945	-8%
Poultry	3,436,430	4,054,529	18%
Dogs	135,549	129,313	-5%

MARINE SPECIES

Namibia has one of the post productive fishing grounds in the world, with rich populations of fish forming the basis for the Namibian fisheries sector. The country's fishery sector includes industrialized marine capture fisheries, recreational fisheries, inland capture fisheries, mariculture and freshwater aquaculture. The 200 nautical mile Exclusive Economic Zone (EEZ) contains about 20 different species – consisting primarily of small pelagic species (such as pilchard, hake and horse mackerel) as well as large pelagic species including adult mackerel, demersal hake and other deep sea species (such as monkfish, sole and crab) (MFMR, 2013). The status of selected marine species as at 2013 (the last available dataset) and a short description is provided below:

- **Hake** (*Merluccius Capensis and M. Paradoxus*): In 2013, the total hake biomass was estimated to be around 1.39 million tonnes. This reflects a 70% increase in the total biomass (from 819,954 tonnes of 2012). The increase in total biomass is mainly due to the huge increase in the non-fishable biomass (hake size <36 cm) that has increased by 119 % since 2012 estimates. The fishable biomass (hake size >35 cm) has decreased;
- **Monkfish** (*Lophius vomerinus*): A 54% decrease in the relative total biomass was estimated, from 48,000 tonnes to 22,000 tonnes. The recorded length distribution showed a decrease in all length classes of the monkfish population, affecting both the recruits (small fish) and spawners (large fish). The observed decrease has resulted in the downward trend record of the relative total biomass for the 2012/2013 season, as compared to the 2011/2012 fishing season;
- **Horse mackerel** (*Trachurus Capensis*): In 2012, the total horse mackerel biomass was estimated at 1,579,000 tonnes. The annual average midwater catch-per-unit effort (CPUE) has decreased from 22.0 tonnes/hour recorded in 2011 to 16.7 tonnes/hour recorded in 2012;
- **Pilchard** (*Sardinops Sagax*): An increase in the sardine biomass was observed from 2008 to 2010. The recruitment of new sardine species was very low between 2010 and 2012. It was estimated that pilchard species declined from 331,000 tonnes in 2011 to 116,000 tonnes in 2012. This, together with the prevalent high natural mortality of sardine, resulted in a drastic decline of the stock, which is expected to continue in future; and
- **Deep sea red-crab** (*Chaceon erytheiae*): An increase in the total deep sea red-crab biomass was observed from 2011 (estimated at ~7,000 tons) to 2012 (estimated at ~11,000 tons).

FRESHWATER AQUACULTURE

Aquaculture is defined in Namibia's Aquaculture Act (No. 18 of 2002) as "the farming and ranching of aquatic organisms". Aquaculture offers tremendous opportunities for Namibia. This growth industry can improve food security, reduce poverty, create employment and increase inward investment to the country. In addition, aquaculture represents a sustainable economic use of our coastal and inland living aquatic resources, which means that aquaculture activities can grow in the future – providing economic opportunity without depleting non-renewable resources. There are currently four aquaculture centres producing fingerlings for the production of fish by fish farmers, cooperatives and the Ministry of Fisheries and Marine Resources (MFMR) fish farms at Epalela and Onavivi. These centres include Onavivi Inland Aquaculture Centre (Onavivi IAC), Ongwediva Inland Aquaculture Centre (OIAC), Kamutjonga Inland Fisheries Institute (KIFI) and Hardap Inland Aquaculture Centre (HAIC). Table 2-11 describes the overall fish production and aquaculture centres across Namibia.

Table 2-11 *Fingerling and fish production at aquaculture centres*

Aquaculture Centre	Fingerling production (number)			Fish production (tons)	
	Tilapia	Catfish	Carp	Tilapia	Catfish
Onavivi IAC+ Epalela Fish Farm	655,148	977,374	0	33,7	1.26
KIFI	250,000	500,000	0	0	0
Karovo + Mpungu Fish farms	0	0	0	2,43	0
Hardap IAC	205,000	15,000	11,100	0	0
Total	**1,110,148**	**1,492,374**	**1,100**	**35,7**	**1,26**

2.5

Landcover, ecosystems & biodiversity - challenges & responses

This section highlights the most prominent challenges pertaining to land cover ecosystems and biodiversity and the responses that have been implemented. It also highlights selected opportunities that might be imbedded in the challenges Namibia is facing. A recommended way forward is presented at the end of Chapter 2.

2.5.1

Land cover changes

Land cover changes and the condition and quality of soil and land is closely interlinked. As described in Section 2.2.3, land degradation and the resulting land cover changes are caused by multiple factors, of which population pressure is an important part. The increase in unsustainable use of timber for fuel and domestic use clearing for infrastructure development pose severe strain on the environment, as do uncontrolled wildfires, selective logging through timber concessions, unlicensed curio carving and habitat destruction by elephants. Deforestation and woody biomass loss not only leads to the fewer resources for human activities, but it also results in desertification and severe degradation of land (MEFT, 2020).

Bush encroachment has led to the rapid decrease in previously classified grassland (shrubland and savanna) areas (MEFT, 2020). This phenomenon has severe negative consequences on key ecosystem services, especially agricultural productivity and groundwater recharge (UNIDO, 2020). Bush encroachment influences groundwater recharge through the mechanism of evapotranspiration; it intercepts some rainwater before it reaches the ground, which then evaporates into the atmosphere. Bush also competes with grasses to take up significant amounts of water from the soil through their root systems. In this process, the main loss of water occurs during transpiration (Birch et al., 2017).

Several integrated initiatives are underway to help address the impact of land cover changes on the Namibian landscape and people. Namibia is a signatory of the UNCCD and has an active management plan in place to combat desertification. In addition, Namibia contributes to land assessments conducted by the UN FAO (Veshiyele, 2019). The impact of land cover changes on land use and ecosystem services are discussed in Chapter 3 – Environmental resources and their use.

2.5.2

Ecosystems degradation & biodiversity loss

Namibia's wetlands have been identified as the most threatened ecosystems. The country's wetlands are highly vulnerable to a variety of threats such as pollution and human activity. The added stress of climate change is likely to further exacerbate the ability of Namibia's wetlands to provide valuable ecological services such as water retention, purification and flood attenuation. In addition, the river mouths of the Cuvelai River Basin are wetlands of international importance under the Ramsar convention. These wetlands are likely to suffer severe ecological impacts as a result of reduced flow regimes and over-abstraction in future decades (MEFT, 2014a).

Globally, biodiversity loss is identified as a major threat affecting the well-being of wildlife, with consequent impacts on human survival and economic nourishment. Despite being rich in biodiversity, Namibia continues experiencing a rapid loss in biodiversity – mainly from anthropogenic rather than natural influences (MEFT, 2014a). The increasing population – at 2,324,388 (2016) in resource-abundant areas – places severe strain on the environment. This relates to the unsustainable land management practices and harvesting of forest and woodland resources, clearing of large tracks of land for farming and housing, and problems such as bush encroachment by invader species (MEFT, 2014b). Bush fires are also a major threat to national parks such as Etosha, Namib Naukluft and those in the north-east (MEFT, 2014a), and is discussed at length in Chapter 5 – Extreme events and disasters.

Namibia is a signatory of the United Nations Convention on Biological Diversity (UNCBD) and its commitments are managed through the Multilateral Environment Agreement (MEA) division of the MEFT. In line with the aims of the UNCBD, the MEFT has set the following three targets, to help protect ecosystems and biodiversity:

- Develop national strategies, plans and programmes for biodiversity and sustainable land management;
- Integrate sustainable land management into relevant sectoral and cross-sectoral plans, programmes and policies; and
- Report to the UNCBD and UNCCD.
- To meet these targets, Namibia's second National Biodiversity Strategy and Action Plan (NBSAP II) is under implementation. This plan is formulated to run from 2013 to 2022 and has to date produced the following outputs (Andreas, 2019):
- Developed a baseline for biodiversity expenditure in Namibia;
- Compiled and inventory of ecosystem services in Namibia;
- Conducted a feasibility study of natural capital accounts in Namibia and fast-tracked the compilation of water accounts; and
- Conducted a series of research projects on The Economics of Ecosystems and Biodiversity (TEEBs):
  - The value of ecosystem services;
  - State protected area financing; and
  - Payments for ecosystem services.

Increasing wildlife human conflict

The increased level of HWC perceived in north-eastern regions such as Kunene and Caprivi remains a potential future threat to species such as elephants and large carnivores by jeopardising the currently positive attitudes of local communities towards wildlife. Although the conservancy approach was partly developed to provide local communities with income from the use of wildlife that could offset HWC losses, conservation success has led to increased and unforeseen HWC problems. The government has been using CBNRM as an approach to internalize the costs and benefits of living with wildlife.

Under the Human-Wildlife Conflict Self-Reliance Scheme 45 Conservancies received the amount of N$2,700,000 for livestock losses and crop damage for the year 2020 (MEFT, 2020/2021). Payouts for State land and resettlement farms for 2020 included the following: for livestock losses 320 people were paid out an amount of N$1,260,301; for crop damage 626 people were paid out an amount of N$1,387,150; for injuries 14 people were paid out an amount of N$140,000; and for death cases three families were paid out an amount of N$300,000.

The MEFT staff routinely investigate HWC cases to verify information received, and take appropriate action, which includes verification for the HWC Self-reliance Scheme, the translocation or destruction of problem causing animals (including snakes), chasing back into Parks (elephants) the deterring of problem causing animals, closing of holes in Park fences, the construction of ring trenches and stone walls around reservoirs and water tanks, the recovery of human remains, awareness creation, information sharing and advice.

Over the year, areas with chronic HWC have been identified through the use of the newly upgraded HWC database. Technical solutions for mitigating HWC in Kunene Region included the construction of five protection walls around water infrastructure, the construction of one new elephant dam and repair of a second dam, the replacement of three diesel pumps with solar installations, the drilling and rehabilitation of 18 boreholes, the construction of seven predator proof kraals in five Conservancies, and fitting of ten elephants with collars to facilitate early warning for communities. Furthermore, HWC awareness has been ongoing.

Although measures are being put in place to mitigate HWC, consideration should be given to integrated coordination between local, regional/district and national and international levels to strengthen the government response.

2.5.3

Threats to inland fisheries & marine resources

Namibia's arid climate means that inland fisheries are limited, with perennial rivers located only in the southern and northern border areas. Overfishing, notably in the northern regions, poses a threat to biodiversity. This is exacerbated by the use of illegal fishing gear such as monofilament nets, as well as challenges and governance issues in transboundary fisheries management.

Marine biodiversity off the Namibian coast declines from south to north. This is an anomaly, as generally biodiversity increases as one moves from the poles to the tropics.
A southward movement of warm tropical waters reduces marine biodiversity in Namibia. The impact is expected to be exacerbated by water flow reduction at river mouths (including the coastal Ramsar sites) under the combined pressure of increased human water demand and increased temperature and evaporation (MFMR, 2013). Furthermore, fish and aquatic invertebrate stocks – as well as aquatic plants – are threatened by habitat loss and alteration due to off-shore mining and exploration, land-based pollution, invasive species and inconsistencies in the Benguela upwelling system (MEFT, 2020). In a response to declining fish stocks, a community-managed fisheries reserve has reportedly been established which currently comprises 10 sancturies.

Namibia and its regional partners (Angola and South Africa) are implementing Marine Spatial Planning (MSP) under the framework of the Benguela Current Convention (BCC). To ensure coordination across national jurisdictions with the bordering countries, a Regional Technical Working Group under the BCC has developed an agreed MSP strategy to ensure consistency and coherence in MSP across the three BCC parties.

Namibia is progressing well with the process of identifying new areas that meet the Ecologically or Biologically Significant Marine Area (EBSA) criteria and updating the existing recognized EBSAs within the marine space by incorporating new scientific knowledge. The new and updated EBSAs were presented to the NBSAP Steering Committee and will be fed into the MSP with the agreed conservation and management measure in the plan's regulations (MEFT, 2014b).

Namibia promulgated the Inland Fisheries Resources Act in 2003 in an attempt to conserve and protect aquatic ecosystems and promote sustainable development of inland fisheries resources. The MFMR, through stakeholder consultations and research, developed and gazetted new regulations for the conservation of inland fisheries, which came into effect on 1 December 2016. Furthermore, an aquaculture master plan has been developed and a task team is expected to be established to oversee its implementation.

2.5.4

Threatened species

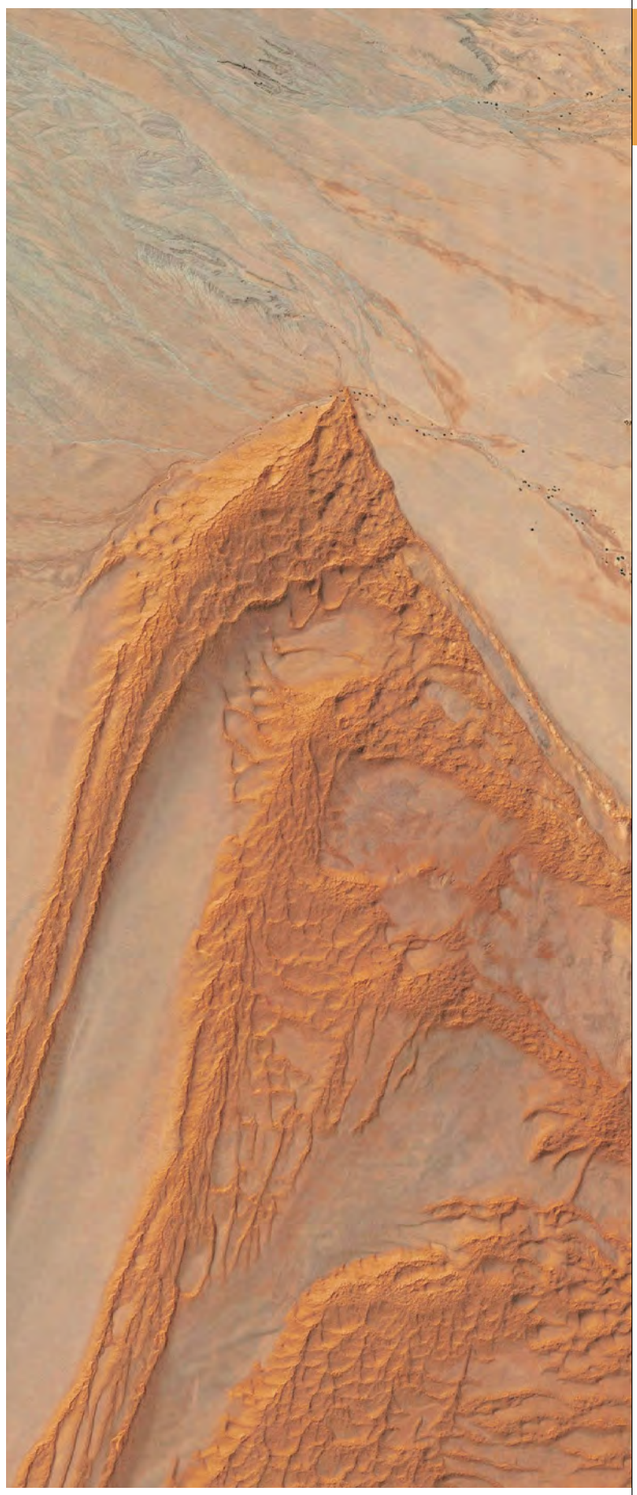
Under the Red List project of the National Botanical Research Institute (NBRI), a long-term monitoring programme is in place to monitor population parameters of dwarf succulents over time. NBRI also re-assessed the conservation status of two species, while a further 19 species that were not previously assessed were assigned a national status. The MEFT conducted two workshops on the Biodiversity Monitoring Framework for the Tsau //Khaeb National Park.

From 2014 to 2015, the MEFT and other Law Enforcement agencies have intensified security measures in protected areas and the poaching of high-value species declined significantly after reaching a high point in 2016. An anti-poaching awareness campaign was developed to raise awareness to the public, discourage involvement in poaching activities, and encourage the public to report poaching activities. The MEFT continued with the development of a Wildlife Monitoring System and database to ensure the capture of relevant data throughout the country and at all border crossings, international airports and harbours. To strengthen the prosecution of wildlife crimes, the MEFT is working on the new Parks and Wildlife Management Bill.

2.6

Way forward

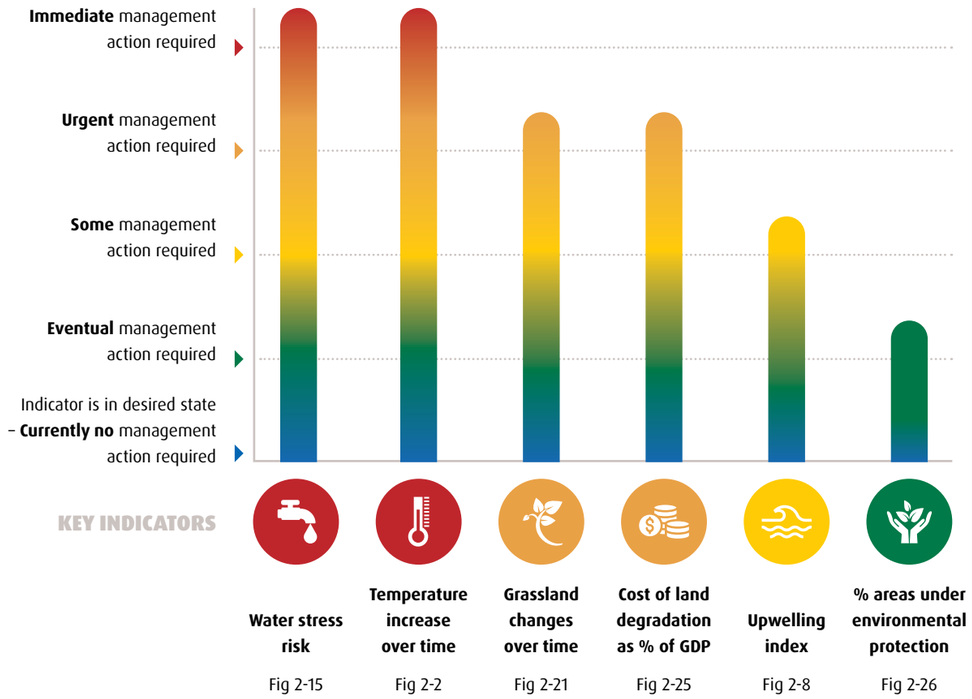
In charting a way forward for each of the FDES (2013) components of environmental management statistics, the most relevant indicators were aggregated into an action dashboard. This approach provides a structured way forward and can support policy-makers and decision-makers with the setting of priorities. It also indicates in which sub-components and underlying indicators intervention is most urgently needed. The replicability and reliability of these dashboards will improve as Namibia's environmental statistics system expands and aligns with international databases. Figure 2-29 provides the action dashboard for Namibia's environmental conditions and quality. Recommended actions on each of these indicators can be found in Section 5 of this chapter and involve a variety of approaches from policy and capacity-building, to funding and research.



Aerial view of Namibian plains | Mohit Kumar

4

Environmental conditions & quality



Management actions

Water stress Implement IWRM plan and continue to develop desalination plants along Namibia's coastline.

Tempreature increase Continue to apply measures set out in the voluntarily developed INDCs to contribute to climate change mitigation.

Grassland changes Undertake a grassland assessment to better manage and limit the extent of bush encroachment.

Cost of land degradation Continue to develop strategies, plans and programmes in collaboration with UNCBD and UNCCD.

Upwelling index Monitor upwelling changes over time closely and determine impact on marine life.

% areas under environmental protection Better implement and enforce environmental protection regulations.

Figure 2-29 *Action Dashboard for Namibia's environmental conditions and quality*

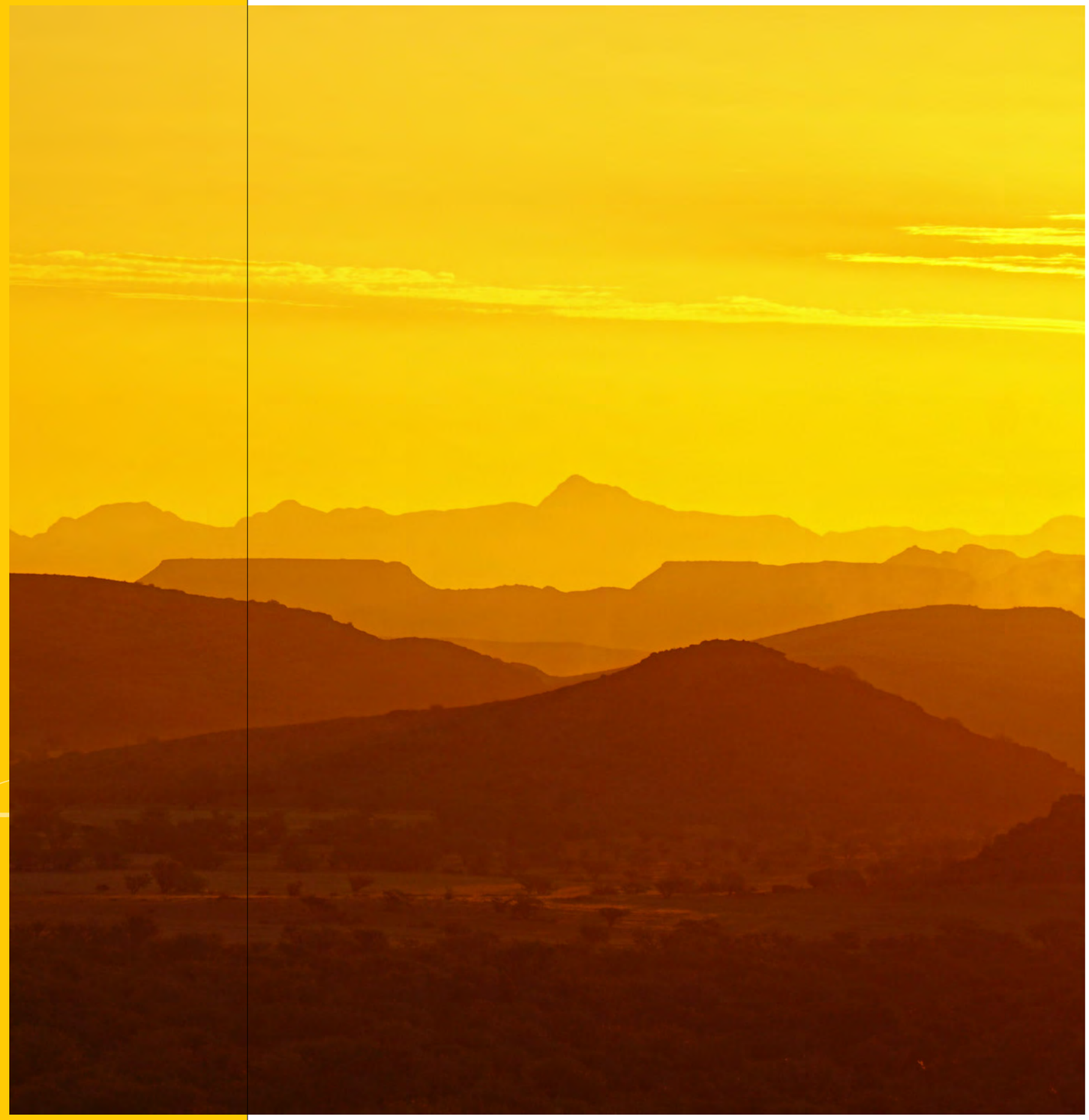
Dunes in Namib Desert | Jean Wimmerlan

Underpinning the success of the communal conservancy programme is the simple but revolutionary idea of turning communities into wildlife protectors...

POHAMBA SHIFETA

CHAPTER 3

Environmental Resources & Their Use



Sunset over the mountainscape | Joe McDaniel

Environmental resources (or assets) are naturally occurring living and non-living components of the earth, which collectively make up the biophysical environment and may provide benefits to humanity. Environmental resources include mineral and energy resources, soil resources, biological resources and water resources, and could be renewable or non-renewable.

United Nations, 2017

3.1

Introduction

Environmental resources are foundational to human existence on earth. They provide resources that human existence and quality of life depends on – such as shelter, food, health care, infrastructure, transportation, defense and recreation. Environmental conditions and quality in Namibia were discussed in Chapter 2. Chapter 3 shifts the focus to how environmental resources are used, the challenges that this utilization presents to society, and the responses that are required from the Namibian people to ensure that environmental resources in the country are used sustainably.

3.2

Status quo of environmental resources & their use

Status quo refers to the current state of specific environmental conditions relating to mineral resources, energy resources, land, biological resources and water. It is informed by how indicators relate to these conditions and how they are trending over time. The following 42 indicators are used in this section to report on the current state of environmental resource use:

- Nambia's export rank for non-fuel minerals in Africa
- Trends in mining's contribution to Namibia's GDP;
- Total taxes paid by mines;
- Mining's contribution to exports;
- Trends in Diamond output;
- Exports of ores and minerals;
- Uranium output;
- Energy supply composition;
- Namibia's installed capacity;
- Proportion of population with access to electricity;
- Renewable energy as a percentage of total energy supply;
- Hydropower as a percentage of total energy supply;
- Solar power as a percentage of total energy supply;
- Trends in land allocation;
- Communual land as a percentage of total land allocation;
- Urban areas as a percentage of total land allocation;
- Freehold farms as a percentage of total land allocation;

- State land as a percentage of total land allocation;
- Ownership patterns of agricultural land in Namibia in 2018;
- Percentage contribution to GDP of agriculture, forestry and fishing;
- Employment contribution of agriculture;
- Contribution of tourism to economy;
- Employment contribution of tourism;
- Travel and Tourism Competitiveness Index (TTCI);
- Tourist arrivals in Namibia;
- Fishery imports and exports;
- Trends in hake and mackerel catches;
- Inland fisheries annual catches;
- Percentage of population for whom subsistence farmering is the only income;
- Trends in Namibia's maize yield;
- Trends in Namibia's wheat yield;
- Trends in Namibia's millet yield;
- Head counts of cattle, goats, pigs and sheep between 2009 and 2018;
- Livestock slaughtered between 2009 and 2018;
- Export value of hides and skins;
- Contribution of trophy hunting to Namibia's economy;
- Percentage of water supply provided by groundwater in Namibia;
- Percentage of water supply provided by surface water in Namibia;
- Number and type of water schemes;
- Percentage of annual water consumption per largest customers;
- Percentage water supply by volume per region;
- Projected water demand for Namibia as of 2008; and
- Number ant types of water infrastructure projects by NamWater.

Sossusvlei Desert dunes | Felko Bähtlingk

3.3

Mineral resources - status quo

Mineral resources are by definition not renewable, and their depletion reduces their availability in the environment over time. The scale and intensity of their extraction can determine the amount of stress placed on the environment. Namibia is the fourth-largest exporter of non-fuel minerals in Africa, with this category contributing around half of all the country's exports over the past decade (Namibian Chamber of Mines, 2019). Namibia's mining industry produces diamonds, uranium, copper, magnesium, zinc, silver, gold, lead, semi-precious stones and industrial minerals. Diamonds and uranium represent the country's most valued commodities in terms of export revenue. The importance of the mining sector to the economy of Namibia has merited its inclusion in this ISOER. This chapter provides an overview of mining, how it impacts the environment and is in turn affected by natural and human induced phenomena.

3.3.1

Mining's contribution to the economy

Namibia is a country rich in mineral resources, the most valued of these being the diamondiferous beach and river gravels found along the Orange River and on the south-western coast – as highlighted in the map of Namibia's mines contained in Figure 3-1. The country's diamond resources are located both offshore and onshore. The Erongo Region, situated in the mid-western area of Namibia, is endowed with a large deposit of uranium. In addition to diamonds and uranium, Namibia also produces copper, magnesium, zinc, silver, gold, lead, semi-precious stones and industrial minerals. The majority of these minerals are located in the interior of the country, as highlighted in Figure 3-1.

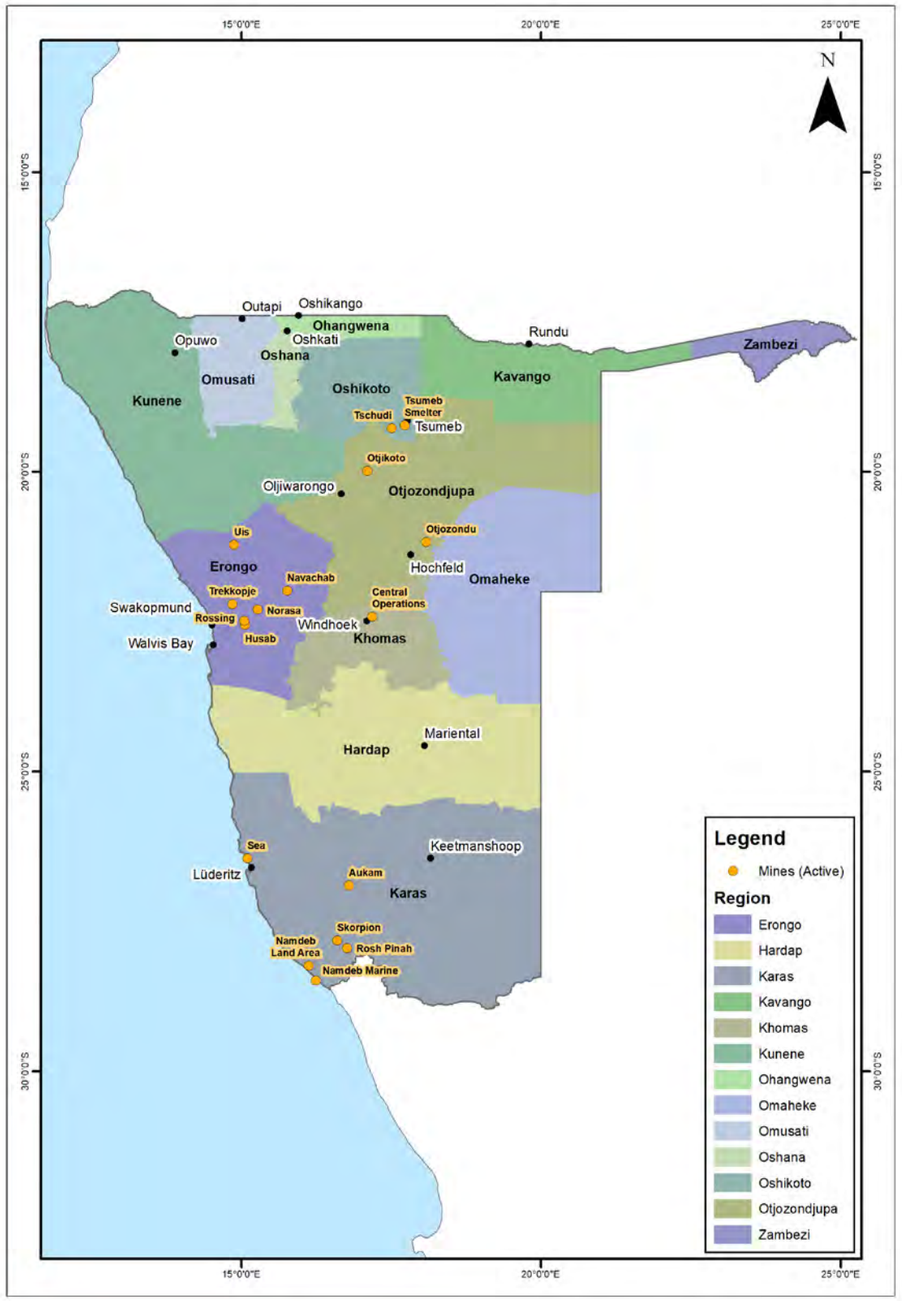


Figure 3-1 *Map of Mines in Namibia (Namibian Chamber of Mines, 2019)*

As of 2019, the mining industry's overall contribution to the Namibian economy averaged 9.3%, down from an average of 17% at the time of the commodity boom in 2008, as highlighted in the Figure 3-2. Despite this decline, mining remains the biggest primary sector, ahead of agriculture and fishing. In 2019, the mining sector directly employed 16,342 individuals, with wages and salaries totaling N$6.027 billion. Further calculations by the Namibian Chamber of Mines (2019) suggest that the mining industry created 114,394 downstream jobs, accounting for approximately 15.5% of Namibia's employed population of 735,742 (NSA, 2018). The industry maintained its high local expenditure component; N$13.405 billion was spent on local businesses and suppliers, providing additional sources of income for households and individuals (Namibian Chamber of Mines, 2019).

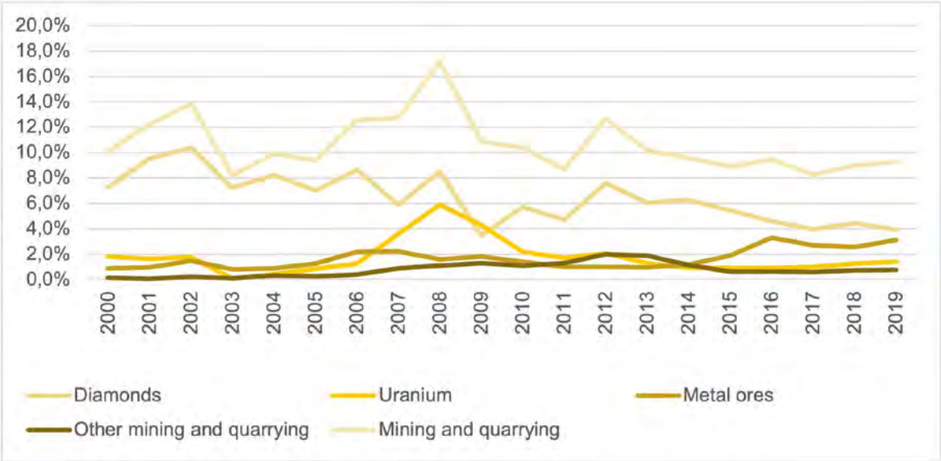


Figure 3-2 *Mining's contribution to GDP (%) between 2000 and 2018 (NSA, 2020)*

In addition to creating employment opportunities for Namibians, mineral resources form an important part of the government's revenue base through royalties, export levies and corporate taxes. The sector's total contribution to government revenue decreased by 7% between 2018 and 2019. This was caused by reduced diamond mining output and sales values realized from lower commodity prices. Total taxes paid by Chamber members in 2019 amounted to N$1.729 billion in royalties, N$243 million in export levies and N$1.437 billion in corporate tax. Minerals also make up the bulk of Namibia's exports; the value of these in 2019 was N$31.2 billion. This figure was approximately 51% of all goods leaving the country (Namibian Chamber of Mines, 2019).

3.3.2

Production & trade of minerals

Mining and quarrying contribute substantially to the value of goods and services produced by many countries including Namibia. The outputs of minerals such as metal ores (iron and non-ferrous), stone, sand and uranium are denominated in terms of tonnage, while diamonds are given in carats, which complicates direct comparison of outputs across different minerals. Indicators of the amounts of minerals extracted or produced – as well as their imports and exports – are important as they measure the pressure on these resources. More than half of Namibia's exports are mineral resources, valued at N$31.2 billion in 2019 (Namibian Chamber of Mines, 2019). Diamonds make up the largest share of mineral exports, followed by uranium and metal ores (Namibian Chamber of Mines, 2019).

Diamonds

In 2020, Namibia was among the top 10 diamond producing countries in the world (Chamber of Mines, 2019), even though diamond output decreased from 2 million carats to 1.7 million carats between 2018 and 2019, as evidenced in Figure 3-3. The reduced output has been driven by a decline in global commodity prices. The overall decline in diamond production is also partially due to land-based diamond deposits diminishing over time – declining from 1 million carats in 2007 to below half of that amount in 2019. The total output has, however, grown over the past 10 years, as Namibia's diamond output increasingly comes from offshore and deep-sea mining. Diamond production contributes to 15.6% of Namibia's total mining output (Namibian Chamber of Mines, 2019), with deep-sea mining contributing up to 76% of the total carats produced in 2019. These marine diamonds are mined through Namdeb, a 50/50 joint venture between the GRN and De Beers, a global diamond mining and trading company. The addition of marine-sourced diamonds to Namibia's output has brought marine-related impacts to the forefront.

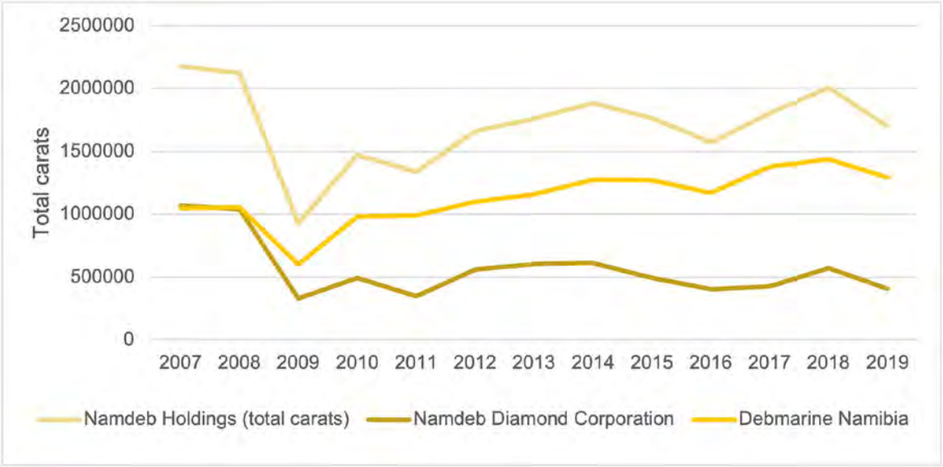


Figure 3-3 *Namdeb diamond output between 2007 and 2019 (Namibian Chamber of Mines, 2019)*

Uranium

In 2019, Namibia was the world's fourth largest producer of uranium, contributing to just above 10% of the world's supply (World Nuclear Association, 2020). During the same year, the country produced 5,476 tonnes of uranium, up from 2,993 tonnes produced in 2015. This represented a 83% increase, as displayed in Figure 3-4. The mid-western regions of Namibia have a large number of uranium deposits and prospects, with many of these first discovered in the 1960s. There are two active uranium mines in Namibia: Rössing and Husab. Once the Husab Mine reaches full production, Namibia is projected to become the world's second-largest producer of uranium oxide (World Nuclear Association, 2020). Rössing Uranium, which is majority-owned by Rio Tinto, is the country's longest-running open pit uranium mine, having been in operation since 1976.

In line with Namibia's increase in the production of uranium ore, there has been an upward trend in the monetary value of uranium exports, growing approximately 70% from N$5.4 billion to N$9.2 billion between 2013 and 2019 (Figure 3-4). Uranium's share in mineral resource exports has also increased over the same period from 25.6% to 29.4% (Namibian Chamber of Mines, 2019).

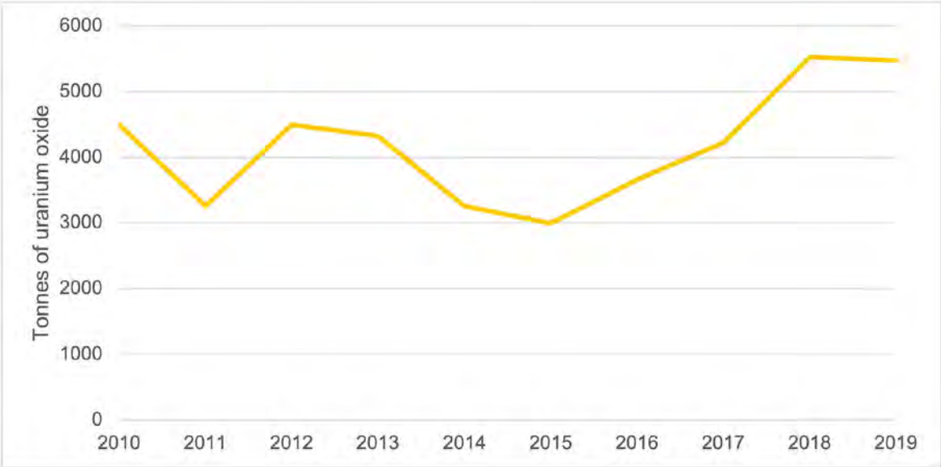


Figure 3-4 *Namibia's total uranium output (Chamber of Mines, 2019)*

Copper, metal ores & zinc

Namibia's metal ores – copper, magnesium, zinc, silver, gold and lead – make up a growing share of its exports. Over the past seven years, the monetary value of metal ore exports has tripled in value from approximately N$2 billion in 2013 to N$6 billion in 2019 (Figure 3-5). A large proportion of this economic value accrues from B2Gold's Otjikoto gold mine, which produced 5,429 kg of gold bullion in 2017, a 15% increase from 4,714 kg produced in 2016 (Namibian Chamber of Mines, 2019).

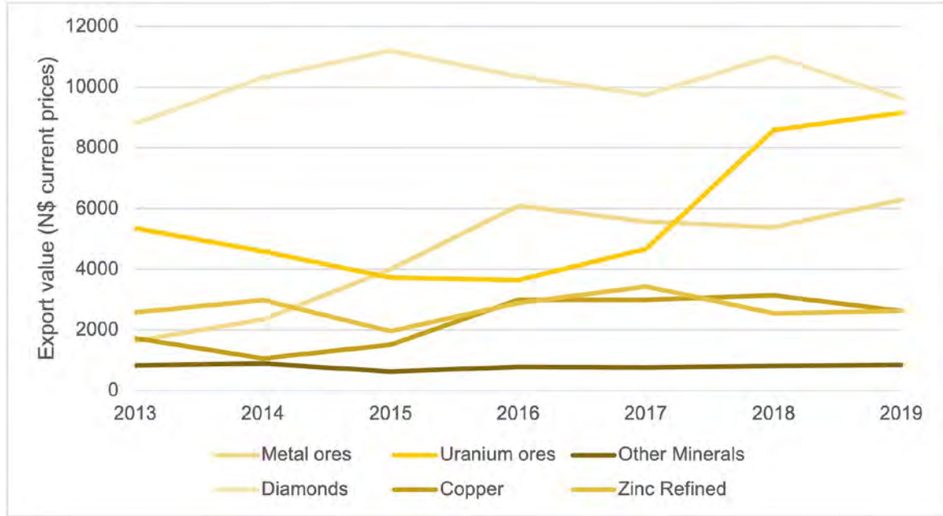


Figure 3-5 *Exports of ores and minerals (N$m current prices) (Chamber of Mines, 2019)*

Copper is Namibia's fourth largest mineral export, with a monetary value in 2019 of N$2.6 billion, up from N$1.7 billion in 2013 (Namibian Chamber of Mines, 2019). The Tschudi Copper Mine, situated in the Otavi Mountainland in northern Namibia, produced 15,466 tonnes of copper cathode in 2017, a reduction of 5.6% from the 16,391 tonnes produced in 2016 (Namibian Chamber of Mines, 2019).

A large share of Namibia's zinc production is mined from the Rosh Pinah Zinc Mine, where zinc concentrate output increased from 80,560 tonnes in 2016 to 97,364 tonnes of in 2017. Over the same period, refinery production decreased from 85,427 tonnes to 84,215 tonnes. In terms of exports, approximately N$2.6 billion worth of refined zinc was exported in 2019, making up 8.4% to the total mineral exports (Namibian Chamber of Mines, 2019).

Other minerals

Namibia also produces various types of industrial minerals, including graphite, wollastonite, bentonite, salt and others. Apart from graphite and salt, these minerals are mined on a small scale (Ministry of Mines and Energy, 2002). Namibia is also home to a wide variety of quality semi-precious stones, which are predominantly mined in the ||Kharas, Erongo and Kunene regions. These include quartz (rose, clear, strawberry and smoky), tourmaline, sodalite, topaz, varieties of beryl (aquamarine, heliodore and morganite), garnet, dioptase, chrysocolla and pyrophyllite and amethyst (Musiyarira et al., 2016). The export value of all non-core minerals as of 2019 was N$842 million (Namibian Chamber of Mines, 2019).

3.3.3

Mineral resources - challenges & responses

This section highlights the most prominent challenges pertaining to the extraction of mineral resources in Namibia and the responses that have been formulated and implemented. It also highlights selected opportunities that might be imbedded in the challenges Namibia is facing. A recommended way forward is presented at the end of Chapter 3.

The mining industry plays a vital role in the growth and development of Namibia's economy. However, it does impact environmental resources, in particular biodiversity, water resources and waste.

Biodiversity & ecosystem services

There are major overlaps in the location of critically endangered species, rare biodiversity areas and the presence of minerals in Namibia. Biodiversity and ecosystem services can be significantly affected throughout the life-of-mine due to factors such as: land clearance for facilities and infrastructure; pressures linked to mine-induced in-migration; habitat loss; pollution; and the unintended introduction of invasive species (Intergovernmental Forum, 2020).

Conserving and protecting biodiversity and ecosystem services have become increasingly important for both government and mining firms, in recognition of the role that biodiversity can play in supporting economies and operations and in maintaining the well-being of surrounding communities. In the context of Namibia's significant nature-based tourism, any compromising of the country's ecosystems and biodiversity could directly impact the economy and livelihoods. Many of the impacts of mining on biodiversity may be unavoidable, and should be carefully weighed up as communities and government balance development priorities with conservation needs. In response, it is crucial that government and mining firms collaborate to limit and restore any negative effects on biodiversity from mineral extraction, and offset the residual impacts that cannot be avoided.

The Namibian government has formulated policy to increase the protection of the country's natural resources from mining activities. The National Policy on Prospecting and Mining in Protected Areas (MEFT, 2018) outlines Namibia's policy regarding exploration and mining in protected areas. The framework aims to ensure that prospecting and mining activities do not cause any negative impacts to biodiversity, ecology and the tourism potential of protected areas. Moreover, it identifies protected areas that should not be exposed to prospecting or mining activities, due to their high conservation, aesthetic and tourism value. The policy also seeks to provide clarity on the different exploration and mining tenets that may be granted in protected areas. The policy excludes the following areas from prospecting:

- Biodiversity Priority Areas;
- High value tourism areas;
- Known breeding areas of certain species, including marine species;
- Important wetland areas;
- Areas with existing economic activities that would be compromized by prospecting and/or mining;
- Areas with the potential to be developed into economically viable tourist or other compatible operations, and
- Sites of high and/or unique cultural historic and/or archaeological value.

By applying these criteria, it was determined that the following protected areas be excluded from prospecting and mining: Cape Cross Seal Reserve; Daan Viljoen Game Park; Etosha National Park; Gross Barmen; Hardap Game Park; Nkasa Rupara National Park; Popa Falls; Von Bach Game Park; and the Waterberg Plateau Park. In addition, the following parks – which include marine protected zones – were also excluded from prospecting and mining: Ais National Park, Bwabwata National Park; Khaudum National Park; Mudumu National Park; Namib-Naukluft Park; Dorob National Park; Khaeb (Sperrgebiet) National Park; and the Skeleton Coast Park.

Water resources

Chapter 2 provided an analysis of the water availability risk Namibia is facing. The mining industry has an exceptionally high water usage rate. In the 2018/19 financial year, mines consumed 13,138,186m³ which amounts to 9.9% of NamWater's total water supply (NamWater, 2019). Mines predominantly use water for ore processing, cleaning, maintenance and consumption by staff. There are increasing levels of competition for the same water resources from agriculture, households and other industries.

It is imperative that the Namibian government coordinate with mining firms to ensure their approach to water management leads to the protection of the water availability and quality for its population and its ecosystems. This requires balancing various competing demands for water while ensuring access to quality drinking water and sanitation. In addition to governing the extraction of valuable water resources, government aims to ensure that water use, water discharges and water quality is managed efficiently. By managing water at the watershed level and regional scale, it is simpler to influence the changes needed to meet water usage goals.

Released in 2020, the Intergovernmental Forum's Mining Policy Framework proposes good practice guidelines for mining. It recommends a suite of measures to manage the water issues associated with mining. These include the implementation and enforcement of standards for the use of surface and groundwater. It also requires that mining entities ensure that the quality and quantity of mine effluent streams discharged to the environment are managed and treated to meet established effluent discharge guideline values. Mines should also ensure that water-leaching or percolating waste dumps, tailings storage areas and leach pads have equivalent protection. Practices and plans need to be put in place by mines to minimize the likelihood of impacts beyond the mining site, particularly potential transboundary impacts.

Namibia's mineral endowment implies that mining and the environment will continue to interact, hence there is a need for collaboration between mines and stakeholders to ensure that mineral resources are extracted in a sustainable manner (Abiye and Shaduka, 2017). There are various policies related to the governance of water resources within the context of the mining industry; however, the development of water management plans for each mine and the prevention of ground and surface water pollution remain challenges (GRN, 2010). For instance, the Minerals (Prospecting and Mining) Act, No. 33 of 1992, details certain provisions for groundwater abstraction. The Environmental Management Act (EMA), No. 7 of 2007, requires that all ecosystems be provided with sufficient water to meet their ecological needs and that adequate flow is available to sustain water dependent ecosystems. In addition to obtaining groundwater abstraction permits that comply with the purposes and mandates of the EMA, a mining company will also have to comply with water policies such as the Water Resources Management Act of 2013 (WRMA) (GRN, 2013).

Waste management

Waste management is a key consideration in the interaction between Namibia's mineral endowment and the environment. Mining processes expose mineralized rock at a much faster rate than natural erosion processes, and

these newly exposed materials release metals and chemicals as they are exposed to water and air (Intergovernmental Forum, 2020). In combination with chemicals needed in the extraction process, there are further risks of mining wastes releasing high concentrations of particles that can be harmful to the environment. Moreover, large quantities of non-mineralized materials and excess materials from mineral processing often need to be kept in perpetuity in manufactured structures such as tailings dams, which may have physical stability risks. Waste management responsibilities often extend well beyond mining operations into post-mine closure, with considerable risk associated with mine waste, as demonstrated by recent high-profile accidents around tailings dams (Intergovernmental Forum, 2020). Thus, applying a high standard to the management of pollution and waste is of utmost importance to mining firms, communities and government. The design and management of mine waste facilities is a key focus of government policy and legislation, and requires environmental assessment and permitting by competent authorities. A more detailed breakdown of the residuals emitted from mining process are captured in Chapter 4.

Abanoned mine sites

Namibia has 157 registered and likely in excess of 250 abandoned mine sites in total. These sites may pose a serious risk in terms of groundwater and soil contamination and dust pollution. There are a variety of abandoned mines in Namibia, both in terms of mining method, minerals mined and size. Depending on these variables, these mines have a negative visual impact and pose safety risks in terms of degradation of hazardous structures. The Otavi Mountainland and Erongo Region are the most affected regions with 19 and 63 abandoned mine sites respectively. Fuana and flora in the proximity of abandoned mines are threatened due to contaminated soil and water sources (BGR/GSN, 2010).

Abondoned mines remain an environmental and social hazard to the fauna, flora and communities in its proximity. The hazards are often compounded by loss of economic diversification in communities surrounding abandoned mines where job lossess and resulting migration to other areas are common. In 2010, Germany's Federal Institute for Geosciences and Natural Resources (BGR) in collaboration with the Geological Survey of Namibia (GSN) commissioned the adaptation of a Chilean framework for mining environmental liability remediation for Namibian conditions. The resulting handbook provides a technical framework to address the impacts caused by historical mining by remediating of abandoned mines that pose a significant risk to humans, the environment or economic activities (BGR and GSN, 2010).

In spite of the tools provided by this handbook, little action is taken on rehabilitating and/or securing abandoned mines in Namibia. A recent study by Salom and Kivinen (2020) indicated that the legal framework related to mine rehabilitation is fragmented and incomprehensive making it difficult to keep mine owners liable for rehabilitation. These authors recommend a holistic approach to addressing the complex issues surrounding mine closure, including implementing and monitoring a binding financing mechanism for mine rehabilitation and developing local skill sets in mine rehabilitation.

Sand mining

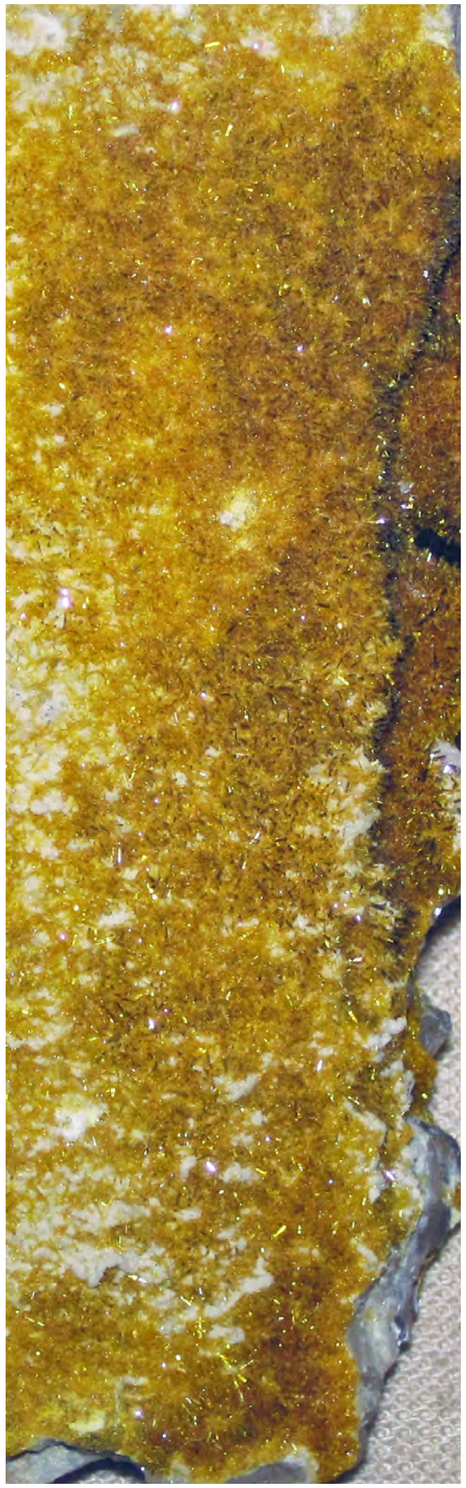
Illegal sand mining has been an increasing challenge in several areas in Namibia over the past decade, especially in the Northern part of the country. Unregulated sand mining and unrehabilitated minig pits has caused damage in communal areas, wildlife habitats and settlement areas, even leading to loss of human lives. Sand and gravel are indispensable to the construction industry, but it is a non-renewable resource that are essential for healthy ecosystems. Sand mining is a regulated activity requiring an environmental permit to operate legally, but these laws are

poorly enforced and undermined by lack of coordination and communication between National, regional and traditional authorities (Hans Seidel Foundation, 2020). In response to this crisis, MEFT is in the process of crafting new regulations for sand and gravel mining under the Environmental Management Act (Act No. 7 of 2007). The new regulations will include stricter measures and procedures as well us more severe consequences for those not adhering to the law.

2.4

Energy resources - status quo

Energy resources can broadly be defined as the capture, extraction or manufacturing of fuels or energy in forms which are ready for general final use consumption (United Nations, 2017). Energy is produced for human consumption in different ways, depending on its source. Energy production, transformation, distribution and consumption involve different efficiency rates and these processes cause distinct environmental impacts, such as land use change, air pollution, GHG emissions and waste. A careful analysis of energy production and its subsequent distribution is key to environmental sustainability in Namibia.



Uranophane from Rossing Mine | Wikicommons

3.4.1

Energy production

Imported power

NamPower, the state energy utility, reported 4,435 gigawatt hours (GWh) units into the system in 2019. This was down from 4,826 GWh in 2018 (NamPower, 2020). A breakdown of the country's energy supply composition is presented in Figure 3-6. Between July 2018 and June 2019, 50.7% of the supplied energy consisted of energy imports from neighbouring southern African countries, highlighting a large dependency on imported electricity. More specifically, 37.1% of Namibia's energy supply came from Eskom, South Africa's state energy company.

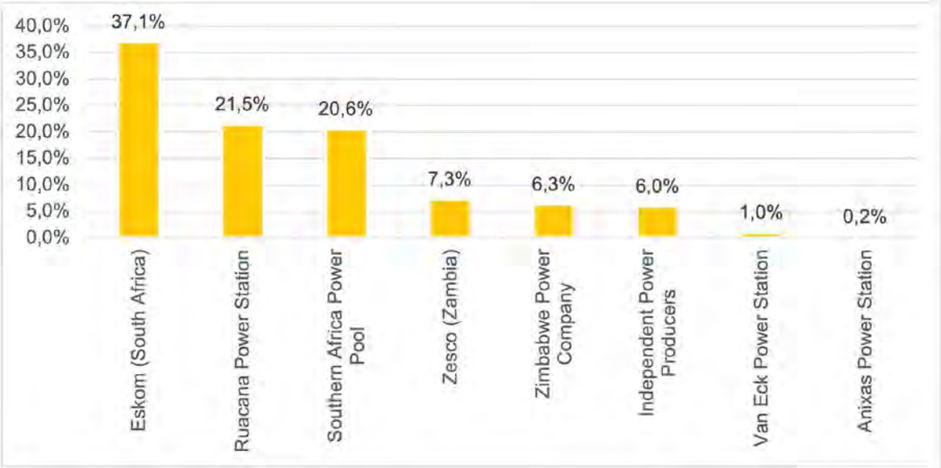


Figure 3-6 *Namibia's energy supply composition 2018/2019 (NamPower, 2020)*

Namibia's installed capacity

Namibia produces approximately 33% of its total supply needs in-country.This is achieved through a combination of coal and hydroelectrical power stations. Namibia's total installed capacity for 2019 is illustrated in Figure 3-7 and indicates that the bulk of power produced in Namibia is generated at Ruacana hydro-power station. Climate change – and the resulting uncertainties in water supply and rainfall patterns – will make Namibia particularly vulnerable to power shortages in the medium- to long-term.

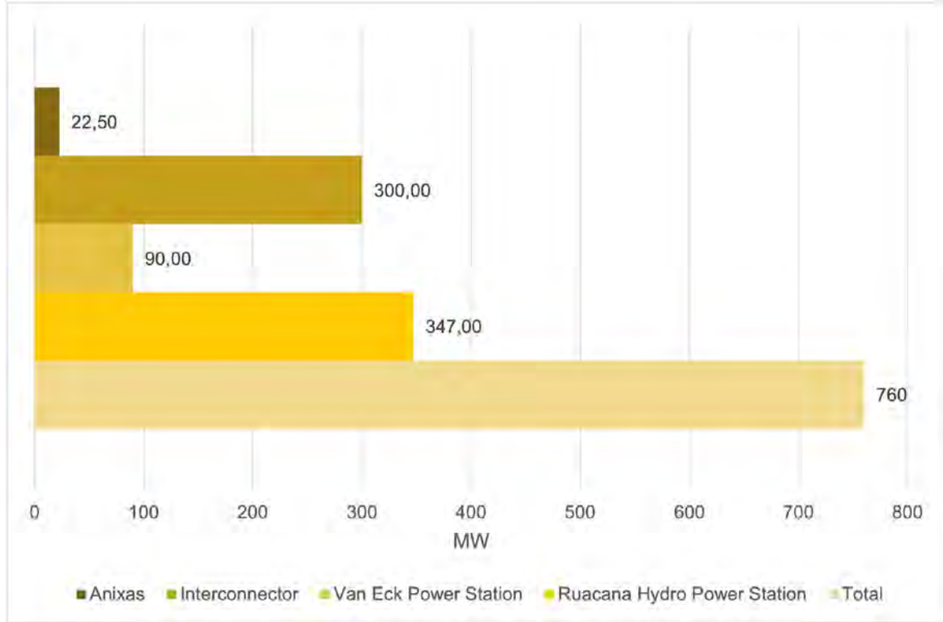


Figure 3-7 *Namibia's installed capacity in 2019 (NamPower, 2020)*

Non-renewable energy

In addition to power imported from coal powered stations in the region, Namibia also generates energy from power stations powered by fossil fuels. Its second largest power station is the coal-fired Van Eck Power Station, situated in the capital city, Windhoek. This contributes up to 90 MW of installed capacity (NamPower, 2020). In 2013, thepower station was extensively refurbished, effectively extending its operating life by five to 10 years. However, major upgrades have since been required, resulting in a wider scope of work and an extended project timeline.

The Anixas Power Station, located in Walvis Bay, has an installed capacity of 22.5 MW and is used mainly as a standby facility. It is powered by Light Fuel Oil (diesel) at cold start-up, switching over to more economical Heavy Fuel Oil (HFO).

Renewable energy

Renewable energy is derived from natural processes that are replenished constantly. Included in the definition is electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources and biofuels, as well as hydrogen derived from renewable resources. Renewable energy as a proportion of Namibia's total energy supply originates from independent power producers (IPPs), and energy consumption from these sources has declined from 36% to 28% between 2000 and 2017, as highlighted in Figure 3-8.

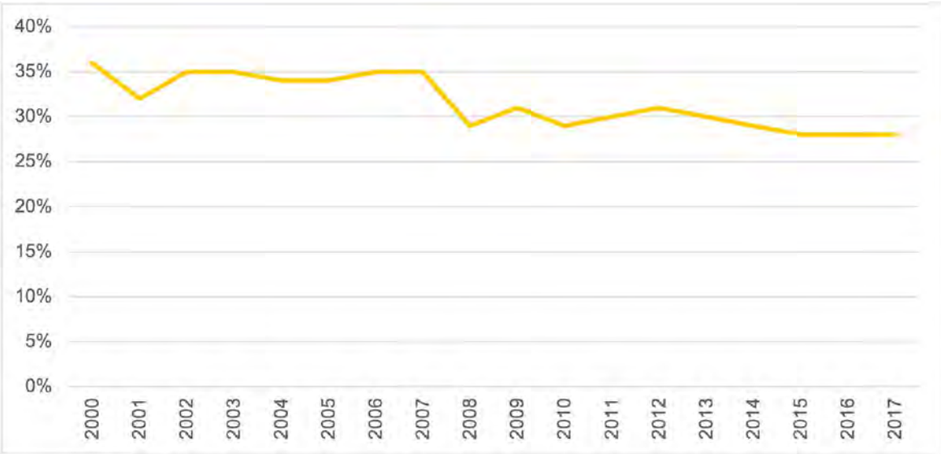


Figure 3-8 *Renewable energy as a percentage of total energy consumption in Namibia (2000-2017) (International Energy Agency, 2019)*

Solar panels at Gobabeb Research Centre | Klemens Riha

Hydropower

Ruacana Hydroelectric Power Station is the largest power station in Namibia, with an installed capacity of 347 MW and contributing 21.5% of the country's energy supply between July 2018 and June 2019. To maximize energy generation from the available flow in the Kunene River, NamPower optimizes the dispatch of Ruacana Power Station – operating at baseload during high river flows and as a mid-merit power plant during the remainder of the year when the flow of the river is lower (NamPower, 2020).

Solar power

Solar energy has only recently begun supplementing Namibia's power supply. The country's first on-grid solar energy plant, with a capacity of 4.5 MW, was commissioned in May 2015 and is operated by the IPP InnoSun. Between July 2018 to June 2019, IPPs produced 6% of the country's energy supply.

In 2019, NamPower had 18 supply agreements with local IPPs to generate power from renewable sources. Fourteen of these IPPs are now operational and the remaining four were commissioned in the 2018/19 financial year. This resulted in an increase in the capacity of IPPs from 49.5 MW to 116.5 MW (NamPower, 2020).

Even though Namibia has made considerable progress introducing solar energy as a part of its energy mix over the past five years, there is still vast untapped sustainable solar power and development potential throughout most of the country. The Energy Sector Management Assistance Programme (ESMAP) released the Global Photovoltaic Power Potential by Country Report in 2020, evaluating the theoretical, practical and economic potential of photovoltaic power generation. The report indicated that Namibia had the highest average practical photovoltaic power potential in the world – at 5.379 kilowatt hours per installed kilowatt peak (kWh/kWp) (ESMAP, 2020).

The photovoltaic power potential of Namibia is shown in Figure 3-9; it ranks second in Africa in terms of the average theoretical potential (6.405 kWh/m^2) for the long-term distribution of solar resources versus current electricity shortage (ESMAP, 2020). For a country that relies heavily on power imports from neighbouring countries, the emergence of solar as a realistic alternative has the potential to transform Namibia into a net exporter of electricity.

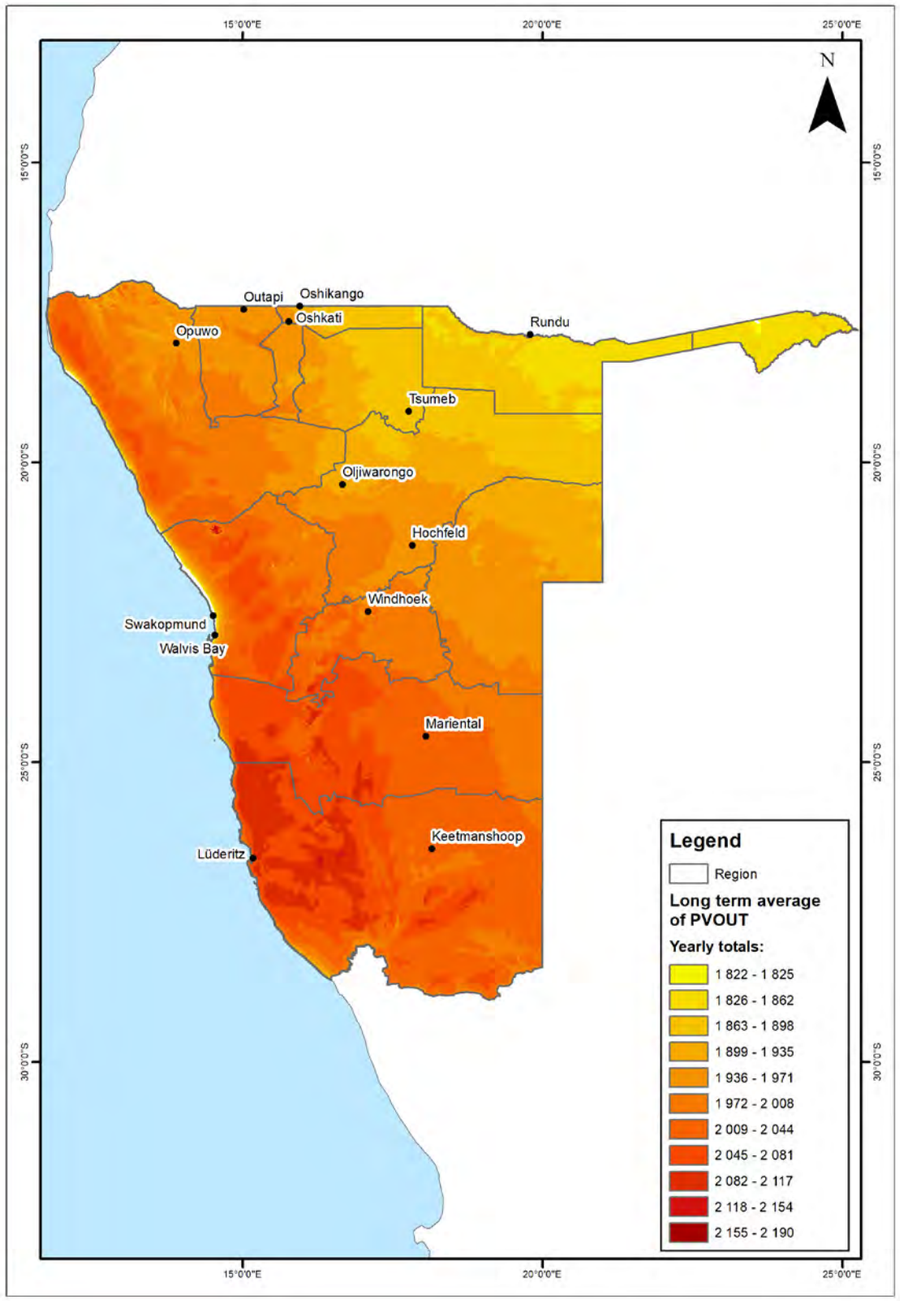


Figure 3-9 *Photovoltaic power potential of Namibia (World Bank, 2019)*

Wind energy

The Namibian Government recently approved the construction of four wind powerplants in the Tsau//Khaeb National Park close to Luderitz. As part of its NDCs (GRN, 2015), Namibia committed to increase the contribution of renewable energy in Namibia to 70% of total energy production by 2030. Wind powerplants form an important part of the strategy to attain this goal. Namibia has one operating windfarm near Luderitz which produces 5 MW of power. The four approved wind powerplants will add 180 MW of capacity; these are a 40 MW project by United Africa, two NamPower projects of 40 MW and 50 MW, and an Innosun project of 50 MW (Takouleu, 2020).

3.4.2

Energy availability & cost

A well-functioning economy is dependent on a reliable and affordable source of energy in order to function smoothly and to develop equitably. A well-established energy sector supports all economic sectors and remains a key factor in the eradication of poverty. Namibia has made significant progress in ensuring access to electricity between 1992 and 2018, as highlighted in Figure 3-10. The graph shows that the proportion of the population with access to electricity has more than doubled from 26% to 55%. This increase has mainly been driven by the population situated in rural areas, with access increasing from 10% to 36% over this period. In contrast, access in urban areas has remained relatively constant, with 71% of the population having electricity – considerably higher than in rural areas (World Bank, 2018).

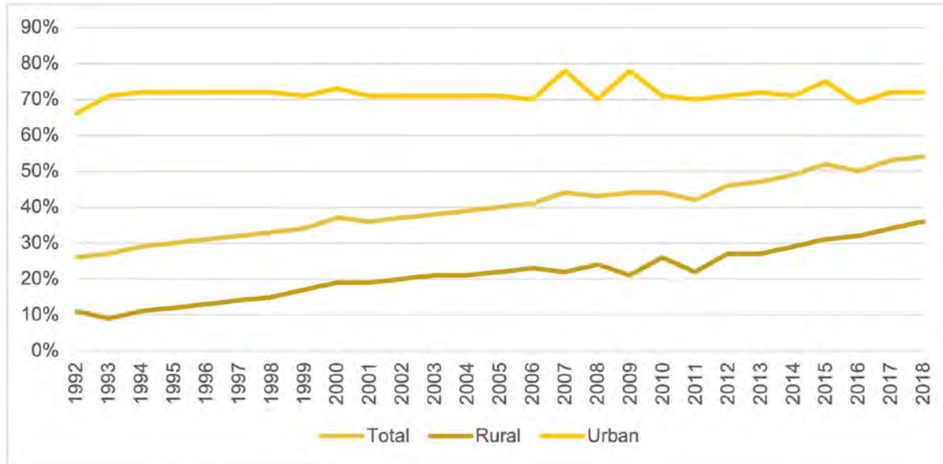


Figure 3-10 *Proportion of the population with access to electricity (World Bank, 2018)*

While electricity production – in terms of units into the system – has been relatively constant at around 4,500 GWh units between 2011 and 2019, the operating cost per customer has increased from approximately N$200,000 to N$550,000 over this period (NamPower, 2020). This increase in the cost per customer is also reflected in the cost per kWh of electricity, which has also nearly doubled between the 2010/11 and 2018/19 financial years – increasing from an average of 0.9 N$/kWh to 1.7 N$/kWh. These costs are primarily driven by the cost of imported electricity, which made up 67% of total supply in 2019 (Electricity Control Board, 2019).

During the 2018/19 financial year, the average electricity import costs totalled approximately 1.1 N$/kWh, in comparison to the average cost of local generation through NamPower of 0.7 N$/kWh. Local generation via IPPs contributed 6% of the energy supply composition and was considerably more expensive at 1.45 $/kWh (Electricity Control Board, 2019).

3.4.3

Energy resources - challenges & responses

All energy sources have some impact on our environment. Energy production using fossil fuels present substantially higher risks and impacts than renewable energy production. Namibia remains highly reliant on imported electricity that it is generated in coal power stations in South Africa. Moreover, the effects of global warming, a by-product of fossil fuel intensive energy production, have manifested in an increased prominence of droughts experienced over the past 10 years in Namibia.

Energy supply security

It is important to note that even though Namibia only produces 1% of its energy supply composition (July 2018 to June 2019) using fossil fuel sources, 51% of its electricity supply composition is imported from neighbouring SADC countries and comes predominantly from fossil fuel intense energy production (NamPower, 2020). South Africa, through Eskom, is the main supplier of electricity to Namibia, contributing 37.1% of the country's energy supply composition (July 2018 to June 2019), followed by Zambia and Zimbabwe with 7.3% and 6.3% respectively. South Africa is still largely reliant on coal-based electricity. The electricity, gas and water supply industry report (2016) highlights that fossil fuels generated 85,7% of the South Africa's power in 2016, followed by nuclear power (5.2%) and natural gas (3.2%) (Statistics South Africa, 2016). This situation poses risks for Namibia's energy supply security, given Eskom's ongoing power supply challenges and intermittent national load shedding events.

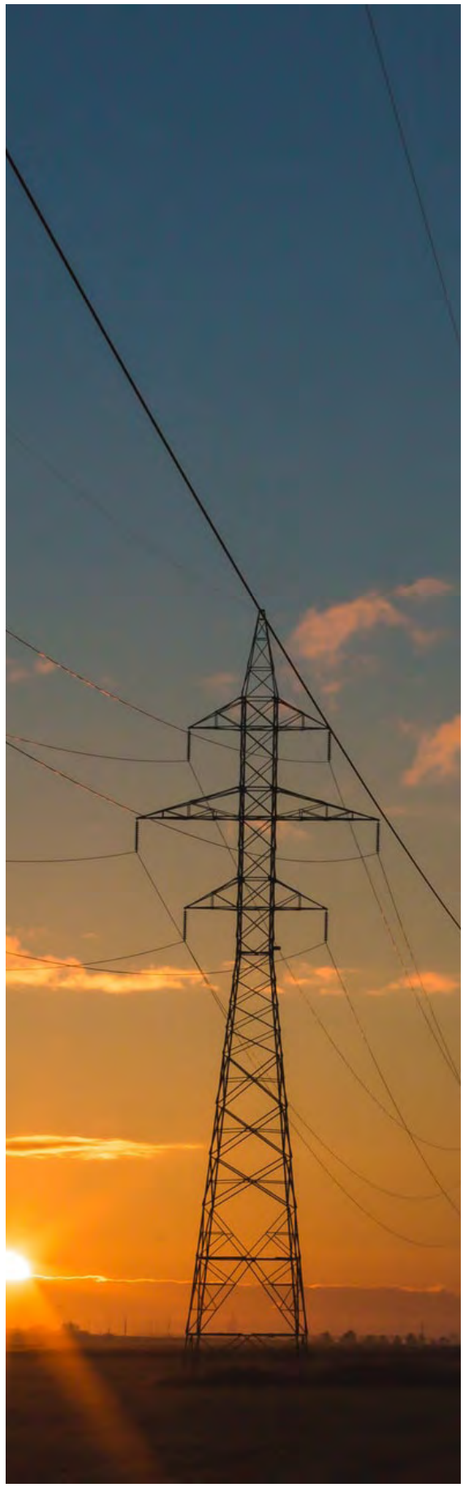
There are media reports that oil and gas exploration is planned in northeast Namibia and that an EIA is underway for seismic surveys. The exploration license covers the entire Kavango sedimentary basin, an area of approximately 25,341.33km². If commercially viable and approved by the environmental authorities, the proponent will receive a 25 year production licence. Stakeholders are reportedly concerned about the threat to groundwater resources in the area.

The El Niño-induced droughts during the 2013/14, 2014/15 and 2015/16 rainfall season, have not only resulted in large declines in agricultural production throughout the country (FAO, 2016), but have also impacted Namibia's electricity supply. The operation of the Ruacana Power Station continues to be affected by the variable flow of the Kunene River. Significantly lower river flows were recorded during the 2017/2018 and 2018/2019 financial years compared to the previous five years. During the wet season of the 2018-2019 financial year, the highest recorded average river flow was 169.83 m³/s while the required flow for continuous operation of all four generators at full load is 280 m³/s. The declining trend in average river flow since 2014 can be attributed to the drought affecting the northern part of the country. The total energy generated by Ruacana during the 2018/19 financial year amounted to 954 GWh – a record low for the past 10 years and significantly below the 10-year average of 1,400 GWh/annum (NamPower, 2020). Droughts have also affected hydroelectric facilities outside the country that supply Namibia with power.

Namibia's energy policy in the recent past is characterized by a shift in the feasibility of altering the composition of Namibia's electricity supply from largely imported fossil fuel generated electricity to a focus on local renewable energy production. More recently, the National Energy Policy (MME, 2017a), National IPP Policy (MME, 2017b) and National Renewable Energy Policy (MME, 2017c) have been adopted to elaborate on the government's objectives for the energy sector going forward. The main goals of these policies are to ensure electricity supply security, affordability and reliability, primarily by increasing the private sector's investment in renewable energy, both on-grid and off-grid.

The IPP Policy also states that small IPPs (less than 5 MW) should be procured through a renewable energy feed-in tariff (REFIT) scheme, while medium (5-100 MW) and large (100 MW and above) IPPs should to be procured via a competitive tender process (MME 2017b). Through the National IPP Policy, there was further formal implementation of the modified single-buyer market model. This gives IPPs the right to sell to NamPower and transmission customers such as distributors or large consumers, and endows the national electricity planning document (NIR) with legislative power.

Namibia's turnaround in private power investment programmes has been a significant milestone, from having no private power generation capacity before 2016 to facilitating one of sub-Saharan Africa's most rapid and successful private power investment programmes – comprising more than 20 IPP projects (Alao et al., 2019).



Electric pylons | Matthew Henry

3.5

Land resources & use - status quo

Land is a unique environmental resource, delineating the space in which economic activities and environmental processes take place and within which environmental resources and economic assets are located. The two primary aspects – land resources and land use – are closely related. While land cover describes the biophysical aspects of land, land use refers to the functional aspects of land. Changes in land cover can be the result of natural processes and of land use changes. Generally, the total area of a country remains unchanged from one period to the next (United Nations, 2017).

The status quo of landcover and land allocation to nature conservation, the condition of soil and land as well as land degradation and desertification were discussed in Chapter 2. This section focuses on how land is used as a resource, through analysing trends in land ownership as an indicator of land use.

3.5.1

Land use

As highlighted in the 2004 Namibia state of the environment report, which included land-changes and forms of land tenure as a key indicator, the relationship between land tenure and land degradation may be crucial in assessing the effects of desertification found in many parts of the country. It is necessary to break down the available information regarding land ownership patterns in Namibia to understand land tenure classifications and their corresponding environmental impacts.

Land, as a basic and essential natural resource, can be owned in various ways. There are three general land tenure classifications in Namibia: communal, freehold and state land. Communal tenure can be described as land that belongs to the state and is held in trust for the benefit of traditional communities living in those areas. Communal land cannot be bought or sold, but tribal authorities can allocate a customary land right or a right of leasehold to a part of communal land, in terms of the regulations in the Communal Land Reform Act (GRN, 2002). A customary land right gives the holder a right to live on the land and/or to farm on the land, whereas a right of leasehold entitles the holder to use the land for business purposes upon paying a rental amount (Werner and Bayer, 2016).

In contrast, freehold tenure is the ownership of property, usually land, with permanent and absolute tenure of that land or property – which includes the freedom to dispose of it at will. Lastly, state land is any public and unappropriated land controlled by government on behalf of its citizens.

Figure 3-11 depicts the overall trends in land ownership in Namibia between 1902 and 2018. Back in 1902, 64% of land was under state ownership, which at the time was under the authority of the German government. At that time, 30% of the land was designated to communal authorities, while 6% was freehold land. These land ownership patterns have changed significantly over the past 120 years. By 2018, the largest share of land allocation was in the form of freehold land (42%), followed by communal and state land with 35% and 23% respectively.

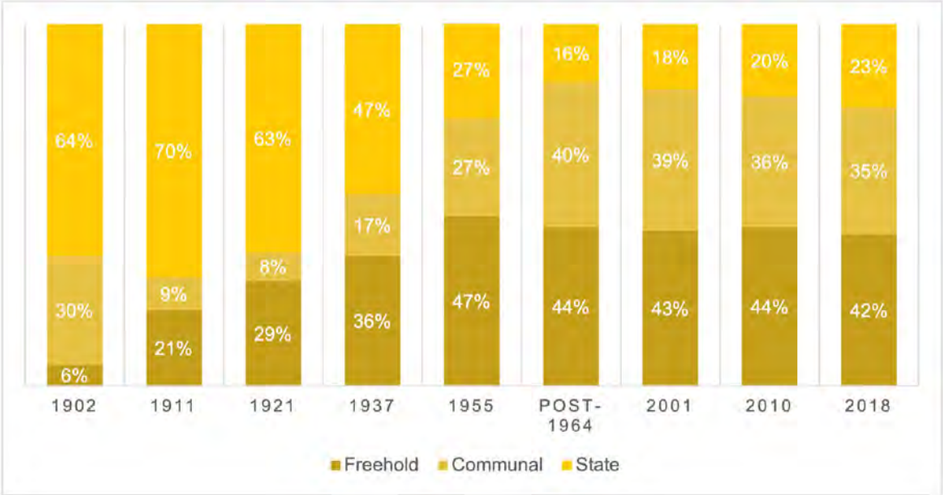


Figure 3-11 *Trends in land allocation in Namibia 1902 - 2018*

As highlighted in Figure 3-11 (see Chapter 2) showing land tenure distribution, state land is predominantly situated along the Namibian coastline. The northern part of the country is comprised of communal land, while the interior is mainly made up of private freehold land. A more detailed breakdown of the trends within these respective land tenure classifications is highlighted in the sections below.

Communal land

Communal land made up 35% of Namibia's total land in 2018 (NSA, 2018). The proportion of designated communal land has remained largely constant since 1964, when 40% of Namibia's land mass was communal land. Between 1902 and 1955, communal land fluctuated between 8% and 30% of the total land share. Communal land in Namibia is generally situated in the northern part of the country along the Angolan border and is home to approximately 1.1 million people – just over half of the total population. The remaining population is found in urban areas (42%) and on freehold farms (6%). Hence, tenure in communal areas is a key concern for many people in large portions of Namibia (Mendelsohn et al., 2012).

Several government and international donor initiatives have focused on improved management and ownership structures in communual areas. In particular, recent studies investigated the potential of leaseholds to contribute to economic development (Werner and Bayer, 2016). These studies are based on the premise that access to land ownership for commercial use in communal areas, can help small-scale farmers farm more sustainably at scale. There are several barriers to implementing this type of access, among which is a lack of understanding of the requirements for registration amongst potential beneficiaries – as well as limited financial, technical and logistical skills in potential beneficiaries (Werner and Bayer, 2016). Although the leasehold registration process is relatively straight forward, the associated costs are outside the financial capabilities of the potential beneficiaries.

In this regard, the Millennium Challenge Corporation (MCC) reported on a five-year

programme implemented in collaboration with the the MAWLR's National Communal Land Administration System (NCLAS) (2019). The objectives of this collaboration were to:

- Secure group land rights
- Facilitate and adopt legal and regulatory reforms;
- Train potential beneficiaries;
- Correct land parcel boundaries and/or incorporate them in the land system; and
- Formalize household land rights.

The programme resulted in over 2,500 participants being trained in their land rights, approximately 8,800 parcels of land registred on the national system and over 4,300 household rights formalized. On their own, land rights registration and formalization are not enough to eradicate inequality and poverty in communal areas, but it contributes significantly to social cohesion and stability.

Freehold land

In 2018, private freehold land in Namibia (excluding government farms) comprised 42% of the country's land mass of 82,400,000 hectares, compared to 44% in 2010. Between 1902 and 1955, freehold land grew from 6% of the total land mass to 47% (NSA, 2018). Since 1955, freehold private land has fluctuated between 47% and 42% of the total share of land ownership. Freehold land is distributed throughout the inland central and southern areas of the country (Figure 3-12Error! Reference source not found.).

In the SADC region, Namibia ranks highly in terms of its percentage of private land ownership. Back in 2010, the country was ranked third highest in terms of the percentage of private land ownership, at 44%. Mauritius registered the highest percentage of private land ownership at 80%, followed by South Africa at 72% (AUC-ECA-AfDB Consortium, 2010).

Abandoned station master house | Simon Hurry

State land

State land in the country constitutes 23% of Namibia's total land mass. State land can be further broken down into parks and restricted areas, which account for 94% of total state land. The remaining 6% belongs to local authorities situated in urban areas (NSA, 2018). In terms of trends in the tenure allocation of state land, the first half of the 20th century saw the percentage share of state land decrease from a high of 70% in 1911 to 16% post-1964. Since then, there has been an upward trend in the share of Namibia's land belonging to the state, increasing from 18% in 2001 to 23% in 2018 (NSA, 2018).

In terms of parks and restricted areas, the Namib Desert Conservation Area comprises 62% of this land, the Etosha Nature Reserve constitutes 17%, and the remaining state reserves makes up the rest (NSA, 2018). State land belonging to local authorities includes land found in municipalities, towns and village councils among freehold, private land. This makes up approximately of 1% of the total land mass of Namibia.

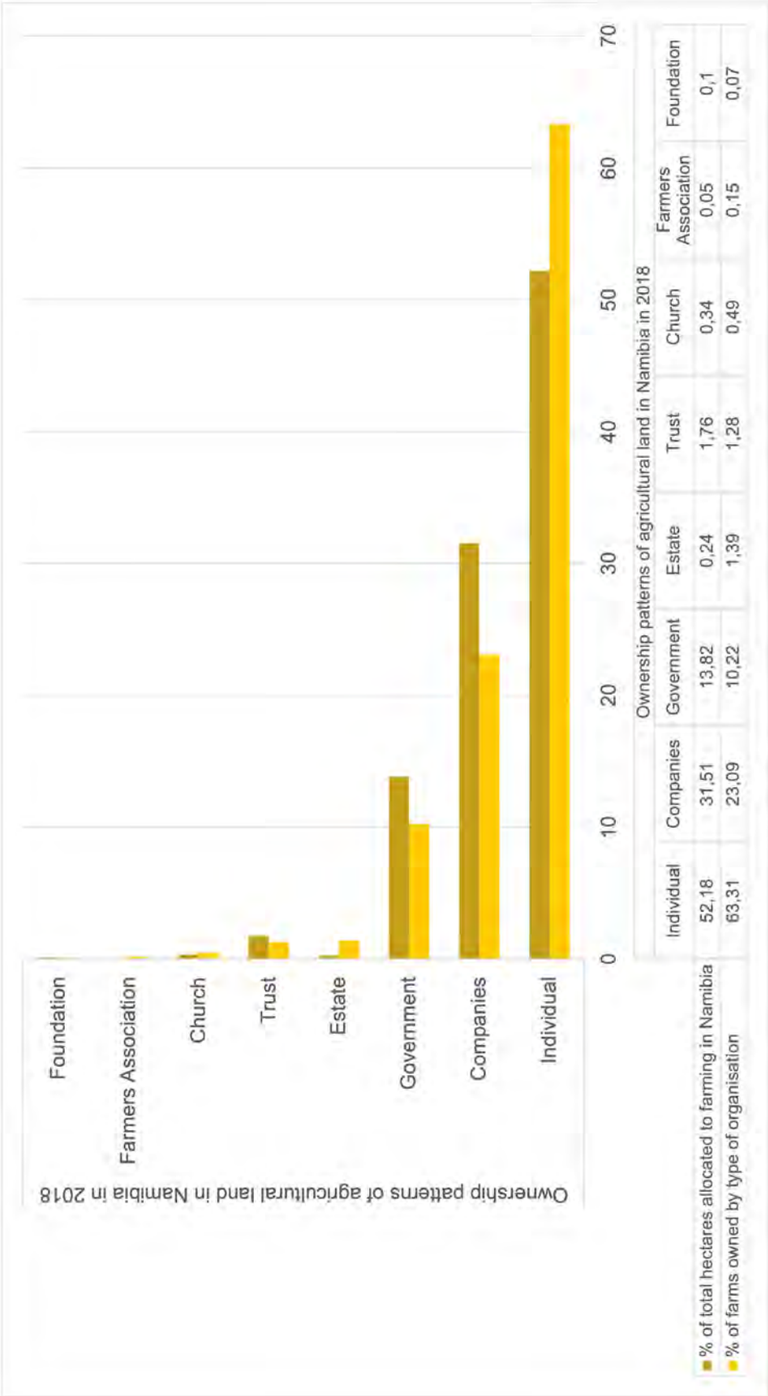
The City of Windhoek is the largest urban area in the country with the size of more 64,000 hectares covering the old boundary of the city and the farm Groot Aub. The extended boundary of the capital now measures 514,216 hectares, which is more than the combined size of all other municipalities in the country. Municipalities make up the biggest portion of land designated as local authorities at 467,488 hectares (59%), followed by village councils at 175,727 hectares (22%), while town councils constitute 150,029 hectares (19%) (NSA, 2018).

Agricultural land

The agricultural commercial land valuation roll of 2012 to 2017 has a record number of 12,382 farmland registrations consisting of farms and portions of farms. The farmland totals 39,728,364 hectares and is inclusive of agricultural government land such as farms for research, resettlement and servitudes (Ministry of Land Reform, 2018).

The ownership breakdown of agricultural commercial land by ownership is shown in Figure 3-12. The majority of agricultural (commercial) land in Namibia belongs to private entities; 34,237,254 hectares (86.2%) is privately owned by individuals, companies, estates, trusts, churches, farmers' associations and foundations. The remaining 5,491,110 hectares (13.8%) belong to the state and are mainly used for resettlement farms, servitudes and research farms.

A further breakdown of private agricultural land shows that individuals own 52.2% of 12,382 farms followed by companies at 31.5% and government at 13.8%. Farmers' associations, foundations, estates and churches each own less than 2% of the country's commercial land. Of the commercial farms and portions of farms, 97.7% are owned by Namibian nationals – making up 38,345,295 hectares.



Ownership patterns of agricultural land in Namibia in 2018	Individual	Companies	Government	Estate	Trust	Church	Farmers Association	Foundation
% of total hectares allocated to farming in Namibia	52,18	31,51	13,82	0,24	1,76	0,34	0,05	0,1
% of farms owned by type of organisation	63,31	23,09	10,22	1,39	1,28	0,49	0,15	0,07

Figure 3-12 *Ownership patterns of commercial agricultural land in Namibia in 2018 (Ministry of Land Reform, 2018)*

3.5.2

Land - challenges & responses

Based on the available data, it is evident that Namibia has seen many changes over the past century regarding distribution of land rights and tenure. The country has responded decisively to inequalities in private agricultural land ownership; however, challenges remain in communal land areas and continue to threaten the livelihoods of Namibia's most vulnerable populations

Historical inequality in land tenure

The Namibia Land Statistics Booklet defines 'previously disadvantaged' as a person or place that is disadvantaged in terms of a past social or economic position that is poorer than other people or places. In Namibia, this relates to Namibian citizens who have been socially, economically or educationally disadvantaged by past discriminatory laws or practices (NSA, 2018).

Currently, previously disadvantaged farm ownership makes up 16% of private ownership of commercial agricultural land, which includes farms acquired through the Agricultural Bank of Namibia's government Affirmative Action Loan Scheme (AALS) and farms privately funded through commercial banks (NSA, 2018).

A total of 3 million hectares have been acquired through the National Resettlement Programme since 1990, with 5,352 beneficiaries. The programme acquired 496 farms which benefitted many households originating from the Hardap, Khomas, Omaheke, Otjozondjupa and Kharas regions. Government waived a total of 5.1 million hectares from 1992 to 2018, with Otjozondjupa region having the biggest portion of waived land (NSA, 2018).

A total of 6.4 million hectares of land were acquired through the Agricultural Bank of Namibia between 1992 and 2018. Of this, 3.4 million hectares (54%) of commercial farmland were acquired through the AALS programme, while 2.8 million hectares (46%) were acquired privately on commercial interest rates. Only 10% of the total population of females benefited through the AALS programme, compared to 60% of the total population of males (NSA, 2018). When viewed through the framework of gender equality, this situation suggests there is a need to increase agricultural land ownership among previously disadvantaged females.

Privatisation & overexploitation of communal land

Communal land in Namibia provides much of the population who live there with a variety of resources, most of which are extremely important for their livelihoods – such as grazing, firewood, building materials, fruits, bush meat and water. Access to these resources are crucial, particularly given the economic context facing the majority of the population living in rural Namibia, where 33.5% of the population are unemployed and 78.9% of employees are in informal employment (NSA, 2018).

However, access to such resources is not guaranteed, as there are no mechanisms in place for residents to protect land rights over commonage which the state and traditional authorities may privatize at their discretion. Except for certain resources in conservancies and community forests, communal residents are also unable to gain commercial benefits such as grazing fees from non-residents who use commonage resources commercially.

A policy objective of the state is for communal land to be available and free for any Namibian wishing to settle. This is aimed at those individuals who may not have the means to live elsewhere. This policy is outlined in the Communal Land Reform Act of 2002, where Article 17 (1) states that: "Subject to the provisions of this Act, all communal land areas vest in the State in trust for the benefit of the traditional communities residing in those areas and for the purpose of promoting the economic and social development of the people of Namibia, in particular the landless and those with insufficient access to land who are not in formal employment or engaged in non-agriculture business activities".

Communal land is also free for people who are not poor, and many wealthier people have used their influence to acquire large farms. The extent of privatisation of communal land into large farms is significant, especially in Kavango, Oshikoto, Otjozondjupa, Omaheke and Omusati regions. These farms were acquired in one of three ways: from the South African administration or second-tier authorities prior to independence; through allocation by traditional authorities; or by unilateral fencing-off of land by private individuals (Mendelsohn et al., 2012).

There is evidence to suggest that the privatisation of communal land continues to take place. As a result, the customary value of communal land as a free-range resource for local residents has deteriorated in many areas and thus such land no longer provides a safety net for the poor residing in these areas (Mendelsohn et al., 2012).

A further issue pertaining to land tenure allocation is the lack of daily management of communal land by traditional authorities. Notably, most traditional leaders do not manage or control stocking rates or the harvesting of timber, thatch, fish, firewood, wildlife, water or wild fruit (Mendelsohn, 2008). Open access to communal land without the regulation of livestock numbers or monoculture results in the highly levels of exploitation of land resources. There are two subsequent impacts that arise from this exploitation: the poor are often left with unproductive land which cannot be used to support their livelihoods; and environmental degradation accelerates. This situation is excaberated by the linkages between drought and its impacts on community resilience, which is discussed in detail in Chapter 5.

In addition to uncontrolled land take and use, commonage grazing is also often appropriated by people who live and earn their income from salaries and businesses elsewhere. These people often own more of the livestock in communal areas than the local residents. Pastures are also exploited through dual grazing when the owners of large communal and freehold farms move their animals on to commonage until pastures and water sources are depleted. The livestock are then moved back to feed on the pastures that have remained protected within the private enclosures of the farmers (Mendelsohn, 2006).

The current system of land tenure regulation has contributed to land degradation as discussed in Chapter 2, and has led to conditions in communal areas that are not conducive to economic development and cause local residents to lose their commonage resources. The former is related to concerns of the rights of individuals to use and invest in their properties to create wealth, while the latter focuses on the rights of communities to the commonage resources they share. Solutions to addressing these issues are complex, but consideration should be given to the introduction of secure group tenure rights, which afford a level of protection for commonage areas and allow the community to benefit from additional economic opportunities. This will allow residents in communal areas to enter into rental agreements with people who wish to use their commonage (Mendelsohn et al., 2012).

Currently, tenure rights are governed by Article 16 of the Constitution and the National Land Policy of 1998. In theory, definitions in these laws enable groups of communal area residents to become holders of land rights. Such groups include conservancies, community forest management bodies, water point associations and other bodies constituted to serve the interests of communities of residents. Moreover, the National Land Tenure Policy (2008) makes provision for residents of villages to demarcate

and register their village land, as well as to legally constitute themselves as a group which holds rights over land and resources within the village boundary (Mendelsohn et al., 2012).

This legislation is a step in the right direction. However, it does not allow for land holders to transfer, sell, assign and sub-divide land easily. Furthermore, this legislation does not allow for properties in communal areas to be legally registered with deeds, and to be surveyed according to appropriate standards so that they can be used as collateral. Individuals situated in urban areas may not use customary land rights for commercial uses and are not able to alter these into leasehold rights. Until legislation is amended to ensure secure group tenure land rights, the privatisation and overexploitation of communal land is likely to remain prevalent.

Lack of cohesive data

With many of the state and communal land boundaries still being based on sources collected in 2001, there is a need for a centralized national land statistics database for easier access and dissemination of land statistics throughout the country. The NSA should facilitate the gathering of vital land statistics through the various institutions which are responsible for generating land statistics as administrative records. In this regard, Namibia has applied integrated land use planning at the regional level through the development of Integrated Regional Land Use Plans (IRLUPs) for its regions. Land use planning is a cross-sectoral and integrative decision-making process that facilitates the allocation of land to the uses that give the greatest sustainable benefit. Although a step has been taken in the right direction, significant work is still needed to ensure the fair and equitable use of Namibia's land resources (MEFT, 2020).

3.6

Biological resources & their use - status quo

Biological resources are renewable resources capable of regeneration through various natural processes, and are a critical component of biodiversity and ecosystems, as discussed in Chapter 2; they can also be used for aesthetic purposes such as nature-based tourism. If the management, use and harvesting of such resources exceeds the natural or managed regeneration, biological resources may face the prospect of depletion (United Nations, 2017).

3.6.1

Biological resources & the economy

Biological resources contribute extensively to Namibia's economy. Agriculture, forestry and fishing as a whole contributed to 7.3% (N$13.1 billion) of the country's GDP in 2019 (Figure 3-13). Of this GDP amount, livestock farming contributed 2.9%, fishing and the processing of fish made up 2.7% and crop farming comprised 1.7% (NSA, 2020). Biological resources also form an important part of Namibia's exports, with prepared and preserved fish making up 18% of all exported goods. Live animals, animal products and crops comprised 4% of exports.

Fish exports in terms of value nearly doubled between 2010 and 2020 and are currently valued at N$10 billion. The top three fish export markets as of June 2020 for Namibia were Spain, Zambia and the Democratic Republic of the Congo, with each importing 42.4%, 14.1% and 12.4% respectively (NSA, 2019).

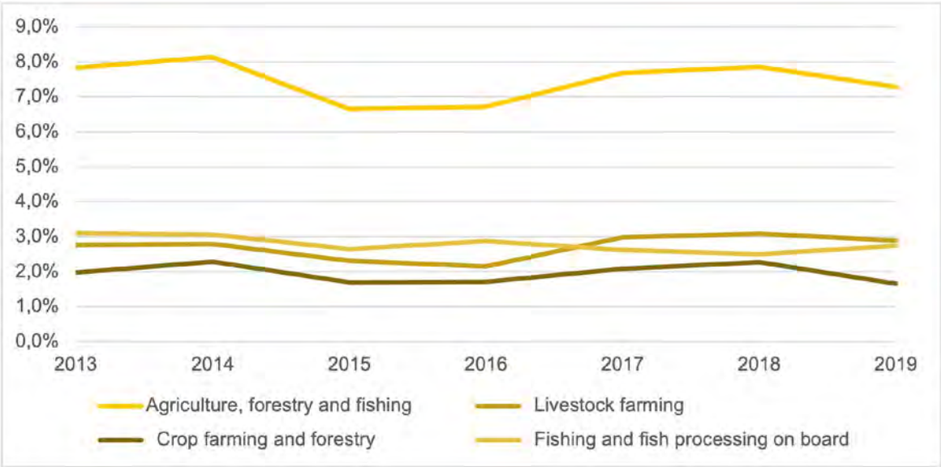


Figure 3-13 *Percentage contribution of biological resources to Namibia's GDP (NSA, 2020)*

Contribution to livelihoods & employment

Agriculture, forestry and fishing play an integral part in the livelihoods of a large portion of the Namibian population. The Namibia Labour Force Survey (LFS) reported that the main source of income for 19.8% of all households is from subsistence farming, while this figure was 41.6% for households situated in rural areas. The importance of subsistence farming as a source of income is most pronounced in the northern regions of Namibia, particularly in Ohangwena (60.6%), Omusati (58.8%), Kavango West (57.1%) and Oshikoto (42.1%) where the average household reported subsistence farming as their main source of income. In contrast, 0.5% of households reported commercial farming to be their main source of income (NSA, 2019).

Agriculture, forestry and fishing also contribute significantly to employment throughout Namibia. In 2019, 167,242 people (or 23% of the workforce) were directly employed in agriculture, forestry and fishing sectors. The vast majority of workers (87.6%) in these sectors are, however, informally employed (NSA, 2019).

Nature-based tourism

Namibia's fauna and a pristine natural environment attracts tourists from all over the world, making tourism a significant contributor to Namibia's economy. In 2019, hotels and restaurants contributed N$3.75 billion to the economy (2.1%), up from N$2.76 billion in 2015 (NSA, 2020). Other economic sectors also benefit from tourism, including transportation, hospitality, shopping and entertainment services.

The tourism spend generates tax income and contributes significantly to the country's foreign exchange reserves. Travel and tourism also generate employment for a significant number of Namibians. A total of 83,056 Namibians (11.4%) are employed in the accommodation and food services sector, with 77% of these being female workers (NSA, 2019). It is noted that for every 13 tourists that arrive in Namibia, one additional job is created (MEFT, 2016).

There are a number of factors which make Namibia an attractive travel destination for prospective travellers; these include proclaimed parks, favourable climatic conditions, political stability, cultural diversity, good infrastructure networks, high-quality tourism facilities and a well-functioning information and communication technology sector. Namibia also has a great diversity of scenery, from cold and desolate coasts through gravel plains, dunes, scrublands, thorn savannahs and rocky hills to moist woodlands and tropical floodplains. Some of the key attractions of Namibia include the Etosha National Park, the eco-tourism products of north-western regions, the Namib Desert and the coastal regions. The Travel and Tourism Competitiveness Index (TTCI) of the World Economic Forum measures factors and policies that make it attractive to develop the travel and tourism sector in different countries. In 2019, Namibia ranked 81st out of 140 countries by global standards, up from 82nd in 2017. Regionally, Namibia is ranked 4th in sub-Saharan Africa, behind Mauritius, the Seychelles and South Africa. The upward trend in the ranking since 2017 is attributable to advances in human resources and the labour market, prioritisation of travel and tourism, international openness, ground and port infrastructure, and tourist service infrastructure (World Economic Forum, 2019).

In terms of tourist arrival figures, Namibia recorded a 2.5% increase from 1,557,279 in 2018 to 1,595,973 in 2019. This represented a continuing upward trend since 2014, as evidenced in Figure 3-14. This number is expected to contract substantially as a result of the COVID-19 pandemic, which significantly decreased air travel throughout the world.

Tourist arrivals to Namibia are predominantly from African neighbours, with Angola, South

Africa and Zambia accounting for 36.1%, 16.9% and 15.4% of all arrivals respectively. The top five countries in terms of the category of holiday travellers were Angola (115,999), South Africa (99,404), Germany (79,277), France (24,622) and Zambia (24,128) (MEFT, 2019). The average intended length of stay varies, with 30.6% of tourists intending to stay in Namibia for four to seven days. African travellers spent on average four to seven days, compared to European and North American travellers who spent an average of eight to 14 days in the country (MEFT, 2019).

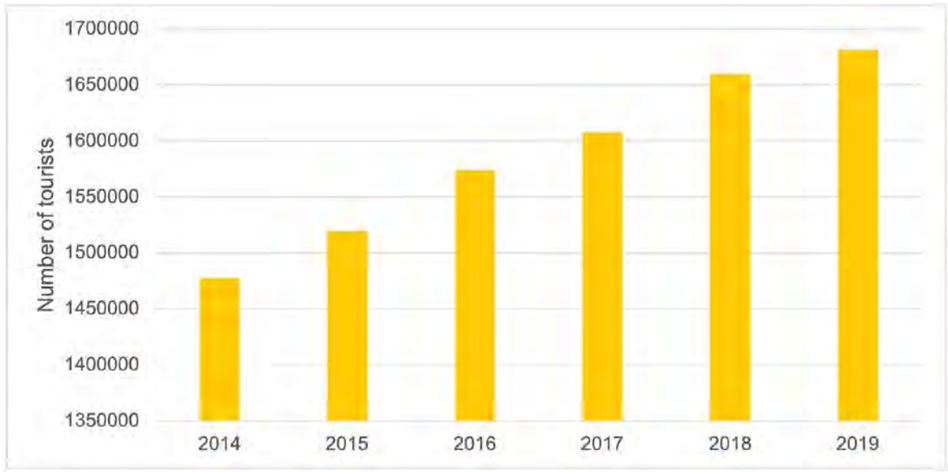


Figure 3-14 *Tourist arrivals in Namibia (MEFT, 2019)*

It is evident that nature-based tourism in Namibia benefits from a rising utilization of biological resources for human enjoyment. Even though the international travel restrictions due to the COVID-19 pandemic is likely to impede the trend illustrated in Figure 3-14, it is expected to continue rising once international borders open fully again.

Even though Namibia's natural resources are abundant and unique, making Namibia a desirable international eco-tourism travel destination, there is a danger in suggesting that Namibia's natural resources are boundless and infinite when promoting the country. The truth is that Namibia's natural resources are finite, and that many of its ecosystems are fragile and prone to degradation. It is necessary to prepare and implement natural resource management plans that are integrated into all economic activities including eco-tourism.

Local perspectives

Nature-based tourism in Etosha-Kunene

1. In 1998 Namibia championed community-based conservation through making legal provision for communities to manage natural resources, including wildlife.
2. Community conservancies are often set up and run as nature-based tourism enterprise on conservancies with tourism rights through a partnership between communities and private investors.
3. Visitors to the Kunene area conservancies are rewarded with free roaming wildlife and authentic local experiences. However mounting environmental and social pressures threaten the conservancy way of life.
4. Issues such as human-wildlife conflict, growing numbers of domestic cattle in conservancy areas, dust caused by road travel and uneven distribution of the opportunities and benefits of nature-based tourism in the Kunene region to local communities need to be addressed.
5. Several non-governmental organisations are campaigning to support community-based natural resource management in Kunene.

Contact **https://tosco.org** & **http://www.nasco.org.na** to partcipate.

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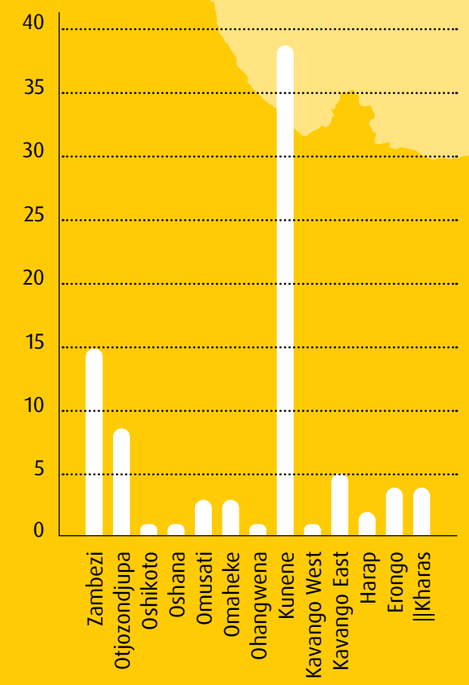
the number of people living in conservancies in the Etosha-Kunene region. During the 2017 travel season, the Kunene region had the highest bed occupancy rates (47.7%) in the country.

Number of conservancies in Namibia



Source Interview with Dr Selma Lendelvo, Head of Life Sciences Division, Multi-disciplinary Research Center, University of Namibia.

The use of aquatic resources

As described in Chapter 2, Namibia's aquatic resource are made up of industrialized marine capture fisheries, recreational fisheries, inland capture fisheries, mariculture and freshwater aquaculture.

Marine resources

Before independence in 1990, Namibia had minimal control over the more lucrative offshore fisheries. As a result, most of Namibia's fisheries operated as an open-access resource, and thus fish stocks were severely depleted (van der Westhuizen 2001). After 1990, Namibia established control over the 200-mile EEZ next to its coastline, and the Fisheries Policy (1991) and Sea Fisheries Act of 1992 were enacted. This policy aimed to ensure ecologically sustainable management of fisheries and to maximize benefits for Namibians from the fisheries sector.

The catches from Namibia's fisheries are landed at both Walvis Bay and Luderitz, with the majority taking place at the former due to its proximity to the major fishing grounds and easier access. The Namibian EEZ's commercial species comprises the two species of hake (Merluccius capensis and Merluccius paradoxus, also known as the shallow water and deep water hakes respectively), monkfish (Lophius vemerinus), horse mackerel (Trachurus capensis and Trachurus trecae), sardine (Sardinops sagax), deep sea red crab (Chaceon maritae) and rock lobster (Jasus lalandi). An allocation of seal pups and bulls is also made annually to concessionaries in the seal industry. These seven species are regulated through an allocation of a Total Allowable Catch (TAC) for which surveys are conducted annually to determine the status of the stocks by the MFMR.

Namibia's fishery industry contributes 3.6% percent to the country's GDP and remains an important part of Namibia's agricultural sector. Figure 3-15 indicates Namibia's fishery imports and exports, showing that Namibia has been exporting significantly more fish than it imports. Also evident in Figure 3-15 is the fact that there was a slight decline in Namibia's exports in 2015 to 2016, with a corresponding increase in imports (FOA, 2017). Namibia exports high value fish species such as hake and monkfish mainly to European markets, whereas horse mackerel, snoek, angelfish and small hake are consumed locally. In terms of fish protein's contribution to total protein consumption in Namibia, Namibians get 6% of their daily protein needs from fish; the rest of Africa gets 4.7% of their protein needs from fish, indicating Namibia's slightly higher reliance on aquatic resources for dietary needs. This emphasizes the importance of the marine industry's role in Namibia reaching SDG goal number two – Zero Hunger (FOA, 2017).

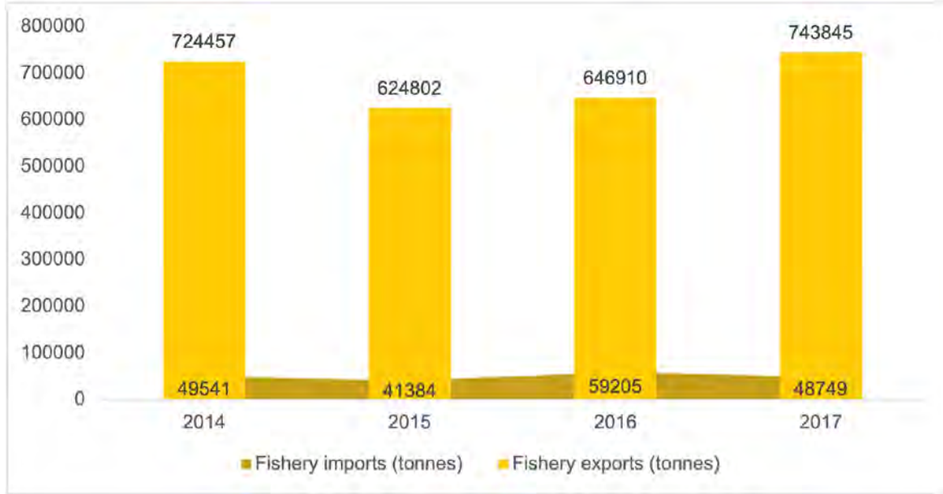


Figure 3-15 *Namibia's fishery imports and exports (2014 to 2017) (FOA, 2017)*

A recent study by Kainge et al. (2020) involved a detailed analysis of fisheries yield, climate change and ecosystem-based management of the Benguela current marine ecosystem – and spanned across Namibia, South Africa and Angola. The study listed trends in total catches since the measurement of exploitation began in the 1960s. Although different data points exist for the various species caught in Namibian waters, the trend analysis provides an overview of the status of fisheries in Namibia. Figure 3-16 provides a sample of this analysis by plotting trends in hake and horse mackerel catches, based on the data supplied by Kainge et al. (2020). The study concludes that while the harvest of several fish species in Namibia have been declining since the 1960s, several measures put into place to encourage sustainable fisheries have helped to stabilize fish harvest numbers over the last two decades. This is especially true for horse mackerel and hake, as indicated in Figure 3-16, but not for all species. It is estimated that a third of the monitored stocks are currently exploited at a biologically unsustainable level.

In Namibia, small pelagic fish stocks (mainly sardine Sardinops sagax, anchovy Engraulis encrasicolus and round herring Etrumeus whiteheadi) are at particular risk and are currently in a collapsed state (Kainge et al., 2020). This could be attributed to heavy overfishing in the 1960s from which the stock never recovered. The low-oxygen and warm water events of 1994 and 1995 might have sustained this decline.

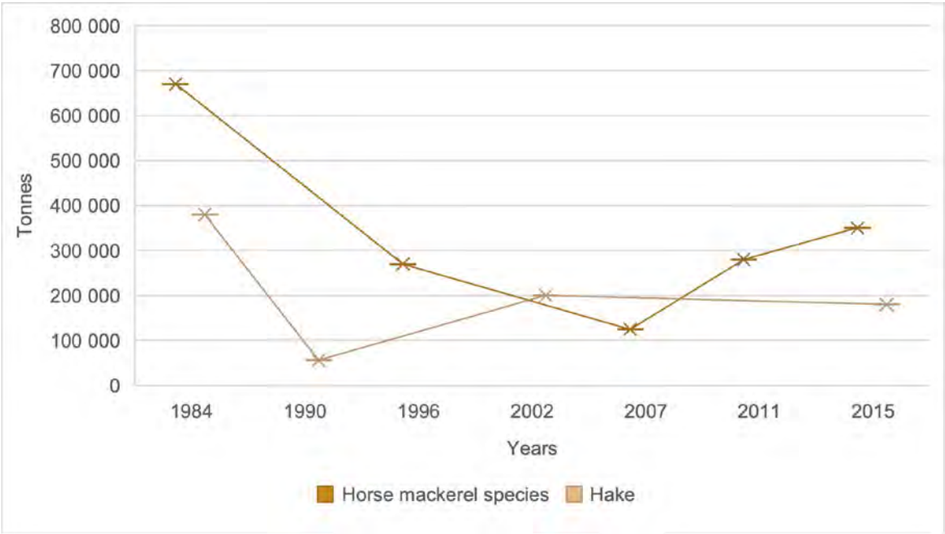


Figure 3-16 *Trends in hake and mackerel catches (1984 to 2015) (Kainge et al., 2020)*

These trends suggest that the fishing resource is under pressure and that a multi-factorial analysis is needed to understand and address contributing factors. A cohesive database of trends in catches integrated with an early warning system for unsustainable practices can support the management of this valuable resource.

Land-based aquatic resources

Namibia's inland capture fisheries are mainly situated in the Kavango and Zambezi regions on the Kavango River and Lake Liambezi, but limited activities also take place along the Cuvelai basin as well as the Kunene river in the north-west and the Orange river in the south. About 21 species are caught, including tilapias, catfish and tiger fish, with the Cichlidae contributing more than 60% to the total catch. The fishing season and catches vary annually and seasonally depending on the rains and flooding. The inland fisheries are mainly subsistence, with 60% of the households in the Zambezi and Kavango regions depending primarily on it for their food supply (FAO, 2015).

A total annual catch of 5,340 tonnes has been estimated for the inland fisheries in 2012. The catches from the Zambezi (mostly Lake Liambezi) and Kavango regions make up 90% of the total catch, while the Cuvelai basin contributes the rest. In 2011 and 2012, the catches from the Zambezi Region alone totalled 1,634 and 1,963 tonnes respectively, worth approximately US$1.3 million and US$1.5 million (FAO, 2015).

The number of landing sites in the inland capture fisheries are difficult to determine as many points exist along the rivers and floodplains, while the fisherman also vary the fishing sites. Two permanent sites are located at Lake Liambezi from where the majority of the fish caught in the Zambezi Region emanate (FAO, 2015).

Surveys of fish markets in the Zambezi Region note that of the 22 species caught, tilapias (mainly Oreochromis andersoni, Tilapia rendalli and Oreochromis macrochir) comprise the majority of catch, both in terms of weight and counts. The three species together contribute more than 60% of the total catch, followed by Serranochromis macrocephalus and Hydrochromus vittatus, where each make up

about 10% by weight. Catfish (Clarias gariepinus) contribute about 6%. The biannual biological survey – conducted in 2012 to collect biological data on the Kavango river resources – found that species such as Synodontis nigromaculatus were the most common in terms of numbers. Tiger fish (Hydrocynus vittatus) were found to be more abundant in terms of weight (FAO, 2015).

The Ministry of Fisheries and Marine Resources (MFMR) states in its 2017 to 2022 strategic plan that one of the pillars to mitigate dwindling marine fish stocks is the development of inland aquaculture initiatives (MFMR, 2017). A dual goal of the Ministry is to strengthen socio-economic resilience and food security in marginalized communities through aquaculture. There are currently 13 active inland aquaculture projects in various stages of development spread over nine regions in Namibia. Inland aquaculture in Namibia is increasingly making a contribution to supplement Namibia's threatened fish harvest.

Civic society in Namibia, as well as the internationaly donor community, are also making contributions to strengthen the resilience of inland fisheries in Namibia. The Namibian Nature Foundation, in collaboration with the European Union, completed a community fisheries project from 2013 to 2018 during which lessons learned from previous projects were integrated into a strategy to strengthen inland fisheries in the Upper Zambezi, Chobe and Okavango catchments in Namibia, Zambia and Botswana. The purpose of the project was to contribute to environmental conservation and to improve socio-economic benefits and food security, especially for women, children and the rural poor through capacity building and the development of regional and international networking platforms. One of the outcomes of this project in collaboration with the MFMR, was that the Ministry banned the sale and use of monofilament nets, extended its gazette Fish Protection Areas and instituted a closed season in the Zambezi/Chobe river system from 1 December to 28 February to allow fish stocks to naturally regenerate (Namibia Nature Foundation, 2016).

These and other initiatives geared towards the promotion and regeneration of inland fisheries are contributing to economic activity, livelihoods and the resilience of inland fishstocks.

Local perspectives

Illegal fishing in the Kavango Region

1. "We have almost no fish left in the Kavango, because stock has been drastically reduced through the use of legal and illegal fishing nets. Kavango fisherman complain about Caprivians conducting commercial fishing in the Kavango River, especially during the three months when commercial fishing is not allowed in the Zambezi," says the senior Fisheries Biologist at the Kamutjonga Inland Fisheries Institute (KIFI), Dr Francois Jacobs.

2. The downturn in fish sticks will indirectly impact tourism. A healthy fish poulation affects the diversity of birds which in turn attracts tourists. Another aspect of the ecological balance is that fewer birds on the riverbanks leave fewer droppings, ie. vital nutrients for plants; and fewer plants translate yet again into fewer fish and birds.

3. The Lodge owners and fishing experts have demanded that all fishing nets be banned. The traditional leaders, who have strictly regulated fishing along the Kavango fer decades, are also in favor of a ban. Stricter and better controls are demanded for the other rivers, too – the Kwando, Chobe, Linyanti and the Zambezi. Private individuals and companies have employed fish guards for a section of the Zambezi River.

4. In response, the EU has increased funding estimated funding estimated at €1.5 million to combat Illegal Wildlife Trade in the Kavango-Zambezi Trans-Frontier Conservation Area.

24 000

the estimated number of people whose livelihoods depend on subsistence fishing along the Kavango River alone.

Source Adapted from Heinrich (2019).

Vibrant maize crop | Ranjan Prabhat

Crops

Given Namibia's dry and arid climate that covers the majority of the south and interior of the country, agriculture is subject to recurrent droughts and poor rainfall performance, resulting in low agricultural productivity in communal areas. In particular, the rainfall seasons of 2013/14, 2014/15 and 2015/16 had persistently below-average rainfall performance, resulting in large losses in agricultural production in most parts of the country (FAO, 2016). Agriculture remains a crucial part of the livelihoods of Namibians, with 19.8% of households reporting subsistence farming as their main source of income (NSA, 2019).

In addition to subsistence farming – which is mainly confined to the communal areas of the populous northern parts of the country – commercial farming also plays a significant role in the agricultural sector. Commercial farming is generally more organized and mechanized, and hence displays higher levels of productivity. The main crops produced throughout Namibia include pearl millet (Mahangu), maize, sorghum, wheat, grapes and dates (MEFT, 2018). A more detailed breakdown on each of these commercial crops is provided below.

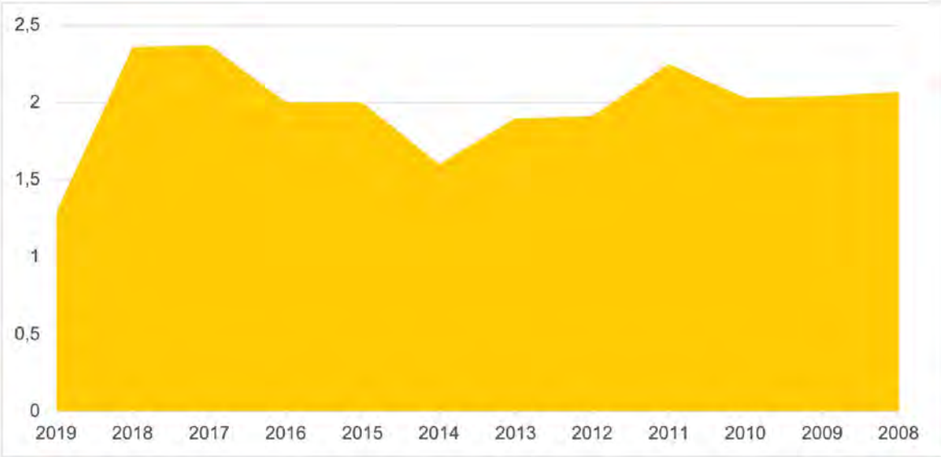


Figure 3-17 *Namibia's maize yield in mega ton per hectare from 2008 to 2019 (Shifiona et al, 2016)*

Maize

Namibia's white maize is exclusively produced for human consumption and is one of the country's staple grains. White maize is planted under both dry-land conditions and irrigation. The irrigation areas are the Hardap Irrigation Project, the government's projects along the Kavango River and in the Omusati Region, as well as a number of farms in the eastern production area and the Maize Triangle. The dry-land production areas are mainly in the Maize Triangle, the Zambezi Region and the eastern production area in the Summerdown environs (NAB, 2018).

Namibia's maize yield has remained relatively steady since 2008 (Figure 3-17). Over 11 years, maize yields have remained between 1 and 2.5 mega ton/ha, highlighting that maize production has been a dependable and sustainable source of staple food for Namibia. The demand for maize has risen in recent years as a result of its dependability, but also because millet production has been unpredictable due to floods and droughts that affect the millet production each year (Shifiona et al, 2016). The increase in yield up to 2011 was brought upon by a 16 % spike in maize demand in the country (Ibid); however, a two-year drought in 2014/2015 caused a significant decrease in maize yield of about 40% from the previous five-year average (FAO, 2018). Maize production recovered steadily since the drought years, with consistent rainfall being a significant factor (FAO, 2018). In 2018, maize yields began to drop again as rainfall decreased and a new drought occurred in the 2018/19 year (Shikangalah, 2020). Maize yields saw a significant decrease (2.3 to 1.3 mega ton/ha) during this drought period.

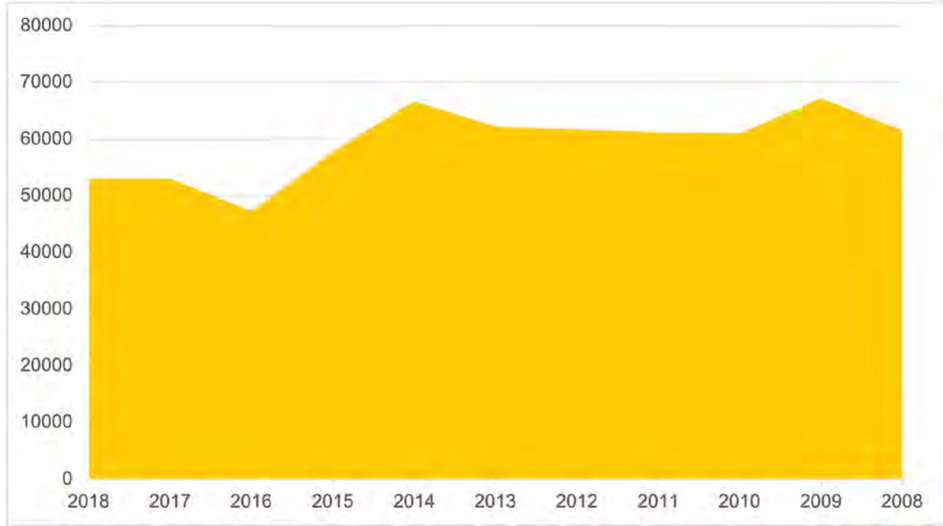


Figure 3-18 *Namibia's wheat yield in hectograms per hectare (2008 to 2018) (Shifiona et al, 2016)*

Wheat

Wheat, as a winter crop, is only planted under irrigation in Namibia. The main wheat production areas are the Hardap Irrigation Scheme at Mariental in the south and the government irrigation projects next to the Okavango River. Small amounts of wheat are produced at irrigated farms in the Maize Triangle (NAB, 2018).

Namibia's wheat yield has fluctuated between 45,000 and 70,000 hg/ha since 2008 (Figure 3-18Error! Reference source not found.). This shows a relatively consistent yield percentage which can be largely attributed to wheat's need for controlled irrigation in the winter. While maize and millet yields decreased in 2014, wheat yields increased as high staple food demands now required a higher yield of wheat in order to supply the population with sufficient supply (Shifiona et al., 2016). Wheat yields were not significantly affected by the recurring droughts due to the heavy reliance on winter irrigation. Although wheat production is controlled through irrigation, a marked drop in yields between 2014 and 2016 occurred.

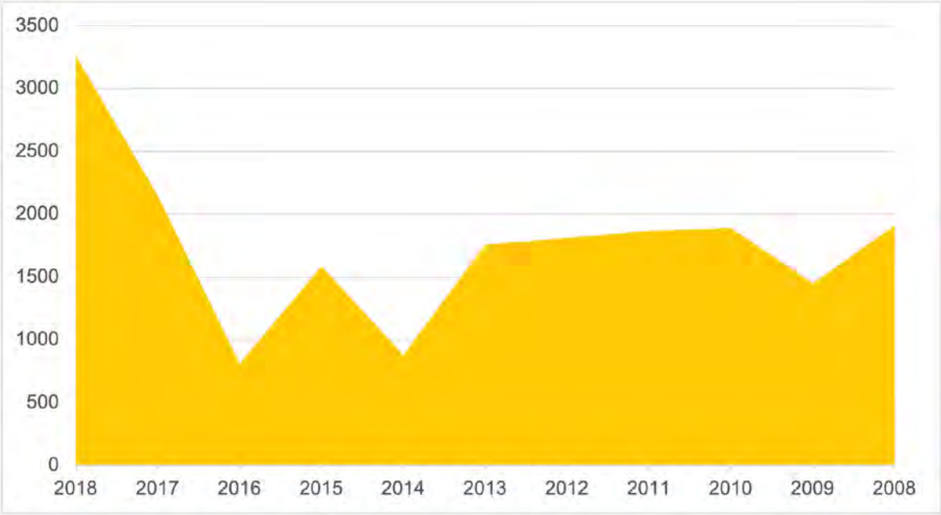


Figure 3-19 *Namibia's millet yield in hectograms per hectare (2008 to 2018) (Shifiona et al, 2016)*

Millet

Millet is known as the world's most important cereal grain and is commonly named Mahangu in Namibia (Eric et al., 2012). It is a subsistence rain-fed cereal crop and a crucial food grain for over 50% of the Namibian population. It is mainly produced by small-scale farmers in the northern communal areas for household consumption (Matanyaire, 1996). It can be grown in areas of low rainfall (300 mm – 500 mm per year) and areas of very high temperature (Andreas, 2013). Pearl millet is the principal source of food security to the majority of the country's small holders, sown to almost 80% of cropped area and accounting for 24% of the total calorie intake and approximately 40% of cereal grain intake by Namibian consumers (Rohrbach et al., 1999).

Namibia's millet yield has fluctutated between 500 and 3000 hg/ha since 2008, which emphasizes the sensitivity of millet yield in the country (Figure 3-19Error! Reference source not found.). Due to the significant fluctuations of millet yield, Namibia has relied on imports of millet as well as higher yields of maize (Shifiona et al, 2016). The millet yield has been a product of its area harvested, which has been inconsistent over the years. The combination of a reduction in the area harvested and severe floods in 2009 resulted in a decreased millet yield (Shifiona et al, 2016). Millet production stabilized to above average yields in 2010 up until 2014, when the yields were significantly impacted by recurring droughts (FAO, 2018). The 2014/2015 droughts reduced the harvest area of millet until 2017, when millet yields dramitically increased as rainfall became more consistent (FAO, 2018).

Chick in incubator | Jason Leung

Livestock

Unlike crop farming, livestock farming is practiced throughout Namibia. Livestock farming comprises both commercial and subsistence farming and includes cattle, goat, sheep and pig production. Sheep and goats are mainly reared in the central and southern regions, while the northern regions farm cattle and goats (NAB, 2018). Namibia is showing a downward trend in livestock numbers influenced by a range of environmental and economic factors, which impacts the sustainability of livestock farming.

Since 2016, there has been a declining trend in cattle numbers in Namibia, decreasing by 9% from a high of 3.17 million head of cattle in 2016 to approximately 2.9 million in 2018 (Figure 3-20). Over the same period, the number of cattle slaughtered has also decreased – from 137,181 head to 101,197 head – indicating a decline of 26% (Figure 3-21). The decrease in cattle stock cannot be directly attributed to the overharvesting of cattle, but is instead attributed to a number of other factors including the global increase in production cost, drought, land degradation, bush encroachment, disease, and the shrinking of the commercial output due to disinvestment (Meat Board of Namibia, 2019).

Sheep and goat numbers have also been in decline, decreasing from approximately 2,850,000 and 2,150,000 respectively between 2011 and 2018 to 1,720,000 and 1,900,000. The decrease in sheep and goat livestock coincided with the El Niño-induced drought years of 2013/14, 2014/15 and 2015/16. Over the same period, the number of sheep slaughtered also decreased from approximately 750,000 to 640,000, while the number of goats slaughtered grew from 315,000 to 330,000. In 2018, there were approximately 94,746 pigs in Namibia; there were 101,197 pigs slaughtered, with the net balance being made up by live animal imports (FAOSTAT, 2020).

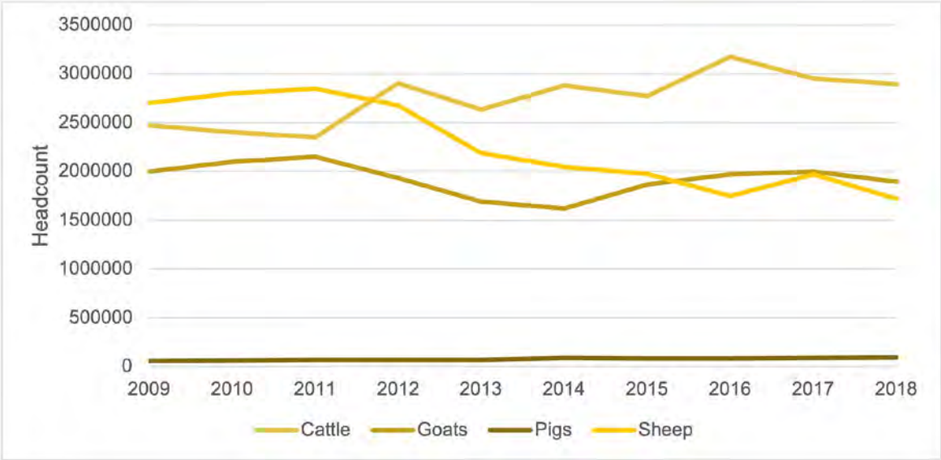


Figure 3-20 *Head counts of cattle, goats, pigs and sheep between 2009 and 2018 (FAOSTAT, 2020)*

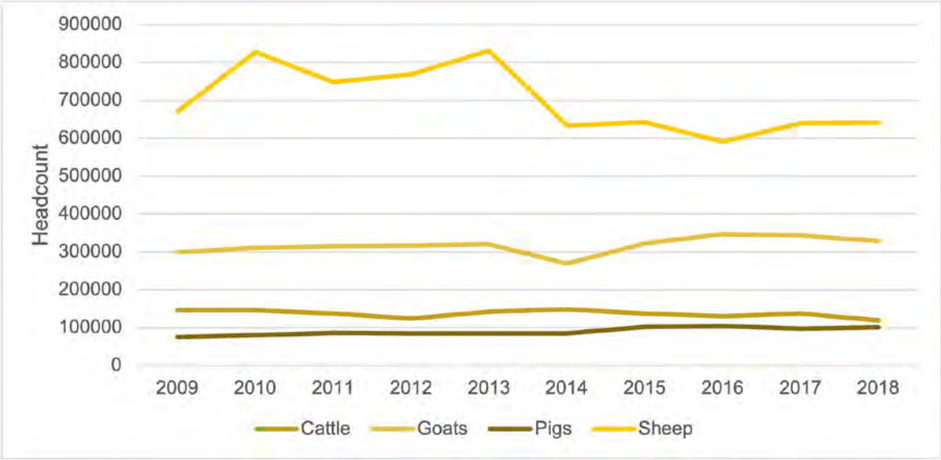


Figure 3-21 *Head counts of cattle, goats, pigs and sheep slaughtered between 2009 and 2018 (FAOSTAT, 2020)*

The export value of cattle between 2017 and 2018 grew from $145,6 million to $161,4 million. Despite the decline in live marketing of cattle in 2018, the export value grew by 10.8%. This decline can be attributed to changes in price and exchange rate parity, as well as quality of (and consumer confidence in) Namibian meat products. Over the same period, there was an increase in the export value of live sheep (12.32%) and goats (6.8%). The export value of fresh chilled sheep carcasses and half carcasses (excluding lambs) also increased by 55.41%, while the export value of meat of sheep or goat (chilled or frozen) declined by 16.16% (Meat Board of Namibia, 2019).

In addition, Namibia is an exporter of hides and skins, including raw hides and skin, leather and leather products, fur skins (pelts) and artificial fur. An export value of N$263,6 million was realized in 2018 for hides and skins. The export value for leather and leather products for the same year was worth over N$3 million and fur skins were worth N$57,8 million. There was an increase in export value of fur skins and artificial fur products in 2018 compared to a decrease in the other categories (Meat Board of Namibia, 2019).

Wildlife tourism and game farming

Wildlife tourism and game farming are some of the ways in which natural resources are used to contribute to Namibia's economy. There are six types of consumptive wildlife uses permitted in Namibia under varying conditions:

- shoot-and-sell;
- trophy hunting;
- biltong hunting;
- management hunting;
- shooting for own use; and
- live capture and sale.

Trophy hunting is of particular importance because of its high value and low volume in terms of consumption. Trophy hunting is highly regulated in Namibia with many stipulations and conditions. Permits for trophy hunting specifically and wildlife utilisation generally are administered through the Permit Office of the Directorate of Scientific Services within the MEFT. Trophy hunts must be guided by registered hunting professionals on registered hunting farms, conservancies or through concessions in national parks.

Within the wildlife tourism sector, trophy hunting activities in particular have been a lucrative way to support and incentivize nature conservation in Namibia. In 2016, trophy hunting and related expenditiure generated an estimated N$431 million for Namibia's economy (Maclaren et al., 2019).

The consumptive use of wildlife resources through trophy hunting has been contributing to conservation through the Game Products Trust Fund. Between 2013 and 2016, trophy hunting raised N$39 million for conservation projects through this project. Wildlife conservancies on communal land have become increasingly dependant on trophy hunting. On average, a third of the income for communal conservancies is derived from trophy hunting, while some conservancies rely fully on trophy hunting activities. Furthermore, as a major revenue earner, trophy hunting helps to fund state budgets and also incentivizes investment in conservation and sustainable development in wildlife-based areas (Maclaren et al, 2019).

If properly regulated, trophy hunting provides a strong market-based incentive to pursue sustainable land management practices and conservation activities, especially in areas in Namibia that are less favourable to wildlife tourism. However, due to the potential risks associated with unregulated hunting and consumptive utiilisation of wildlife, it is essential that decisions for this sector are based on reviewed scientific evidence. Trophy hunting exports contribute over half of the total income from the wildlife tourism sector. These economic benefits are threatened by trophy hunting import bans being considered in the European Union and the United States of America. Should trophy hunting imports be banned in these countries, the economic impact for Namibians, especially those in communal conservancies, could be devastating.

More evidence on how to maximize the economic and ecosystem benefits derived from trophy hunting could support the development of this sector in a more inclusive, sustainable and regulated manner. This is necessary to maintain and enhance financial benefits to Namibians, while at the same time optimizing environmental benefits to Namibians and the Global Community. The draft Charter for Hunting, Wildlife Conservation and Habitat Protection in Africa proposed by the Namibian Government offers a useful entry point to work towards aligning trophy hunting to maintain and enhance its provisioning of and support towards ecosystem services while seeking to balance social and cultural values (Maclaren et al., 2019).

3.6.2

Biological resources & their use - challenges & responses

Cultivated biological resources (e.g. mono-cultivated, intensive crops that use irrigation and increasing amounts of fertilizers and pesticides) may impact the environment differently than natural biological resources. The impacts caused by subsistence farming also differs from those caused by commercial farming (United Nations, 2017).

Chapter 5 discusses extreme events and disasters in detail, and the dire need for more sustainable water resources has been highlighted in other sections of this report. Water scarcity is a major threat to development in Namibia, including for the agricultural sector which needs high volumes of water to survive. This is important given the recurring drought conditions caused by erratic and persistently below-normal rainfall performance during the 2013/14, 2014/15 and 2015/16 rainfall seasons. Drought severely impacted agricultural and livestock production throughout most parts of the country. While commercial crop farming in Namibia is primarily confined to irrigation schemes, and thereby is less affected by drought, subsistence rain-fed crop production remains extremely vulnerable, with yield losses of up to 50% reported in the 2013/14 drought. The FAO undertook an assessment in 2016 to determine the needs of the worst hit communities in the Erongo, Kunene and Omusati regions and ascertain potential food insecurity. The study findings highlight that the average crop losses for maize were 94.7% and 72.6% in Omusati and Kunene Regions respectively (FAO, 2016). This effect is also captured in the NAB statistics, where record low yields were recorded for both maize and millet over the same period (NAB, 2018).

El Niño-induced drought events also increased animal disease prevalence and risks, and pasture degradation – while also severely reducing overall access to water, with major longer-term negative consequences. The results show that cattle were the most affected by drought among the main livestock species, with most livestock reported to be in a condition ranging from very poor to fair (FAO, 2016). These trends are also highlighted in the headcounts of livestock numbers captured in Figure 3-20, where there is a clear decline in the number of goats and sheep counted between 2013 and 2016 (FAO, 2020).

Given the importance of agriculture to the livelihoods and food security of the majority of Namibians, government has prioritized growth and productivity within the agricultural sector. In this regard, the government has published a number of policies and plans focused on agriculture. The agricultural sector features in numerous national plans and strategies, most recently Namibia's 5th National Development Plan (NDP5). The NDP5 is a broad national strategy that sets out the country's development goals from 2017 to 2022. The plan notes that a substantial increase in agricultural production is one of five "game changers" which could promote

a more productive and stronger economy (GRN, 2017). NDP5 makes particular mention of smallholder farmers, with the aim of supporting them to improve production and thus food security. As such, smallholder and communal farmers will be incentivized to organize themselves into cooperatives while being offered assistance with infrastructure, additional land, seeds and market access. Government also aims to promote locally produced goods when procuring food for hospitals, schools and other government-run institutions.

The country's response to climate change is outlined in the National Climate Change Strategy and Action Plan 2013-2020 (NCCSAP). The NCCSAP acknowledges that the agricultural sector is particularly vulnerable to climate change, with a corresponding risk to food security. The document highlights a number of adaptation and mitigation strategies to reduce the impact and increase the resilience of the agricultural sector to climate change. These include goals such as developing, identifying and disseminating climate-resilient crop farming practices, promoting sustainable land management methods, and limiting harmful greenhouse gases through improved land use.

Specific to the agricultural sector, the National Agriculture Policy (NAP) of 2015 emphasizes the objective of increased and sustained agricultural production. This policy document recommends that all agricultural activities should take place in a sustainable manner with regards to the use of natural resources based on principles such as crop diversification, combating plant pests and soil conservation.

The Namibian government adopted Green Schemes to fund irrigation projects. The Green Scheme programme aims to increase food production through irrigation production (GRN, 2008). The programme is designed to maximize irrigation opportunities along the maize triangle area of Grootfontein, Tsumeb and Otavi in the Oshikoto and Otjozondjupa regions as well as north-central and north-eastern regions of Namibia by utilizing the Kunene, Kavango and Zambezi rivers. In addition, the Green Scheme promotes the agricultural projects in the south of the country by utilizing the water from Orange River and dams such as Naute and Hardap – and in the near future the Nickartal dam. The programme further seeks to harness the resources of government and other stakeholders in order to increase agriculture productivity and social development in the Harambee Prosperity Plan, a Presidential plan on poverty reduction, and the Vision 2030 strategy. To date, there are 11 Green Scheme projects across the country, ranging in size from 150 hectares to 1,263 hectares. The combined total area for these schemes currently stands at 7,641.6 hectares of which 56% (4282.6ha) is under cultivation. They produce variety of crops from cereals (maize andwheat), vegetables (tomatoes, onion and cabbages) and fruit.

Although the Green Scheme's ultimate aim is to increase food supply in Nambia, the scheme's methods to achieve this are focused on increased production, increased water use and consumption which does not necessarily mean environmental protection. Land that is cleared for irrigation purposes involves the removal of soil and vegetation, creating a disturbance in the local ecosystem which, without comprehensive environmental impact assessments and management measures, may result in negative environmental impacts. This could place biodiversity at risk and disturb the already fragile water balance in the country. If not carefully managed, the loss of natural land cover could be counter-productive to Namibia's goal to revegetate areas as part of NDCs to mitigate climate change.

3.7

Water resources & their use - status quo

The features of Namibia's water resources were explored in Chapter 2. This section focuses on the abstraction, use and returns of water, which involves the flows of water between the environment and the human settlements within populated areas. Water abstraction is the amount of water that is removed from any source, either permanently or temporarily, in a given period of time. Water is abstracted from surface water and groundwater resources by economic activities and households. It can be abstracted for own use or for distribution to other users. Statistics on water abstraction become meaningful when disaggregated by the source of the water (surface or groundwater) and by abstractor (economic activity or households) (United Nations, 2017). Water abstraction usually refers to the off-stream use of water. The most important off-stream uses for which water is abstracted are: water supply to human settlements; water for agriculture; water for industries; and water for cooling in thermo-electricity generation.

3.7.1

Usage of water resources

Water is at the core of sustainable development and is critical for socio-economic development, healthy ecosystems and human survival itself. It is vital for reducing the global burden of disease and improving the health, welfare and productivity of populations (UN Water, 2020). However, water is a finite and irreplaceable resource that is fundamental to human well-being. It is only renewable if well-managed.

Water supply

In the context of Namibia, the understanding of Namibia's climate as well as the interaction between climatic and physical determinants is crucial for sustainable development and management of the water sector (Heyns et al., 2009). An important step in the sustainable management of water resources is understanding the consumption patterns and use of water. As indicated in Figure 3-22, only 42% of the total water usage is derived from surface water sources; 38% comes from groundwater abstracted from aquifers, with a very slow recharge rate, especially during drought years.

Groundwater is mainly used for domestic purposes and livestock watering in rural areas. In urban areas, industry and households rely on groundwater. A number of Namibian cities and towns are 100% reliant on groundwater (Walvis Bay, Swakopmund, Otjiwarongo, Tsumeb, Luderitz, Grootfontein and Usakos), making them especially vulnerable to the impacts of climate change on aquifer levels. Several mines – including the Rössing Uranium Mine, the Husab Mine and the Langer Heinrich Mine – are also dependent on groundwater, but the recent installation of desalination plants have reduced this reliance.

There is a lack of recent data documenting national water usage in Namibia. As a proxy for national data, water distributed by NamWater, the public enterprise responsible for bulk water

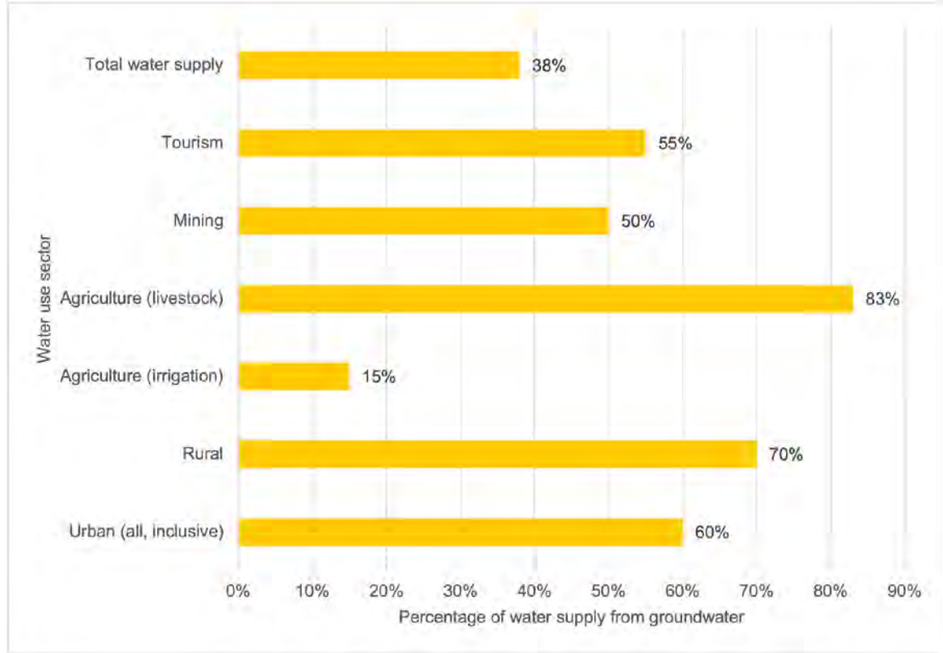
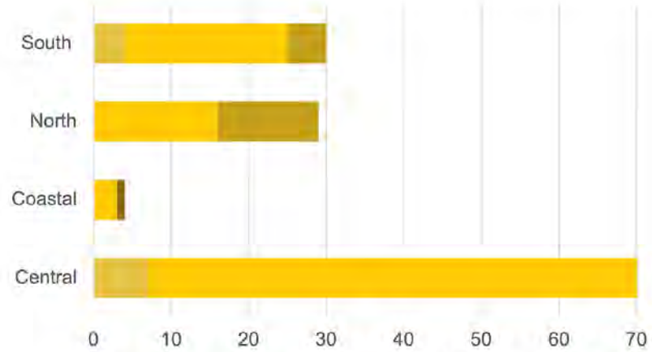


Figure 3-22 *Percentage of water supply provided by groundwater in Namibia (MAWLR, 2012)*

supply, is discussed. These figures do not include total water usage as there are numerous private and often unregulated boreholes in Namibia.

NamWater distinguishes four types of water supply sources per region in Namibia: dams, boreholes, rivers and desalination plants. Figure 3-23 provides an overview of the number and type of water schemes supplying water to regions in Namibia. It is evident that central Namibia is currently highly dependent on groundwater for its water supply, and that urgent augmentation of water sources is needed for that area (NamWater, 2019).



	Central	Coastal	North	South
Number of schemes supplying water from dams	7	0	0	4
Number of schemes supplying water from boreholes	63	3	16	21
Number of schemes supplying water from rivers	0	0	13	5
Number of schemes supplying water from deslination plants	0	1	0	0

Figure 3-23 *Number and type of water schemes supplying water to regions in Namibia (NamWater, 2019)*

Water consumption

Annually, NamWater supplies 82 million m³ of water to its customer base, with the mining industry being the largest single recipient of water annually as depicted in Figure 3-24. The next largest consumers of water supplied by NamWater are four cities and towns, who in total use 44.5% of supplied water in Namibia. Although NamWater's mandate does not include supplying water to individual customers (it provides bulk supply to local authorities), it has in recent years become more difficult to ignore the water needs of individuals who live adjacent to water pipelines and schemes. As a result, NamWater's individual customer base has risen from 839 in 2006 to 48,438 in 2019, mostly due to growth in peri-urban settlements not serviced by local authorities.

Rural water supply is conducted by the MAWLR sub-division, the Directorate of Rural Water Supply. In some cases, rural water supply is managed by private entities such as mines, commercial farms and lodges – who have applied for permits to abstract groundwater. The MAWLR have constructed over 3,000 kilometres of rural water supply pipelines and established over 7,000 water points for rural communities between 1990 and 2009 (Desert Research Foundation of Namibia, 2009).

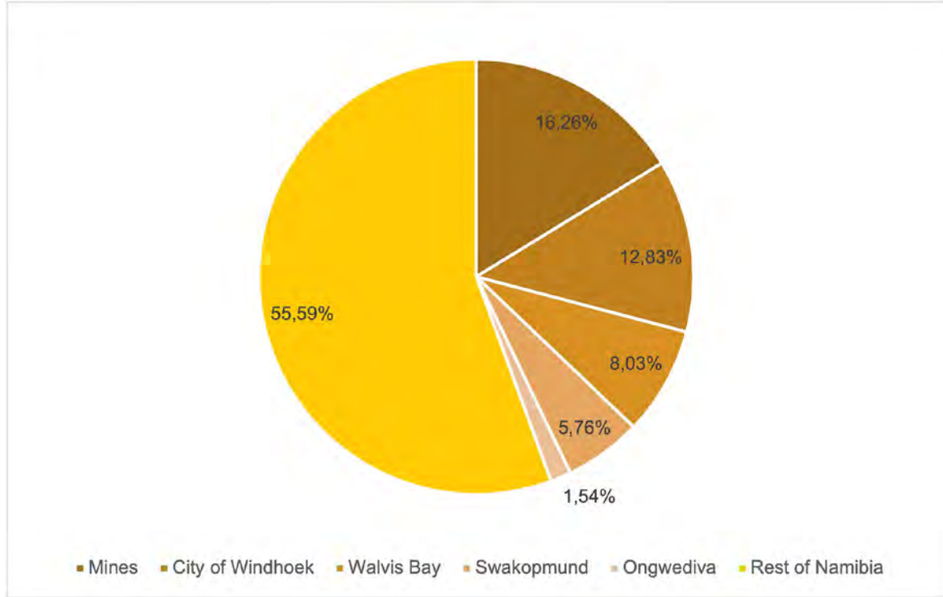


Figure 3-24 *Number and type of water schemes supplying water to regions in Namibia (NamWater, 2019)*

The annual consumption of water supplied by NamWater during the 2018/19 financial year amounted to 133,133,737m³. This demand is primarily driven by irrigation for agriculture, which annually consumes 52,013,245m³, 39.1% of the total water supplied by NamWater. The second largest consumer of NamWater isthe mining sector, who make up 9.9% of NamWater's consumer base. NamWater currently supplies 33% of mines' water usage. Windhoek is the largest municipal consumer of water with an annual consumption of 10,407,942m³ (7.8%) followed by Walvis Bay where 6,512,500m³ (4.9%) is consumed. During the period under review, the central area (33%) and central northern (30%) areas of Namibia received the biggest supply compared to the coastal (25.5%) and southern areas (11.5%) (NamWater, 2019), as indicated in Figure 3-25.

Rossing Uranium Mine | Wikicommns

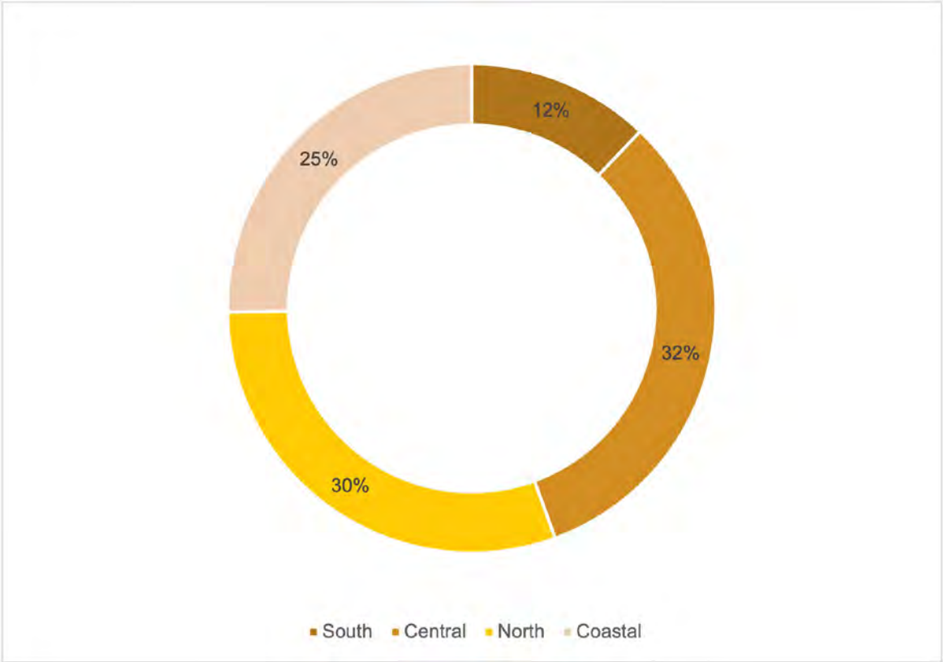


Figure 3-25 *Percentage water supply by volume per NamWater-defined region (NamWater, 2019)*

Water demand

The most recent official statistics of nationwide water consumption were reported in 2008 in the Integrated Water Resource Management Plan (MEFT, 2010). This plan also included the projected water demand for various sectors for the years 2015, 2020, 2025 and 2030 (Figure 3-26). The forecast total annual water demand is set to more than double from 334.1 million m³ to 771.7 million m³ between 2008 and 2030. This projection suggested that the large increase will primarily be driven by the increase in water usage for irrigation, which in 2030 will make up 64.4% of total water usage.

The plan suggests that in line with the Green Scheme, most new irrigation schemes will be concentrated along the perennial rivers, resulting in a significant increase in the water requirements in these areas. Moreover, the proportion of water used for livestock farming is forecast to decrease from 26% to 11.2%, due to the limited livestock-carrying capacity of the soil, influenced mainly by annual rainfall and availability of grazing. Given that Namibia's urban population is set to increase to 2.24 million in 2030 along with rising incomes, urban water demand is projected to increase from 66 million m³ to 117.2 million m³ (MEFT, 2010).

A significant amount of planning and work has been done by NamWater to improve water infrastructure in Namibia and respond to projected future water demand. A large focus on upgrades to existing water infrastructure and water supply studies are noted. NamWater has over 45 water infrastructure development projects underway (Figure 3-23), which include the rehabilitation of dilapidated water pump stations and distribution canals across the country (MEFT, 2019). The development of water pipelines and processing plants to source water from shared water courses such as the Orange and Kavango rivers are also under consideration.

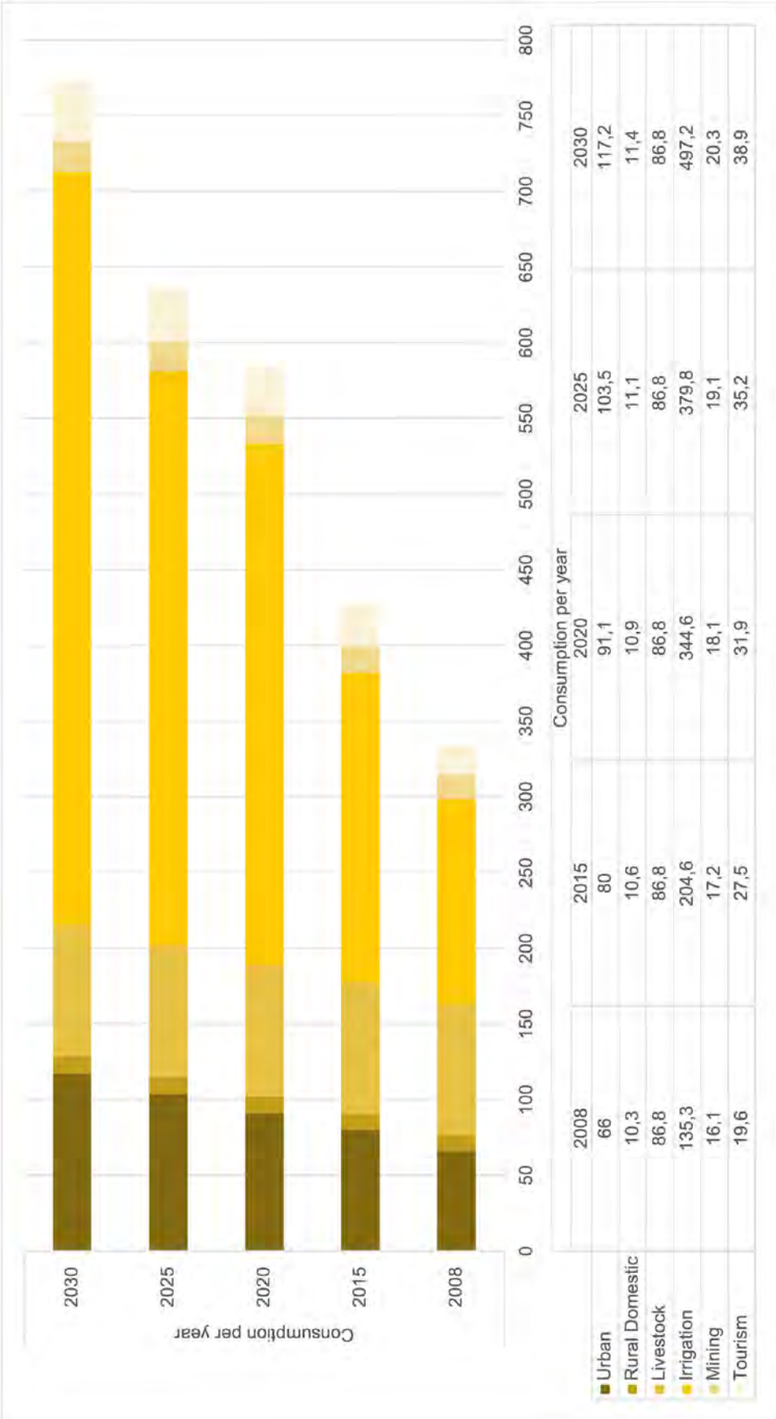


Figure 3-26 *Projected water demand for Namibia 2008 – 2030 (MEFT, 2010)*

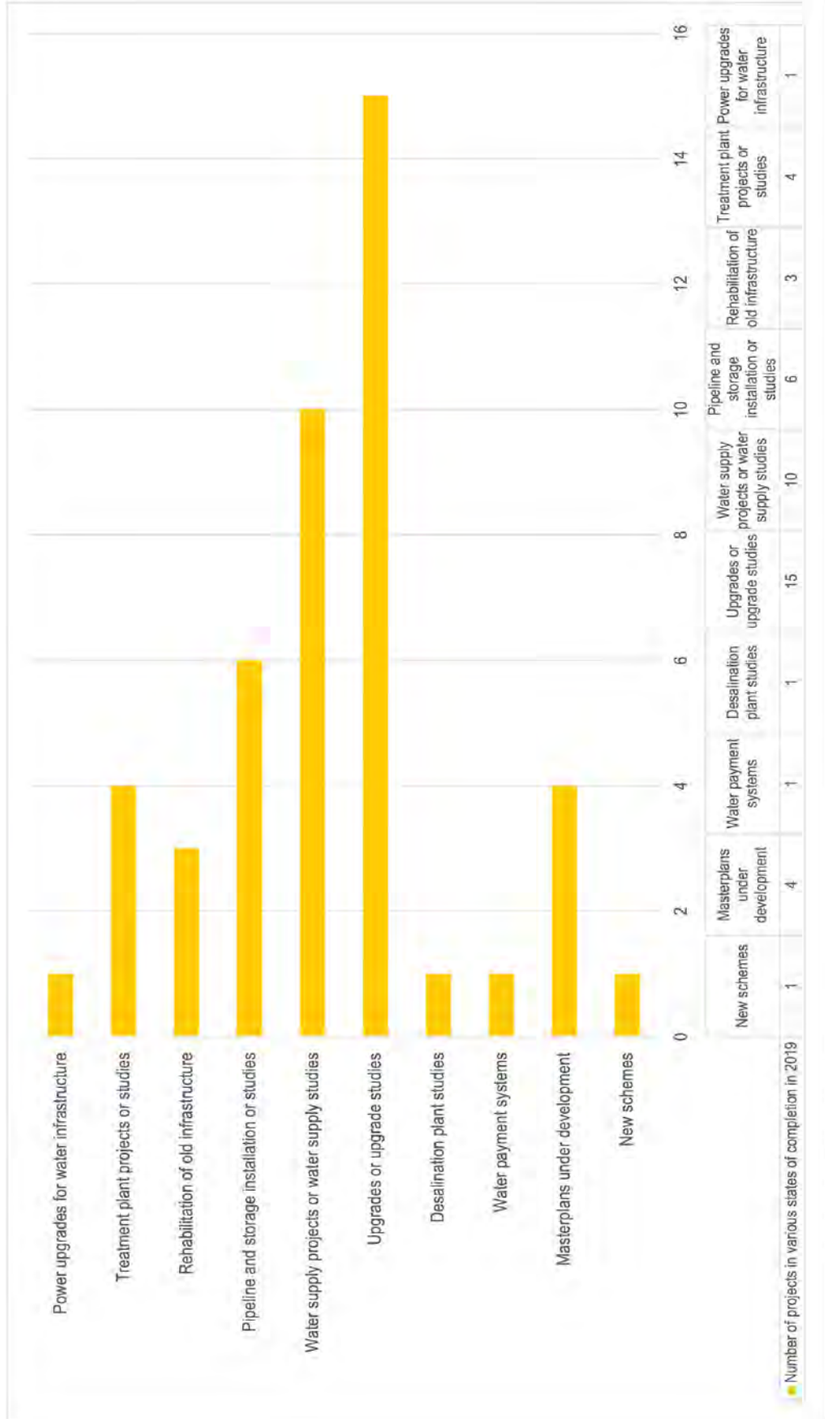


Figure 3-27 *Number and types of water infrastructure projects by NamWater in 2018/2019 (NamWater, 2019)*

3.7.2

Water resources & their use - challenges & responses

Chapters 2 and 3 highlight the common theme of growing vulnerability to increased water stress and extreme weather events. Some of the impacts of increased water stress could include an increase in the frequency of drought, drying up of rivers and dams, poor water quality in surface and groundwater systems, and precipitation and water vapour pattern distortions (Urama and Ozor, 2010). It is apparent that water demand is growing, not only for domestic use but also for economic sectors that make a crucial contribution to the Namibian GDP. Trade-offs between water allocations to mining, agriculture and industry on the one hand, and domestic and rural purposes on the other, will become more common if urgent attention to water security in Namibia is not expedited. The overall impact could have devastating consequences to the ecosystem and communities, ranging from economic and social impacts to health and food insecurity.

Namibia has implemented various measures to reduce freshwater depletion and increase the value of water of the last decade. These measures include a stricter approach to water pricing, water conservation and the development of water re-use and reclamation strategies, discussed in Chapter 4. The country has seen significant policy reform for the water sector that has enabled the implementation of these type of measures. These policy reforms are steered by the IWRM Plan (GRN, 2010). The Water Resources Management Act, No. 24 of 2004 (GRN, 2004), replaced the Water Act, No. 54 of 1956, taking cognizance of the legal requirements to implement the IWRM plan.

Further, responses to augment current and future water demand and supply are desperately needed and some actions have been prioritized in recent years. Figure 3-28 provides an overview of integrated national responses needed to address Namibia's water challenges. In some of these areas, progress has been made, but other areas need urgent attention. Policy frameworks and plans as laid out by the various acts and regulations are a step in the right direction, but will remain ineffective if proactive implementation and monitoring of the policies and plans is not carried out. The policies and plans currently in place provide a roadmap for the implementation of impactful management measures. The status of the national water policy framework – and the need for an updated IWRMP and integrated data collection system – was discussed in Chapter 2. Chapter 8 provides an overview of these and other overarching environmental issues.

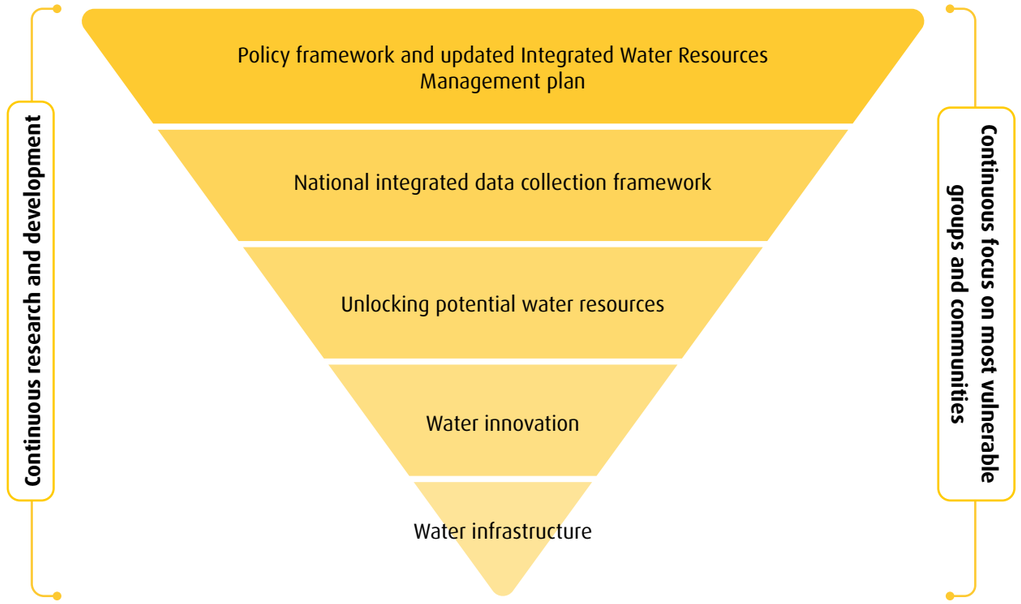


Figure 3-28 *Suggested key responses to Namibia's water security challenge (extracted from MAWLR, 2019)*

Unlocking potential water resources

Limited current data is available to understand the true groundwater potential in Namibia and an integrated plan on how to unlock that potential is also lacking. In 2012, Namibia had a reported installed capacity of 95 million m³ per year from groundwater and the sustainable potential of groundwater was estimated at 360 million m³ per year. It is noted that Namibia shares several transboundary aquifers with its neighbouring countries, including the Caprivi Kalahari Basin, the Northern Kalahari Basin, the Southeast Kalahari Basin, the Cuvelai-Etosha Basin, the Orange River Coastal Aquifer and the Cunene River Coastal Aquifer. Transboundary aquifer management programmes will be needed to understand the current status of groundwater in these aquifers and to unlock its potential fairly between Namibia and its neighbours.

Namibia shares four significant watercourses with neighbouring countries, including the Zambezi, Okavango, Kunene and Orange rivers. In order to unlock the surface water potential of these rivers, Namibia and its neighbours have established four River Basin Commissions to manage water extraction. Of these, Namibia only has an agreement with the Permanent Joint Technical Commission (PJTC) of the Kunene River to increase its current extraction rate from 70 million m³ per year to 180 million m³ per year. The lack of formal shared watercourse use agreements in three of its transboundary rivers makes Namibia particularly vulnerable to water-related conflicts, as its neighbours are subject to the same impacts from climate change and rising regional temperatures.

Walvis Bay shoreline | Matthew Henry

Water innovation & infrastructure

In response to Namibia's vulnerability to water stress, the MAWLR (2019) has proposed several innovative approaches to increase water security. These include the development of mega water desalination plants along Namibia's coastline. Desalination is an energy-intensive process and harnessing solar energy to operate these plants can increase its sustainability. In 2010, Namibia established the Erongo desalination plant close to Swakopmund, with an installed capacity of 20 million m³ per annum. There are plans to upgrade the plant to a capacity of 26 million m³ per annum. Namibia recently installed its first solar-powered seawater desalination system along the beach line adjacent to the University of Namibia's Henties Bay campus. This facility is capable of producing 3,500 litres of water per hour from the ocean with zero energy costs and without batteries (Burger, 2019). A further desalination plant is planned for Walvis Bay and will help sustain Windhoek's water supply and provide water as far as Gaborone in Botswana (Takouleu, 2020).

Other innovative water supply options that are at various stages of consideration are: the reuse of semi-purified water at sports grounds and parks; recycling of industrial and mining water; reclamation of water effluent (discussed in Chapter 4); managed artificial aquifer recharge; use and purification of brackish water; rainfall harvesting; and fog harvesting (MEFT, 2019).

Water security & urbanisation

Urbanisation trends in Namibia are indicating a rapid migration to urban areas, as discussed in Chapter 6. This trend is placing pressure on Namibia's scarce water resources, especially in the central areas' water supply system. This system constitutes the eastern national water carrier consisting of the following infrastructure: a canal from Grootfontein to the Omatako dam; the Omatako–von Bach pipeline; the Von Bach water treatment plant with supply to Windhoek and its surrounds; the von Bach–Swakoppoort pipeline; the Swakoppoort–Okongava pipeline; the Okongava–Navachab pipeline; and the Karibib water treatment plant.

This system is currently under severe pressure. According to the Pre-Feasibility Study into the Augmentation of Water Supply to the central area of Namibia and the Cuvelai (Ministry of Agriculture, Water and Forestry, 2016) the existing supply shortfall of 5.23 million m³/a is projected to grow to a shortfall of some 54.75 million m³/a by 2049/50. Much work is therefore being done currently to determine the most appropriate solution to the water supply problems of the central areas of Namibia.

However, it is not only the central areas that are vulnerable. The Cuvelai area, which covers all of the towns in the densely populated northern regions of the country, is served by a water supply scheme. This scheme draws water from the Kunene River at Calueque in Angola and transfers it via an inter-basin scheme across the watershed between the Kunene and Cuvelai River systems into Namibia. This scheme, which was started in the 1960s, now consists of over 100 km of canal, 7,500 km of pipeline and numerous water purification plants, pump stations and reservoirs (MEFT, 2016). Although this system seems able to supply the existing demand, there are fears about its dependence on Angola and the security of supply to this important part of the country.

Water supply at the coast is also under pressure. The main supply source until recently has been the Omdel Dam in the Omaruru Delta and groundwater from the Kuiseb aquifer close to Walvis Bay. However, over the years – and with the development of a number of mines in close proximity to the coast – the sustainable yield of this system has been gradually exceeded to a point where the developers of the Trekkopje mine decided to establish a dedicated desalination plant at Vlotzkasbaken. This mine has since been put under care and maintenance as a result of the drop in world uranium prices and the desalination plant is now an important contributor to the overall supply of drinkable water delivery system managed by NamWater. It provides approximately 75% of the overall drinking water for the town of Swakopmund as well as the nearby uranium mines and other industries.

Water security is regarded as one of the key issues in Namibia's urban areas, with many other towns and villages located outside of these supply schemes also being water insecure from time to time.

Local perspectives

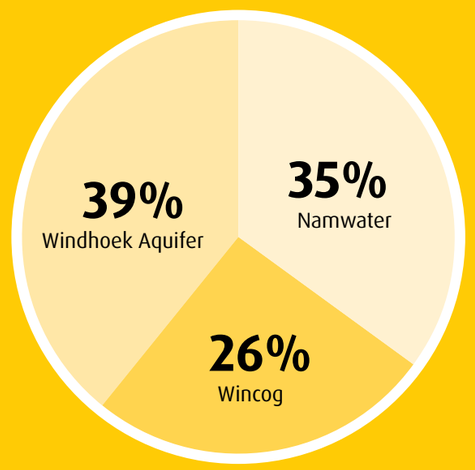
Windhoek water supply

1. To help cope with the disaster of the CoW moved to Category D of their water management plans (WMP) - instituting severe water restrictions.
2. Compared to other cities with similar water security issues, CoW was well prepared. It has a WMP in place and has been working on water reclamation and innovation since the 1960s. Globally, CoW is considered a pioneer in water supply management. More studies are underway to increase water supply and security.
3. Measures taken during the drought of 1996 included building three reservoirs to store water, increase in capacity of the waste water reuse plant managed by Wincog and artificial groundwater recharge to prevent evaporation.
4. For citizens of the CoW water stewardship is a way of life - the city worked consistently to institute a culture shift in perceptions of water use. These efforts payed off, during the 2018 to 2019 season, CoW was able to achieve an average water usage saving of 9%.

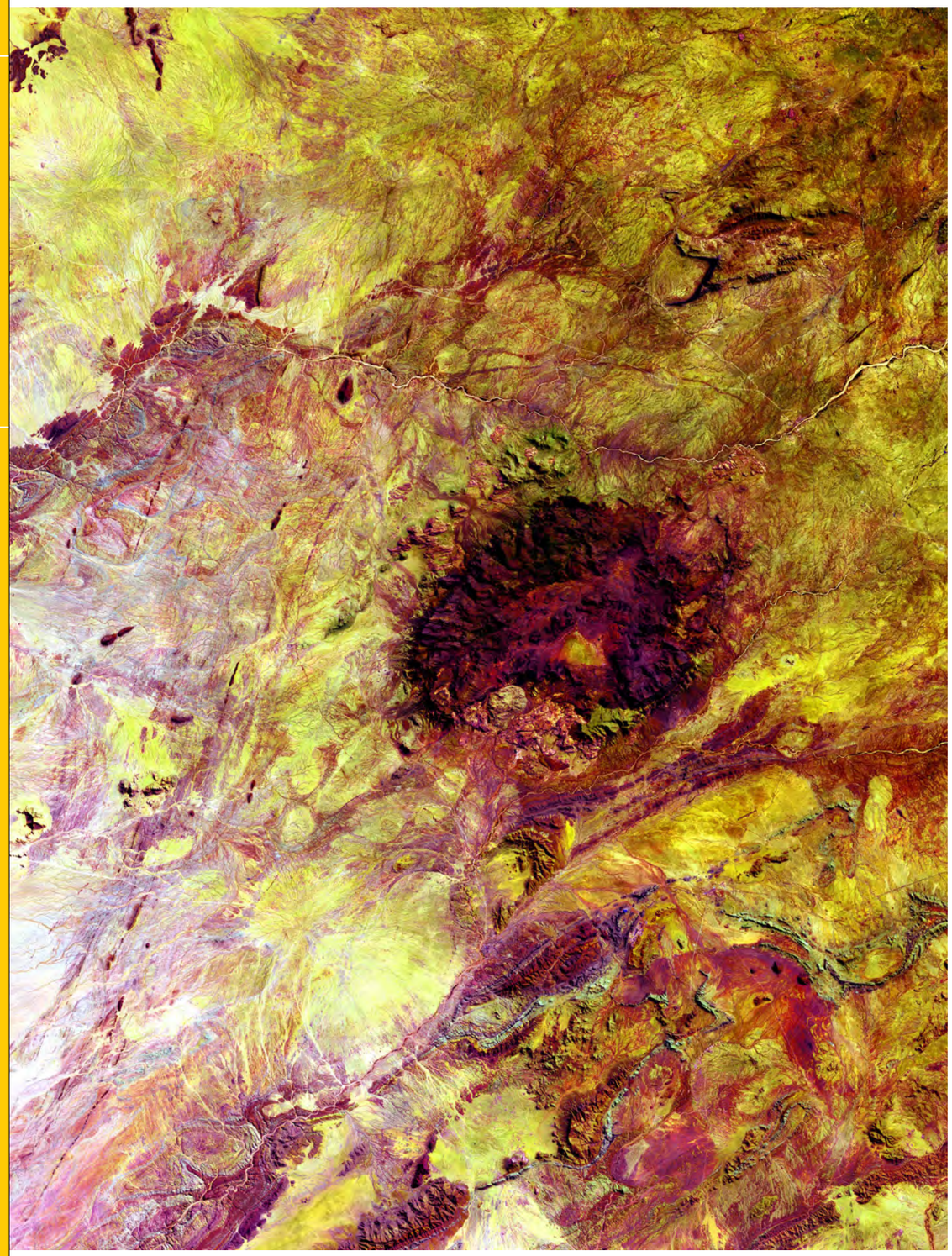
370 mm

the average annual rainfall in the city of WIndhoek (CoW) over the last 20 years. During the drought of 2019 the city recorded the lowest rainfall since the records began in 1891.

Water supply to Windhoek



Source Adapted from Reliefweb (2017).



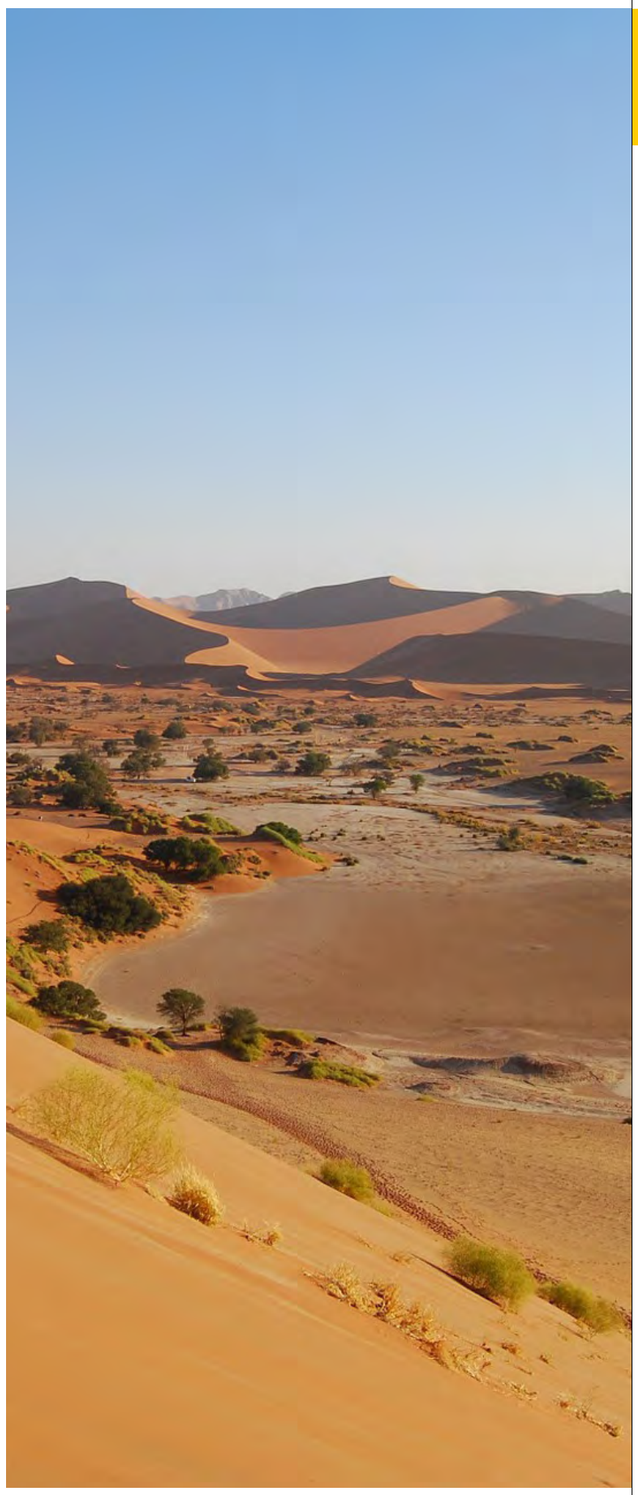
Erongo Massif, an isolated, sheer-walled mountain that rises 1,200 meters | United States Geological Survey

3.8

Way forward

In charting a way forward for each of the FDES (2013) components of environmental management statistics, the most relevant indicators were aggregated into an action dashboard. This approach provides a structured way forward and can support policy-makers and decision-makers with the setting of priorities. It also indicates in which sub-components and underlying indicators funding is most urgently needed.

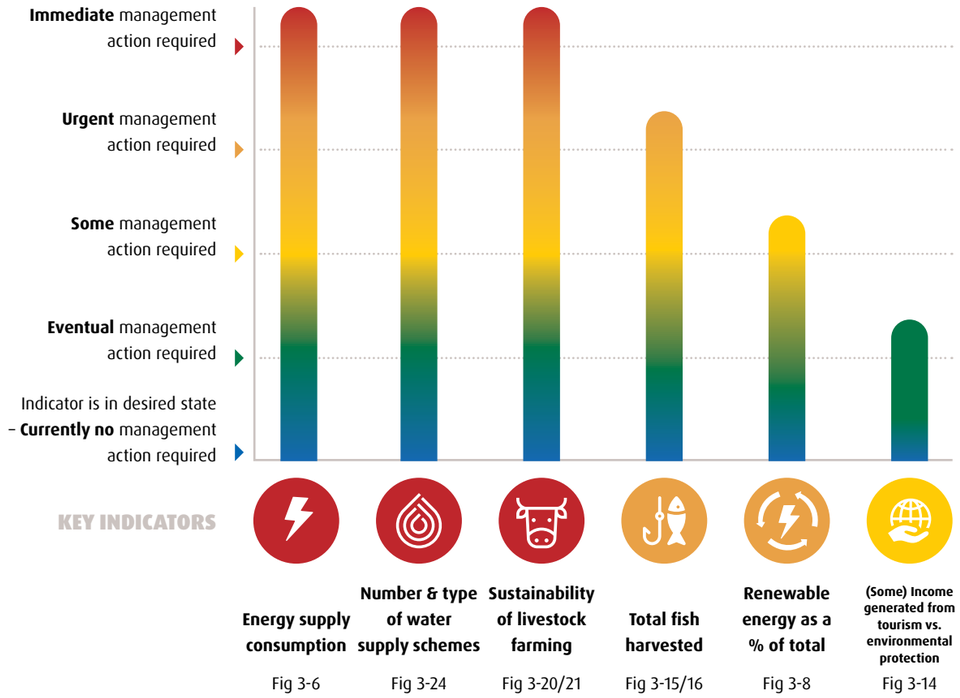
The replicability and reliability of these dashboards will improve as Namibia's environmental statistics system expands and aligns with international databases. Figure 3-29 provides the action dashboard for Namibia's environmental conditions and quality. Recommended actions on each of these indicators can be found in sections 3.3, 4.3, 5.2, 6.2 and 7.2 of this chapter and involves a variety of approaches from policy and capacity building, to funding and research.



Sossusvlei | Wikicommons

5

Environmental resources & their use



Management actions

Energy supply Actively support the expansion of a renewable energy sector to reduce reliance on energy imports & fossil fuels.

Number and type of water supply schemes Continue investments into water supply infrastructure.

Sustainability of livestock farming Utlise integrated land use planning mechanism to support the promotion of sustainable livestock farming.

Total fish harvested Expand and protect gazette marine protection areas.

Renewable energy Investigate further means to reduce the reliance on imported energy supply in order to expand renewable energy production.

Tourism vs. environmental protection Promote low-impact nature-based tourism that supports national programmes and plans for the protection of the environment.

Figure 3-29 *Action dashboard for environmental resources and their use*

We need to ensure that all citizens are equipped with relevant knowledge, attitudes, values and skills required for managing natural resources in a way that causes no significant damage to the environment and considers the needs of present and future generations.

POHAMBA SHIFETA

Views over Etosha | Felco Böhlingk

Okahandja Location Cleanup | Wikicommons

CHAPTER 4

Wastes & Their Management

This chapter contains data and analysis on the level of residuals (waste) produced and managed by humans during which waste is discarded into the environment according to the local regulatory requirements. Waste is made up of air emissions, wastewater and general waste. These waste materials can be solids, liquid and/or gaseous materials emitted by industries and households during production and consumption.

United Nations, 2017

4.1

Introduction

Residuals are waste materials that have been discarded after their primary use. These waste materials are usually derived from household, agricultural, construction, industrial and mining activities. They must go through a post-use management process where they are processed and separated according to their respective classification.

Air emissions, wastewater and solid waste pose different environmental and human risks and impacts, depending on their volume and composition. Some waste materials may be absorbed back into the ecosystem or continue to build up because of variation in the magnitude of contamination and the reciprocal effect that the local environment could have on the accumulation of waste (United Nations, 2017).

4.2

Waste and waste management - status quo

Status quo refers to the current state of specific environmental conditions relating to waste and waste management, such as air emissions, wastewater, waste and the release of chemical substances. It is informed by how indicators related to these conditions are trending over time. The following 9 indicators are used in this section to report on the current state of waste and waste management in Namibia:

- National emissions, removals and net removals;
- Emissions per sector;
- Annual mean concentration of PM2.5;
- Daily discharge of treated wastewater and type of water use for WWTPs in Windhoek;
- Compliance status of WWTP in Namibia;
- Percentage households with regular garbage collection;
- Solid waste processed in Windhoek per month;
- Percentage distribution of households by means of waste disposal; and
- Recycling volumes in Windhoek.

4.2.1

Air emissions

Emissions to the air are made up of waste gases (gaseous and particulate matter) discharged into the environment. They are measured per gas, per volume in the air. To make it easier to compare the volumes and impacts of different gases, scientists use the global warming potential (GWP) scale, where the measurement of the heat absorbed by different gases is converted to how much heat an equivalent of one tonne of carbon dioxide (CO^2) will absorb. Air emissions are measured on the type of substance (solid, liquid or air) and the receiving environment (water, air and soil). There are several types of gases contributing to greenhouse gas (GHG) emissions, each with its own value according to the GWP scale. The GWP value for CO^2 is 1 and the GWP for methane (CH^4) is 25, implying that CH^4 has 25 times the warming effect of CO^2 (UNCCC, 2020).

When calculating the GHG inventory of a country, several components of the air emission lifecycle must be considered. These include the sources and amounts of GHG emitted into the air through activities in Namibia, as well as the Namibian landscape's potential to absorb these gases and break it down or serve as a sink. (Natural elements such as soil, water and plants can absorb, store and process GHGs and are called carbon sinks). When the GHG emissions in a country are more than what can be naturally processed by carbon sinks, the country is considered to be a global net contributor to GHG emissions (UNCCC, 2020).

GHG emissions are a driver of climate change because they trap heat and contribute to respiratory disease from smog and air pollution. They also lead to extreme weather events and the associated natural disasters such as droughts and increase in wildfires. It is important to note, that because emissions to air are not contained by national boundaries, emissions created by activities in other countries contribute equally to the impacts of climate change in Namibia (UNCCC, 2020).

Namibia was one of the first Non-Annex I Parties to prepare a Biennial Update Report (BUR) for the United Nations Framework Convention on Climate Change (UNFCC). To date, Namibia has submitted three BURs and two National GHG Inventory Reports. The submission of the third BUR in 2018 brought Namibia's reporting requirements from the period 1994-2014 up to the standards required by the UNFCC. Reporting on national GHGs in Namibia is not without challenges, and the third BUR (2018) describes data gaps and needs in detail, while also providing a planning roadmap for the improvement of GHG inventory data (GRN, 2018).

The aggregated emissions trend results published in the third BUR indicate that Namibia remained a net GHG sink over the period 1994 to 2014, as the Land category removals exceeded emissions from the other categories. The net removal of CO_2 increased by 20,484 Gg from 77,770 Gg to 98,254 Gg in 2014, representing an increase of 26.3% over 21 years. During the same period, the country recorded an increase of 12.1% in emissions, 2,291 Gg CO_2-eq from 18,889 Gg CO_2-eq to 21,180 Gg CO_2-eq. The trend for the period 1994 to 2014 indicates that the total removals from the Land category increased from 96,659 Gg CO_2-eq in 1994 to 119,434 (23.6%) Gg CO_2-eq in 2014 (Figure 4-1). Per capita emissions of GHG decreased gradually from 11.9 tonnes CO_2-eq in 1994 to reach 9.9 tonnes in 2002. GHG emissions plateaued between 9.8 and 10.0 tonnes up to 2005, after which it seesawed to reach 9.6 tonnes CO_2-eq in 2014. The GDP emission index decreased almost steadily from 100 in the year 1994 to 46.6 in 2014 (GRN, 2018).

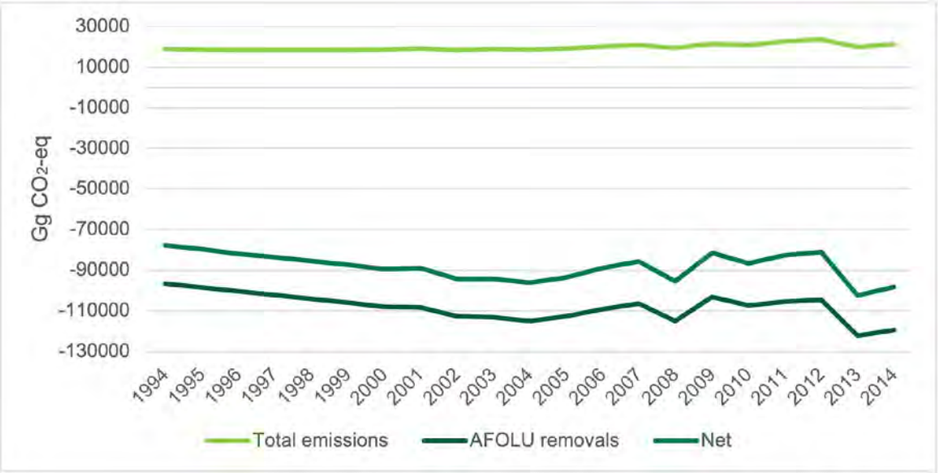


Figure 4-1 *Namibia's national emissions, removals and net removals (Gg CO2-eq) (1994 – 2014) (GRN, 2018)*

The sectors contributing most to GHG emissions in Namibia are: industrial processes and product use (IPPU); agriculture, forest and land use (AFOLU); energy; and waste generation. As indicated in Table 4-1, the IPPU sector's emissions increased the most over time, whereas emissions from the AFOLU sectors decreased. This could be an indication of increased urbanisation and industrialisation in Namibia since 1994. The waste sector doubled its emissions over the past 10 years, whereas energy has seen a 121% increase in emissions over the same time period – indicating Namibia's growing demand for power (GRN, 2018).

Table 4-1 *Emissions per sector from 1994 to 2014 (GRN, 2018)*

Year	Total Emissions	Energy	IPPU	AFOLU	Waste
1994	18,889	1,464	22	17,328	75
1995	18,752	1,473	23	17,183	72
1996	18,439	1,566	23	16,777	73
1997	18,442	1,617	24	16,726	76
1998	18,495	1,759	24	16,633	79
1999	18,553	1,893	25	16,551	83
2000	18,684	1,934	25	16,637	88
2001	*19,157*	2,116	25	16,927	90
2002	18,353	2,163	27	16,073	91
2003	18,842	2,454	110	16,176	101
2004	18,742	2,521	237	15,879	103
2005	19,135	2,671	260	16,094	110
2006	20,194	2,823	255	17,003	112
2007	20,725	2,907	293	17,415	109
2008	19,416	2,752	291	16,256	117
2009	21,549	2,832	303	18,289	125
2010	20,720	2,923	301	17,365	131
2011	22,699	2,796	438	19,326	138
2012	23,542	3,003	515	19,875	149
2013	19,829	2,861	528	19,291	149
2014	21,180	3,234	522	17,271	153

Namibia's mitigation and adaptation responses to GHG emissions are discussed in Section 4.3 of this chapter and expounded on in Chapter 8.

Air quality

The International Association for Medical Assistance to Travellers (IAMAT, 2020) evaluates air quality in Namibia in accordance with the World Health Organization (WHO) guidelines. Air quality is classified to be moderately unsafe with the most recent data indicating that the country's annual mean concentration of PM2.5 is 25µg/m³, exceeding the recommended maximum of 10µg/m³. Poor air quality in Namibia is attributed to food processing, the mining industry, vehicle emissions and waste burning (IAMAT, 2020). City-specific air quality data is, however, not available.

In reality, contributors to poor air quality in Namibia are location-specific and it would be a gross over-generalisation to apply classification of air quality to the entire country. Food processing occurs mainly in the fishing trade in Walvis Bay, and waste burning occurs in the northern parts of the country where agricultural waste and veld burning in the communal farming areas are common. Waste burning also occurs at solid waste dump sites in towns across the country. As Namibia is not densely populated, air quality issues must be addressed at localized level with industry and community-specific interventions.

4.2.2

Generation & management of wastewater

Wastewater comprises discharged water that is no longer in use and usually contains contaminants from economic processes and household activities. Wastewater can be reclaimed through wastewater treatment to remove contaminants and convert it into an effluent; this can be returned to the water cycle with acceptable impact on the environment, or reused for various purposes.

Wastewater can be managed in two ways: either indirectly, through the process of discharging treated wastewater into the environment; or directly, by collecting effluent through sewerage systems for treatment at WWTPs. This method prepares wastewater for further reuse and consumption, typically after further treatment in a reclamation plant to meet water quality standards. Table 4-2 highlights the necessary treatment required for different types of water uses, including potable use and irrigation.

Table 4-2 *Treatment required per water end-use category (GRN, 2008)*

Type of recycled water use	Treatment required
Potable use	Activated sludge system and trickling filters, sedimentation, maturation ponds, coagulation, dissolved air flotation, rapid sand filtration, ultra-filtration, ozonation, disinfection, stabilisation and blending
Irrigation (e.g. fields, parks, vegetation)	Primary and secondary maturation ponds

Collection & treatment of wastewater

Namibia treats wastewater in its most populated and industrialized areas, including Arandis, Otjiwarongo, Swakopmund, Tsumeb, Walvis Bay and Windhoek (NamWater, 2019). Treated wastewater is commonly used for irrigation purposes in local fields and gardens. The direct reclamation of wastewater for potable use is undertaken in Windhoek, having been pioneered there in 1968 (NamWater, 2019). Treated water for potable use is either discharged in the raw water supply to the city in a local aquifer or blended with Windhoek's potable water supply (NamWater, 2019).

The Windhoek wastewater treatment system has undergone continued development since 1968 into what is now the sixth generation (NamWater, 2019). The system increased its capacity from 4,800m³/d in 1968 to 21,000m³/d when the new Goreangab reclamation plant commenced operation in 2002 (Menge, 2010). There are about 350,000 people who are supplied with potable water in Windhoek, which is about 35% of the city's average demand of 57,500m³/d (Lahnsteiner and Lempert, 2007 and Veolia, 2020). Depending on the season, the demand for potable water use can reach as high as 75,000m³/d and as low as 40,000m³/d (Lahnsteiner and Lempert, 2007). Volumes of 21,000m³/d or 651,000m³/month are still discharged for potable use to date (Veolia, 2020). The original Goreangab reclamation plant is now used for the treatment of effluent for irrigation purposes.

The Goreangab reclamation plant is supplied with water from the Goreangab dam and the Gammans WWTP, which is one of the three WWTPs operating in Windhoek (Sibeya, 2016). The Gammans WWTP, together with the Otjomuise WWTP, treat 80% and 20% of the city's municipal domestic wastewater respectively (Sibeya, 2016) while the Ujams WWTP is purely for industrial treatment and discharged for irrigation purposes and industrial reuse. The Ujams WWTP underwent major efficiency improvements in 2012 and commenced operations again in 2014. It has served the northern industrial area of Windhoek by treating approximately 5,175m³ of effluent daily (NamWater, 2019). Table 4-3 summarizes the total discharge of treated wastewater for reuse at each WWTP in Windhoek.

Table 4-3 *Daily discharge of treated wastewater and the type of water use for WWTPs in Windhoek (NamWater, 2019; Lahnsteiner and Lembert, 2007; Sibeya, 2016)*

WWTP	Treated Water Discharge (m³/d)	Water use
Gammans	25000	Potable and irrigation
Otjomuise	15000	Irrigation
Ujams	5175	Irrigation and industrial reuse
Old Goreangab reclamation plant	5000	Irrigation

Compliance

Namibia manages its wastewater treatment process in alignment with the Water Resources Management Act, No. 24 of 2004, as well as the IWRM plan of 2010. WWTPs must be registered with the MAWLR. The prescribed process follows a permitting system to ensure that water pollution control is efficiently managed. Routine wastewater treatment system inspections are carried out in local authorities, mines, lodges and fish factories.

In spite of these controls, there is reportedly a nationwide lack of compliance with the MAWLR's permitting system for WWTPs. As at December 2019, there were 450 registered WWTPs in Namibia, of which only 75 had a valid permit (Figure 4-2). These numbers indicate a dire need for tighter controls and more governance capacity in regulating WWTPs in Namibia.

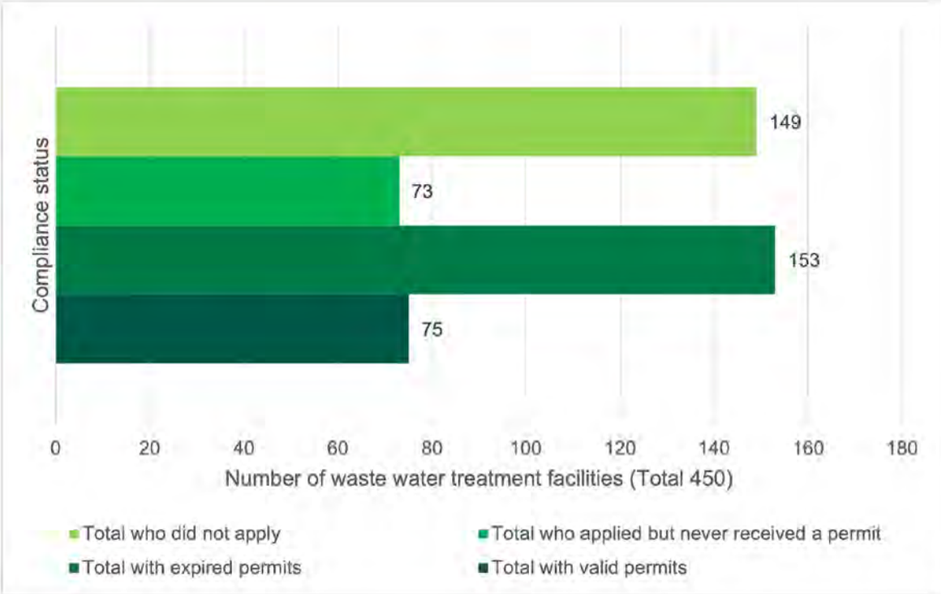


Figure 4-2 *Compliance status of WWTPs in Namibia (MAWLR, 2019)*

Illegal dumping at Ugab Canyon | Wikicommons

Discharge of wastewater to the environment

The discharge of treated wastewater to the environment is considered as the indirect reuse of effluent or wastewater. Treated wastewater is discharged into an adjacent surface stream for downstream reuse and/or ecosystem service maintenance and/or recreational purposes (NamWater, 2019). However, due to Namibia's vast spatial distribution of urban areas, the absence of major perennial rivers in the country, and the land's high evaporation rates, the indirect commercial reuse of water is not feasible with the exception of a few urban areas along the perennial rivers of the borders of Namibia (NamWater, 2019).

4.2.3

Generation & management of solid waste

The management of solid waste is essential to ensuring human health and a functioning and sustainable environment. The uncontrolled management of solid waste can lead to air and water pollution, soil contamination and an increased risk of exposure to pathogens and toxins. Poorly managed solid waste can also contribute to climate change via methane off-gassing and can, in some cases, alter the region's biodiversity (EPI, 2020).

Sources of solid waste

There are many sources and types of solid waste. Table 4-4 provides a summary of the different types of solid waste generated from specific sources (United Nations ESCAP, 2018).

Table 4-4 *Different types of solid waste generated per source (UN ESCAP, 2018)*

Source	Typical waste generator	Types of solid waste
Residential	Single and multi-family dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g. bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes
Commercial	Stores, hotels, restaurants, markets, office buildings, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, hospitals, prisons, government centres	Same as commercial
Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc.
Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational area, sludge
Process	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing	Industrial process wastes, scrap materials, off-specification products, slag, tailings
All of the above is classified as "municipal solid waste"		
Agriculture	Crops, orchards, vineyards, dairies, feedlots, farms	Spoiled food wastes, agricultural wastes, hazardous wastes (e.g. pesticides)

In 2017, MEFT identified an urgent need for a National Solid Waste Management Strategy. A baseline report was developed through a rapid assessment of the current status of solid waste management systems responsibilities and priorities across Namibia. This report provides valuable insight into solid waste estimates, current solid waste practices and the current legal and institutional frameworks.

Due to a lack of integrated waste data management system, the estimated volumes of waste being generated in Namibia per year cover a wide range. MEFT (2017) estimates that between 75 and 550 kilotons of solid waste are being generated in Namibia per year.

Even though this range might seem low on a country level, the vast distances between main centres in Namibia implies high transport costs and contributes to increasing the cost of waste management on a per tonne or per person basis.

In Namibia's urban areas, only 70% of national households have regular garbage collection (Figure 4-3). In some regions it is better, and in others worse. The Kharas region fares the best with 88.9% of urban households having regular garbage collection, while the Kavango regions fares worst with only 20.5% of urban households indicating that they receive a regular garbage collection service.

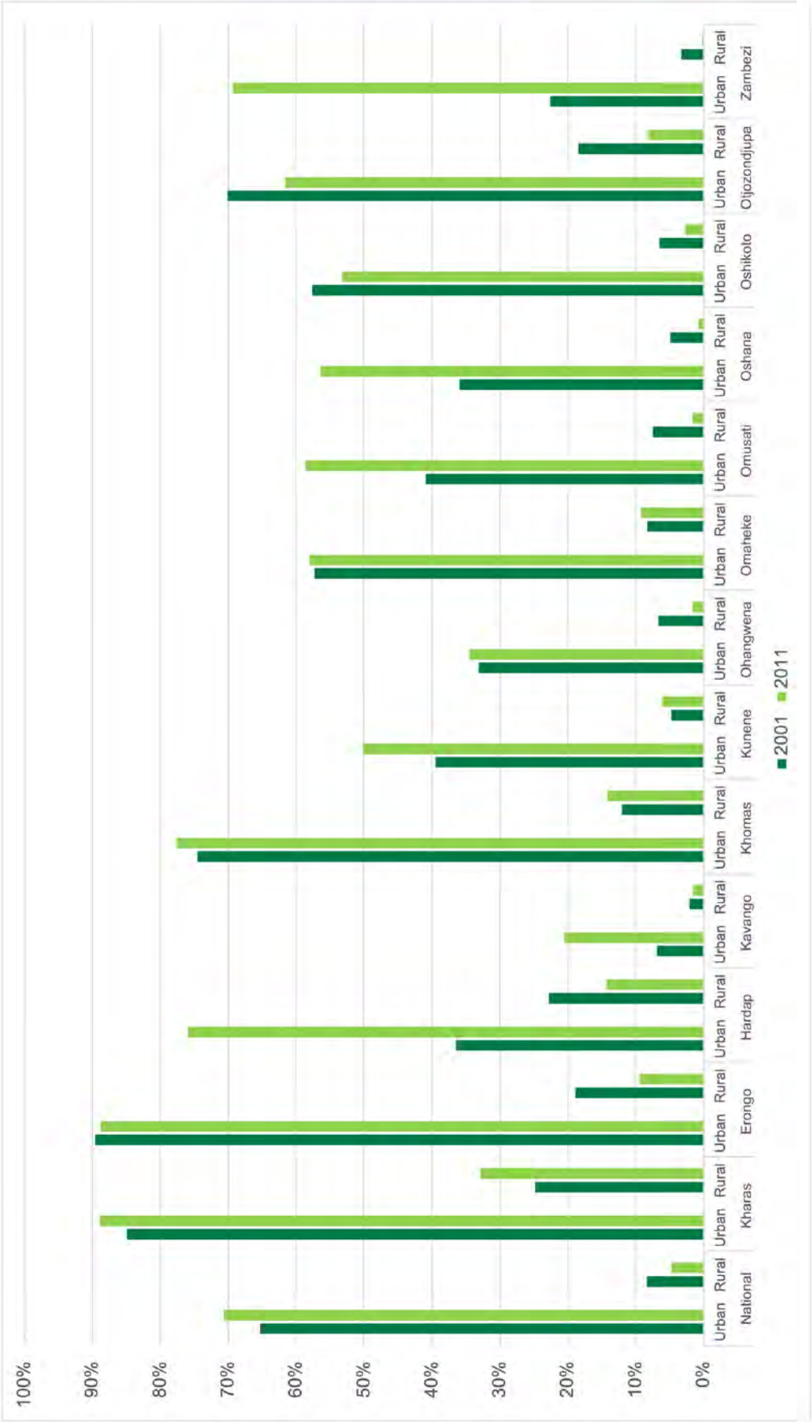


Figure 4-3 *Percentage of households with regular waste collection services (NPC, 2013)*

Infrastructure, volumes & management

The City of Windhoek division of Solid Waste Management (SWM) was formed in 1998, initially for the cleaning of streets and open spaces and for the removal of household refuse. The SWM division has since expanded operations and is now the largest division in the DIWWM (CoW, 2019). The functions of the SWM division include: landfill sites and technical support; licensing, research, education and special projects; operations; and financing and administration.

Namibia has one fully operating landfill site, located in Windhoek. The solid waste management in the rest of the country is conducted at waste sites with no proper control or management. The lack of sufficient solid waste infrastructure and the unavailability of waste quantification data has classified Namibia as having uncollected or missing end states of solid waste (EPI, 2020). It is estimated that approximately 69% of the country's solid waste ends up in open dumps. This status quo extends throughout sub-Saharan Africa where there is a lack of resources and infrastructure to effectively manage the growing waste demands and sustain rapid urbanisation (EPI, 2020). Although the collection rate for solid waste is 100% in Windhoek, this figure does not account for the informal sector where the volume of collection is about 30% (CoW, 2019).

Waste collection is not the only challenge; the nature and management of solid waste disposal sites in urban areas is a major cause of concern. Namibia, as a medium income country with a growing and wealthy urban middle class and significant urban drift, is feeling the pressure of significant amounts of waste generated from its facilities throughout the country and more especially in the urban areas (GRN, 2018). Solid municipal waste is dumped in landfills or open dumps while most large urban settlements are connected to reticulated wastewater treatment systems.

Disposal sites in Namibia have been operating for many years, and a large proportion did not have an Environmental Impact Assessment (EIA) carried out before they started operation (MEFT, 2017). Visits to disposal sites by the MEFT during the Baseline Assessment in 2017 indicated that most sites do not appear to be properly implementing Environmental Management Plans. In addition, at many sites, there have been changes in the local setting, and therefore changes in the potential receptors that could be impacted since the disposal sites started operation (e.g. new housing constructed, and/or new groundwater boreholes installed). There is therefore an increasing risk of environmental and human health impacts (e.g. local freshwater contamination).

The City of Windhoek, under the Khomas local authority, currently uses one landfill site for the bulk of its solid waste management. There are seven smaller satellite sites that are used as well. Solid waste is channelled through two transfer stations and all Health Care Risk Waste (HCRW) is processed through Windhoek's HCRW treatment facility (CoW, 2019). Table 4-5 shows the monthly total volumes of solid waste processed in Windhoek.

Table 4-5 *Monthly total volumes of solid waste processed in Windhoek (CoW, 2019)*

Waste type	Volume managed (monthly)
General waste	7,500 tons
Hazardous waste	650 tons
Building rubble	12,500 m^3
HCRW	700 tons

A rapid assessment and waste data collection project undertaken in August 2019 in north-east and north-central Namibia indicates that management of the landfills and dumps are not at the highest standards (MEFT, 2019). Waste is generally burned in open dumps to reduce the volume or reduce health risks. In general, the waste management trends between 2001 and 2014 (GRN, 2018) in Namibia showed:

- There was a general increase in regular collection of waste from 30.9% in 2001 to 36.1% in 2014;
- Irregular waste collection decreased from 11.5% in 2001 to 4.8% in 2014;
- Burning, which releases harmful chemicals into the air, increased from 18% in 2001 to 34.4% in 2014; and
- Roadside dumping decreased from 14.7% in 2001 to 9.7% in 2014.

The country's top priority is to reduce risks to the environment and public health from current waste disposal sites and illegal dumping in many areas of Namibia (MEFT, 2017). Although the waste collection system at most local authorities is generally operating to an adequate standard, waste disposal remains inadequate and lacks suitable procedures and controls. There is also scope for improvement in waste collection at all local authorities, in particular related to waste collection coverage in informal housing and rural areas.

Data regarding the number of waste disposal sites in Namibia was not readily available and hence could not be reported on. There is reportedly general concern regarding the management of waste disposal sites and the standard of the overall facilities in urban centers with the exception of Windhoek, Walvis Bay and Swakopmund.

4.2.4

Waste & waste management - challenges & responses

Remaining a net GHG sink

Namibia is in the fortunate position to be a net GHG sink, meaning that its capacity to absorb GHGs is greater than its emissions. It will, however, take planning and concerted effort to remain a net GHG sink, especially in the light of Namibia's drive to increased industrialisation and economic activity. The main contributors to increases in GHG emissions are industry and transport, the waste sector and the energy sector. Careful consideration should be given to how these industries are regulated in terms of air emissions, and more robust reporting systems will assist in how emissions are reported. Coupled with strategies to reduce emissions, active work on land degradation and deforestation will increase Namibia's natural carbon absorbing capacity. This highlights the need for different governmental departments, non-government organizations (NGOs) and communities to work together (GRN, 2018).

Namibia has been on the forefront of African countries in committing to international climate change action. It ratified the NFCCC in 1995 as a Non-Annex 1 Party and has been complying with all reporting requirements. Complying with the technical requirements of the NFCCC has not been without challenges, and the third BUR report provides a detailed summary of specific challenges faced and suggests ways to mitigate challenges. Most notably, significant data gaps exist in various underlying environmental subsections, such as solid waste – for which limited indicators are available in centres outside of main cities.

Increasing the efficiency & quality of wastewater treatment infrastructure

Due to an increasing population, and economic development (particularly industrial development), there is growing potential to improve the efficiency and capacity of existing WWTPs in Namibia. The rise in population and economic activity has already put pressure on Namibia's ability to treat industrial and domestic wastewater, and to provide safe and healthy discharge water for potable and irrigation purposes (Sibeya, 2016).

The quality of reclaimed wastewater in Windhoek for potable use and irrigation is above international WHO standards, and more stringent national standards should be developed by the MAWLR for reclamation (Moyo, 2012). Although wastewater treatment in Namibia is processed to high quality standards, pressure is being applied on WWTPs by the increase in industrial effluent (Foster et al., 2014). Furthermore, Namibia faces wider challenges including:

- An increasing demand for fresh water in an increasingly semi-arid environment, as discussed in Chapter 2;
- A lack of capacity to permit and inspect WWTPs in Namibia;
- Freshwater source pollution because of leaks from WWTPs (for example, pollution of Swakoppoort Dam which supplies fresh water to Windhoek);
- Public health issues from industrial WWTPs, which emit unsafe odours from the maturation ponds; and
- A lack of knowledge of wastewater re-use for agricultural purposes. Selection methods for irrigation are not informed and can result in unsafe crop production – for example, flood irrigation has been used for vegetables which end up as fresh salads (Moyo, 2012). This poses serious human health issues.

The MAWLR has approached these challenges through the implementation of minimum quality standards for the discharge of effluent wastewater and enforcing the 'polluter pays' principle.

The Namibia Sanitation Strategy of 2011 has identified the eventual re-use of wastewater for irrigation as a selection criterion for the establishment of sanitation systems (Moyo, 2012). Awareness around the re-use of wastewater for irrigation purposes has not been fully explored. An increase in awareness surrounding the use of wastewater for crop production and specific irrigation uses can widen paradigms and better inform decision-makers. The exploration of agricultural trade-offs with wastewater irrigation may reduce the amount of pollution in freshwater sources connected to the area. There may be an opportunity to supply capacity building programmes to local authorities, community residents, farmers and policy-makers to enhance knowledge and skills regarding the re-use of wastewater.

Mining & wastewater management

Research on the mining industry has found that mining companies are making use of water-conscious and innovative means to secure and conserve water for operations (Musiyarira and Dzinomwa, 2017). The regulated development of water management plans for each mine and the prevention of ground and surface water pollution, however, remain a challenge (GRN, 2010). The Minerals (Prospecting and Mining) Act, No. 33 of 1992, focuses on mineral extraction, but also provides some provisions for groundwater abstraction. The Environmental Management Act (EMA), No. 7 of 2007, requires that all ecosystems be provided with sufficient water to meet their ecological requirements, or that adequate environmental flow is available to sustain water-dependent ecosystems. To obtain groundwater abstraction permits that comply with the purposes and mandates of the EMA, a mining company will also have to comply with water policies such as the WRMA (Climate Technology Centre and Network, 2020).

The use of water in mining has the potential to affect both the quantity of water available as well as the quality of surface and ground water surrounding the mines. In Namibia, an Environmental Clearance Certificate is required to legally operate a mine, under which provision for water management is made. Limited data is available as to how these water provisions are being enforced, but several best practice case studies are available in the Namibian mining industry to illustrate commitment to sound water stewardship. This is notable in the construction of desalination plants and wastewater treatment plants by certain mines to mitigate the level of water stress on groundwater and surface water (Musiyarira and Dzinomwa, 2017).

Local perspectives

The impacts of uranium mining on groundwater in the Erongo Region

① The worldwide increasing need for energy in the early 2000s, triggered an increased interest in uranium exploration, often referred to as "the Namibia Uranium Rush". All in all, five mining licenses were granted by the Namibian Government, with there being two mines currently in operation (Rössing and Husab), with a third under construction undertaking trial mining.

② The Erongo region is located in the arid Namib Desert with minimal vegetation and has an average rainfall of less than 150mm. As such the economy and population of the region rely heavily on groundwater as its main source of water. In the context of such high dependency on groundwater and large mining operations in close proximity there is often a risk of environmental spillovers.

③ One such example was evidence of seepage from the tailing dam of the Langerheinrich mine in 2008, which was observed along the roads in the mine site downstream of the tailings and within the flood plain of the Gawib River. In response Abiye and Shaduka (2017) investigated the possibility of uranium seepage from the unlined tailing dams and dispersion downstream through groundwater flow. The authors found that the expansion of uranium mines has contributed its share to the deterioration of quality of the groundwater through seepage from tailing dams and groundwater flow within the aquifer system. The unlined tailing dams had a significant impact in releasing uranium into the alluvial groundwater.

100%

the percentage of water supply via groundwater for Walvis Bay, Swakopmund, Otjiwarongo, Tsumeb, Luderitz, Grootfontein and Usakos.

④ Moreover, the authors note that the radioactive contaminants could spread into the deeper aquifer system through major structures such as joints and faults. The contamination plume could also spread downstream into the Swakop River unless serious interventions are employed. There is aloso a very high risk of the plume to reach the Atlantic Ocean through seasonal flash floods that occur in the area.

Source Insights from Abiye and Shaduka (2017)

Strengthening solid waste management

Waste disposal is the main challenge for Namibia's current solid waste management system. The lack of waste infrastructure and the insufficient management of existing solid waste disposal sites has created a wide window of opportunity for improvement. The government is steadily working on developing a more controlled waste management system.

A number of challenges and opportunities have been brought to light through the National Solid Waste Management Strategy (NSWMS) which was developed by the MEFT (2017), including the following:

- The legal framework for solid waste management is weak, and an approach for the step-by-step tightening of standards is needed. Minimum standards for waste disposal need to be adopted and implemented;
  - There is significant interest from the private sector in solid waste management services, but more support is needed from the government to facilitate private sector participation;
  - Dumping and littering in the areas under the administration of regional councils are major problems. In many cases, there is no formal waste collection system in these areas; and
  - A major shortfall and constraint to improving solid waste management in Namibia at present is the lack of a co-ordinated approach between stakeholders and the lack of a national strategy. There is an urgent need for management strategies to be adopted (particularly the NSWMS) to ensure that national and local action plans take improvements forward in consistent directions.

In acknowledging Namibia's solid waste challenges (MEFT, 2017), the MEFT has identified the following specific objectives:

- Strengthen the institutional, organizational and legal framework for solid waste management, including capacity development;
- Install a widespread culture of waste minimisation and to expand recycling systems;
- Implement formalized solid waste collection and management systems in all populated areas, including under the administration of Regional Councils;
- Improve municipal waste disposal standards; and
- Plan and implement feasible options for hazardous waste management (including healthcare waste management).

This strategy provides a sound framework to deal with solid waste management in the country, but its implementation has been slow, probably due to a lack of resources and infrastructure. A set of universal solid waste management regulations will also contribute to improved performance, provided that the required monitoring and evaluation takes place. Another challenge is the quantification and classification of waste. This does not seem to happen at any of these local authorities and a methodology – as well as equipment – to quantify and classify waste is urgently required.

The budgeting system for solid waste management has been inconsistent and has often fallen short of the necessary amount to cover expensive capital and operating costs (MEFT, 2017). The MEFT has expressed the opportunity to plan budgets thoroughly and to cover budget costs fully at local authorities (MEFT, 2019). The responsibilities for solid waste management cut across several national and local institutions, including ministries and municipalities. The roles of different national stakeholders, particularly in terms of funding, need to be clarified. Local authorities need more resources (i.e. personnel) for organising solid waste management, monitoring waste generators and reducing the problems with illegal dumping. The MEFT (2017) advocates prioritising waste minimisation and recycling above waste treatment and disposal, as indicated in Figure 4-4.

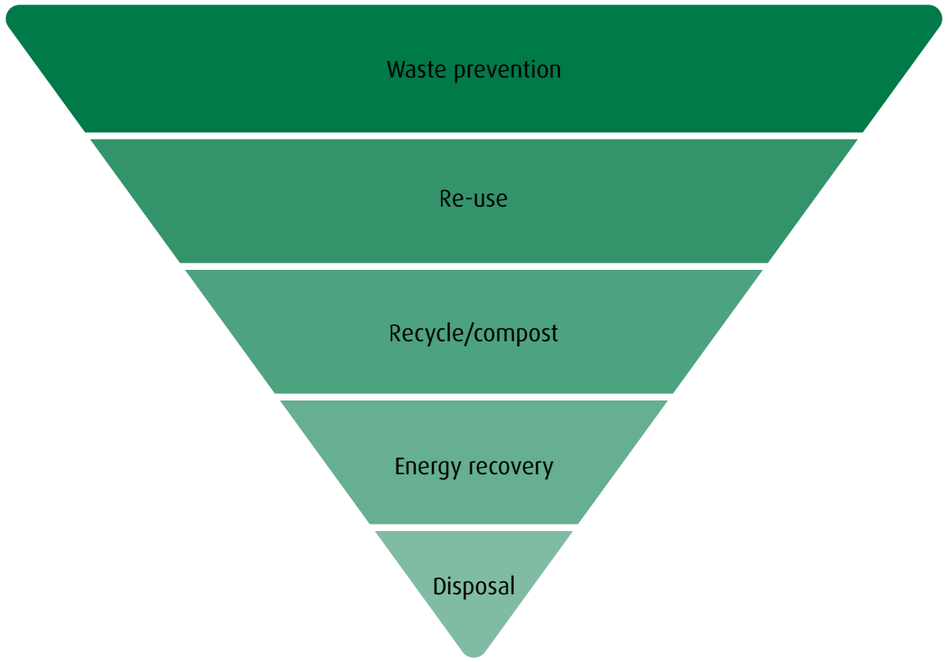


Figure 4-4 *The MEFT's waste management hierarchy*

Although waste prevention and recycling are prioritized, solid waste prevention and in particular recycling, are constrained by the large transport distances and the high transport costs (MEFT, 2017). However, there is significant scope for expansion of recycling in some large cities and towns such as Windhoek, building on the successful aspects of the current systems and increasing participation of households through more awareness-raising activities. Recycling data was only available for the City of Windhoek.

The City of Windhoek collects plastic, paper, glass and tin for recycling purposes and has created about 70 new jobs as a result (CoW, 2019). The clear bag system for recycling has been in place since 2010 and has ensured that less waste ends up in Namibia's landfills or open dumps. This enables solid waste volumes to be controlled to a greater extent (CoW, 2019). Table 4-6 shows the average number of clear bags used and the average volume of recycled waste generated monthly. Windhoek collects approximately 65 tonnes of recyclable material every month and uses 16,520 clear bags in the process (CoW, 2019). The 65 tonnes represent about 5% of the total recyclable volume potential in Windhoek, which shows that there is great opportunity to grow and develop recycling in Namibia (CoW, 2019). There are reportedly other recycling initiatives that are being implemented such as Rent A Drum, but reliable and up-to-data information is not readily available.

Table 4-6 *Daily discharge of treated wastewater and the type of water use for WWTPs in Windhoek (NamWater, 2019; Lahnsteiner and Lembert, 2007; Sibeya, 2016)*

Recycling material	Volume (monthly)
Clear bags	16,520
Collected recyclable material	65 tons

Waste data collection & management

Namibia holds minimal data and information on waste quantities and practices. Improved data are important to facilitate better planning and to monitor that improvements are implemented.

The MEFT, after collecting waste data for the UNFCCC's biennial update report in 2019, highlighted the unavailability of informative and meaningful waste data across Namibia (MEFT, 2019). The Ministry noted that there were no or insufficient databases for the following indicators:

- Quantification of waste generated annually;
- Average waste generated per capita;
- Average composition of solid waste generated by percent of total volume – including organic, plastic, paper, tin, glass, tyres and metal; and
- Average waste generated per capita at the state or national level.

The MEFT proposes an integrated data collection system that includes methods from the South African National Integrated Waste Management Plan (1999) and methods used for data collection in Windhoek and Walvis Bay (MEFT, 2019). The MEFT intends to develop a Namibian system for waste collection that can effectively cover the scope of Namibia. The development of a structured waste quantification method and guidelines will give local authorities the necessary resources to adhere to local and international reporting requirements.

Informal waste collectors/pickers form a large constituent of Namibia's total solid waste management, which contributes to recycling and composting services (EPI, 2020). The informal sector contributes positively to environmental outcomes but is often overlooked as the statistics are not captured as part of Namibia's formal waste management statistics. The formalisation of waste pickers in Namibia can improve data collection, enhance waste control and empower waste pickers with social benefits (EPI, 2020).

4.3

Way forward

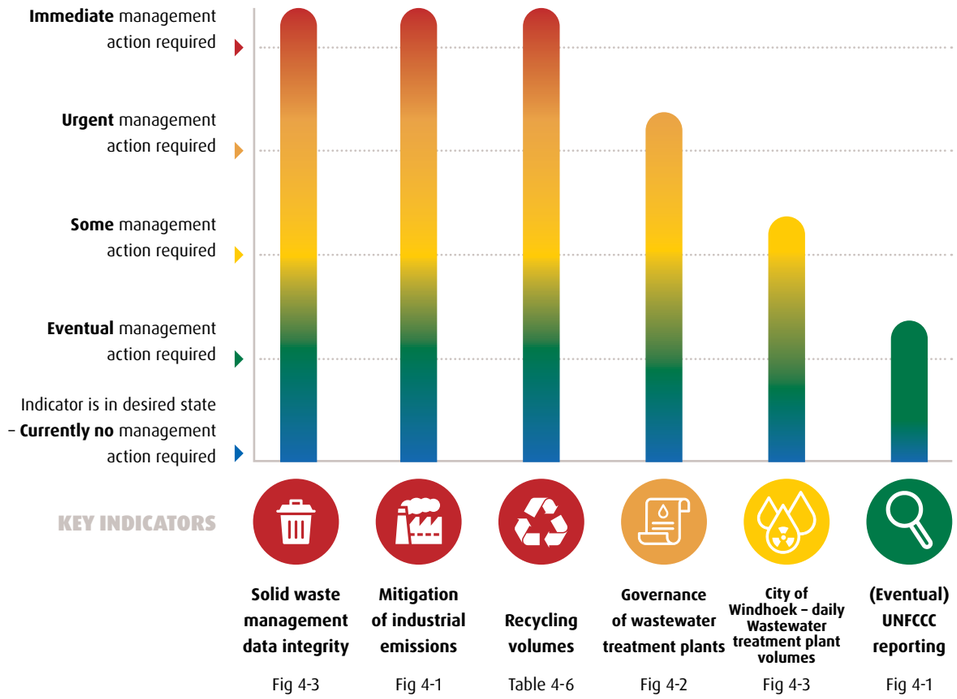
In charting a way forward for each of the FDES (2013) components of environmental management statistics, the most relevant indicators were aggregated into an action dashboard. This approach provides a structured way forward and can support policy-makers and decision-makers with the setting of priorities. It also indicates in which sub-components and underlying indicators funding is most urgently needed. The replicability and reliability of these dashboards will improve as Namibia's environmental statistics system expands and aligns with international databases.

Figure 4-5 provides the action dashboard for Namibia's waste management. Recommended actions on each of these indicators can be found in Section 4.2.4 of this chapter and involves a variety of approaches from policy and capacity building, to funding and research.

Sign in Swakopmund | Elfraim Munsaka

6

Waste products & their management



Management actions

Solid waste data Develop an integrated solid waste management database.

Mitigation of industrial emissions Develop and implement strategies to reduce industrial air emissions and land degradation.

Recycling volumes Establish a widespread culture of waste minimization and expand recycling systems.

Governance of wastewater treatment Registration, monitoring and management of WWTPs should be prioritised.

City of Windhoek wastewater treatment Improve the Implementation of the MAWLR's permitting system for WWTPs to improve compliance.

UNFCC reporting Continue reporting and follow up with actionable implementation plans related to reported data.

Figure 4-5 *Action dashboard for waste and waste management in Namibia*

The future we want is one where all citizens care for and nurture the environment.

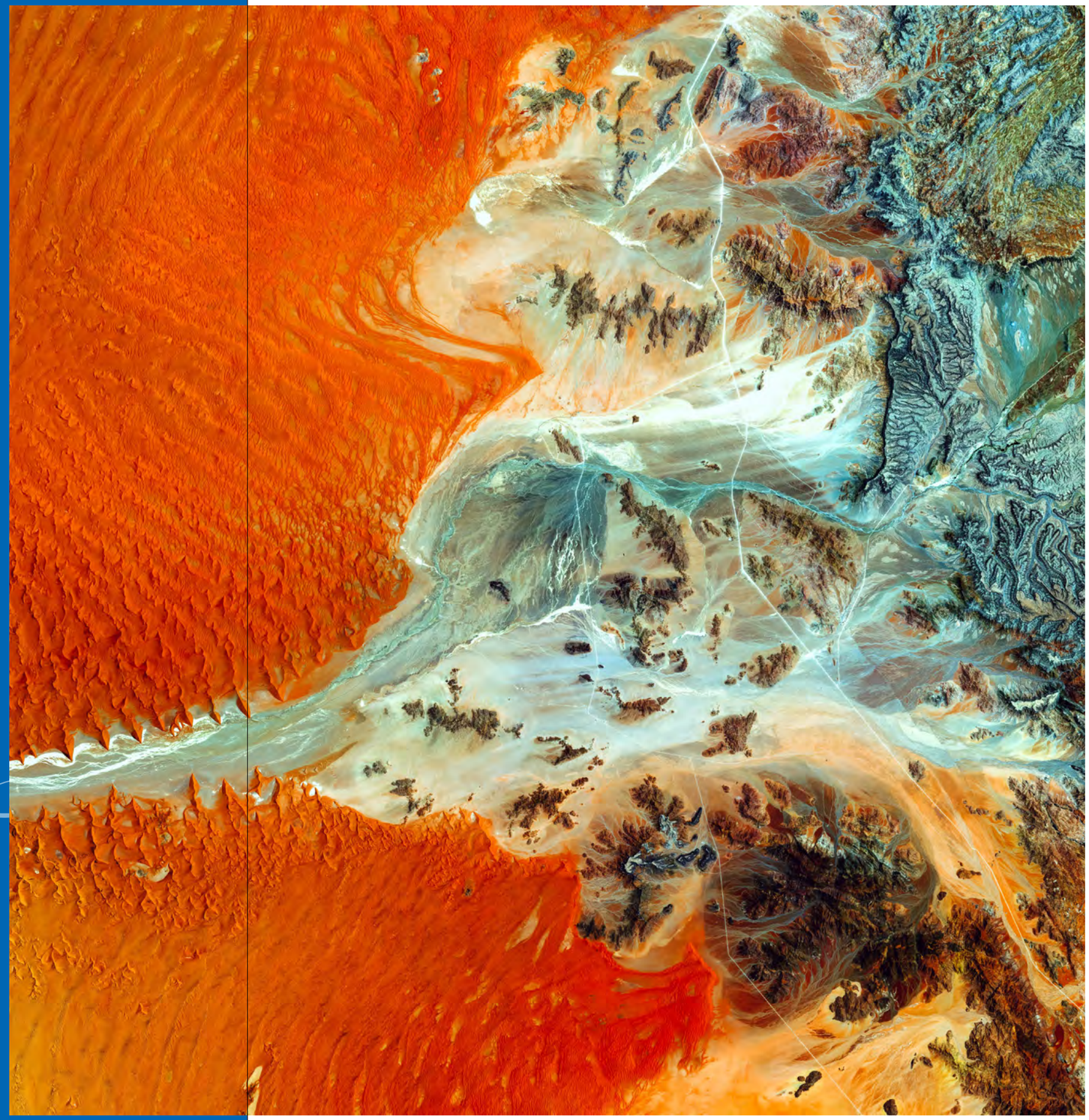
POHAMBA SHIFETA

CHAPTER 5

Extreme Events & Disasters

This chapter reviews data on the frequency and intensity of extreme events and disasters deriving from natural phenomena, as well as their impact on human lives and habitats, and the environment as a whole. Statistics on natural extreme events and disasters are important to policy-makers, analysts and civil society – not only to assess the impact of an ongoing disaster, but also to monitor the frequency, intensity and impact of disasters over time.

United Nations, 2017



Aerial of the Sossusvlei | Mickael Tournier

5.1

Introduction

An extreme event is an incident that occurs at a specific location, even if it is statistically unlikely for that event to occur in that particular area. The Centre for Research on the Epidemiology of Disasters (CRED) defines a disaster as an unforeseen and often sudden event that causes great damage, destruction and human suffering (EM-DAT, 2009). Disasters are caused by natural hazards such as floods, droughts, cyclones and earthquakes, the impact of which may be worsened by underlying factors such as poverty and inequality, fragile or weak governance, urbanization, climate change and environmental degradation (International Organization for Migration, 2015).

In recent decades, increased extreme events have led to more frequent, intense, destructive and deadly natural disasters. Climate change has been iodentified as a causal factor in this increasing frequency and severity of extreme weather events. It has resulted in increased global temperatures, rising sea levels, increased storms and precipitation, droughts, floods, tropical cyclones, hurricanes, tornadoes and other climatic disruptions in many places around the world. As the occurrence and intensity of natural extreme events and disasters have increased globally, countries have faced greater social and economic impacts (United Nations, 2017).

This chapter provides statistics on the occurrence of extreme events in Namibia and the impact of each individual event, including their type and the human and economic impact. Where possible trends, challenges and responses are discussed.

5.2

Natural extreme events & disasters - status quo

Status quo refers to the current state of specific environmental conditions relating to natural extreme events and disasters. It is informed by how indicators related to these conditions are trending over time. The following 16 indicators are used in this section to report on the current status of natural extreme events and disasters and management in Namibia:

- SADC climate disasters
- Projected temperature change of Namibia for mid-century and end century;
- Projected precipitation changes of Namibia for mid-century and end century;
- Five-day precipitation: 25-year return level in Namibia for 2040 to 2059;
- History of flooding in Namibia 2008 to 2013;
- Annual average number of people affected by floods in Namibia current climate;
- Annual average number of people affected by floods in Namibia future climate;
- Average annual revenue lost due to floods;
- History of drought events in Namibia from 2003 to 2019;
- Annual severe drought likelihood;
- Possible climate change effect on GDP per sector;
- African swine fever case fatality rate in 2020;
- Cost of foot and mouth disease outbreak in 2015;
- Major epidemics over the past 20 years;
- Average number of hectares affected by veld and forest fires per year; and
- Spatial distribution of the composite index of social vulnerability and natural hazards within the districts of Namibia.

Climate events account for the largest percentage (67%) of natural disaster deaths globally. In the past four decades (1980-2015), the SADC experienced 491 recorded climate-disasters (meteorological, hydrological and climatological) that resulted in 110,978 deaths, left 2.47 million people homeless and affected an estimated 140 million people. The region's exposure to weather-related events, particularly floods, droughts, wildfires and storm surges is likely to increase into the 21st century (Davis-Reddy and Vincent, 2017).

Namibia is the driest country in sub-Saharan Africa, with 92% of the country being classified as hyper to semi-arid (DRFN and Integrated Development Solutions, 2017). Compounded by extreme dry conditions and erratic rainfall patterns, the country is exposed to recurrent droughts and floods (DRFN, 2008). As a result, Namibia is classified as one of the countries that are most vulnerable to natural hazards (Birkmann and Welle, 2015). The potential losses due to disasters is set to increase as the impact of climate change continues to unfold (GRN, 2011).

The average predicted monthly temperature and rainfall changes in Namibia are discussed in Chapter 2. As indicated in Chapter 2 Section 2.1, it is predicted that Namibia's temperature will increase by 2°C and 4°C respectively, with the highest increase in the interior (Figure 5-1). Changes to the precipitation are less certain and depend on the forecasting methodology used to create projections. Precipitation is expected to decrease, rainfall variability is likely to increase (Figure 5-2), and extreme events such as droughts and floods are likely to become more frequent and intense (MEFT, 2020).

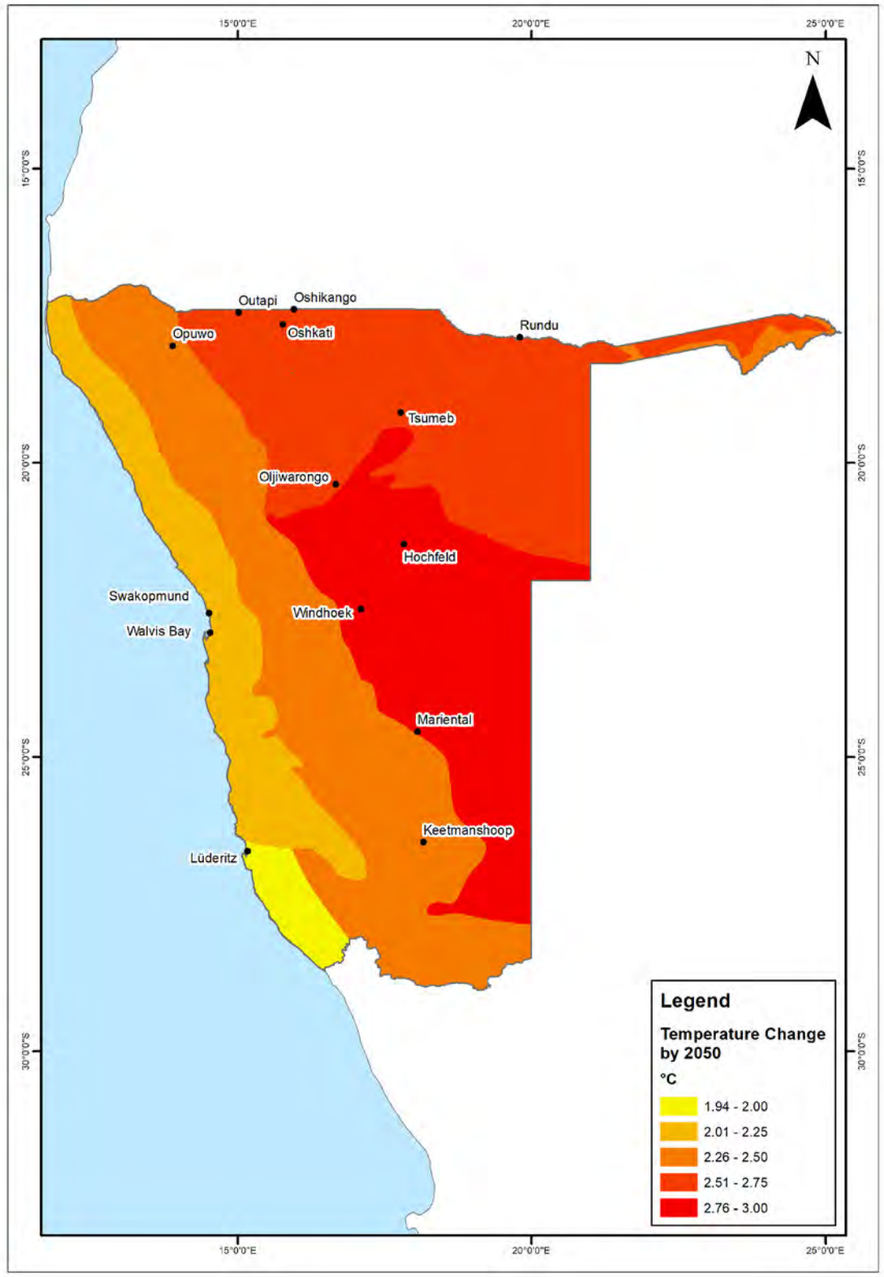


Figure 5-1 *Projected temperature change in Namibia for mid-century (2045 – 2069) and end-century (2070 – 2099) (MEFT, 2020)*

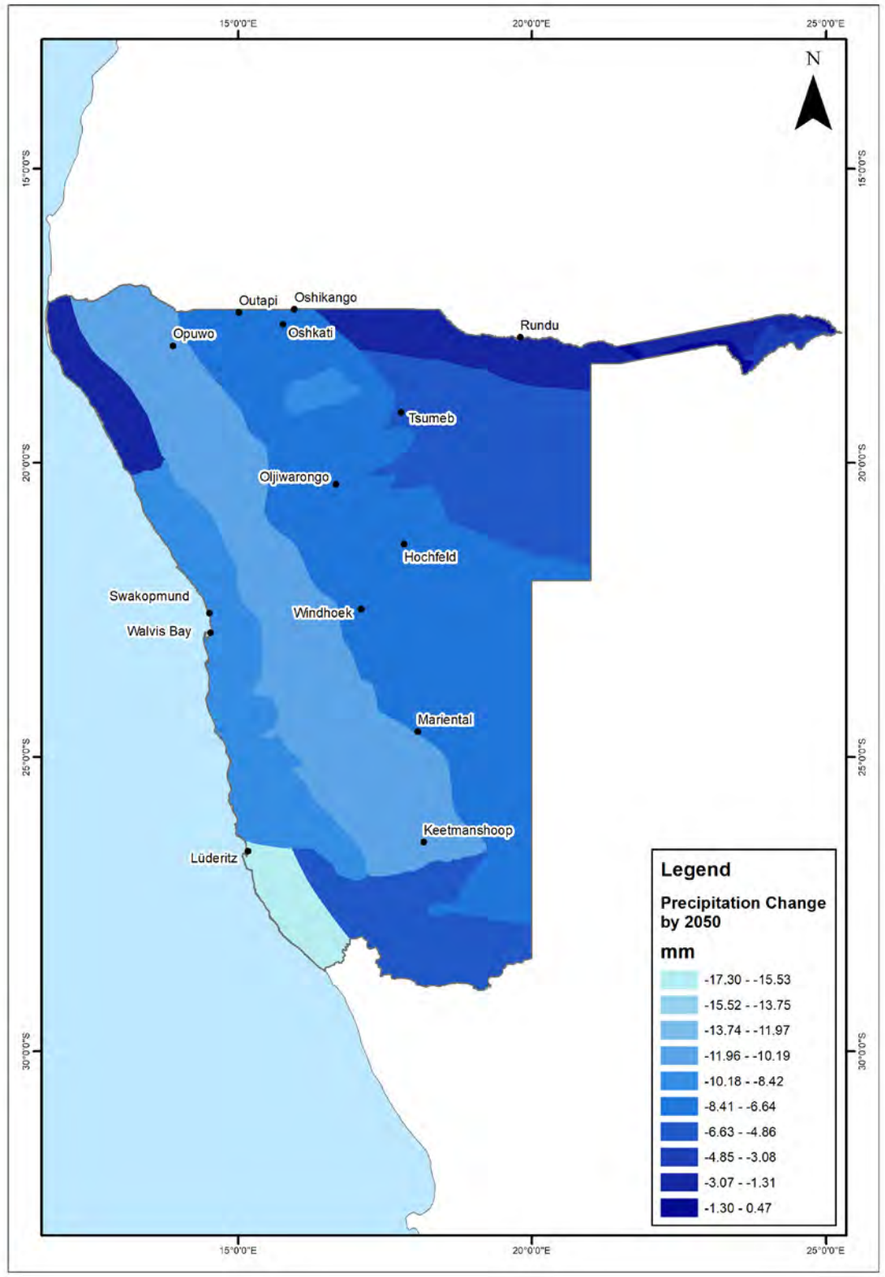


Figure 5-2 *Projected precipitation change in Namibia for mid-century (2045 – 2069) and end-century (2070 – 2099) (MEFT, 2020)*

Most common hazards with potential for disasters in Namibia include floods, droughts, veld fires, and human and animal disease outbreaks. These have had adverse effects on communities, the economy, infrastructure and the environment. They have also highlighted the development priorities of the country. Although not so common, Namibia is also at risk of earthquakes, oil spills at sea, hazardous substances accidents, industrial accidents, mine accidents, transport accidents (e.g. air, land and sea), cross-border population movements and terrorism.

Given the increasing regularity and severity of natural disasters, the Namibian government has recognized that a national, coordinated and cooperative effort is required to enhance the country's capacity to withstand and recover from emergencies and disasters (GRN, 2011). One of the most urgent needs to inform this effort is a nationally coordinated disaster data system, where definitions and methodologies are determined (Kapuka and Hlásny, 2020). A disaster management database will greatly assist the Namibian government in identifying trends and patterns in the occurrence of national disasters.

5.2.1

Floods

Floods may occur as a result of heavy downpours of rainfall, upon which the areas become inundated, leading to submerged agricultural land which cannot be cultivated – as well as livestock losses due to the lack of grazing, loss of human life, and property damage to roads and infrastructure (Sobhee, 2016). Individual daily rainfall is often linked to flash-floods of limited spatial extent, but multi-day rainfall generally has a broader spatial footprint and thus more extensive flooding can be experienced. A five-day cumulative rainfall indicator focuses on the maximum rainfall amount that is expected over a 25-year period. Any changes can have significant impacts on infrastructure and endanger lives and property through direct physical effects and potentially through water quality issues (World Bank, 2018).

Figure 5-3 shows the recorded five-day cumulative rainfall for Namibia between 1986 and 2005, as well as the projected five-day cumulative rainfall 25-year return level by 2050. This projection is based on ensemble modelling of Representative Concentration Pathways (RCPs) of the Coupled Model Inter-comparison Project, Phase 5 (CIMP5). The model consists of four different scenarios: RCP 2.6 (low emission), RCP 4.5 (medium-low emission), RCP 6.0 (medium-high emission) and RCP 8.5 (high emission). In the worst case scenario (RCP 8.5 ensemble) data suggests that annual precipitation will decrease by -40.85 mm (-188.82 mm to 82.43 mm) between 2040 and 2059, and the annual maximum five-day rainfall will rise by 2.66 mm (-49.05 mm to 56.40 mm) between 2040 and 2059 (World Bank, 2018). These modelled scenarios confirm the likelihood that Namibia is likely to receive less rain and is most likely to see more variabilities in rainfall patterns.

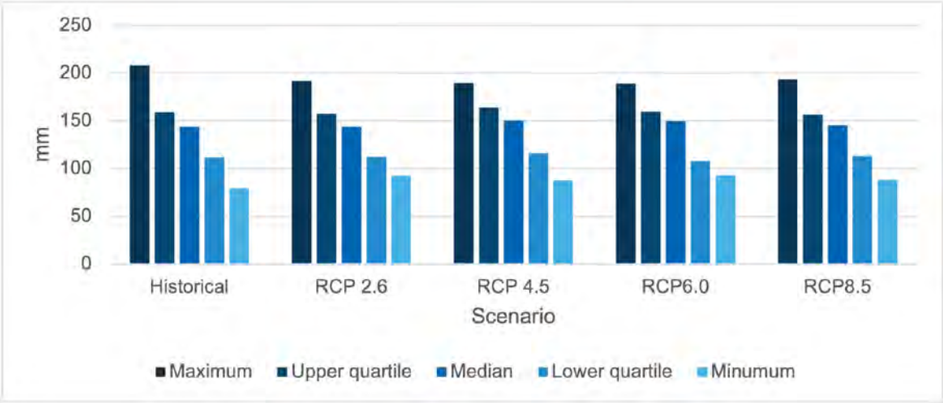


Figure 5-3 *Five-day precipitation: 25-year return level in Namibia for 2040 to 2059 (World Bank, 2018)*

Floods triggered by torrential rains, and often amplified by land degradation and deforestation, particularly affect the northern part of the country. The north-central areas of Namibia are prone to flooding caused by a combination of rainfall and inundation relating to the hydrological regime of the Cuvelai Delta. The Cuvelai Delta catchment area extends from southern Angola to the Etosha Pan in northern Namibia. From upstream to downstream, the topography flattens creating a complex network of shallow and poorly defined ephemeral watercourses known as "Oshanas", fanning out into a 70 to 130 km wide delta known as the "Cuvelai Delta" (Marsh and Seely, 1992). The north-central area is divided into four regions: Omusati, Oshana, Ohangwena and Oshikoto (NSA, 2017).

From 2008 to 2013, several communities in Namibia experienced episodes of intense flooding. Table 5-1 provides an overview of the most significant floods from 2008 to 2013.

Table 5-1 *History of flooding in Namibia from 2008 to 2013*

Date and area	Number of people affected	Description / More info	Source
2008 in north-central regions along the Cuvelai Delta	350,000 people affected 102 mortalities	Approximately 17% of the country's population affected	Office of the Prime Minister, 2008
2009 in northern Namibia *(Second event in two years following on three successive low rainfall years)*	700,000 people affected 50 people displaced 102 mortalities	Response allocation from the government amounted to N$209 million 110 relocation camps in six regions established	National Planning Commission, 2009
2011 in north-western region	500,000 people over 60,000 displaced and 19,000 placed in relocation camps 65 mortalities	263 schools closed 22 health clinics closed 114 000 school children's education disrupted	Taukeni et al., 2011
2013 in north-eastern regions	12,000 people evacuated to 13 temporary camps	Disrupted water supply, damage to sewerage systems and increase in water-borne diseases	Namibia Red Cross Society, 2013

Namibian communities face devastating environmental, structural and economic losses caused by floods (GRN, 2011). Floods affect on average approximately 15,000 people in Namibia every year, which is about 0.6% of the total population (Rudari et al., 2018). Most of the affected people are concentrated in the central north and north-east of the country, with hotspots in the Khomas, Kavango and Zambesi Regions (Figure 5-4 and Figure 5-5).

On average, about US$100 million per year is lost every year due to flood events in Namibia. This equates to about 0.9% of Namibia's total GDP. Of this, a large portion of losses is due to the damage to housing, services and transport infrastructure, accounting for about 85% of the overall loss. The productive assets account for about 15%.

Electric transmission lines | Deon van Zyl

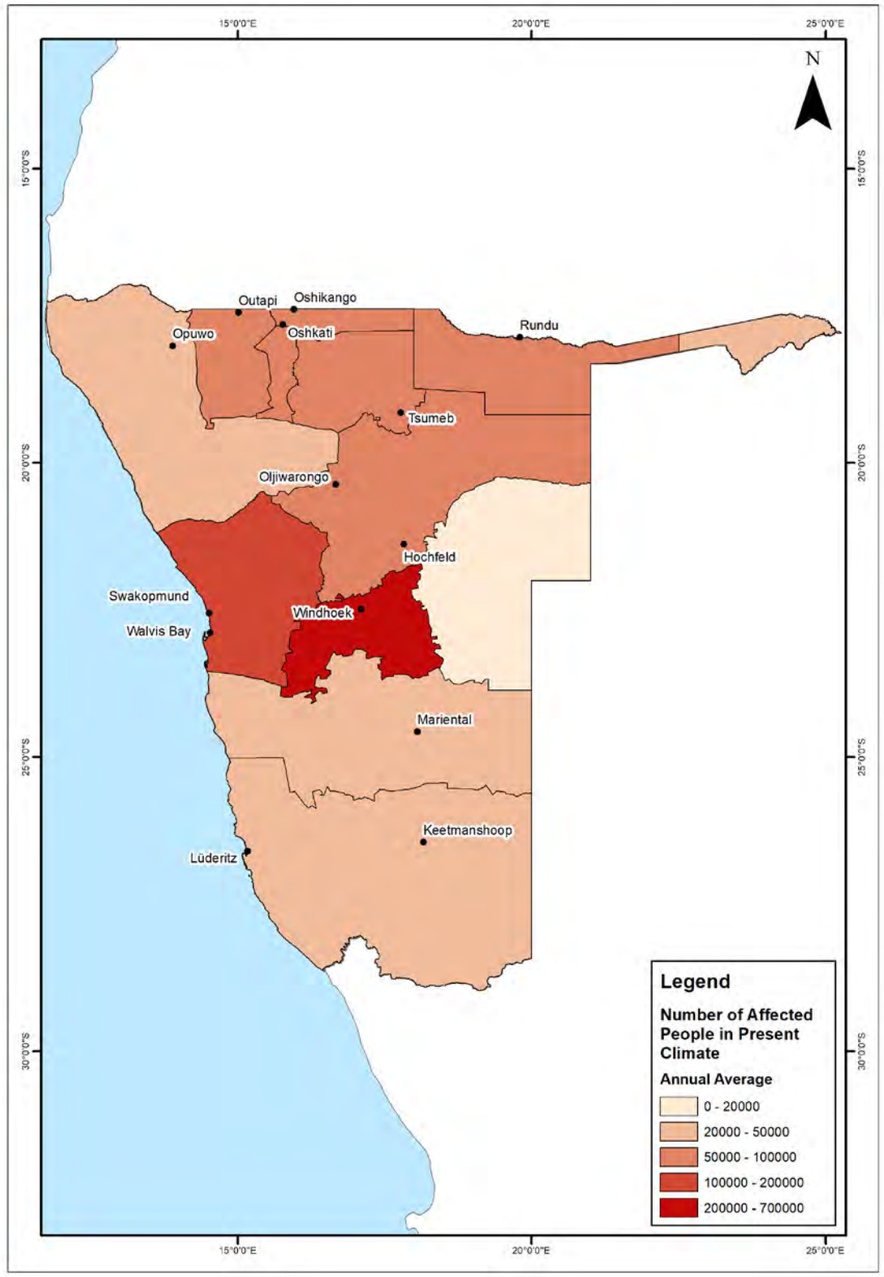


Figure 5-4 *Annual average number of people affected by floods in Namibia (present climate) (Rudati et al., 2018)*

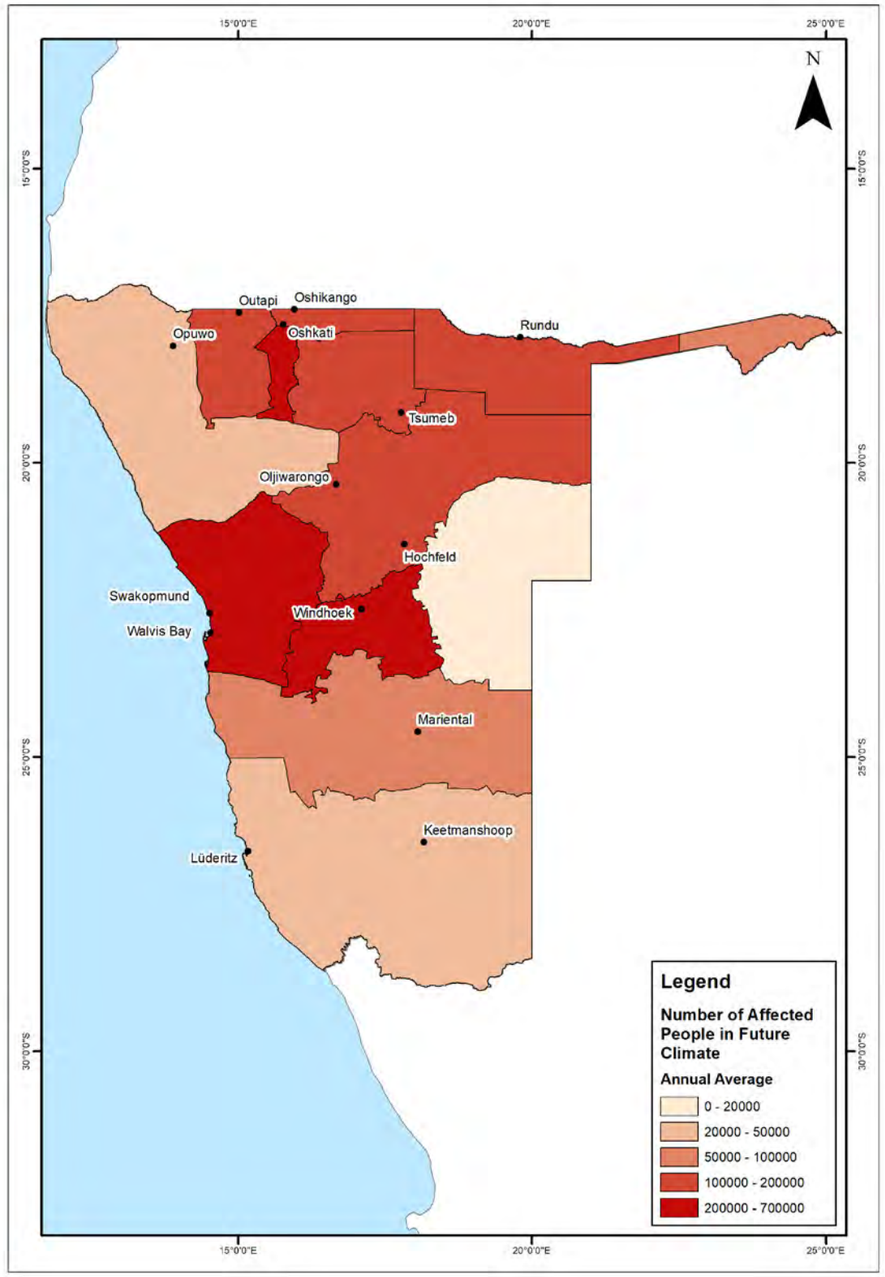


Figure 5-5 *Annual average number of people affected by floods in Namibia (future climate) (Rudati et al., 2018)*

5.2.2

Droughts

On an annual basis, about 780,000 people (about 31% of the total population) are potentially affected by droughts in Namibia. This number is likely to increase to 77%, taking into account population growth (Rudari et al., 2018). Table 5-2 provides an overview of drought events that occurred in Namibia from 2003 to 2019, and indicates an increase in the occurrence of drought and its severity over the last four years.

It is projected that the annual severe drought likelihood for Namibia will increase in coming years (Figure 5-6). The percentage of GDP potentially affected as a result of droughts is on average about 33% - which is equivalent to US$3,6 billion per year. Under future climate and socio-economic conditions, it is likely that 76% of the GDP will be affected, equating to US$8,2 billion per annum. If socio-economic projections are included, this figure will increase to US$45 billion per annum (Rudari et al., 2018).

Table 5-2 *History of drought events in Namibia from 2003 to 2019*

Date	Number of people affected	Description / More information	Source
2003	369,611 people affected		MEFT, 2004
2004	642,539 people required food assistance		MEFT, 2004
2008	540,000 people required drought relief		MEFT, 2004
2012	Approximately 42% of the total population experienced food insecurity		Shikangalah, 2020
2013 - 2016	450,000 people affected		Luetkemeier and Liehr, 2019
2018	80,000 livestock died Widespread food insecurity	Worst drought event in 40 years	Awala et al., 2019
2019	One third of Namibian population depended on drought relief systems 36% exposed to food insecurity 8.64% from rural areas		SADC, 2019

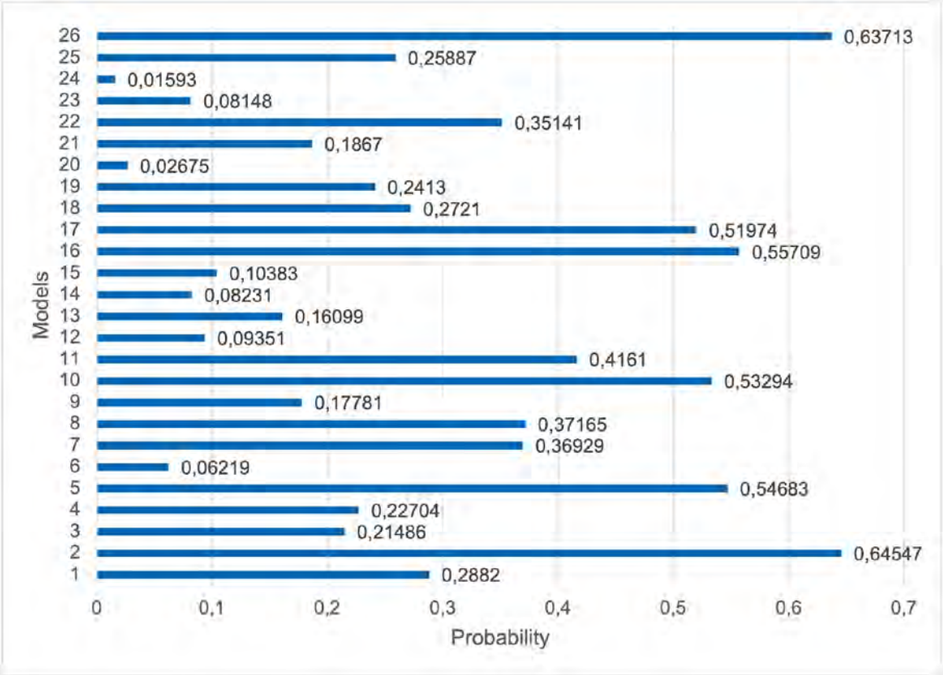


Figure 5-6 *Annual severe drought likelihood (RCP 4.5) for period: 2040-2059 (World Bank, 2018)*

According to the Bank of Namibia (2019), the overall output of primary industries in Namibia was expected to decline in 2019 due to the drought. Extremely low rainfall in 2019 led to production in the primary sector falling by 17.5% and severely affecting crop growing, with output declining from a positive 10% in 2018 to a negative 18% in 2019. Moreover, livestock production was already in negative territory in 2018 and this declined further in 2019 (Rudari et al., 2018). While overall crop production fell in 2019, cereal production in particular was estimated to be 53% lower than in 2018, and 42% lower than the 20-year average (SADC, 2019).

Data produced by Reid (2007) suggests that the effects of climate change could result in a general decrease in GDP contribution, with the largest decrease expected in traditional agriculture and livestock production (Table 5-3). Based on the projections, fishing could either experience an increase of 30% or a decrease of 50% in GDP contribution. Production in the crop farming and forestry sector fell by 17.5% and crop growing was severely affected as a result of extremely low rainfall in 2019 (Shikangalah, 2020).

It is uncertain whether the tourism sector will experience an increase or decrease in GDP contribution. Tourism is a key economic activity in Namibia, particularly wildlife and coastal tourism. With the recent changes in the climate of Namibia, the industry is more at risk, as some activities can no longer occur due to floods or other disasters (Keja-Kaereho and Tjizu 2019). It has been established that climate change and associated aridification could threaten the lucrative tourism sector in Namibia (Midgley et al., 2005). Many visitors to Namibia value its biodiversity and desert landscapes, but it is difficult to know how sensitive tourism demand would be to, for example, an expansion of deserts. It is very difficult to estimate the importance of

biodiversity, for example, to tourism value, as tourism demand is a function of many different features of the chosen destination (Reid, 2007).

The tourism sector in the Oshana, Otjozondjupa, Karas, Ohangwena, Hardap and Oshikoto regions have medium vulnerability to climate change related stressors, since they have high adaptive capacity relative to the regions with high vulnerability. The regions with low vulnerability to climate change related stressors are Khomas and Erongo, due to these regions' high adaptive capacity relative to the other regions. Since the Erongo and Khomas regions are the top destinations for both international and domestic tourism, it can be concluded that the tourism sector in Namibia is to some extent resilient to climate change impacts (GRN, 2015).

In areas of Namibia with higher rainfall and high soil fertility, exotic species (i.e. farming systems) generally provide more income than indigenous biodiversity production systems. But in arid zones, the markets generally support indigenous biodiversity production systems. In the Nama Karas biome, for instance, the economic rates of return for communal livestock, freehold livestock and tourism are 5.5%, 9.8% and 12.9% respectively (Reid, 2007).

Table 5-3 *Possible climate change effect on GDP per sector (Reid, 2007)*

Values	Current contribution to GDP	Description / More information	Effect on GDP in millions of N$ per year	Confidence in range of change
Use values				
Cereal production	0.5%	Decrease (10-20%)	-16 to -32	Low to medium
Crop production	1.0%	Decrease (10-20%)	-32 to -65	Low to medium
Livestock production	4.0%	Decrease (20-50%)	-264 to -660	Medium
Traditional agriculture	1.5%	Decrease (40-80%)	-197 to -395	Medium to high
Fishing	6%	Increase (30%) Decrease (50%)	0 to -990	Low
Tourism	2-3%	Increase/decrease	-	Low
Forests	+*	Unchanged	0	Low
Non-use value	+*	Decrease	-	Low
Total value			-509 to -2,142	

NOTE | *not included in the traditional national accounts

5.2.3

Human & animal disease outbreaks

Veterinary diseases, also known as animal disease, refers to a disease that affects or may affect an animal or that may be transmitted by an animal to a person (GRN, 2011). These diseases include: anthrax, foot and mouth disease (FMD), black quarter or black leg, botulism and the lumpy skin disease (LSD) among cattle; sarcoptic mange among goats; rabies among dogs; and Newcastle disease among chickens (MEFT, 2004). Prolonged heavy rains, flooding or droughts can result in livestock developing a poor nutritional condition, which makes them susceptible to diseases and parasites. The most common flood-related animal diseases include LSD, contagious pustular dermatitis (Orf), African swine fever (ASF), and internal parasites in small stock and donkeys.

Because Namibia is a dry country with conditions which do not favour vector multiplication, the incidences of LSD are relatively low. During 2016 to 2018, however, Namibia suffered outbreaks in Kavango West, Kavango East, Oshikoto, Ohangwena and Omusati – resulting in 20 cases with an apparent case fatality of 20% (World Organisation for Animal Health (OIE), 2018).

Outbreaks of ASF have previously been reported in the Omusati and Oshana regions in villages bordering southern Angola. ASF outbreaks usually originate from Angola and are then introduced through the cross-border pig trade. The most recent outbreak occurred in April 2020, affecting the Omusati and Kunene regions; this outbreak resulted in 46 cases and 31 deaths, which equates to an apparent case fatality rate of 67.39% (OIE, 2020b).

Heavy loads of internal parasites (Verminosis) are the primary cause of deaths in small stock following heavy rains and flooding. Small stock are suseptable to becoming severely immuno-compromized after prolonged starvation and wet conditions. The Namibian Director of Veterinary Services does not show cases of internal parasitism, but this issue poses a serious problem to farmers and will require government assistance (Rukandema et.al, 2009).

The OIE recognizes Namibia as an FMD-free zone (OIE, 2019). Namibia had an outbreak of FMD in the surveillance and infected zones during 2010, in the area between the Okavango River and the Mukwe District of the Kavango Region. All outbreaks were traced to infection originating from the neighbouring countries of Angola, Zambia or Botswana. Botswana poses a threat to the livestock population of the Zambezi Region as a result of the large herds of free-roaming African buffalo between Botswana and the Zambezi (Schneider, 2012).

In 2015, there was an outbreak of FMD in the north of Namibia – the worst case in 40 years. The outbreak spread to over three regions in less than five months. A total of 14 regions in the northern communal areas reported FMD cases from January to June 2015. It eventually cost N$180 million to control. Namibia was finally declared free of the disease in January 2016. A major factor in Namibia's success was that its fully functional Namibian Livestock Identification and Traceability System (Prinsloo, 2019). The Zambezi Region once again had an outbreak of FMD in August 2019, which resulted in 10 cases and zero deaths (OIE, 2019). The latest report of FMD to the OIE was in October 2020, with 16 cases being reported in Kavango East up to that date (OIE, 2020a).

In humans, floods can potentially increase the transmission of the following communicable diseases:

- Water-borne diseases: typhoid fever, cholera, leptospirosis and hepatitis A; and
- Vector-borne diseases: malaria, dengue and dengue haemorrhagic fever, yellow fever and West Nile Fever.

Namibia has experienced human disease outbreaks in the past that have warranted state intervention. Epidemic prone diseases in Namibia include malaria and cholera. The major epidemics which have occurred over the last ten years are summarized in Table 5-4. Chapter 6 discusses water-related diseases in more detail.

Table 5-4 *Major epidemics in Namibia over the past 10 years (WHO, 2019)*

Date	Disease	Cases	Number of deaths
2010	Malaria	2601	6
	Cholera	0	0
2011	Malaria	3671	9
	Cholera	0	0
2012	Malaria	5884	15
	Cholera	0	0
2013	Malaria	8109	20
	Cholera	3	0
2014	Malaria	26278	67
	Cholera	485	13
2015	Malaria	20092	51
	Cholera	0	0
2016	Malaria	41608	106
	Cholera	0	0
2017	Malaria	89611	229
	Cholera	0	0

5.2.4

Forest & veld fires

Fire is a natural and regular occurrence and has a fundamental role in the vegetation, wildlife and land use of the region (Beatty, 2011). Burned area mapping in Namibia dates back to the mid-1990s when a National Oceanic and Atmospheric Administration Advanced - Very High-Resolution Radiometer (NOAA-AVHRR) receiving station was installed at the Etosha Ecological Institute (Le Roux, 2011). Fires burn during Namibia's severe dry season from April to October. The vast majority occur as surface fires that spread in the grass and shrub layer. Crown fires and ground fires occur over only limited geographical areas. The amount and connectivity of the predominant grass and shrub fuel is highly variable spatially and temporally, controlled by a severe rainfall gradient oriented in an approximately south-west to north-east direction (Global Fire Monitoring Centre, 2001). Generally, fire-affected areas in Namibia are confined to the central and north-eastern regions of the country and follow an east to west rainfall gradient. The savanna woodland areas display higher fuel loads and ignition potential for fire (Le Roux, 2011).

The Kavango east and Zambezi regions have also experienced patterns of repetitive fire regimes for at least 17 years, with late dry season fires between August and October dominant throughout these regions (Beatty, 2011). Communal lands have experienced low fire frequency around settlements and higher frequencies away from settled areas due to the existence of vegetation away from settled areas (Ibid). Following the Namibia–Finland Forestry Programme (NFFP) Integrated Fire Management (IFM) programme in the late 1990s, a 54% reduction in burned areas was achieved annually and a 70% reduction in fires (Moore et al., 2002).

In Namibia, 1 million hectares of forest and veld land burn every year, although this can fluctuate. In 2016, 1.1 million hectares of land were burned and in 2017 an area of 2.1 million hectares was burned (GRN, 2019). Most of the fires occur in the fire-driven savanna ecosystems in northern Namibia, which were found to be resilient to a wide range of fire regimes (Van Wilgen, 2009). In 2020, the first fire incidents were reported in April around Oshana, Oshikoto and Zambezi region, which was relatively small in size. Large burned areas were detected in the north and northeast between August and November 2020 (Directorate of Forestry, 2021). Figure 5-7 provides maps showing the spatial extent of fire scars in 2019 and 2020. There has been a dramatic increase in forest and veld fires in 2020.

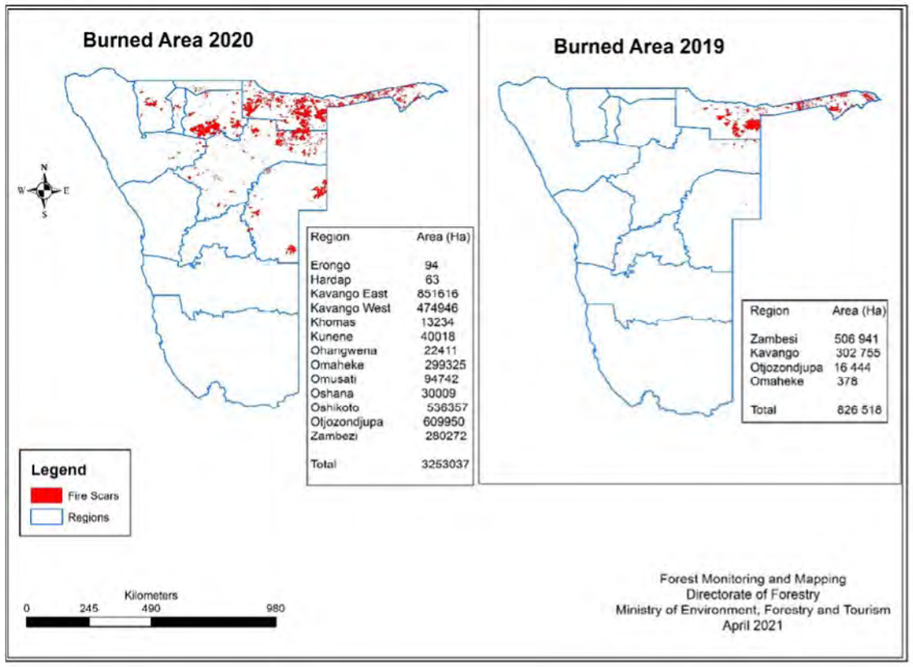


Figure 5-7 *Spatial extent of fire scars in 2019 and 2020 (Directorate of Forestry, 2021)*

Lightning fire is the most significant natural cause, but accounts for a small percentage of all fires. The majority of fires are ignited by people, either deliberately or accidentally (Global Fire Monitoring Centre, 2001). Most of the fires (90%), particularly in the north-central and north-eastern parts, are anthropogenic and relate, for example, to slash-and-burn agriculture practices (GRN, 2016; Sheuyange, Oba and Weladji, 2005). Fires mostly occur during the dry and windy seasons from May to July (early dry season: low intensity fires) and from August to September (late dry season: high-intensity fires) (Siljander, 2009). The most fire-prone areas are the communal lands in the north-central and north-eastern parts of the country (Verlinden and Laamanen, 2006).

5.3

Environmental challenges & responses

Climate change is manifested through increasing temperature, increasing or decreasing rainfall and increasing frequency and intensities of extreme weather and climate events, particularly strong winds, floods and droughts. These extreme events are often associated with devastating socio-economic and ecological implications (GRN, 2011). As discussed in Chapter 2 and 3, the impacts of climate change contribute to land degradation and desertification which, in turn, reduce resilience to natural extreme events and disasters.

5.3.1

Building community resilience

Disasters increase the vulnerability of the poor, overstretching their coping capacities, deepening their poverty and preventing them from taking advantage of economic opportunities. Disaster risk reduction measures must therefore focus on economic and social upliftment, and on building resilience (Kapuka and Hlásny, 2020). The expected increase in weather-related disasters poses significant challenges for disaster risk management in southern Africa and is expected to negatively impact infrastructure and the transport, agriculture, health, tourism and insurance sectors, among others (Davis-Reddy and Vincent 2017). The increased exposure – combined with agrowing population, poor land-use practices, and an increasing number of people living in exposed areas – is likely to compound the current levels of disaster risk.

As depicted in Figure 5-8, communities in north-western Namibia are socially most vulnerable and hence more exposed to the increased occurrence of natural hazards (Kapuka and Hlásny, 2020).

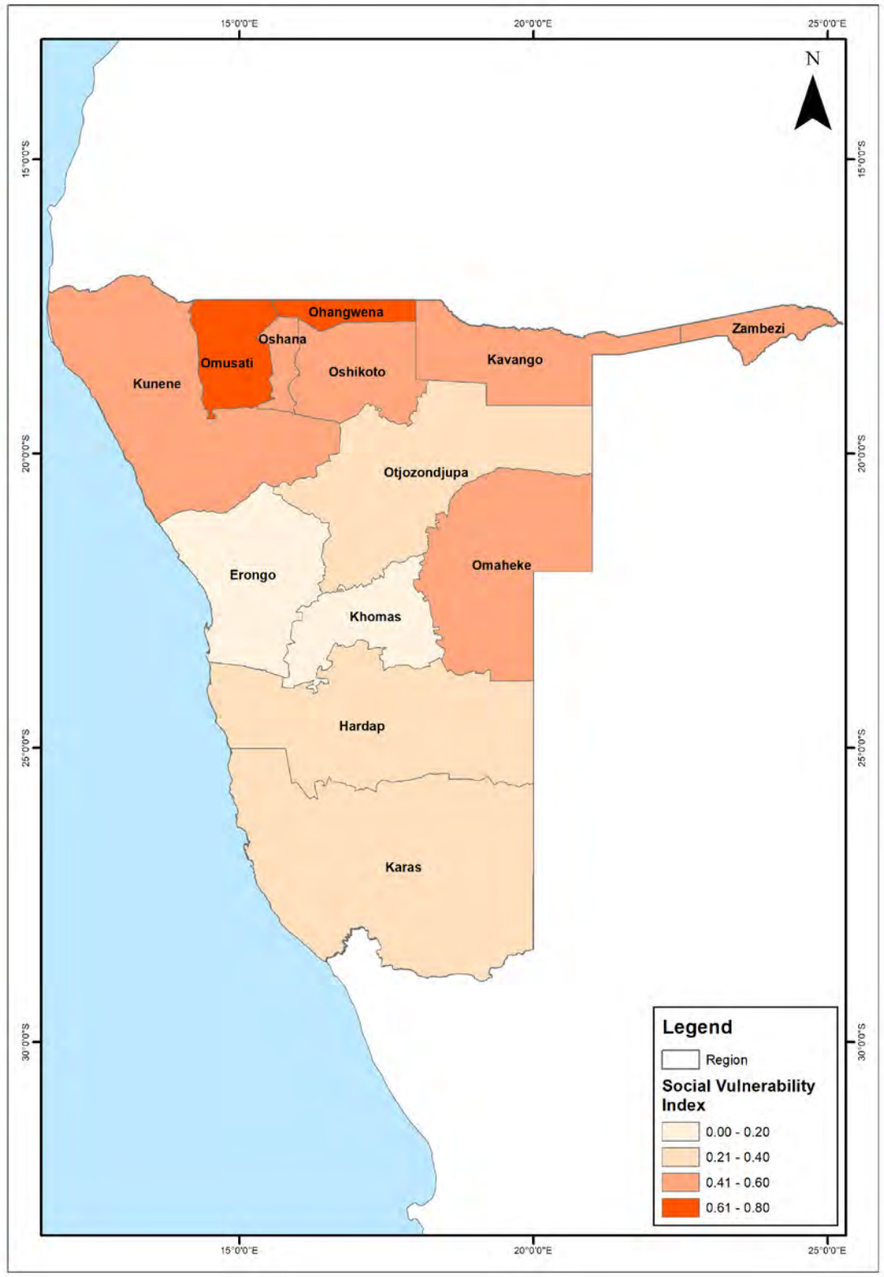


Figure 5-8 *Spatial distribution of the composite index of social vulnerability and natural hazards within the districts of Namibia (Kapuka and Hlásny, 2020)*

The reduction of risks associated with extreme events and disasters should be viewed as a shared responsibility across social, economic, governmental and professional sectors. Comprehensive disaster risk management needs to involve a variety of segments of society, including members of the public who are themselves most exposed to anticipated hazards. Achieving this paradigm shift is essential if communities are to become more resilient to the effects of hazards, so that disaster losses can be reduced going forward.

Over the past decade, the Namibian Government has collaborated on reforming disaster management approaches. In 2009, the National Disaster Risk Management Policy was approved, advocating improved capacity for early warning, tracking, monitoring and disseminating information on activities that trigger disaster events.

5.3.2

Strengthening flood management

The north-central area of Namibia is low-lying, which means that the impacts of the floods are aggravated by poor planning such as uncontrolled urban developments, informal settlements built in the flood prone areas, poorly maintained infrastructure such as blocked culverts and storm drains, poor risk mapping, and lack of integrated early warning system (Marsh and Seely, 1992).

Flooding is influenced by a combination of weather-related factors (e.g. rainfall intensity, extent and duration) as well as geophysical characteristics of the catchment – including its size, steepness, soil and land uses (Forsythe et al., 2018). Floods have had significant impacts in the affected areas, including displacement of the population, loss of life and livestock, and destruction of homesteads, crops and social infrastructure – while generally impacting severely on the livelihoods of the affected populations. Although there is no accurate documentation of economic impacts of floods, there is evidence that floods have caused structural damage, loss of life and property, and have resulted in economic and livelihoods losses that have a long-term impact on Namibia's development (MEFT, 2004).

When floods occur in Namibia – mostly in the northern parts of the country – families have to be relocated, and schools and businesses need to be closed down due to the damage the flood may cause. Temporary shelters also need to be set up for families in need. In addition, the people are at higher risk of diseases such as malaria, caused by mosquitoes breeding in the floodwaters. Other health risks are also likely to occur during floods, due to the spread of water-borne diseases and viruses (Kaereho and Tjizu, 2019).

During recent floods, damage to roads and loss of agricultural crops has resulted in food shortages among poor households (Office of the Prime Minister, 2009). Other impacts include damage to water supply and sanitation infrastructure, transport and energy infrastructure, industry and commerce, housing and health, and education facilities. In addition, floods also lead to the displacement of people, health facilities and schools (ibid). The combined effects of flooding, heavy rainfall and poor sanitation exposes the displaced communities to contaminated water and vulnerability to waterborne diseases (Namibia Red Cross Society, 2013).

In response to flood events and their associated impacts, the Namibian Government created a multi-pronged policy response to deal with the threats posed by extreme events and natural disasters. These include:

- The National Climate Change Policy;
- The National Disaster Risk Management Plan (NDRMP);
- The National Disaster Risk Management Framework and Action Plan (2017- 2021);
- The National Policy for Disaster Risk Management;

- The National Disaster Fund; and
- The Africa Regional Strategy for Disaster Risk Reduction.

While these high-level instruments provide much-needed guidance in times of crisis, a well-developed national disaster database could provide information to facilitate early response and targeted interventions.

5.3.3

Responding to droughts

As established in Chapters 2 and 3, Namibia is highly vulnerable to the impacts of climate change, especially droughts. In particular, the agriculture sector is impacted directly by changes in precipitation, temperature, and evaporation, and through secondary impacts such as extreme weather events. Irrigation for agricultural production is obtained from both surface and groundwater sources in Namibia. Dryland crop production is significantly more climate-sensitive than irrigated crop production, with the magnitude of the impacts on production dependant on whether the country is already hot and dry (Kurukulasuriya et al., 2006). Irrigated crops are expected to decrease by 20% in the Nama Karoo and the north-eastern agropastoral region. Dryland cropping is likely to disappear in the savannah and woodland (central areas), with a reduction of 50% and 20% expected in the north-central and north-eastern agropastoral regions respectively (Ibid). Livestock farming is already being affected, as indicated in Chapter 2.

The majority of people living in Namibia depend on small- scale farming, conservancy-related tourism and the use of forest products. All these natural resource- based livelihoods are vulnerable to the impacts of extreme events and disasters. River level fluctuations due to climate change have the potential to increase the dependence of these communities on already stressed groundwater resources. This vulnerability is exacerbated by poor infrastructure, poor soil potential and competition with grazing, particularly along the riverbanks (UNDP, 2018).

Climate limitations are important in determining potential agricultural activities and suitability across the country. Periodic droughts caused by increased temperatures will have serious implications on farm labourers, worsen food security, increase irrigation demands and negatively impact livestock production, particularly in the southern and central regions of the country (MEFT, 2020). The impact of drought largely affects the agriculture and water supply sectors as follows:

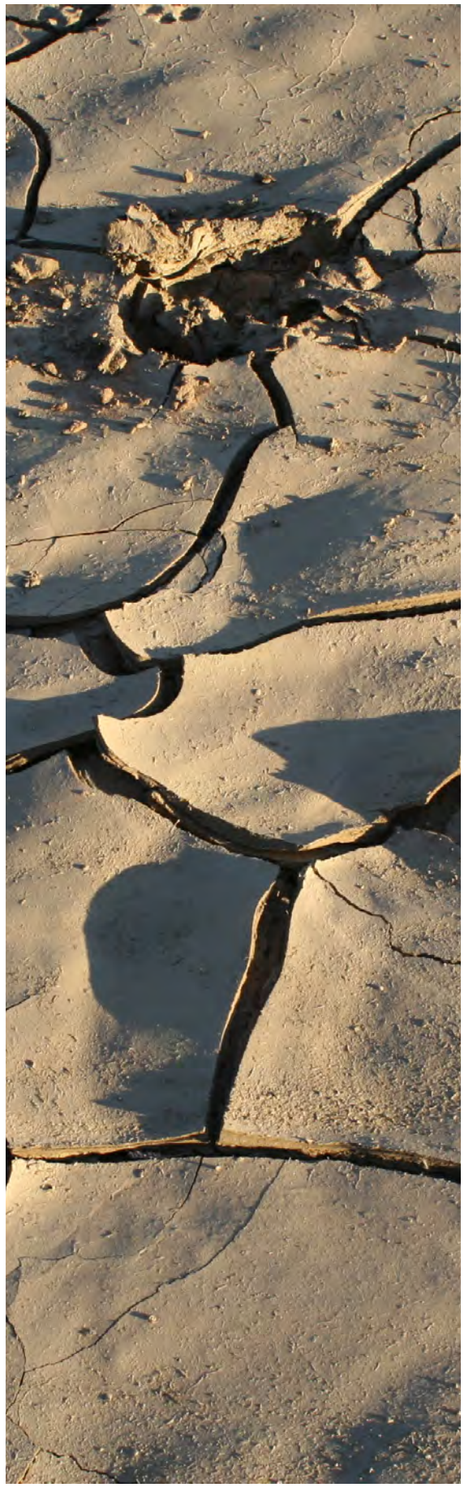
- Drought significantly affects savanna, grassland and forest ecosystems. Forecast increases in the frequency and severity of droughts are likely to exacerbate desertification. Further, declines in rainfall and increased desertification have led to decreases in soil fertility and agricultural, livestock, forest, and rangeland production (Reid et al., 2008);
- It has major impacts on the national economy through agriculture and other strategic sectors. Agriculture has linkages to the wider economy and a drought-induced shock can result in a fall in GDP and a weakening of the balance of payments position (exports may fall, and imports rise);
- It contributes to a decline in employment opportunities in the agricultural sector, and may also lead to a reduction in incomes – which in turn has a particularly negative affect on the poorest of the poor, who are dependent on the labour market; and
- Drought affects water supplies as groundwater levels drop significantly and surface water sources dry up.

Hotter and drier climates may also have a negative impact on the productivity of specific livestock breeds and crop varieties. Certain livestock species may be unable to cope with higher temperatures and therefore become sick, produce less meat, milk and/or develop poor reproduction rates. Generally, food from both crops and livestock will become more difficult to produce and people may suffer from starvation and malnutrition. Pest outbreaks are expected during both drought and flood years and may potentially worsen under the projected climate change scenarios (UNDP, 2018).

Likely impacts on tourism activities could include a change in supply and demand due to loss of biodiversity and a change in demand due to increases in temperature, humidity and malaria (Reid, 2007).

The impacts of droughts are exacerbated in the case of vulnerable communities, as poor infrastructure development, inadequate adaptative capabilities and high dependence on natural resources reduce their adaptive capacity – potentially increasing their risk of food insecurity. It is estimated that more than 10 million people in southern Africa reside within hazard-prone areas, and their livelihoods depend vitally on hazard-exposed agricultural practices (Global Drought Observatory, 2019). Droughts impact on livestock conditions and agricultural labor opportunities; during droughts, pasture conditions and water availability for livestock are below average, resulting in drought-related livestock diseases and deaths. Loss of livestock means that many households no longer have access to this source of income.

Responses to these impacts include those highlighted in Section 5.3.1. In addition, during 2019 a Drought Response Plan was established and implemented countrywide to mitigate the impacts of drought, notably food and water shortages and poor grazing conditions. Interventions included food provision for the needy and drought-affected communities, and livestock marketing incentives such as support for the lease of grazing, transport to and from grazing, and fodder and licks subsidies to sustain small stocks and core breeding herds. It also allowed for the provision of potable water by water tankers, certified seeds, and health and nutrition assistance (Shikangalah, 2020).



Drought in Gobabeb | Klemens Riha

5.3.4

Responding to human & animal disease outbreaks

Climate change impacts may contribute to related changes in the frequency and type of pests and diseases. Floods, for example, disrupt water supplies, damage sewerage systems in the cities and trigger outbreaks of water-borne diseases such as cholera and malaria (GRN, 2009). These impacts can affect vulnerable groups within communities such as children, orphans, women, elder people, or people with chronic diseases. A functioning healthcare system, hygiene, safe water and a healthy food supply is required to mitigate these impacts (Kaereho and Tjizu, 2019).

The major impacts of livestock disease outbreaks include: loss of livestock; loss of income, especially from exports of meat, meat products and other livestock products due to temporary suspension of exports; food insecurity; and costs to contain disease outbreaks due to quarantining of animals, vaccination and disease surveillance (MEFT, 2004; GRN, 2011).

The tourism sector is also affected by the health sector. Specifically, malaria outbreaks – as well as flood-induced cholera and hepatitis (MEFT, 2020) – can reduce the desirability of Namibia as a tourist destination. The COVID-19 pandemic is set to have an unprecedented impact on Namibia's economy. With trade largely concentrated in a few countries and commodities, travel restrictions and lower demand will result in a contraction in exports (World Bank, 2020). Economic lockdown is impacting tourism, retailers and service sectors, which may result in rising unemployment levels. Taken together, these developments are expected to result in a growth contraction of 4.8% in 2020 (Ibid). The growth outlook is subject to significant uncertainty given the unknown profile of the pandemic and likelihood of further restrictions in activity.

In addition to specific responses presented above, the Animal Health Act, No. 1 of 2011, and the FMD Contingency Plan have been implemented to address the impacts of human and animal disease outbreaks. Trends in human and animal health should continue to be monitored and analysed.

5.3.5

Managing forest & veld fires

The occurrence of fires is closely linked to climate and increases in temperature, combined with an increase in dry spells which may result in wildfires affecting larger areas, and fires of increased intensity and severity (IPCC, 2012). The frequency of high-fire danger days is projected to increase across southern Africa and is consistent with the increases in heat-wave days (Engelbrecht et al, 2015).

Depending on the intensity and timing, wildfires may cause environmental degradation and loss of biodiversity, which affects national and regional economies as well as the livelihood of local communities (Pricope et al, 2015). Adverse impacts include, for example, the disruption of plant regeneration and damage to commercially valuable tree species such as Burkea pterocarpus and Baikiaea plurijuga in the northern woodlands (Siljander, 2009; GRN, 2016).

Forest and veld fires have both environmental and economic impacts. These include the loss of biodiversity, pastureland, wood (for the furniture industry), and vegetation cover – resulting in soil erosion in fields for livestock and crops, resulting in food insecurity. They also lead to the destruction of forests and damage habitats and homesteads. The destruction of forests and forest resources as a result of climate change, can affect the economy, the environment and society (MEFT, 2004).

In response to these impacts, fire breaks have been constructed in most fire-prone areas as a means of controlling the spread of wildfires. The MAWLR engaged local people to create about 3,568 km of firebreaks (MEFT, 2017). Data on forest fires, which are collected by the MEFT through remote sensing, shows a dramatic increase in the extent of fire scars between 2019 and 2020; empahsising the urgent need for fire management plans.

5.4

Way forward

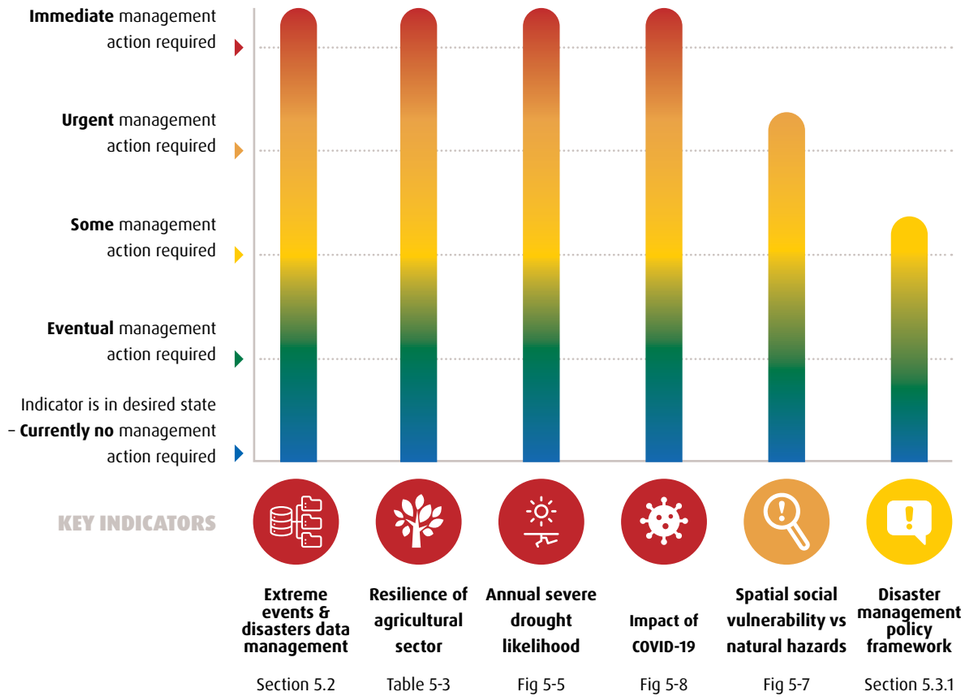
In charting a way forward for each of the FDES (2013) components of environmental management statistics, the most relevant indicators were aggregated into an action dashboard. This approach provides a structured way forward and can support policy-makers and decision-makers with the setting of priorities. It also indicates in which subcomponents and underlying indicators funding is most urgently needed. The replicability and reliability of these dashboards will improve as Namibia's environmental statistics system expands and aligns with international databases.

Figure 5-9 provides the action dashboard for Namibia's management of extreme events and disasters. Recommended actions on each of these indicators can be found in Section 5.3 of this chapter and involves a variety of approaches from policy and capacity building, to funding and research.

Dune 45 | Sean Robertson

7

Extreme events & disasters



Management actions

Extreme events and disaster data
Maintain & monitor disaster management infrastructure country-wide, including a database of extreme events and disasters. plants along Namibia's coastline.

Resilience of agricultural sector
Identify and implement climate-resilient crop farming practices and promote sustainable land management methods.

Annual severe drought likelihood
Regularly update & continue to implement drought response plan to proactively address reoccurring severe drought.

Impact of COVID-19 management actions Strengthen WASH infrastructure and services to address weaknesses identified during the COVID-19 pandemic.

Spatial vulnerability vs natural hazards management action
Continuously adapt National Disaster Risk Management Policy to increase the country's carrying capacity for potential natural disasters

Disaster management policy framework management action
Develop a priority-based response framework including high-level and multi-pronged policies to aid in improving early response approaches.

Figure 5-9 *Action dashboard for extreme events and disaster management in Namibia*

The Ministry of Environment, Forestry and Tourism is doing its utmost to revive the sector and to ensure that it recovers and emerges stronger after the shocks that have been caused by the Covid-19 pandemic.

POHAMBA SHIFETA

Water pans Kaokoveld, Kunene

Namibian Rock Art | Peter Burdon

CHAPTER 6

Human Settlements & Environmental Health

This chapter contains statistics on the environment in which humans live and work, particularly with regard to living conditions and environmental health. It focuses on the delicate interrelationship between people and the environment, and how they shape and form each other.

United Nations, 2017

6.1

Introduction

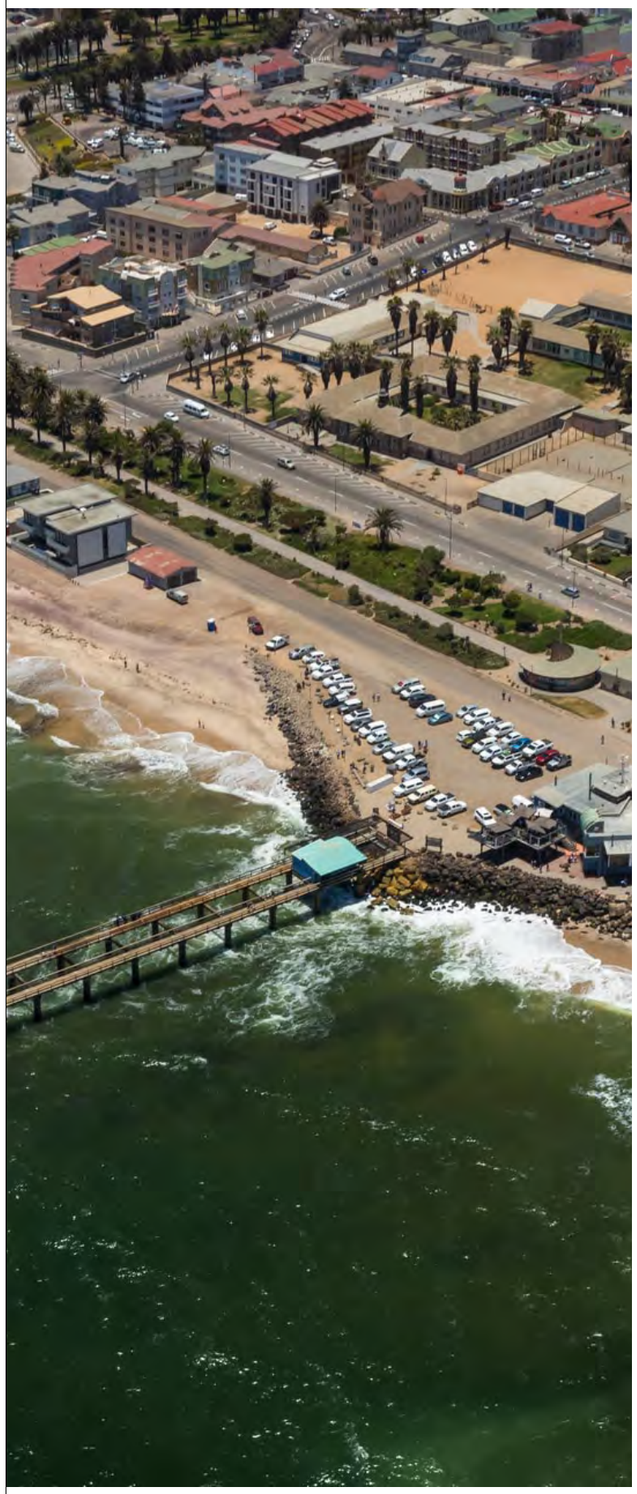
Countries have different ways in which they define settlements and it is often based on the size of the population, the functions served, the position in a hierarchy of settlements, or their administrative function. In the context of Namibia, the Local Authorities Act, No. 23 of 1992, provides for the declaration of areas of local authorities and classifies them as part 1 municipalities, part 2 municipalities, towns and villages. This is elaborated on below:

- Municipalities are those urban areas where an approved township exists, and which are regarded as able to exercise all the powers conferred on them – and to pay out of their own funds any debt incurred in the exercise of such powers and functions;
- Towns are those urban areas where an approved township exists and where the town council can perform the powers and duties accorded to it; they can pay, with or without financial assistance from government, out of their funds for the debts incurred in the exercise of their duties and powers; and
- A village consists of a community which, in the opinion of the minister, is in need of services which are required to be rendered by a village council. A village council will be able to exercise and perform, with or without assistance from government, the powers, duties and functions conferred and imposed upon it by the provisions of the Act.

The Regional Councils Act, No. 22 of 1992, enables regional councils to declare settlement areas if the regional council is of the opinion that the circumstance prevailing in an area requires dedicated management, control and regulation – mainly due to a concentration of people in an urban type arrangement. These are the precursors to the eventual establishment of new local authorities to manage such areas.

From the provisions of these Acts, it is clear that the key consideration of the government in establishing local authority or settlement areas is to manage places where people concentrate, in order to provide urban services to its inhabitants to enhance their health and well-being. These services are defined by regulatory provisions as: potable water; a system of sewerage and drainage; and services for the removal, destruction or disposal of different kinds of waste. It must also provide cemeteries, maintain streets and public places, supply electricity and provide an array of other social services such as ambulances, fire brigades, public transport, museums and libraries.

This chapter provides an overview of the conditions in which Namibians live, with a specific focus on the trends in urbanization, access to basic services and housing. Furthermore, it explores the public health status of the population and highlights key environmental health issues.



Swakopmund Bay | Grant Durr

6.2

Human settlements - status quo

Status quo refers to the current state of specific environmental conditions relating to human settlements in Namibia. It is informed by how indicators related to these conditions are trending over time. The following 14 indicators are used in this section to report on the current state of human settlements in Namibia:

- Namibia's population by gender;
- Namibia's population by age;
- Urbanisation trends;
- Urbanisation trends per region;
- Regional trends in the percentage of population with access to safe water;
- Regional trends in the percentage of population with access to sanitation facilities;
- Regional trends in the percentage of population with access to electricity for lighting;
- Regional trends in the percentage of population who use wood and charcoal as main source of energy for cooking;
- Regional trends in improvised housing units as percentage of total;
- Trends in number of improvised urban houses;
- Short-term regional housing needs per annum;
- Medium term regional housing needs per annum;
- Long term housing needs per annum; and
- Serviced erven in the process of being provided by DWN.

6.2.1

Demographics

Namibia has a population of over 2,3 million people (NSA, 2017). The growth rate is 1.9% per year and its age and gender distribution for 2019 is depicted in Figure 6-1. The population pyramid shows a slightly larger distribution of females to males, indicating that the majority of the population is under 35 years of age. A growing, younger population with increasing life expectancy is anticipated to place pressure on Namibia's resources, cities and job markets (World Bank, 2020).

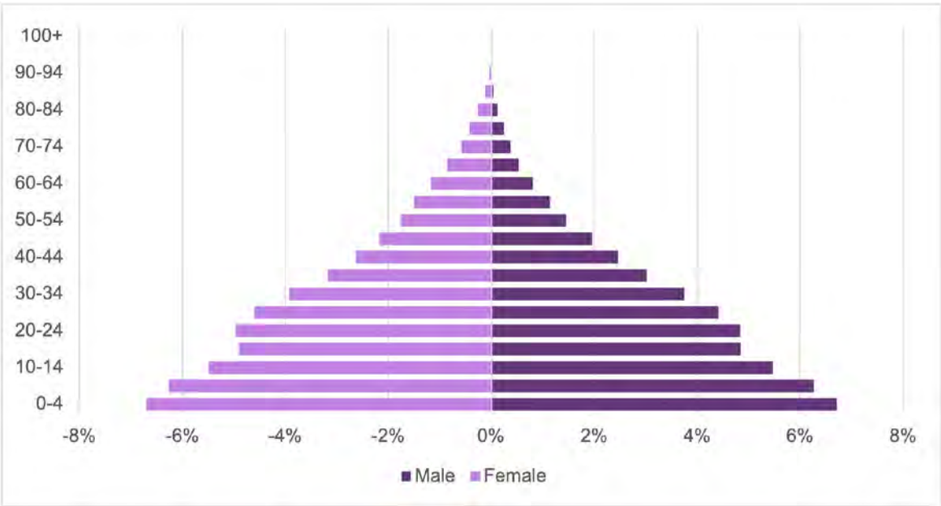


Figure 6-1 *Population pyramid for Namibia by age and gender (Population Pyramid, 2019)*

6.2.2

Urbanization

Urbanization in Namibia happens in two ways: the growth of and in-migration into existing urban settlements, and the establishment of new urban settlements. According to various national population and housing censuses, there has been an approximately 20% increase in national urbanization in Namibia from 1991 to 2016, with slightly more people (52%) living in rural areas than in urban settlements (Figure 6-2) (NPC, 1994; NPC, 2005; GRN, 2013; NSA, 2017).

The perception that there are more and better jobs – and greater opportunities – in cities and towns than in the rural areas pulls people to the urban areas in Namibia. Often, two of the most pressing issues found in fast-growing urban centres throughout Africa are poverty and environmental degradation. A growth in poverty in rapidly expanding urban areas is intensified by an inability of local government to provide services to all people (National Geographic, 2020). Further, rapid and increased urbanization gives rise to a range of environmental impacts and associated health hazards, including air pollution (caused by concentrated energy use and traffic), large volumes of uncollected waste, risk of flash flooding, and pressure on animal populations (due to pollution and habitat loss). Poor air and water quality, insufficient water availability, waste disposal problems and high energy consumption are exacerbated by the increasing population density and demands of urban environments.

Namibia's population distribution is following the same trends as are seen globally, and contributes to several of the environmental challenges discussed in Chapters 2 to 5. The national urbanization percentages displayed

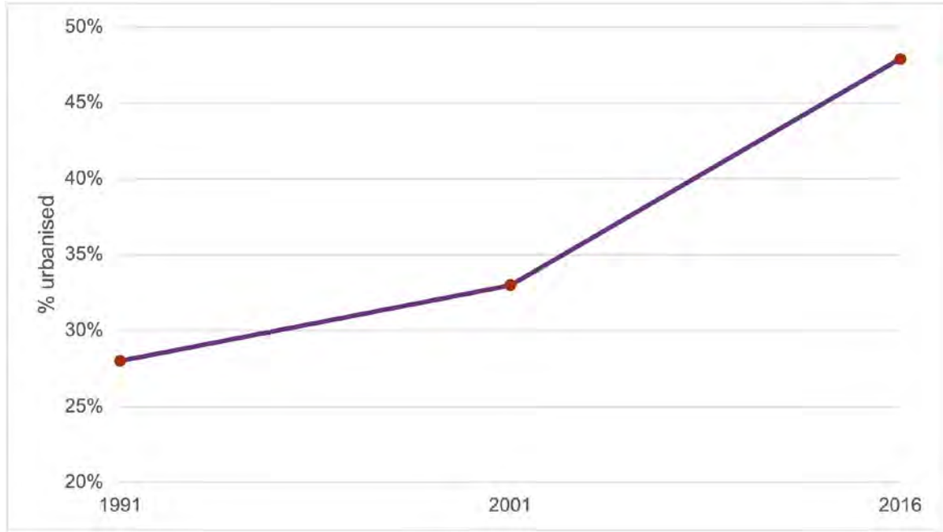


Figure 6-2 *Urbanization trends in Namibia from 1991 to 2016 (NPC, 1994; NPC, 2005; GRN, 2013; NSA, 2017)*

in Figure 6-2 do not provide the full picture, masking substantial differences between regions in Namibia. Figure 6-3 was compiled using data presented in the Namibian census and household income and expenditure surveys. It provides a clear indication of the changes in urbanization in the various regions, as well as the substantial differences between the regions.

Some regions are highly urbanized, such as the Khomas and Erongo regions where more than 90% of the population already reside in urban settlements. The Erongo, Hardap, Kharas and Omaheke regions experienced the highest changes in urbanization trends during this period, indicating increased migration to the towns and cities of north-central and southern Namibia.

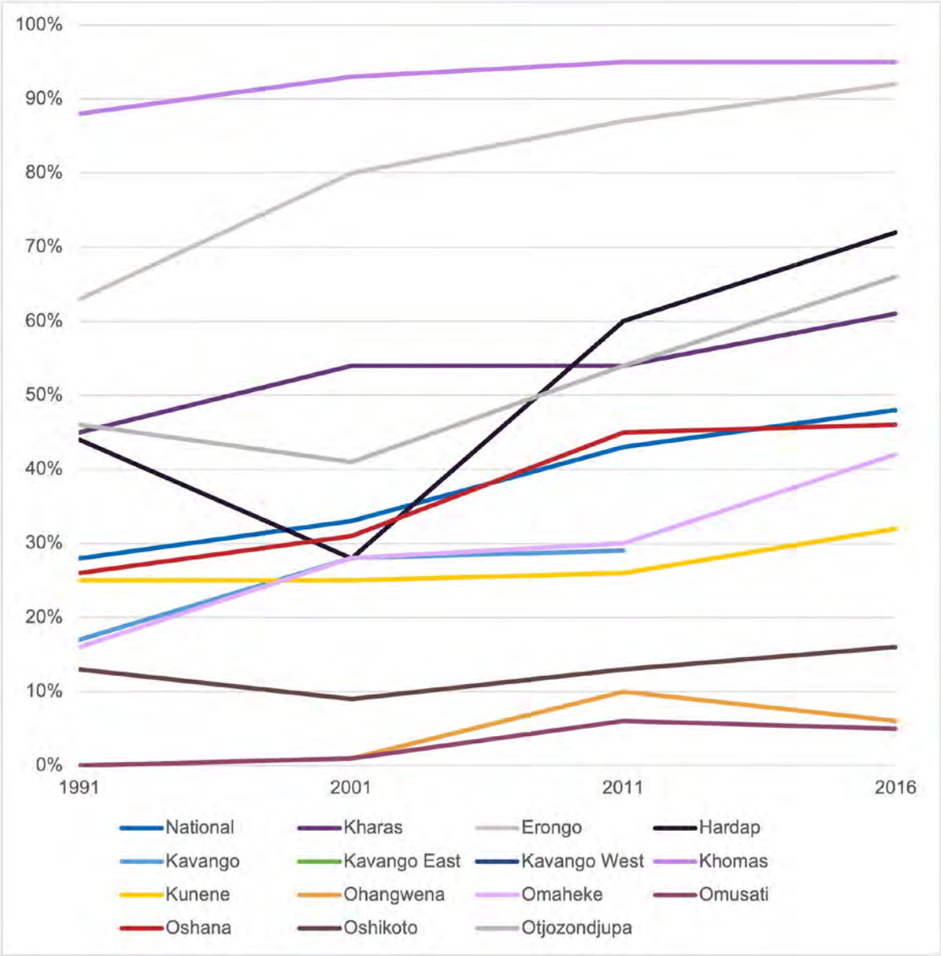


Figure 6-3 *Trends in urbanization in Namibia's regions (NPC, 1994; NPC, 2005; GRN, 2013; NSA, 2017; GRN, 2006; GRN, 2012; NSA, 2016)*

In general, urbanization can have both positive and negative effects on the state of the environment. Table 6-1 provides an overview of each type of impact.

Table 6-1 *Positive and negative impacts of urbanization*

Positive impacts of urbanization	Negative impacts of urbanization
• Services can be provided more cost effectively in an urban environment. • Opportunities for entrepreneurs and for finding employment are better in an urban setting. • Concentration of consumers makes production more profitable and provides an incentive for building manufacturing capacity. • Concentration of consumers makes trade and service industry more viable. • Urbanization leads to a drop in fertility rates and lower rates of natural growth. • Urbanization may contribute to protecting rural environments with naturally low carrying capacities.	• Poverty in urban areas is generally more acute with fewer available coping mechanisms and safety nets. • There is generally more crime and opportunities to engage in illegal behaviour. • Strains on infrastructure and failure to supply services have greater negative impacts. • Health, safety and living conditions require more stringent control. • Changes in consumption patterns lead to substantial increases in per capita water and energy consumption.

If urbanization is well-managed and planned, many of the negative elements can be mitigated. In Namibia, this process is governed by the Ministry of Regional and Local Government, Housing and Regional Development. The Ministry with support of United Nations Habitat (UN Habitat) developed an issue analysis and key recommendation report called 'Towards a National Urbanisation Strategy for Namibia' (Ottolenghi and Watson, 2010). The aim of this report was to act as an impetus for a national strategy to manage increasing urbanization. The report concluded with a proposal for a national work programme to develop a strategy. These and other initiatives to coordinate efforts are hampered by the fact that there are currently 23 different ministries operating in fields of regulation and implementation of issues relating to urbanization (Savela et al., 2020). Urgent attention is needed to facilitate coordination and collaboration between ministries in the planning of a coordinated strategy to manage urbanization.

6.2.3

Access to selected basic services

A review of the trends in access to the availability of basic services provides an indication of how Namibia fares in dealing with urbanization, and its ability to harness the positive impacts of its population migrating from rural to urban centres. This is well-illustrated by a comparison of the availability and use of a number of basic services between 2001 and 2011, according to the population and housing censuses – as indicated in Figure 6-4 (access to safe water), Figure 6-5 (access to toilet facilities), Figure 6-6 (access to electricity for lighting) and Figure 6-7 (use of wood and charcoal as main sources of energy for cooking).

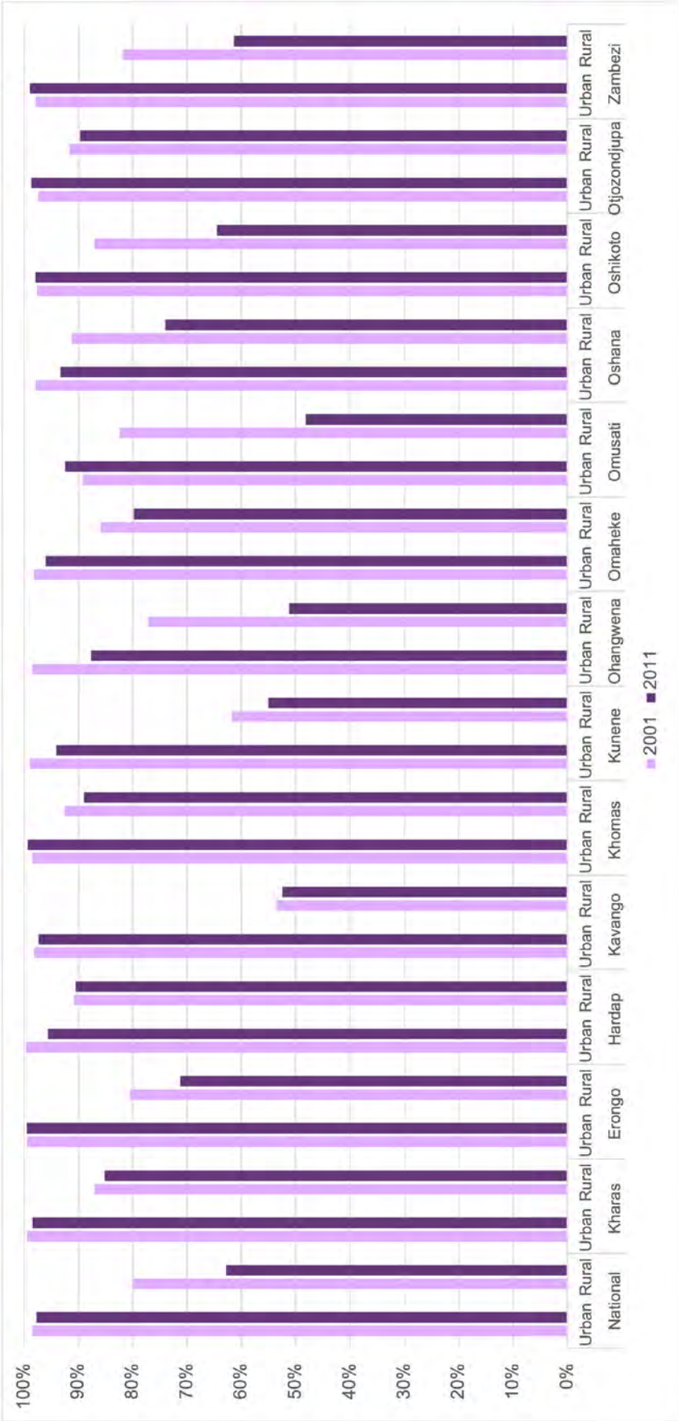


Figure 6-4 *Regional trends in the percentage of the population with access to safe water (2001 to 2011) (NPC, 1994; NPC, 2005; GRN, 2013; NSA, 2017; GRN, 2006; GRN, 2012; NSA, 2016)*

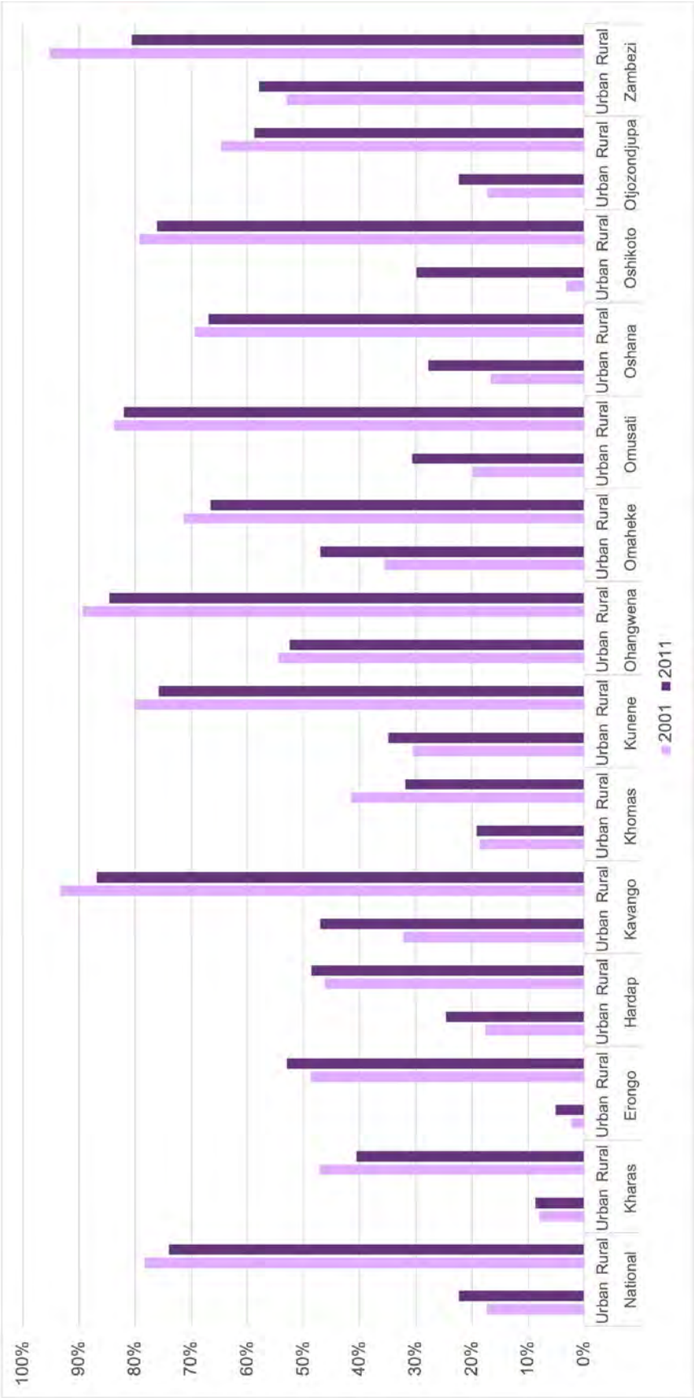


Figure 6-5 *Regional trends in the percentage of the population with no toilet facilities (NPC, 1994; NPC, 2005; GRN, 2013; NSA, 2017; GRN, 2006; GRN, 2012; NSA, 2016)*

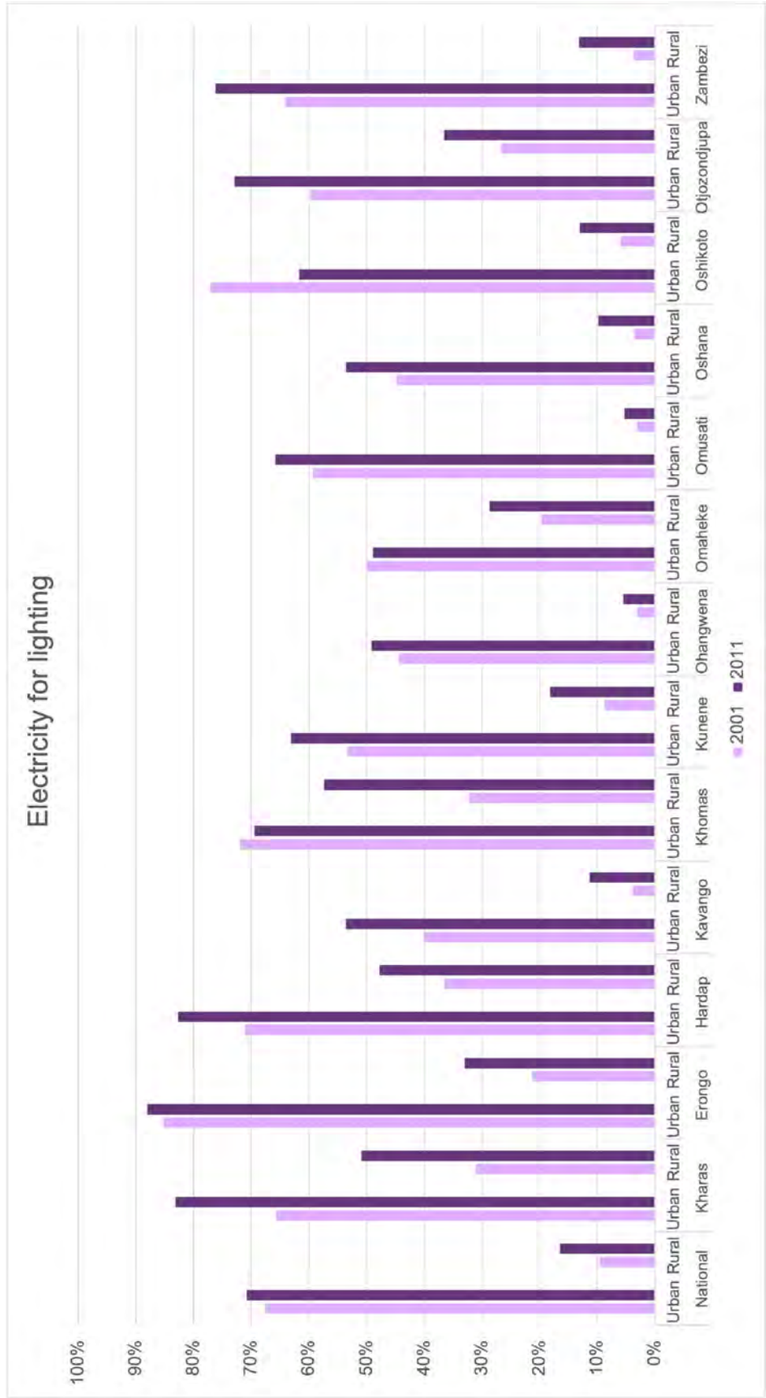


Figure 6-6 *Regional trends in the availability of electricity for lighting (2001 to 2011) (NPC, 1994; NPC, 2005; GRN, 2013; NSA, 2017; GRN, 2006; GRN, 2012; NSA, 2016)*

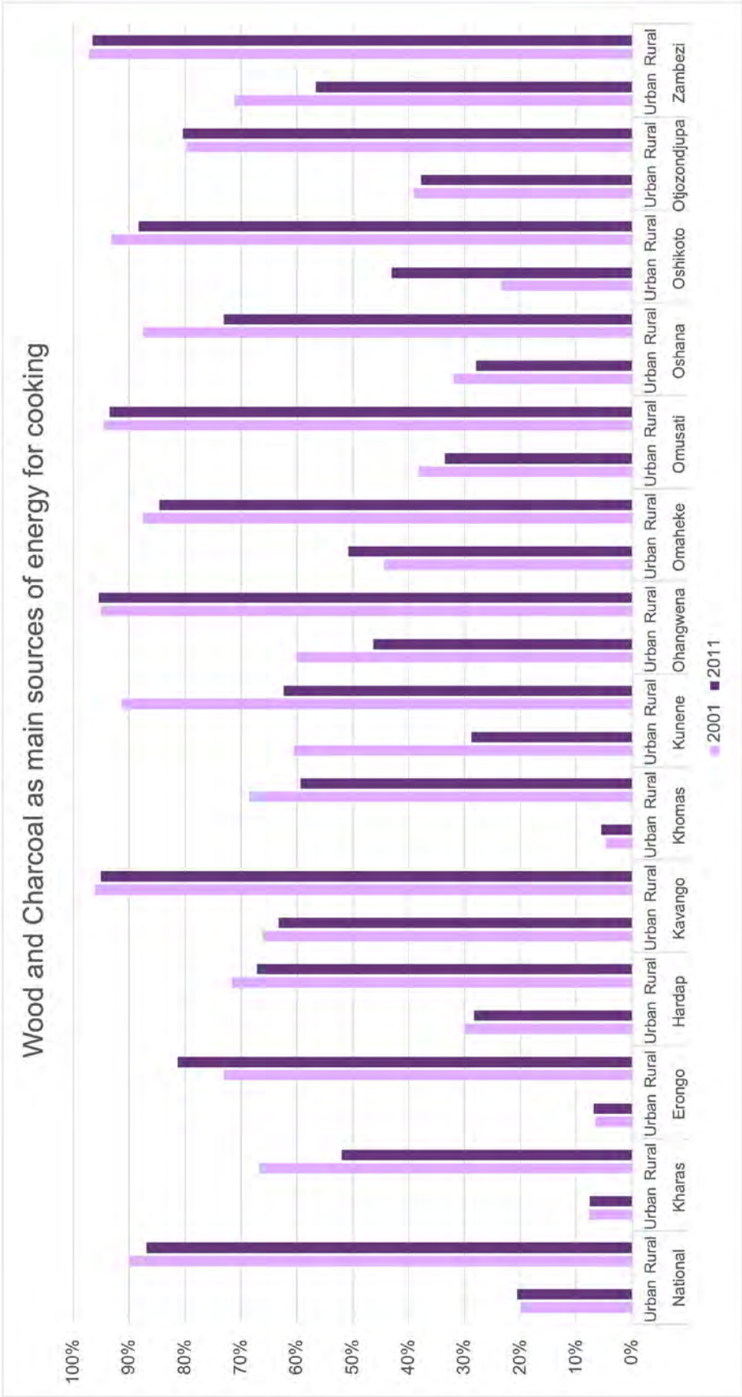


Figure 6-7 *Regional trends in wood and charcoal as main sources of energy for cooking (2001 to 2011) (NPC, 1994; NPC, 2005; GRN, 2013; NSA, 2017; GRN, 2006; GRN, 2012; NSA, 2016)*

An overall interpretation of the trends presented in Figure 6-4 to Figure 6-7 indicates that:

- Nationally, the number of urban citizens using wood and charcoal as their main sources of energy for cooking increased;
- The use of electricity for lighting in urban areas increased slightly over the ten-year period;
- Nationally, the number of people with access to safe water decreased in both rural and urban areas of the country; and
- Nationally, the number of people without access to sanitation facilities in urban areas increased.

These trends show – on three out of four indicators of well-managed urbanization – that Namibia is lagging in performance. More current data is needed to indicate whether efforts implemented since 2011 have improved the provision of safe water, reduced the use of charcoal and wood as a main source of cooking, and provided more sanitation facilities.

There are substantial differences between the regions for some services. In terms of the use of wood/charcoal for cooking, there were slight declines in the ||Kharas, Hardap, Kavango, Kunene, Ohangwena, Oshana and Zambezi regions, while the use of electricity for lighting improved substantially in all the urban areas – with smaller gains in the rural areas as well.

Access to safe water is generally high across all regions but there are a number of regions where access in the rural areas is relatively low and not improving at a meaningful rate. These are the Kavango, Kunene, Ohangwena, Omusati, Oshana, Oshikoto and Zambezi regions, where safe water in the rural areas is available to a smaller percentage of households than before.

6.2.4

Housing conditions

A review of the housing conditions in urban areas of Namibia offers insights into the citizens' interaction with the environment. Provision of adequate housing and serviced urban land is one of the main challenges facing the country (Savela et al., 2020). Currently, largely uncontrolled growth of informal settlements occurs in most of the urban areas in Namibia. Nationally, the percentage of households residing in improvized housing structures in urban settlements grew from 17.6% in 2001 to 27.2% in 2011 (Figure 6-8).

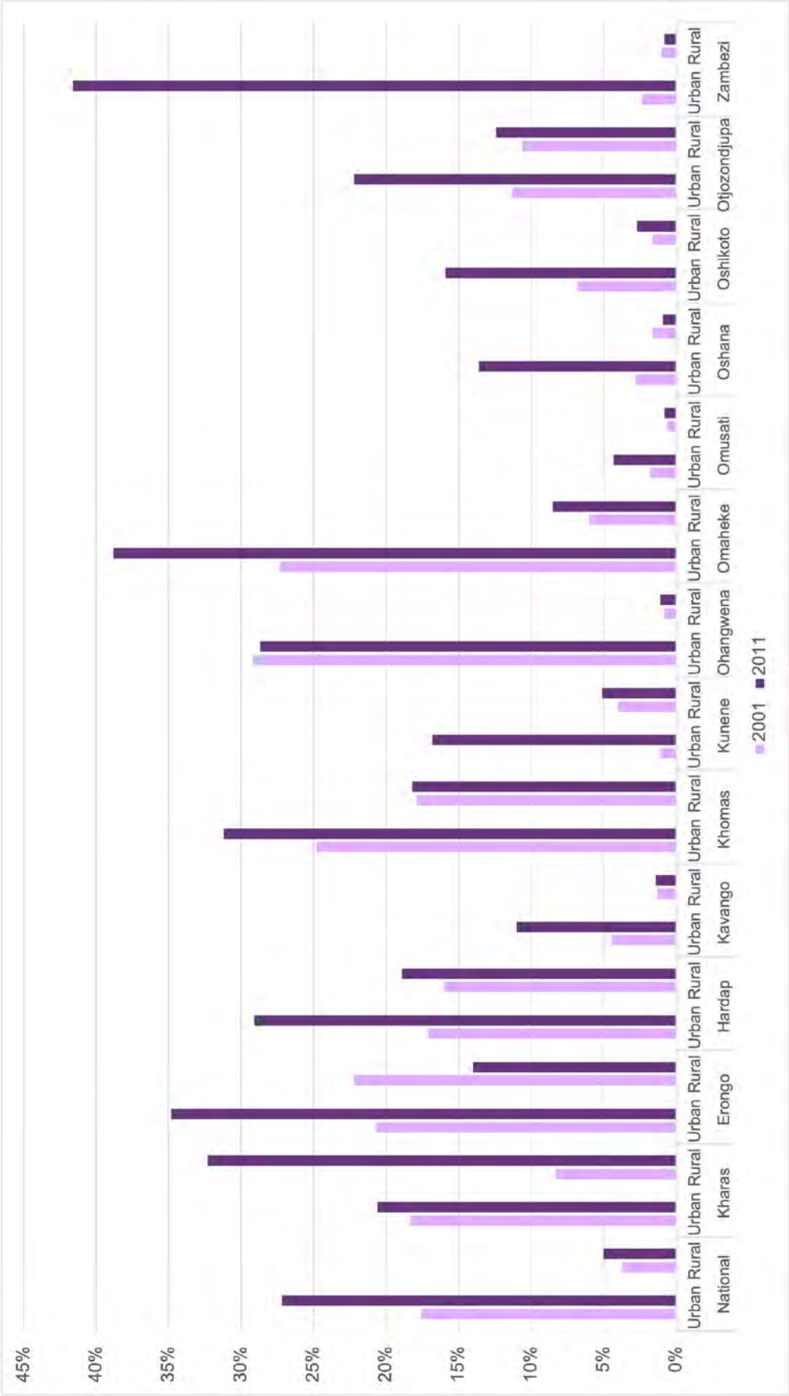


Figure 6-8 *Regional trends in wood and charcoal as main sources of energy for cooking (2001 to 2011) (NPC, 1994; NPC, 2005; GRN, 2013; NSA, 2017; GRN, 2006; GRN, 2012; NSA, 2016)*

This trend is found consistently in the urban areas of all the regions, with the exception of the Ohangwena Region, where the proportion of improvized houses declined from 29.2 to 28.7%. Given the rate of urbanization, it means that the sheer number of informal housing units in the urban areas is fast increasing. This trend is confirmed if data from the 2016 inter-census demographic survey is added to 2001 and 2011 data, as indicated in Figure 6-9. The exponential growth in improvized housing in urban areas in Namibia is of real concern and indicates the need for decisive action on national and regional urbanization strategies.

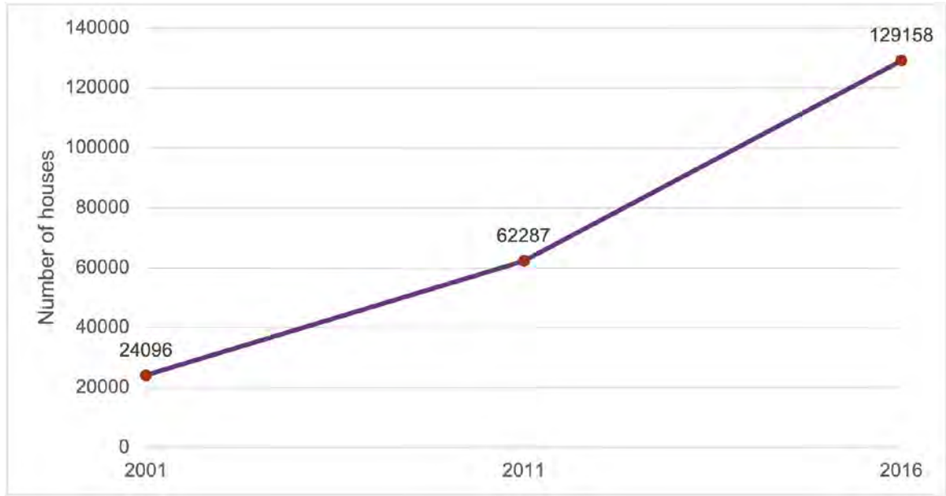


Figure 6-9 *Trends in number of improvized urban houses (2001 to 2016) (NSA, 2016)*

Informal settlements are characterized by improvized shelters and a lack of infrastructure services. While authorities generally try to provide at least safe water, these areas very seldom have access to safe sanitation or electricity. This mostly results in residents using wood or charcoal to satisfy their energy needs, while most use the outdoors for sanitation needs. In low-density rural areas, this may pose a low public health risk, but in high-density urban areas the negative impact on the health and well-being of the residents – as well as the environment – is significant.

6.2.5

Housing needs & serviced land

Housing development is largely taking place in the high and middle income market segements, which is attractive to private sector developers – while very little is done in the affordable housing and social housing segments of the market. The extent to which this need can be satisfied depends on a clear understanding of the extent of the need in the various affordability categories, broken down by urban area. Planners of these urban areas could then plan to address the entire spectrum of the needs and could provide the necessary infrastructure services for housing development to take place. The main challenge, however, is to accommodate those that cannot afford a house or even a serviced stand. Housing subsidies can be used to provide housing for this substantial part of the population; however, this has not been forthcoming.

In contradiction to the National Housing Policy – which states that "By 2017, Namibia will have a robust and effective housing delivery programme where affordability is the key feature of the programme; and that 60% of households will be living in modern houses" – the number of people living in sub-standard housing in informal settlements is on the increase, due to various challenges (Asino and Christensen, 2018).

These challenges are identified as follows:

- Mismatch between the demand and supply of housing;
- Lack of governmental funding for housing programmes for the low-income and middle-income groups;
- Poor access to credit as a result of limited disposable income and poverty;
- Undersupply of affordable urban land across the country; and
- Affordability of housing, which has not been prioritized.

In fact, government continues to insisit on minimum stand sizes of 300 m² – which further drives up the prices of the few plots that are actually provided.

The housing need in the various regions of Namibia has been categorized into short, medium and long term needs (Figure 6-10 to Figure 6-12). The Omusati and Oshana regions have an oversupply of housing at the time of reporting, which was projected to remain until 2020. Thereafter, all regions will be in deficit. The greatest need was found to exist in the two most urbanized regions: Khomas and Erongo (Asino and Christensen, 2018).

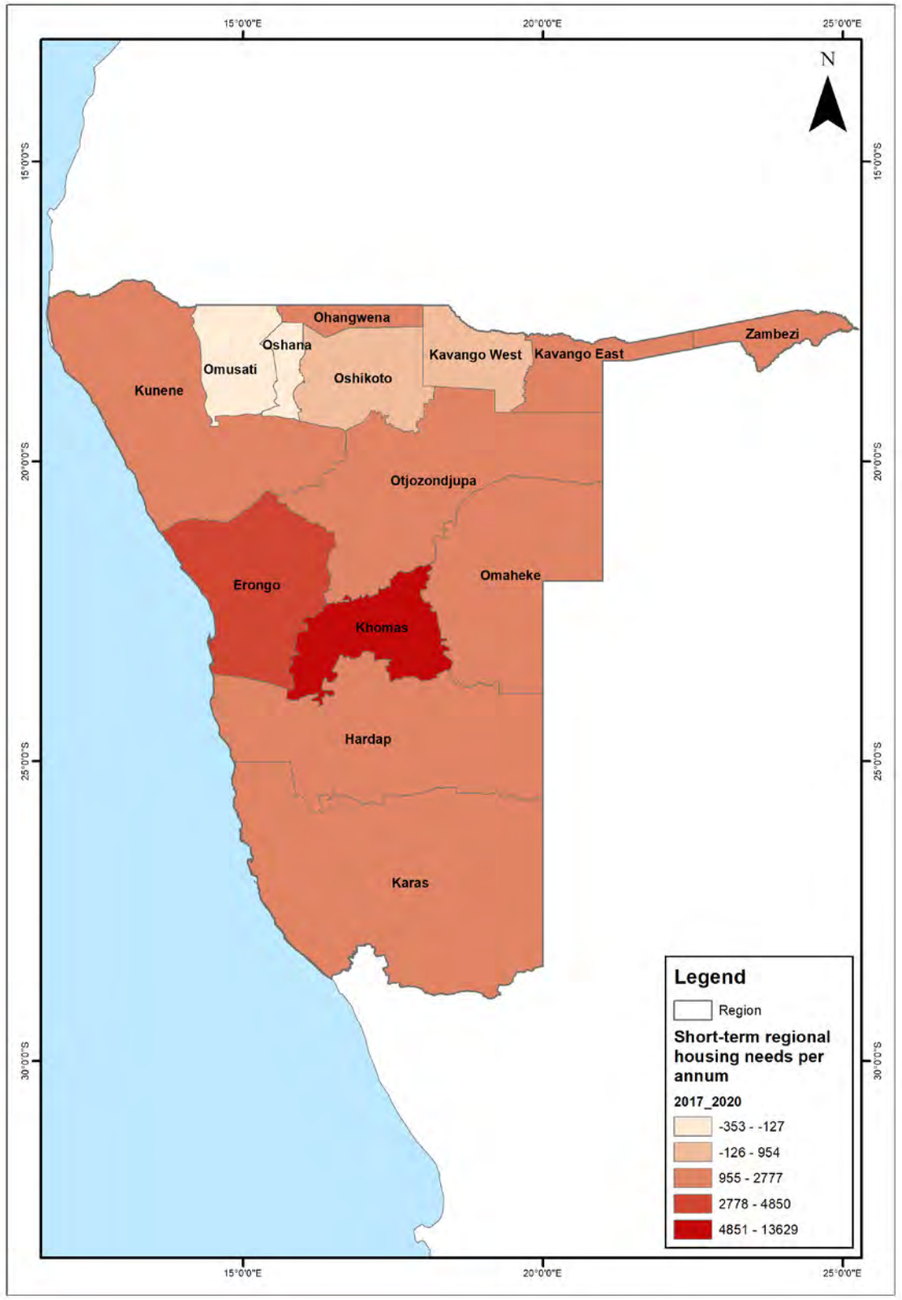


Figure 6-10 *Short-term regional housing needs per annum (Asino and Christensen, 2018)*

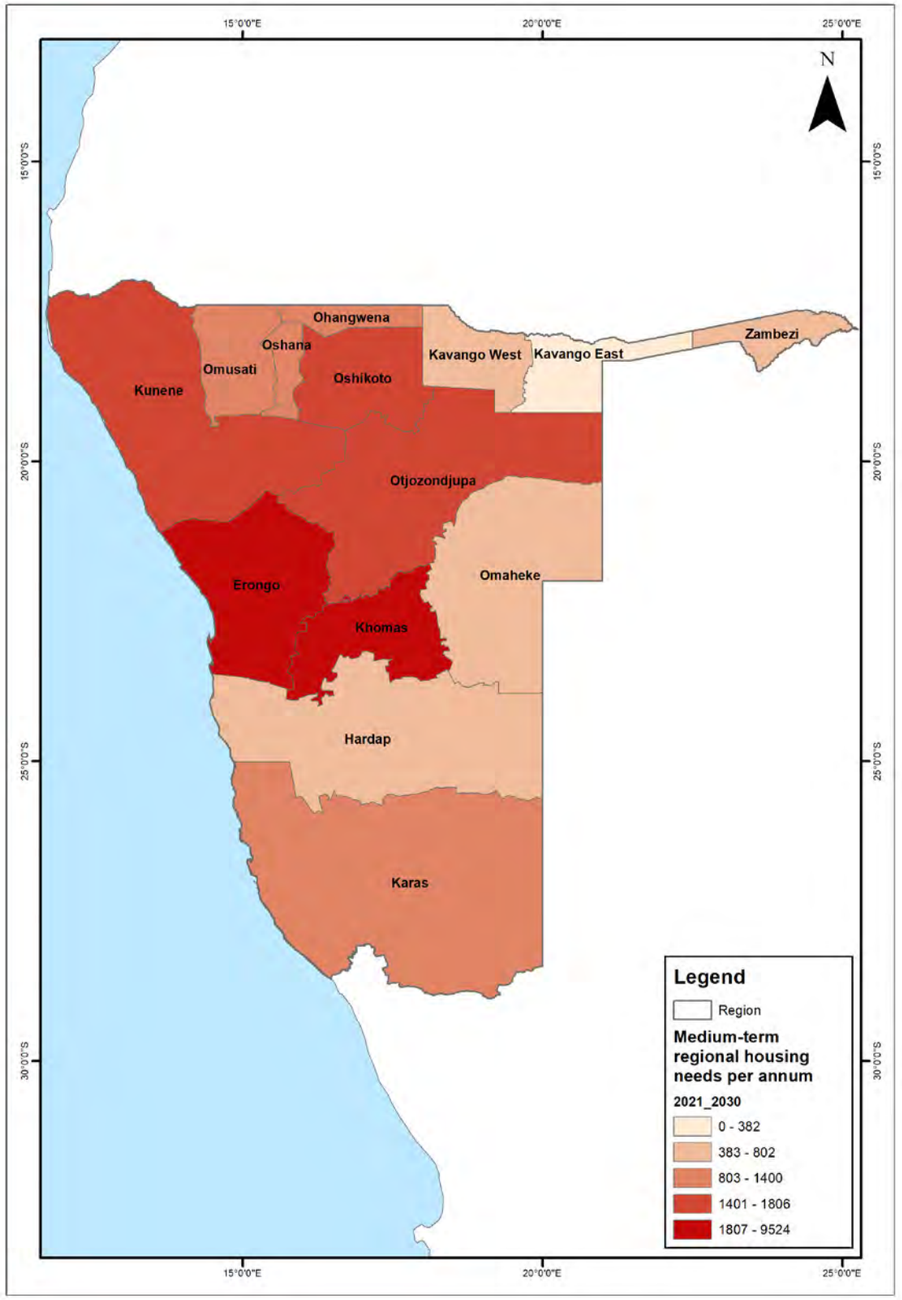


Figure 6-11 *Medium-term regional housing needs per annum (Asino and Christensen, 2018)*

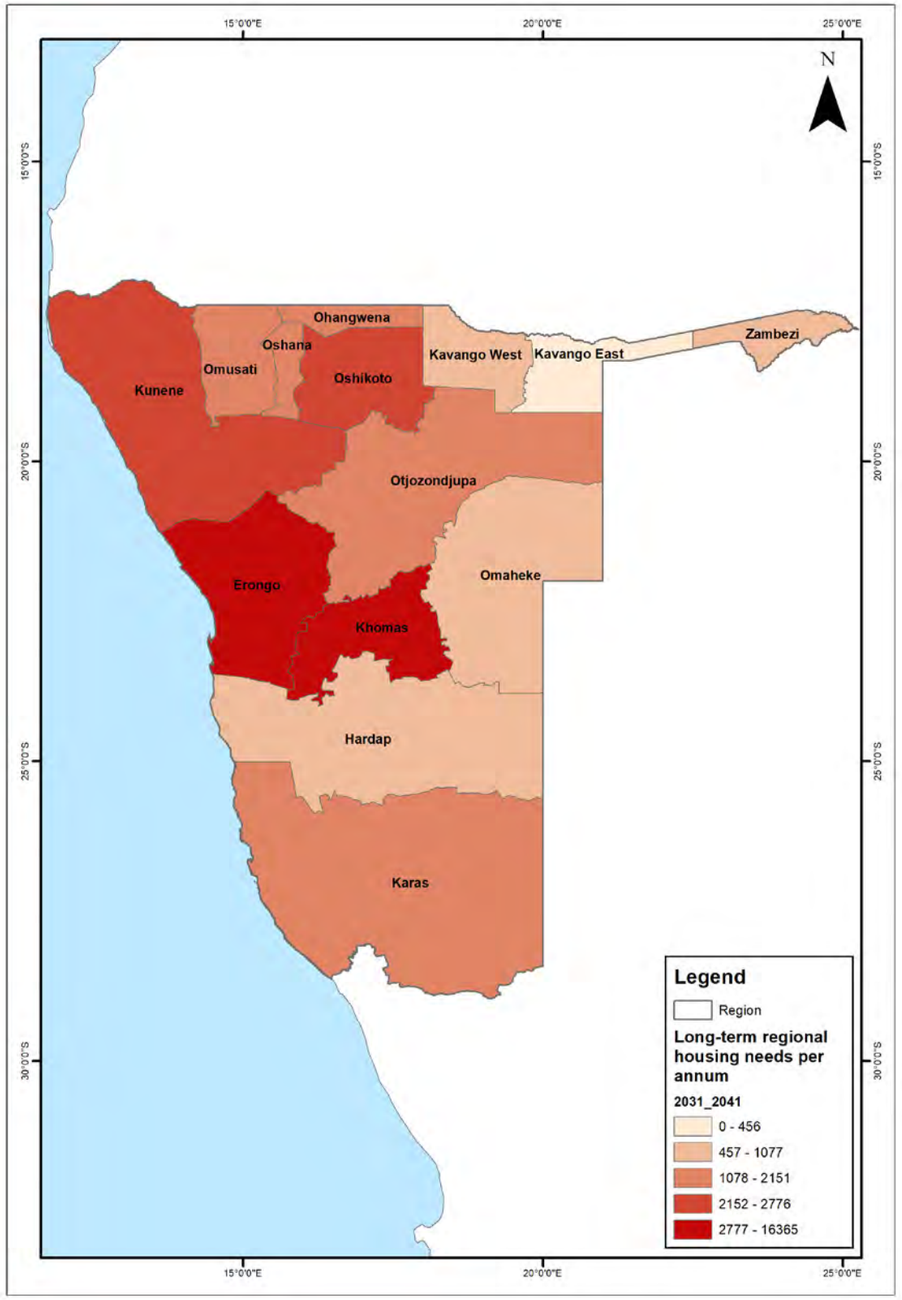


Figure 6-12 *Long-term regional housing needs per annum (Asino and Christensen, 2018)*

Whether or not housing is regarded as serviced stand with a superstructure or only as a serviced stand, supply lags far behind demand. Over the years, many initiatives have been taken to address the problem. Initially, the Build Together project was launched under the then-Ministry of Local Government and Housing. After concept development and testing, it was given to local authorities to implement and administer. However, a large percentage of incomplete Build Together houses in urban areas is testament to the implementation failures, mostly as a result of the cost of houses exceeding the available funds.

The state-owned National Housing Enterprise (NHE) was initially tasked with providing affordable housing. However, it operates in the middle income market (i.e. for people who can access finance based on family income). The cheapest 44 m² NHE house costs between N$328,119 and N$512,076, depending on the area, which is unaffordable to a large proportion of the population (Lukas, P. E-mail. 2020-11-20).

Since 2001, the NHE reportedly constructed 6,166 housing units. This translates to an average of 308 houses per annum. Over the past ten years, the mean housing units constructed per annum was 283 units per annum (Ibid).

In addition, the Namibia Housing Action Group (NHAG) and the Shack Dwellers Federation of Namibia (SDFN) was established to help people to help themselves, with respect to obtaining a form of secure tenure and then building their own houses. The NHAG would assist people to form a savings group and would then help them negotiate an unsubdivided portion of land for the construction of houses. The NHAG would help them plan the area informally and, once enough funds were saved up, commence with house construction. The SDFN is a network of 605 saving schemes with 20,400 members throughout the country (SDFN, no date). Community savings has been used to secure land and to leverage additional government contributions, enabling the groups to build over 3,488 houses and secured land for roughly 6,230 families since its establishment in 1992. The NHAG supports SDFN in housing development, which has translated into to some 222 secured land opportunities per annum since 1992 (Ibid).

Furthermore, the Mass Housing Development Programme was set up by former President Hifikepunye Pohamba in 2013 with the aim of building some 148,000 affordable houses throughout the country by 2030 (Tjitemisa, 2019). Although it seems that quite a number of erven were serviced and houses built, monitoring data for this programme does not seem to be available. The project was plagued with administrative and implementation problems and its achievements are not clear.

Lastly, the Development Workshop Namibia (DWN) is a Namibian-registered charity trust with a focus on human settlements, working to improve living conditions for the disadvantaged. Its work focuses on research and publications, and on the provision of affordable land and housing, water supply and sanitation. Besides work on affordable sanitation and on the COVID-19 response, DWN is currently busy, in partnership with local authorities, to supply serviced land in various local authorities. Table 6-2 provides a summary of inferred calculations of erven in the process of being provided by DWN.

Table 6-2 *Erven in the process of being provided by DWN*

Town	Number of erven	Mean cost per stand with water, stormwater and gravel roads
Oshakati	122	N$10,000
Okahao	730	N$14,000
Karibib	306	Not available yet
Keetmanshoop	344	N$15,000
Opuwo	487	N$15,000
Oniipa	117	Not available yet

6.3

Environmental health - status quo

Environmental health focuses on how environmental factors and processes impact and change human health. It can be defined as an interdisciplinary field that focuses on analysing the relationship between public health and the environment. From a health perspective, environmental health addresses all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviours. It encompasses the assessment and control of those environmental factors that can potentially affect health. It is targeted towards preventing disease and creating health-supportive environments (United Nations, 2017).

Status quo refers to the current state of specific environmental conditions relating to human health in Namibia. It is informed by how indicators related to these conditions are trending over time.

The following 13 indicators are used in this section to report on the current state of public health in Namibia:

- Infant mortality rate;
- Live expectancy;
- HIV/AIDS prevalence;
- Trends in the incidence of TB;
- Incidence of malaria;
- Distribution of suspected and confirmed COVID-19 cases by region;
- Incidence of malaria cases;
- Number of cholera cases in 2014;
- Number of cholera cases in 2018;
- Hepatitis E cases from 2017 to 2020;
- Key demographic indicators of the HEV outbreak;
- Skin cancer cases from 2013-2015; and
- Sanitation facilities coverage in Namibia.

6.3.1

Infant mortality rate & life expectancy

Globally, a country's infant mortality rate and life expectancy are considered as two important indicators of the overall status of public health. The infant mortality rate is defined as the probability of dying between birth and exactly one year of age, expressed per 1,000 live births (United Nations Children's Fund, 2020). Life expectancy indicates the average age at which adults will probably pass away in a country (WHO, 2017). Figure 6-13 indicates infant mortality rate trends in Namibia from 1990 to 2018, and Figure 6-14 shows the trends in life expectancy during the same period.

As indicated in Figure 6-13, the infant mortality rate in Namibia decreased significantly over the last two decades. Despite this improvement, Namibia ranks 55th out of 225 countries, where the country with the lowest infant mortality rate is placed at number 225 (Central Intelligence Agency, 2017). This ranking places Namibia in the bottom quarter of international infant mortality rates. Although Namibia has seen a decrease of 18 points over the past two decades, the country has not met the targets set by the Millennium Development Goals (MDGs) to be achieved by 2015 (WHO, 2020a). The trend data depicted in Figure 6-13 indicates that Namibia is on the right trajectory to reduce its infant mortality rate, but still has a long way to go in the context of international development and goal setting (WHO, 2017).

Figure 6-14 indicates Namibia's life expectancy at birth and shows a dramatic decrease in life expectancy from the mid-1990s to approximately 2010. WHO (2017) ascribes this temporary decline in life expectancy to the HIV/AIDS pandemic. At the end of 2004, Namibia was one of the five most severely affected countries in the world, with an adult HIV/AIDS prevalence averaging 20% – and even higher infection rates in urban areas (WHO, 2005). In the period from 2002 to 2016, the HIV prevalence rate dropped from 22% to 17.2%. This drop is ascribed to an aggressive public anti-retroviral treatment regime, covering 79% of people eligible for treatment. This coverage is among the highest in Africa and does not include people in private treatment (WHO, 2017).

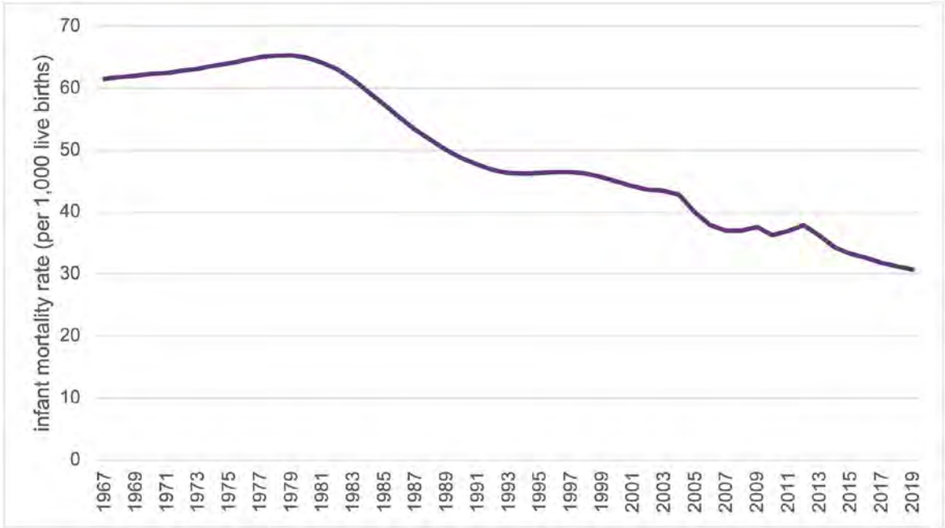


Figure 6-13 *Trends in the infant mortality rate in Namibia (per 1,000 live births) (World Bank, 2020a)*

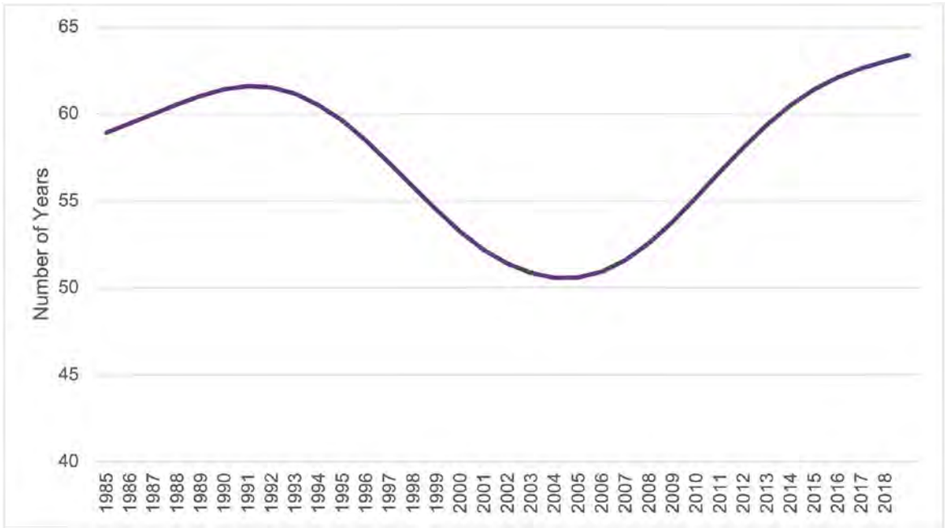


Figure 6-14 *Life expectancy at birth in years 1985 to 2018 (World Bank, 2018)*

The overall country health indicators show that despite challenges, Namibia has made gains in improving public health for all citizens. Remaining objectives include strengthening the health system in the country, combating priority diseases, and improving maternal and infant health.

Against the background of the overall public health status in Namibia, the state of the environment plays an important role in the transmission of and vulnerability to diseases. Categories of diseases that are particularly sensitive to environmental conditions are airborne diseases, water-related diseases and health problems associated with excessive ultraviolet radiation exposure.

6.3.2

Airborne diseases & conditions

Airborne diseases are transmitted through small particles in the air and include diseases such as influenza, chickenpox, measles, mumps, tuberculosis (TB) and COVID-19. People living in high-density areas, without easy access to water, sanitation and hygiene (WASH) services, are at increased risk to contract airborne diseases. There is a close interrelationship between airborne diseases and environmental factors such as high urbanization rates (as discussed in Section 2 of this chapter) and access to potable water and sanitation.

Tuberculosis

Tuberculosis remains a significant health challenge in Namibia. WHO (2016) reports that Namibia is ranked fifth among countries with the highest burden of TB cases in sub-Saharan Africa. Figure 6-15 indicates trends in the incidence of TB in Namibia over the past two decades, showing the success of universal access to community-based TB care through the Stop-TB and End-TB strategies implemented since 2005 (Kibuule et al., 2020).

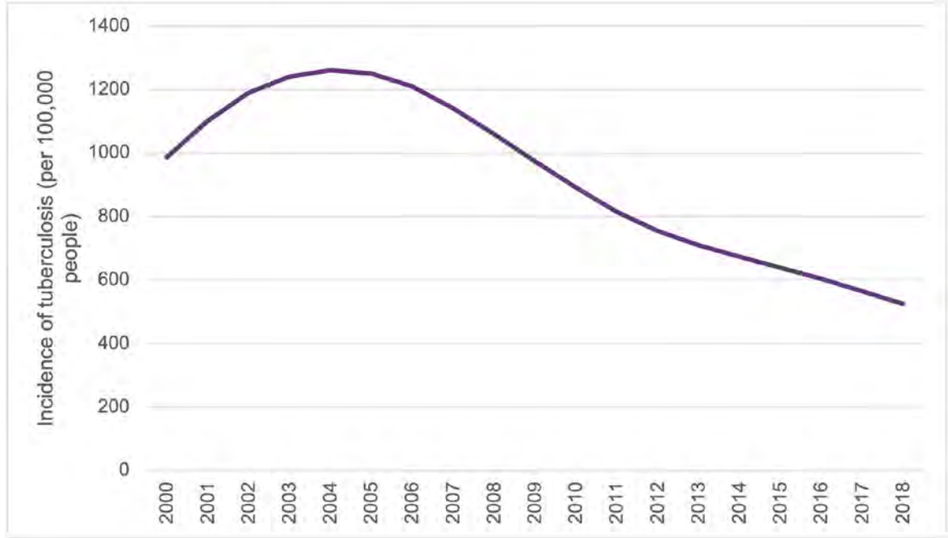


Figure 6-15 *Incidence of tuberculosis (per 100,000 people) from 2000 to 2018 (World Bank, 2020b)*

COVID-19

As part of the global community, Namibia has been subject to COVID-19 infections, global mitigation measures as well as the widespread economic downturn due to restriction of movements across the region and the world. COVID-19 is caused by a coronavirus, which is a group of viruses belonging to the family of Coronaviridae, which infect both animals and humans. Human coronaviruses can cause mild disease similar to a common cold, while others cause more severe disease, such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). A new coronavirus that previously has not been identified in humans emerged in Wuhan, China, in December 2019.

Namibia reported its first COVID-19 cases on 13 March 2020, declaring an outbreak on 14 March 2020 and a State of Emergency on 17 March 2020. The government activated a National Health Emergency Coordination Committee under the Ministry of Health and Social Services, introduced an Incident Management System and strengthened the functionality of the National Public Health Operation Centre.

Practical measures included a phased approach to lockdown, with community awareness and education campaigns. While the global trajectory of the disease remains uncertain, Namibia's daily number of infections (both estimated and reported) seems to be declining (MRC Centre for Global Infectious Disease Analysis, 2020).

6.3.3

Water related diseases

The population of countries with high variability in weather patterns and increased incidents in extreme weather events are more at risk of contracting water-related diseases. Water-related diseases are defined as illnesses caused by micro-organisms in untreated or contaminated water (for example, diarrhoea), or diseases occurring more frequently where water availability is highly variable, such as malaria (United Nations, 2017).

Malaria

Malaria is a water-related disease that has wreaked havoc in sub-Saharan Africa over the past two decades. It is estimated that in 2018, 405,000 people died of malaria in affected countries – most of them young children. Interventions have been scaled up through international efforts to help control malaria, especially in Africa. These interventions have led to a global decrease in mortality due to malaria by 25% from 2010 to 2016 (Centres for Disease Control and Prevention, 2020a). Namibia followed this global trend, with a dramatic reduction in cases until 2014 – but has since seen a sharp rise in the incidence of malaria, as indicated in Figure 6-16.

Based on an analysis of data prior to 2014, WHO published a report in 2016 in which it identifies Namibia as one of 21 countries with the potential to eliminate malaria by 2020 (World Health Organization, 2016). Unfortunately, as Figure 6-16 indicates, a sharp rise occurred from 2015 onwards. The rise in the incidence of malaria is mostly attributed to an increase in extreme weather events, most notably flooding in the northern and north-eastern parts of the country as well as increased drug resistance. As described in Chapter 5, the impacts of climate change have raised the risk of more frequent, severe flooding in these parts of the country. WHO advocates a multi-pronged approach to malaria management in which the Ministry of Health and Social Services have engaged in in collaboration with national and international partners.

Figure 6-16 *Incidence of malaria (per 1,000 population at risk) (World Bank, 2020)*

Cholera

Cholera is a water-related disease caused by bacterium in affected drinking water and/or food, or through the faeces of an infected person. Symptoms include severe diarrhoea and vomiting, leading to rapid dehydration. People living in areas with poor water provision, poor sanitation systems and high population density are at increased risk of contracting cholera. This risk is exacerbated when flooding occurs, as bacteria growth is accelerated in standing water that frequently remains long after the flooding event has passed. Cholera can be prevented and treated through simple hygiene measures related to the provision of WASH services (World Health Organization, 2020b).

In November 2013, Namibia reported its first ever cholera outbreak in Kunene, Omusati, Oshana and Ohangwena regions. By February 2014, 504 cases and 16 deaths had been recorded in these regions. The disease quickly spread to the capital Windhoek, where more cases and deaths were recorded. By April 2014, the disease was under control and the last cholera patient was discharged on 23 April 2014 (Reliefweb, 2014). In 2018, another outbreak occurred in a poor Windhoek neighbourhood characterized by inadequate sanitation and water provision services. This outbreak was contained with only four children affected (Reliefweb, 2018). A rise in cholera cases in the SADC region in recent years is a continued concern as trans-boundary contamination occurs frequently where there are shared watercourses (Africa Centre for Disease Control and Prevention, 2018).

Hepatitis E

Hepatitis E (HEV) is a viral infection caused by ingesting water contaminated with faecal matter. It causes inflammation of the liver and includes symptoms such as fever, fatigue, loss of appetite, jaundice and nausea (Centres for Disease Control and Prevention, 2020b). HEV is seldom fatal but poses a particular threat to pregnant women. Prior to 2018, the first recorded HEV outbreak in Namibia occurred in 1983 among Angolan refugees in Namibia's Kavango region (Isaacson et al., 2020). The 2017 to 2018 outbreak is the largest and also the first nationwide protracted HEV epidemic, centred mostly in informal settlements with poor WASH facilities (Bustamante et al., 2020). Table 6-3 highlights key demographic indicators of the HEV outbreak (2017-2020).

The progression and contraction of the HEV and its long incubation time makes it difficult it is for the Ministry of Health and Social Services to determine the status of the disease over time. Bustamante et al. (2020) has highlighted the concentration of the disease in communities where rapid urbanization has taken place without access to adequate services. The scale and concentration of the HEV outbreak highlights the risks of unplanned rapid urbanization and reinforced the reality of public health needs in informal areas.

Table 6-3 *Key demographic indicators of the HEV outbreak (Bustamante et al., 2020)*

Key demographic indicators of the HEV outbreak (2017-2020)	
1	All of Namibia's 14 regions have reported HEV cases
2	59% of cases occurred in males
3	72% of cases were in persons 20-39 years
4	61 deaths were reported nationally of which 34% were pregnant women
5	84% were from Khomas and Erongo region
6	37% were reported from three informal settlements – Havana, Goreangab and the Democratic Resettlement Community

6.3.4

Health problems associated with excessive ultraviolet radiation exposure

One of the health problems associated with excessive ultraviolet radiation (UVR) exposure is skin cancer. In southern Africa, the ultraviolet index (UVI) values during summer are 10 or higher, with a slightly lower value during winter times. A UVI of higher than six or seven indicates that there is a high risk of harm from unprotected sun exposure (Environmental Protection Agency, 2020).

Personal solar UVR exposure depends on geographical and behavioural factors, while subsequent adverse health risks from excess exposure are influenced by individual susceptibility such as skin prototype and genetic disposition. Skin cancer is classified in two broad groups: cutaneous melanoma (CM) and keratinocyte cancers (KCs). CM is fatal if untreated, while the KCs are disfiguring and debilitating. Globally, CM is the 19th most common cancer worldwide and KCs have the highest incidence of any cancer in the Caucasian population (Wright et al., 2020). While sun exposure is the major environmental risk factor for skin cancer, other compounding factors include: a higher incidence in people with fair skins; cumulative lifetime exposure; intermittent intense exposure; the presence of immune compromising comorbidities such as HIV/AIDS; and advanced age (Wright et al., 2020). The projected impacts of climate change will further exacerbate the occurrence of skin cancer as temperatures increase over time. The time-lapse between ambient temperature and skin cancer incidence is approximately 60 years, hence the full impact of rising temperatures will

not become apparent for some time (Wright et al., 2020). Skin cancer affects 9.6 males and 7.6 females (age standardised rate) per 100,000 people in Namibia, and an average of 836 new cases per annum are reported – as indicated in Figure 6-17. The data indicates that females are more susceptible to CM, whereas males are more susceptible to KCs. Solar UVR is the only modifiable risk factor for skin cancer and international best practice encourages active education and prevention strategies.

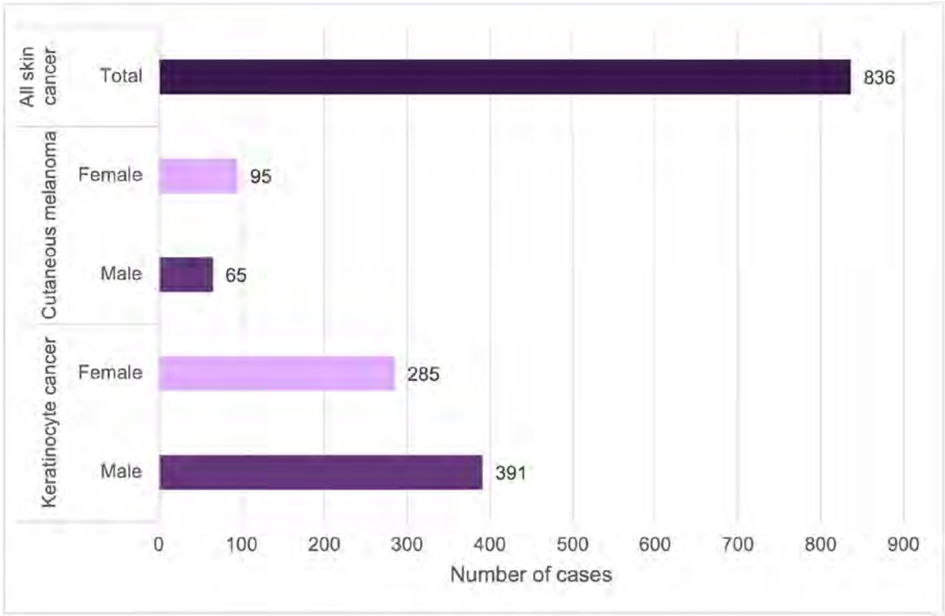


Figure 6-17 *Skin cancer cases in Namibia (2013 – 2015) (Wright et al., 2020)*

Swakopmund | Grant Durr

6.3.5

Human settlements & environmental health challenges & responses

Nowhere else in the state of the environment in Namibia is the complex interrelationship between different natural environments, their use, waste and disaster risk more apparent than where human settlements, health and well-being are considered. Based on the information presented in Sections 2 and 3 of this chapter, it is evident that the population of Namibia has a fragile dependency on the environmental status of the country. While there are many contributing factors to pressures on human settlements and public health, the natural environment and its use provides the foundation for humans to thrive. Challenges in Namibia include rapid urbanization, equitable access to WASH services and the increase in water-related diseases.

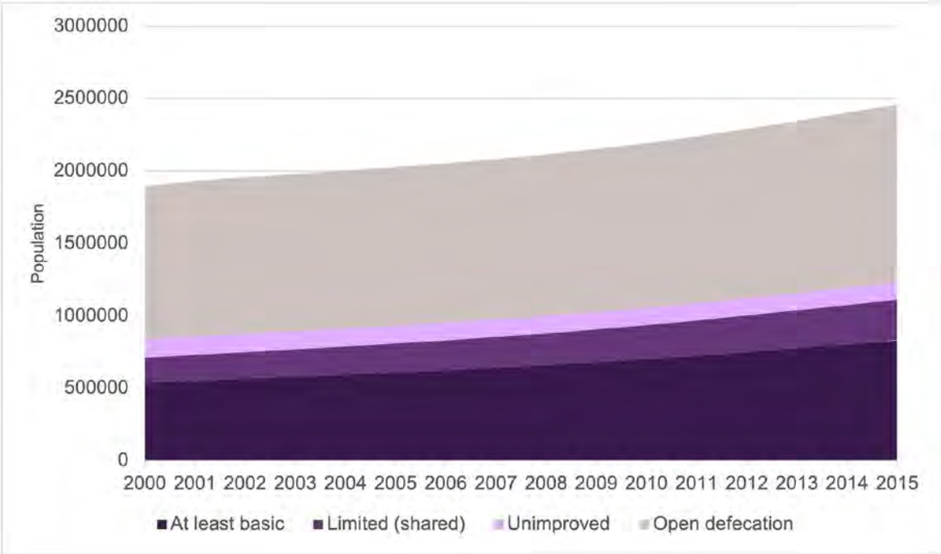
Rapid urbanization

The status quo of urbanization in Namibia was discussed at length in Section 6.2 and indicators pointed to urbanization progressing at a rapid pace – resulting in informal settlements that lack proper planning, management and governance. Rapid urbanization – combined with other factors such as lack of basic services, an increase in water-related diseases and a global economic recession – pose a serious threat to the health and well-being of Namibian citizens. Urgent responses are needed to the threats posed by rapid urbanization, including:

- The development and implementation of an integrated urbanization strategy that will include methods to guide and assist local authorities to plan for and accommodate urban population growth. This should include means to secure tenure and the provision of basic infrastructure services;
- Capacity building at local authority level to equip public officials to deal with the challenges of rapid urbanization;
- Action on the implementation of the National Solid Waste Management Strategy, which was formulated in 2018 but still needs to be implemented. A concerted effort needs to be made to unify stakeholders to commit them to implementation; and
- The Water Resources Act, No. 11 of 2013, needs to be brought into force as a matter of urgency and this should be implemented to protect and manage Namibia's extremely important water resources.

Access to WASH services

The current COVID-19 pandemic has exposed the inequalities in WASH service provision. Globally, 40% of people do not have access to basic handwashing services, an essential component in preventing the spread of the coronavirus. In Namibia, the current level of access to sustainable water services is 85% and access to sanitation services is 54% (Pombo-van Zyl, 2020). As indicated in Figure 6-18, trends in access to sanitation facilities indicate that while there has been some improvement in access to basic sanitation services, over a million people in Namibia still have to revert to open defecation to satisfy their sanitation needs.



KEY | At least basic *Improved sanitation facilities not shared with other households* **Limited** *Improved sanitation facilities shared with other households* **Unimproved** *Facilities without a flush/pour flush system*

Figure 6-18 *Sanitation facilities coverage 2000 to 2015 (WHO, 2017)*

Supported by the African Development Bank (AfDB), the Namibian Government has made a commitment to reach the universal target of improved sanitation for all by 2030. The AfDB made a grant available for Namibia's water sector support programme from its Rural Water Supply and Sanitation Initiative Trust Fund. The planned interventions – to be completed in 2024 – will directly benefit an estimated one million people and have 250,000 indirect beneficiaries, mostly women (Pombo-van Zyl, 2020).

Housing needs

The key to the provision of housing is the supply of planned and serviced urban land in the urban areas of the country. With a formally planned stand, people will be able to secure their tenure. Moreover, people themselves would be able to develop service level and shelter solutions of various types and costs to suit the variety of needs and affordability levels in the urban areas.

However, most local authorities are struggling financially and must sell their land, mostly at such a high cost that it is unaffordable to most. In addition, all services costs are added to the selling price of a stand, which makes a conventionally serviced stand unaffordable to more than 60% of the population (based on NSA, 2016).

There is a need to revisit the housing strategy completely. Some suggestions are to lower the cost of land, subsidizing essential services where it is not affordable, lowering building standards, and allowing individuals to build incremental housing where they are unable to afford a superstructure.

Efforts to date to make a dent in the housing shortage have not been significant in achieving a reduction in the proportion of urban dwellers residing in makeshift shelters. Local authorities, save for a few, are also not able to provide suitably serviced land in their areas to satisfy the demand, especially not for the low-cost housing needs.

Increase in water-related diseases

Rapid urbanization and challenges in accessing WASH services has contributed to the overall increase in water-related diseases in Namibia. Section 6.3.2 highlighted trends in only three of these diseases and in all three indicators an unprecedented increase in cases occurred over the last 10 years. These results indicate a threat to public health that needs urgent attention. Several cooperative partnerships to address these issues are ongoing, one being the United Nations Development Partnership Framework (UNPAF) that is currently in its third iteration with the Government of Namibia (WHO, 2017). As part of this framework, WHO has set out four strategic priority areas to support Namibia to improve public health. This initiative will assist Namibia to: strengthen the health system; combat priority diseases; improve maternal, newborn, child and adolescent health; and promote a healthier and safer environment (WHO, 2017). A cohesive environmental health data collection system helps substantially to monitor these and other initiatives underway to respond to environmental health challenges.

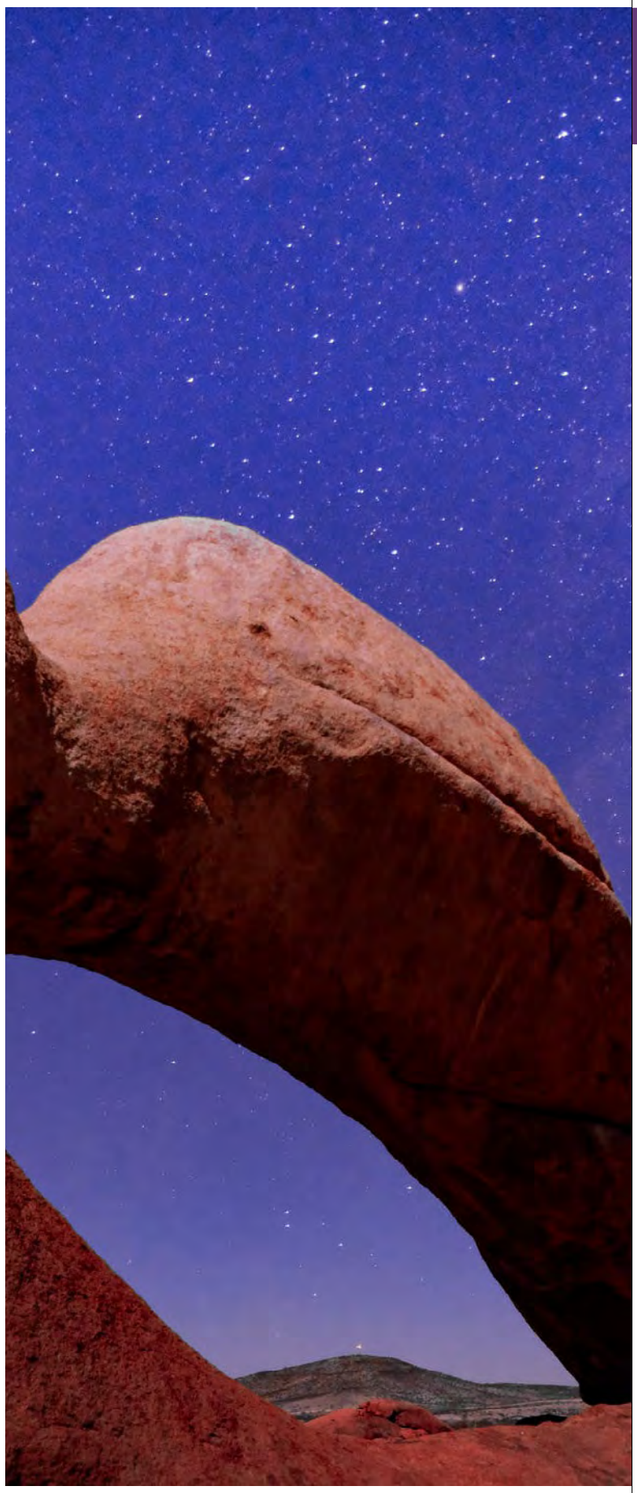
Government's response to Human Health & Disease Outbreaks

As discussed in Chapter 7 Namibia has a Disaster Risk Management Plan in Place which was drafted in 2011 and which managed by the National Disaster Risk Management Committee. Of importance to note that the WHO continuously supports the Government to strengthen its emergency preparedness and response. During a workshop held in May 2019, before the onset of the Covid 19 Pandemic, about 30 hazards were identified These included: ground shaking, flash flooding, riverine flooding, coastal flooding, drought, army worms, oil and gas spillage, chemical spill, fire, radiation, dams and bridge failure, air, road and water accidents, biological contamination, chemical contamination, explosive devices, international conflict, non-international armed conflict, human-animal conflict, civil unrest, anthrax, Viral Hemorrhagic Fevers, Crimean-Congo Hemorrhagic Fever, Ebola Viral Disease, Pandemic Influenza, cholera, hepatitis E Virus, polio, measles and terrorism. A total of 11 hazards were identified as the most significant for the health sector and which warranted a national response. Amongst the 11 were the ongoing Hepatitis E virus outbreak, recurrent Crimean Congo Haemorrhagic Fever, Cholera, pandemic influenza, Motor Vehicle Accidents, drought, flood, Ebola Virus Disease, Anthrax, Polio, and Measles. Human health should continue to be monitored and analysed.

6.4

Way forward

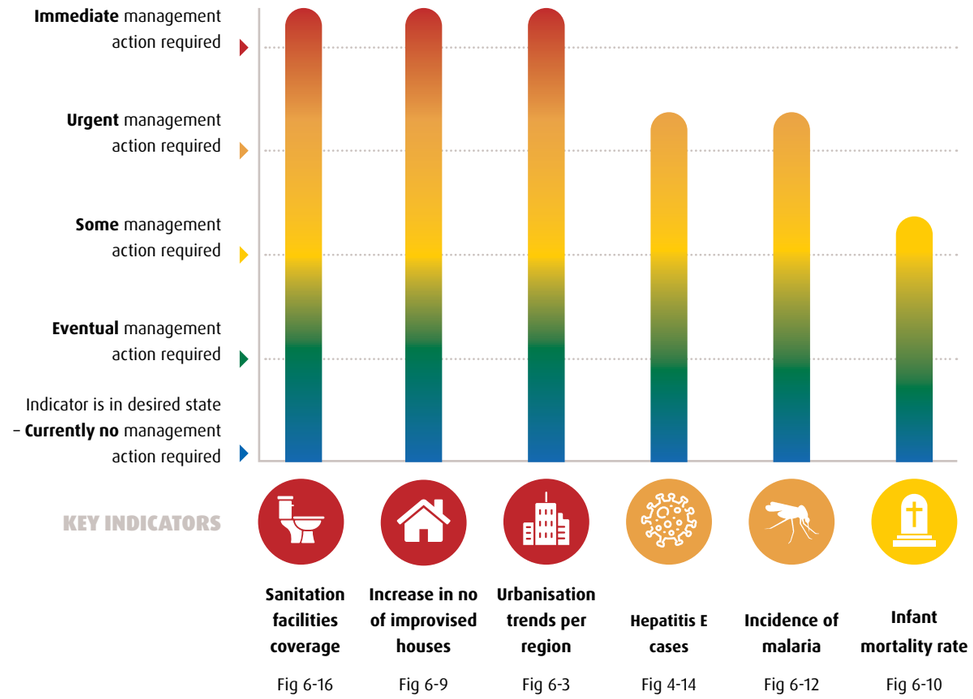
In charting a way forward for each of the FDES (2013) components of environmental management statistics, the most relevant indicators were aggregated into an action dashboard. This approach provides a structured way forward and can support policy-makers and decision-makers with the setting of priorities. It also indicates in which subcomponents and underlying indicators funding is most urgently needed. The replicability and reliability of these dashboards will improve as Namibia's environmental statistics system expands and aligns with international databases. Figure 6-19 provides the action dashboard for Namibia's management of human settlements and environmental health. Recommended actions on each of these indicators can be found in Section 6.3.5 of this chapter and involves a variety of approaches from policy and capacity building, to funding and research.



Rock formation at night | Harry Cunningham

8

Human settlements & environmental health



Management actions

Sanitation facilities coverage Active implementation of national strategies to expand sanitation infrastructure to reach goal of improved sanitation for all by 2030.

Increase in improvised houses Develop and implement programme to lower cost of land, subsidize essential services, lower building standards and allow incremental building of houses.

Urbanisation trends per region Prepare a work programme to develop a national urbanisation strategy for Namibia

Hepatitis E cases Improve sanitation infrastructure to reduce the risk of Hepatitis E outbreaks.

Incidence of malaria Improve on advances and investments into malaria management through collaboration with international investment partners.

Infant mortality rate Continuously invest in the country's health system to improve maternal and infant health care.

Figure 6-19 *Action dashboard for human settlements and environmental health management in Namibia.*

Underpinning the success of the communal conservancy programme is the simple but revolutionary idea of turning communities into wildlife protectors.

POHAMBA SHIFETA

Sossusvlei | Wikimedia Commons

CHAPTER 7

Environmental Protection, Management & Engagement

Quiver Tree at Mesosaurus Fossil Camp | Harry Cunningham

This chapter contains indicators on environmental protection and resource management expenditure to improve the environment and maintain ecosystem health. The close interrelationship between these indicators and environmental information, awareness and engagement are also explored.

United Nations, 2017

7.1

Introduction

A country's engagement in the protection and management of the environment and, therefore, the resources it dedicates to that task, is related to information, awareness and social demand. It indicates the country's ability to finance environmental protection activities and participate in international efforts directed at these activities.

This chapter presents information on Namibia's environmental protection and resource management expenditure to improve the environment and maintain ecosystem health. Statistics on environmental governance, institutional strength, enforcement of regulations and extreme event preparedness are also considered. This chapter includes information on programmes and actions to increase awareness, including environmental information and education as well as private and community activities aimed at diminishing environmental impacts and improving the quality of local environments.

7.2

Environmental protection, management & engagement - status quo

Status quo refers to the current state of specific matters relating to the environment in Namibia, such as environmental protection, management and engagement. It is informed by how indicators related to these matters are trending over time. A total of 14 indicators were used in this section, including:

- Total budget for environmental protection activities against total budget spent;
- Trends in national biodiversity expenditure over time;
- MEFT's contribution to biodiversity spending;
- Percentage decrease in biodiversity expenditure;
- Biodiversity expenditure as a percentage of GDP;
- Trends in GEF funding and number of projects;
- USAID funding trends;
- Trends in Germany-based funding;
- Fragile states index;
- 2018 Ibrahim index of African Governance;

- Trends in EPI Scores;
- Number of MEAs;
- Number of MEAs since 2004; and
- Trends in active number of rainfall stations manned by volunteers.

7.2.1

Environmental protection

Expenditure on environmental protection and resource management is a good indicator of the level of commitment by the public and private sector to protecting, restoring and managing the environment towards more sustainable use in Namibia. Monitoring and tracking the level of environmental protection and resource management expenditure is important for policy-makers, analysts and civil society to determine the current and desired levels of engagement and commitment.

Government-sponsored funding

A variety of government-sponsored funds are in place in Namibia to facilitate social equity and the promotion of sound environmental management. Government-funded environmental protection activities and allocated fees are summarized in Table 7-1.

Table 7-1 *Comparison of the total budget allocated and the total budget assigned to individual activities by the MEFT in 2007/8 (N$ million) (GRN, 2014)*

Programme	Total budget	Total budgeted activities	Difference
Protected area management	90.61	72.45	18.16
Protection and management of key species and natural resources	13.93	12.30	1.63
CBNRM and tourism	53.56	51.13	2.44
Regulation of environmental protection and sustainable resource management	10.99	9.71	1.28
Tourism development	117.24	33.00	84.24
Improving the economic value of natural resources and protected areas in MEFT jurisdiction	13.57	12.46	1.12
Total	**299.92**	**191.04**	**108.87**

In the intervening decade, the MEFT budget allocation grew to N$447,155,000 for the 2019/20 financial year with N$390,280,580 allocated to the Operational Budget and N$56,874,420 allocated to the Development Budget. The overall execution rate for 2019/20 stood at 96% as of 31st March 2020 (MEFT, 2019/20). The following public enterprises and statutory bodies are subsidized and or supported by the MEFT: Environmental Investment Fund of Namibia; Game Product Trust Fund; Namibia Tourism Board; Nature Conservation Board; and Sustainable Development Advisory Council. These bodies are discussed further below.

The Environmental Investment Fund of Namibia (EIF) was founded by the Environmental Investment Fund of Namibia Act, No.13 of 2001. The EIF became operational in 2011 after the Board and the Chief Executive Officer had been appointed and was officially launched in February 2012. The fund aims to promote sustainable economic development in Namibia through investment in and promotion of activities and projects that protect and maintain the natural and environmental resources of the country. To this end, the EIF procures funds from international donors for the maintenance of an endowment that will generate a permanent stream of income and will procure funds within Namibia on an annual basis from conservation fees and levies (Ruppel and Ruppel-Schlichting, 2016).

The results of EIF activities overlap with the results areas of the Green Climate Fund (GCF) in natural resource management, green technology and low carbon development, nature-based tourism, and capacity building. Building on its experience, EIF sought accreditation to the GCF in order to maximize the impact of its climate change and mitigation projects and programmes it implements, while promoting social and economic benefits. The GCF has already provided over $65 million in project funding (GCF, 2020). In 2017/18, the EIF accessed US$ 29.5 million in grants from the GCF as part of the Sustainable Use of Natural Resources and Energy Finance programme which was established by the French Development Agency (EIF, 2018).

The Game Products Trust Fund also operates under the mandate of the EIF and provides financing for wildlife conservation and rural development (Ministry of Environment, Forestry and Tourism, 2017). It is financed from the proceeds of the sale of game products belonging to the state, as well as parliamentary appropriations; it can also receive other donations (MEFT, 2017).

Between 2006/07 and 2012/13, nominal biodiversity expenditure within Namibia increased by 147% to N$676.79 million over the period, although expenditure in 2011/12 was actually N$31.4 million (4.6%) greater than in 2012/13 (GRN, 2014). The rate of growth of MEFT biodiversity expenditure started to slow in 2009/10, before turning negative between 2011/12 and 2012/13. The vast majority of biodiversity expenditure is accounted for by the MEFT, the Ministry of Agriculture, Water and Land Reform (MAWLR) and the Ministry of Fisheries and Marine Resources (MFMR). With the exception of 2010/11, these three ministries are responsible for more than 90% of total biodiversity expenditure in each year. For all years in the period from 2006/07 to 2012/13, the MEFT has been the largest individual contributor to biodiversity expenditure – accounting for between 34% and 47% of the total (GRN, 2014).

The disaggregated biodiversity expenditure was estimated to have risen by much less than nominal expenditure between 2006/07 and 2012/13. This implies that the slowdown in the rate of growth of biodiversity expenditure post-2009/10 is more pronounced in real terms.

Namibia's biodiversity expenditure has been estimated to decrease by 3.3% between 2015/16 and 2020/21 (GRN, 2014). The main implication of this is that – without mainstreaming biodiversity protection and management into national budgets and accounts, and the subsequent additional mobilization of resources – the range of biodiversity-related activities supported by government is likely to be reduced.

Biodiversity expenditure, as a percentage of both total expenditure and GDP, has been decreasing since 2010/11 (GRN, 2014). The latest indication

is that Namibia's total biodiversity expenditure is around N$1 billion per year (MEFT, 2018). This implies that Namibia will be required to double the level of investment in biodiversity protection and resource management in order to achieve the targets of its Second National Biodiversity Strategy and Action Plan (MEFT, 2018).

Other promising biodiversity financing instruments include:

- payments for ecosystem services;
- raising park entrance fees, particularly for international tourists;
- biodiversity offsetting;
- identification and introduction of environmental levies for reinvestment into environmental protection;
- eco-labelling;
- funds raised from lotteries and gambling;
- leveraging public and donor funding; and
- green finance.

Donor funding

In 2012, Namibia had received GEF grants totalling US$55.9 million for 25 national projects in the areas of biodiversity, land degradation, climate change and persistent organic pollutants. These grants leveraged a further US$303.7 million in co-financing (GRN, 2014). Most recent estimates (2020) place the total value of funds at US$99.2 million or N$591.5 million when factoring in the total co-financing grants allocated to Namibia (Global Environmental Facility, 2020). The number of projects increased to 32 national projects and 35 regional projects (Global Environmental Facility, 2020).

The United States Government has funded a number of biodiversity-related projects in Namibia and has been a significant supporter of Community-Based Natural Resource Management (CBNRM) activities since the programme's inception in the early 1990s (GRN, 2014). The US Government, through USAID, invested approximately US$40 million in the Namibian Community Based Natural Resource Management (CBNRM) programme from 1992 to June 2008. This was matched by a similar amount from contributions by partners and the Government of Namibia (USAID, 2008).

USAID funding for biodiversity activities increased significantly in 2011, when the total funding was US$17.4 million, and peaked in 2012 at US$28.03 million. It is worth noting that the apparent dramatic decrease in donor funding post-2014 was caused by the conclusion of major projects that included long-term capital investments (GRN, 2014). This situation essentially resulted in a return to a more stable level of donor funding. There however remains a need for some future investments to ensure that capacity building and institutional development is maintained. A number of new donor-funded projects have reportedly become operational in recent years.

German public funds have supported biodiversity conservation in Namibia for a number of years, with funds targeting specific projects implemented through the German Technical Cooperation via the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and through the German Financial Cooperation via Kreditanstalt fur Wiederaufbau. Total funding fluctuated around €2 million from 2007 to 2012, growing to €2.80 million in 2013. From 2013, expenditure was projected to increase rapidly to €9.23 million in 2016, before falling back to €2.00 million in 2019 (GRN, 2014).

The World Wide Fund for Nature has extensively supported biodiversity conservation in Namibia since the country's independence, and has been key to the development and success of the CBNRM programme. As with other major donors, there is a clear downward trend in funding since 2012. This may also be a reflection of the changing priorities of donors, particularly as a result of Namibia's status as an upper-middle income country (GRN, 2014).

Other contributors to the Namibian initiatives include the European Union, the Food and Agriculture Organization (FAO), Southern African Science Service Centre for Climate Change and Adaptive Land Management, Nedbank Go Green Fund, and landholders involved in wildlife-based land uses – as well as NGOs including the

Namibia Nature Foundation (NNF), Integrated Rural Development and Nature Conservation (IRDNC) and the Desert Research Foundation of Namibia (DRFN). Private investments in wildlife under a central scenario were estimated to reach N$252.89 million in 2020/21. Expenditure throught the IRDNC was estimated to reach N$4.29 million in 2014/15 (GRN, 2014).

7.2.2

Environmental governance & regulation

Policy-makers, analysts and civil society rely on indicators that measure environmental governance and regulation at the national level to provide a holistic view of a country's efforts towards protecting the environment. The magnitude of these activities can inform the extent of institutional development, availability of resources and the existence and enforcement of regulatory and market instruments whose primary purpose is to protect, regulate and manage the changing environment.

Successful national environmental governance requires institutional strength as well as regulatory capabilities. Several measures – such as whether a country has set standards and norms, provides adequate resources and ensures the ability to enforce those standards and norms – can point to its level of governance. Additionally, a nation's participation in MEAs and global environmental conventions also indicates national participation in the global commitment to protect the environment.

Institutional strength

Namibia has a robust democratic and governance architecture. It has succeeded over the past two and a half decades to lay a strong foundation for the institutional underpinnings of democracy, rule of law, governance and individual freedoms such as freedom of speech. These are the key ingredients for achieving and sustaining inclusive development. Namibia is a well-functioning electoral democracy, with accountability at the highest level being further entrenched by the Legislature, the Executive and the Judiciary – which are fully autonomous of each other. Furthermore, the Namibian Constitution (Amendment Act 34 of 1998 (GG 2014)) has mandated institutions such as the Attorney General, Auditor General, Anti-Corruption Commission and the Ombudsman to supplement the accountability architecture in Namibia (GRN, 2016).

Namibia is placed 105th out of 178 countries on the Fragile States Index, where a lower score is more stable, and government effectiveness decreased 6% on the Worldwide Governance Indicators' scores from 2014 to 2018 (USAID, 2020).

2018 Ibrahim Index of African Governance

Namibia continues to be one of the top performers in the Ibrahim Index of African Governance, displaying high scores in the majority of governance components, and ranking in the top five in 2018. In terms of safety and rule of law, as well as participation and human rights, Namibia ranked third. Its position on rule of law and transparency and accountability has slightly deteriorated. Namibia maintained a top 10 ranking in terms of sustainable economic opportunity and climbed to a number 12 ranking for human development (Mo Ibrahim Foundation, 2018).

In spite of Namibia's good performance, it has shown a deterioration in transparency and accountability (losing 7.7 points over the past decade) and in property rights (losing 13.3 points over the past decade) (Mo Ibrahim Foundation, 2018). Going forward, Namibia will need to strengthen its institutions and ensure strong performance in both rule of law and in transparency and accountability, which are imperative for ensuring good governance.

2020 Environmental Performance Index

As indicated at high level in Chapter 1, the 2020 EPI provides a data-driven summary of the state of sustainability around the world. These indicators provide a gauge at a national scale of how close countries are to established environmental policy targets. Overall EPI rankings indicate which countries are best at addressing the environmental challenges that every nation faces. This granular view and comparative perspective can assist in understanding the determinants of environmental progress and in refining policy choices. Namibia scored 58.46 against the EPI, which places the country in a ranking of 104th out of 180 countries. In terms of environmental health, the country ranks at 132, with an increase in its baseline score from 44.46 to 46.34 in 2020. Namibia improved its ranking in terms of ecosystem vitality in 2020, moving from 35 to 25 on the ranking list. In terms of climate and energy, the country's ranking declined from 40 to 48 in 2020, with the largest shift taking place in its CO2 emissions intensity, despite being a net carbon sink as indicated in Chapter 4 (Wendling et al., 2020).

Environmental regulation & instruments

Green Plan & Namibia Vision 2030

Two key documents guide Namibia's development framework: Namibia's Green Plan and the Namibia Vision 2030.

Launched in 1992, Namibia's Green Plan (Brown, 1992) aimed to secure a safe and healthy environment and a prosperous economy. It outlined policy and legislation gaps as well as recommends strategies for key areas. These areas included sustainable management of wildlife, tourism and fisheries, as well as environmental education for sustainable development and links environment to socio-economic development. The Green Plan informed subsequent national policy and legislative processes pertaining to sustainable natural resource management.

Namibia Vision 2030 was launched in June 2004 by the Founding President, Dr Sam Nujoma. The vision's rationale was to provide long-term policy scenarios on the future course of development in the country at different points in time up until the target year of 2030. Vision 2030 regards the sequential five-year National Development Plans as the main vehicles for achieving its long-term objectives (Ruppel and Ruppel-Schlichting, 2016).

Based on the foundation laid by the Green Plan and Vision 2030, Namibia has made Regional Land Use Plans and CBNRM. CBNRM includes Namibia's world-renowned communal conservancies. One further outcome of Namibia's Green Plan was the establishment of the EIF of Namibia (Ruppel and Ruppel-Schlichting, 2016).

Sectoral policies

In the decade following Namibian independence, a plethora of policies were developed to protect and manage the country's extensive natural resources. They aimed to set the country's policy framework on: the environment; wildlife and biotechnology; land and agriculture; water; forests; tourism; and climate change (Ruppel and Ruppel-Schlichting, 2016). The Environmental Assessment Policy (1994) recognized that environmental assessments are a key tool towards implementing integrated environmental management. The Policy for Prospecting and Mining in Protected Areas and National Monuments (1999) emphasizes the need for inter-sectoral collaboration where prospecting and mining is allowed in parks. Other policies that were developed prior to 2002 include:

- Water and Sanitation Policy (1993);
- The Land Use Planning Policy (1994);
- Tourism White Paper (1994);
- National Agricultural Policy (1995);
- Regional Planning and Development Policy (1997);
- National Resettlement Policy (1997);
- Namibia's Drought Policy and Strategy (1997);
- The National Land Policy (1998);
- The National Policy on Enabling the Safe Use of Biotechnology (1999);
- Namibia's Aquaculture Policy (2001);
- Development Forestry Policy for Namibia (2001); and
- National Land Tenure Policy (2003).

In the second decade since independence, Namibia saw a suite of policies that aimed to address ecological diversity and ecosystem functioning. The National Water Policy White Paper (2002) laid the framework for the Water Resources Management Act, No. 11 of 2013 (WRMA). The policy provides a framework for equitable, efficient and sustainable water resources management and water services, and stresses sectoral coordination, integrated planning and management as well as resource management aimed at coping with ecological and associated environmental risks. The 2004 Draft Wetland Policy aims to protect and conserve wetland diversity and ecosystem functioning to support basic human needs, provide a framework for sustainable use of wetland resources, promote the integration of wetland management into other sectoral policies, and recognize and fulfil Namibia's international and regional commitments concerning shared wetlands and wetlands of international importance.

The MEFT adopted the National Policy on Human Wildlife Conflict Management in 2009 to provide a framework for addressing human-wildlife conflict efficiently – to protect biodiversity and to promote human development. This was in response to increased wildlife populations and expanded ranges into communal and freehold farming. This has resulted in conflicts between people and wild animals, elephants and predators in particular, which caused livestock and crop losses, and damage to water installations – and sometimes also led to the loss of human lives.

The National Policy on Tourism for Namibia (2008) aims to secure and develop important tourism areas so that their value is not undermined by other, unsustainable land use options. In 1995, the Community-based Tourism Policy was developed to harness tourism's significant social and economic benefits to previously disadvantaged people, while also promoting biodiversity conservation. Finally, in 2001, the Revised Draft Tourism Policy 2001–2010 was issued and stated that no tourist development should be at the cost of biodiversity, requiring that some of the income derived had to be reinvested into natural resource conservation.

The Namibian government has worked consistently over the last decade to improve water management in the country. Together with partners, it has taken both a bottom-up and a top-down approach to address water-related challenges at national and regional level. Notably, the MEFT published the Integrated Water Resources Management Plan (IWRMP) (MEFT, 2010). The major challenges to IWRMP implementation include a lack of funding, fragmentation between government departments responsible for different aspects of planning, and a lack of capacity to implement the plan at scale across regions.

Namibia is particularly vulnerable to climate change induced impacts. This has prompted government to take necessary actions to mitigate and adapt to climate change. Hence, the National Policy on Climate Change for Namibia was produced in 2011 to better translate government's will and commitment to tackle climate change. The policy seeks to outline a coherent, transparent and inclusive framework on climate risk management in accordance with Namibia's national development agenda and the relevant legal framework. The general aim of the policy is to contribute to the attainment of sustainable development in line with the Namibia Vision 2030 through strengthening national capacities to reduce climate change risk and build resilience for any climate change shocks.

Furthermore, a National Climate Change Strategy and Action Plan for the period 2013 to 2020 has also been developed and paves the way for strategic options to be adopted for coping with climate change challenges while contributing to the international agenda to meet decisions of the Conference of the Parties (COP).

Specific to the agricultural sector, the National Agriculture Policy of 2015 emphasizes the objective of increased and sustained agricultural production. This policy document recommends that all agricultural activities take place in a sustainable manner with regards to the use of natural resources.

Namibia's energy policy in the recent past is characterized by a shift in the feasibility of altering the composition of Namibia's electricity supply. The National Energy Policy (Ministry of Mines and Energy, 2017a), National IPP Policy (Ministry of Mines and Energy, 2017b) and National Renewable Energy Policy (Ministry of Mines and Energy, 2017c) have been adopted to expand on Namibia's objectives for the energy sector going forward. The main goals of these policies are to ensure electricity supply security, affordability and reliability, primarily by increasing private-sector renewable-energy investment, both on-grid and off-grid.

Namibia is steadily working on developing a more controlled waste management system following the development of the National Solid Waste Management Strategy (NSWMS), which was developed by the MEFT in 2017. Although this strategy provides a sound framework to deal with solid waste management, its implementation has been slow, probably due to a lack of resources and infrastructure.

Sectoral legislation

Policy documents are supported through the enactment of legislation. The principal environmental legislation in Namibia is the EMA. It requires adherence to the principle of optimal sustainable yield in the exploitation of all natural resources and gives effect to Article 95(l) of the Namibian Constitution by establishing general principles for the management of the environment and natural resources. One of the major biodiversity-related laws in Namibia is the Nature Conservation Ordinance 4 of 1975, which governs the conservation of wildlife and protected areas. The WRMA provides for the management, protection, development, use and conservation of water resources. Supporting legislation includes:

- Water and marine resources:
  - Inland Fisheries Resources Act, No. 1 of 2003;
  - Aquaculture Act, No. 18 of 2002;
  - Marine Resources Act, No. 27 of 2000;
  - Water Resources Management Act, No. 11 of 2013; and
  - Oil Amendment Act, No. 5 of 2019.
- Land use management:
  - Soil Conservation Act, No. 76 of 1969 of South Africa;
  - Second Soil Conservation Amendment Act, No. 38 of 1971 applies the Soil Conservation Act to Namibia;
  - Petroleum (Exploration and Production) Act, No. 2 of 1991;
  - Minerals Prospecting and Mining Act, No. 33 of 1992;
  - Diamond Act, No. 13 of 1999;

- Forest Act, No. 12 of 2001;
- Communal Land Reform Act, No. 5 of 2002;
- Plant Quarantine Act, No. 7 of 2008; and
- Conservation of Agricultural Resources Bill.

• Biological resources

- Controlled Wildlife Products and Trade Act, No. 9 of 2008;
- Access to Biological and Genetic Resources and Associated Traditional Knowledge Act, 2017 (Act No. 2 of 2017);

• Disaster management

- Disaster Risk Management Act, No. 10 of 2012.

Namibia has also made strides towards devolving rights to local communities in the form of CBNRM programmes. These laws and polices enable communities to manage the natural resources in their areas and use them to benefit communities and improve individual livelihoods. These include: Namibia's Constitution (Art. 95); the Nature Conservation Amendment Act, 1996; the Forest Act, 2001; the Communal Land Reform Act, 2002; the Water Act, 2004; the Inland Fisheries Resources Act, 2003; and the Traditional Authority Act, 2000. Recent developments included the National Policy on Tourism for Namibia (2008), the National Policy on CBNRM (2013) and Namibia's post-2010 National Biodiversity Strategy and Action Plan (NBSAP) (2013-2022).

From an environmental regulatory point of view, only a few pieces of legislation have been passed since 2004. The most significant environmental laws include the Controlled Wildlife Products and Trade Act, No. 9 of 2008, the Plant Quarantine Act, No. 7 of 2008, the Disaster Risk Management Act, No. 10 of 2012, the Water Resources Management Act, No. 11 of 2013, and the Conservation of Agricultural Resources Bill.

In addition to the NBRI, the MEFT has been working on the new Parks and Wildlife Management Bill to strengthen the prosecution of wildlife crimes. The Bill was finalized in early 2019, including the first draft of the Wildlife and Protected Areas Management Bill regulations. The regulations will be finalized once the Bill is promulgated (MEFT, 2020).

Participation in multi-lateral environmental agreements (MEAs) & environmental conventions

International environmental treaties (or MEAs, as they are commonly referred to) regulate the relationships between sovereign states pertaining to the environment. Generally, the first objective of any MEA is the protection and conservation of the environment. The list of MEAs to which Namibia is a party is exhaustive, totalling over 280 agreements. The main MEAs include the Convention on Biological Diversity (CBD) (ratified in 1997), the United Nations Framework Convention on Climate Change (UNFCCC) (ratified in 1995), the United Nations Convention to Combat Desertification (UNCCD) (ratified in 1997), and the United Nations Commission on Sustainable Development (UNCSD).

Namibia is currently in the implementation phase of the Third National Action Programme of the UNCCD, which runs from 2014 to 2024. The MEFT's action plan is supplemented by several ongoing programmes on land-based approaches that are being supported by international and national organizations. These include projects such as the Sustainable Management of Namibia's Forested Lands, Disaster Risk Management Support for Agropastorial Communities in Northern Namibia, and Community Climate Change Resilience Support – funded by a consortium of international donors (Global Mechanism of the UNCCD, 2018). In addition, Namibia contributes to land assessments conducted by the UN FAO (Veshiyele, 2019).

As a Non-Annex 1 Party and a Party to the Paris Agreement, Namibia is obliged to report certain elements of information in accordance with Article 4, paragraph 1 of the UNFCCC. Namibia

has submitted three national communications – the first in 2002, the second in 2011 and a third in 2015. Namibia submitted its Biennial Update Reports in 2014, 2016 and 2018.

Other important MEAs include the 1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar), the 1972 Convention Concerning the Protection of the World's Cultural and Natural Heritage, the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora, the 1980 Convention on the Conservation of Antarctic Marine Living, the 1982 United Nations Convention on the Law of the Sea, and the 1985 Vienna Convention for the Protection of the Ozone Layer.

Since 2004, Namibia has entered into over 100 MEAs including the Benguela Current Concession (BCC) (2013), the Paris Agreement under the United Nations Framework Convention on Climate Change (2015), and the Treaty on the Prohibition of Nuclear Weapons (2017). A Regional Technical Working Group under the BCC developed an agreed Marine Spatial Planning (MSP) strategy to ensure consistency and coherence in MSP across the regional partners.

The Division of MEAs within the MEFT works to promote and support the implementation of all environmental policies and legislation related to biodiversity, sustainable land management and climate change. It negotiates on behalf of Namibia at conferences and meetings of the CBD, UNCCD and UNFCCC, and supports and coordinates all programmes, plans and projects relating to MEAs. It furthermore ensures the fulfilment of Namibia's reporting requirements to the CBD, UNCCD, UNFCCC and UNCSD.

Every membership of an MEA brings about benefits as well as obligations for Namibia. Aside from the immediate benefits of advanced environmental protection, there are also long-term effects. Many MEAs improve environmental governance and generally promote transparency, participatory decision-making, accountability and conflict resolution – and have an indirect positive influence in terms of democratisation processes in any given developing country context (Ruppel and Ruppel-Schlichting, 2016).

Entering into MEAs may assist Namibia in obtaining financial assistance for addressing environmental problems. MEAs may also facilitate technical assistance – for example, through knowledge and technology transfer.

7.2.3

Preparedness for natural extreme events & disasters

The Namibian government has taken steps to manage climate-related risks through disaster prevention, preparedness, response and recovery planning. The National Policy for Disaster Risk Management (DRM) in Namibia (2011) moves away from a reactionary approach to disaster events. Instead, the policy sets out a holistic approach to disaster risk management that aims at reducing the impacts of, and increasing resilience to, natural hazards (GRN, 2011).

Namibia's National Disaster Management System

Namibia's National Disaster Management System, comprising several committees as shown in Figure 7-1, also minimizes duplication of efforts and optimizes utilization of resources by facilitating the alignment and integration of roles and responsibilities for disaster risk management.

Figure 7-1 *Institutional framework for Disaster Risk Management in Namibia (GRN, 2011)*

Various institutions are in charge of data collection and forecasting in the fields of meteorology, hydrology and statistics. The Namibian Meteorological Service is mandated to monitor and provide weather data and to disseminate the information through various means, including radio stations. It recently upgraded its capacity to provide for four regional specialists, six weather stations, 35 automatic weather stations and 173 rain stations throughout the country. The Namibian Meteorological Service participates in DRM and Agricultural Assessments led by the Ministry of Agriculture and/ or Directorate DRM (United Nations, 2016).

Hydrological services in Namibia fall under the mandate of the Hydrology Division under the MAWLR. The Hydrology Division collaborates with several organizations and institutions such as the Namibian Statistics Agency (NSA), Meteorological Services and various regional and international protocols. They also liaise with organizations such as the University of Namibia, the Namibia University of Science and Technology, the National Aeronautics and Space Administration, the United Nations Educational, Scientific and Cultural Organization and intergovernmental councils. Namibia has a network of 15 hydrological stations and 120 data collection points with automatic rain gauges (United Nations, 2016). The division developed a data sharing protocol of information on droughts and floods, including significant rainfall events. The Hydrology Division has also undertaken hydrological mapping in partnership with NSA, which hosts the hydrological data sets.

The NSA is the central statistical authority and collects, produces, analyses and disseminates official and other statistics in Namibia. It provides early warning and response information and undertakes baseline analysis, mapping and projections. The NSA works closely with the University of Namibia and the Namibia University of Science and Technology, enabling a shared curriculum between the institutions. In terms of community-based early warning systems (EWSs), the Zambezi Region, which is the most flood-prone region in the country, has set up EWSs in eight communities along the most flood-prone areas. The Namibia Red Cross has conducted activities to strengthen community resilience to floods by capacitating them to

build resilient houses based on the guidelines delivered with the support of the American Red Cross. In terms of the formal EWS, the Hydrology Division shares information with the Regional Disaster Risk Management Centre (RDRMC) regarding rainfall and river level projections. Early warning messages are also passed by the local radio stations (United Nations, 2016).

Vulnerability assessments

Vulnerability assessments are carried out in Namibia by a number of institutions, including the Directorate DRM, the MAWLR and the Namibian Meteorological Service. The Directorate DRM, with support from World Food Programme, have established a Food and Nutrition Security System that provides harmonized information for early warning and impact analysis – for timely evidence-based decision-making and response. The Southern African Development Community Regional Vulnerability Assessment and Analysis Programme has also supported vulnerability assessments in Namibia (United Nations, 2016).

A Capacity for Disaster Reduction Initiative Capacity Assessment was conducted for Namibia with a focus on national and local capacities for disaster reduction and recovery. Using the indicators set for the implementation of the Sendai Framework for disaster reduction and recovery, the assessment found that there is a need for clearer roles and responsibilities. It also noted skills limitations and a lack of regional presence (United Nations, 2016). Key institutions were found to have relatively weak capacity and collaboration with other institutions on early warning. Although set out in law, funds are mostly provided for disaster preparedness and response itself, rather than for prevention of disasters. There is limited local expertise, which poses a challenge for sustainability beyond donor and development partner support.

7.2.4

Environmental information & awareness

Environmental information and awareness refer to processes that promote pro-environmental engagement and actions by public officials and decision-makers at both local and national levels.

Environmental information

Namibia has a fairly strong institutional network of environmental observing systems consisting of several ministries, parastatals (such as Namwater), the Namibia University of Science and Technology, Namport, the Namibia Tourism Board, the Namibian Maritime and Fisheries Institute and NGOs. NGOs include the DRFN, the NNF, the Namibia Economic Policy Research Unit and the Centre for Research Information Action in Africa (FAO, 2001). Namibia has also launched the Environmental Information Service Namibia (www.the-eis.com), which houses a free online environmental information resource, a platform for citizen science projects, a platform for peer reviewed, free and open access scientific journal articles, a public participation citizen science photo repository, a tool to access a list of sensitive bird species per area, and a collection of data on birds in Namibia. The website is supported and funded by the Namibian Chamber of Environment and sponsored by Paratus Group Holdings, a telecommunications provider.

Published in 2002, the Atlas of Namibia: A Portrait of the Land and Its People, covers a variety of subjects such as land use, soil quality, climate and underground water supplies. Since 2002, the book has been reprinted several times

in response to demand from the public and educational institutions. The last edition was printed in 2010. However, all the reprints relied on the original data sets, which predated the original 2002 publication. A new Atlas of Namibia is in the process of being developed and will meet existing demands for an atlas and provide an opportunity to present new and updated information about Namibia. This also provides an opportunity to analyse and present new information to demonstrate and assess changes in Namibia during the past three decades. Much of the success of the first Atlas was due its informative content, the way in which the data were presented, and the way various chapters and components created a unique and interesting view of Namibia. The new Atlas will build on that success, providing updated and new information presented in a clear and straightforward fashion.

Effective national environmental information networks exist, both informally and formally. These networks are coordinated by the Department of Environmental Affairs (DEA), the MAWLR and the DRFN. The MAWLR is responsible for monitoring the quality of surface water and has 46 monitoring points in perennial river systems and 23 points in ephemeral systems installed. The MAWLR also has 660 water level monitoring boreholes across the country, with 50 of these able to report on water quality. This monitoring system is currently being improved. Eventually, data collation will take place in a National Groundwater Database (GROWAS) (British Geological Society, 2020).

Several initiatives have been implemented over the past decade to quantify the scale of soil and land degradation in Namibia. Namibia also subscribes to the UNCCD, which aims to address degraded areas to increase the amount of usable land in the country and to also ensure sustainability of natural resources in the light of population increase. The NSA has convened a Technical Working Group to develop a national land cover classification system for Namibia. This classification system will need to be Gazetted and regulations issued.

The number of environmental practitioners is small in number and concentrated in Windhoek. This has delayed the functional integration of datasets or electronic databases, with the possible exception of the environmental atlas (FAO, 2001).

The DEA facilitates a number of support projects linked mainly to the Rio Conventions and the Global Environment Facility, including: (MEFT, no date)

- Biodiversity Management and Climate Change (BMCC) Project (2013-2019);
- National Communications and Biennial Update Reports to the UNFCCC (2012-2020);
- Namibian Coast and Conservation Management (NACOMA) Project (2005-2017);
- Namibia Protected Landscape Conservation Areas (NAM-PLACE) Project (2011-2016);
- Kalahari Namib Project (KNP) (2014-2016);
- Resource Mobilisation for effective implementation of Namibia's Updated Biodiversity Strategy Project (2014-2017); and
- Scaling up community resilience to climate variability and climate change in Northern Namibia with a special focus on women and children (SCORE) Project (2014-2019).

The Division of Environmental Information and Natural Resource Economics (EINRE) within the MEFT is responsible for environmental economics, environmental education and awareness and data management. The core functions of EINRE are to establish and maintain a natural resource accounting system, with the regular production of natural resource accounts. It furthermore coordinates all research activities within the DEA, conducting economic analysis and providing economic advice on relevant policies, legislation and interventions. Its mandate is to collect, maintain, update, develop, produce and disseminate environment-related information.

The DEA also provides financial support to the Environmental Investment Fund of Namibia and the Gobabeb Research and Training Centre, which is a joint venture between the MEFT and the DRFN.

The data held by government agencies is principally in the public domain, except where there would be a breach of confidentiality with respect to individual landowners.

Data is provided on request, free of charge, to users with a legitimate reason to have it. There is no overall policy with respect to the data held by NGOs. The DRFN and other NGOs conduct contractual research, so data resulting from these activities is presumably subject to negotiation between potential users and the contractual parties. Most of the NGOs are short of funding, so data may not always be available at nocost.

The principal users of information are government departments themselves and consultants acting on their behalf. Researchers, mostly based at the technical college and universities or in the several technical or development-oriented NGOs, are also users. Several data suppliers listed individual landowners as significant data users (FAO, 2001).

The Namibia Meteorological Service coordinates a network of rainfall stations operated by volunteer observers. Only about 173 of these are active, down from a peak of about 400 in the 1960s. The oldest station dates from 1893, with the major growth in the network occurring in the 1930s. The rainfall is recorded daily and reported either every 10 days or monthly, on paper. There are eight synoptic stations, half-staffed by the weather service itself, recording temperature, humidity and winds three-hourly between 06h00 and 20h00 (two are 24-hour stations). They report three-hourly via telex, fax or e-mail. The service has experimented with 15 automatic weather stations, now largely abandoned due to maintenance problems (FAO, 2001; United Nations, 2016; and World Meteorological Organization, 2013).

The Namibia Meteorological Service publishes a summary bulletin every 10 days covering rainfall, temperature and sea surface temperature. It is provided free of charge to recipients, including government officials, aid agencies, researchers, farmers and economists. Daily forecasts are published on a website and broadcast on Namibian national television (South West African Broadcasting Corporation or SWABC) from an on-site studio. Other information requests are received and serviced free of charge via letters, e-mails, personal visits and telephonic enquiries (FAO, 2001).

Environmental education

The EINRE is responsible for fostering cross-sectoral partnerships and networks, and for coordinating environmental education initiatives nationwide. They organize environmental education events and outreach, as well as the celebration of relevant international environmental days. The EINRE also supports the establishment, management and administration of environmental education centres, activities and programmes.

In 2019, Namibia published the National Environmental Education (EE) and Education for Sustainable Development (ESD) Policy. The policy is coordinated through the National Planning Commission (NPC), the MEFT, the Ministry of Education, Arts and Culture (MoEAC), the Ministry of Sport, Youth and National Service, the MAWLR and the Namibian Environmental Education Network (NEEN). A high-level ESD Task Force was established in 2019 to assist in mobilizing the necessary financial resources for the implementation of EE and ESD activities through their respective institutions. The emphasis of stakeholder engagement lies on participation, information sharing, exchange of views and ideas, and development of relevant skills among the stakeholders. The policy is also aligned to the United Nation's SDGs and acknowledges that EE and ESD play a significant role in achieving all the SDGs (GRN, 2019).

Namibia has several environmental programmes that are supported through NGOs, including the Namib Desert Environmental Education Trust's Environmental Literacy Projects, the AfriCat Foundation Environmental Education Programme, the Khomas Environmental Education Programme (supported by the Giraffe Conservation Foundation), and the Cheetah Conservation Fund. The MEFT also runs EE centres at Etosha, Waterberg and Ontanda which offer practical education programmes for learners at heavily subsidized rates. These serve as catalysts for Environmental Clubs in the country.

Although there are several educational programmes in place, Namibia is not currently measuring the impact of environmental programmes on environmental engagement. Environmental engagement involves the transformation of perceptions and attitudes into concrete, pro-environmental actions. Individual and social participation and engagement in environmental processes is a concrete outcome of EE. In other words, it measures the level of understanding and motivation of, and commitment to, protecting and improving the environment – expressed through a change in behaviour.

Programmes that measure data on pro-environmental activities and programmes should be established going forward. Information about environmental programmes (e.g. conservation, energy efficiency and tree planting) and outreach programmes (e.g. efforts to increase public awareness of key environmental issues) should also be collected and analysed.

7.3

Environmental protection, management & engagement - challenges & responses

There are a number of considerations for strengthening environmental protection, management and engagement in Namibia in the coming years.

7.3.1

Environmental protection

Funding from donors grew from 2008 to 2013 before dipping following the conclusion of major projects with long-term capital investments. Initially, GEF-funded projects were the single largest contributors to these sources of expenditure, but from 1992 until June 2008 this has been replaced by funding from the US Government and private landholders, with the German Government making a significant and sustained contribution. A number of new projects have reportedly become operational. Notable among these is the Namibia Integrated Landscape Approach for enhancing Livelihoods and Environmental Governance to eradicate poverty (NILALEG) Project with funding of US$10.8 million (approximately N$158.9 million) (MEFT, 2019/20).

In order to address critical environmental challenges faced by Namibia, government will have to work together with stakeholders to come up with innovative solutions to mobilize additional resources for biodiversity and conservation. Areas where improvement is required include human-wildlife conflict, inadequate infrastructure in protected areas, the financial sustainability of CBNRM programmes and waste management systems and practices.

7.3.2

Environmental governance & regulation

Namibia's institutional strength is robust and is supported by a variety of independent institutions. However, over recent years, it has shown a decline in transparency and accountability (Mo Ibrahim Foundation, 2018). Going forward, Namibia will have to strengthen its institutions to ensure strong performance in both rule of law and transparency and accountability, which is imperative for ensuring good governance.

The development of new policies and legislation has progressed slowly, with delays in enacting the Wildlife Management Bill. The level of actual compliance and enforcement of existing legislation is reportedly a challenge, and further research on this is needed to chart the way forward.

Since 2004, Namibia has entered into over 100 MEAs; these demonstrate its commitment to environmental protection and can be used to leverage financial assistance for addressing environmental problems. In order to benefit from MEAs, Namibia should invest in sufficient human, technical and financial resources for MEA implementation. On the ground, legislation, administrative measures, and capacity building for implementation and enforcement at the local and national levels should be developed.

Namibia has a fairly strong institutional network for observing environmental systems. There is, however, an overall need to strengthen the capacity and resourcing of the various structures.

Vlei at sunset / JP Desvinge

Namibia has developed several educational programmes covering a range of issues. It does not, however, currently measure the impact of environmental programmes on awareness and environmental engagement. Programmes that measure data on pro-environmental activities and programmes should be established going forward.

7.3.3

Preparedness for natural extreme events & disasters

Existing policies and strategies do not adequately address disaster risk management, which emphasizes coordination, early warning, preparedness and response through knowledge sharing. At the institutional level, the MEFT has weak coordination capacity and institutional linkages to the Directorate DRM and other related stakeholders. The weak monitoring system and lack of a risk profile is an additional challenge. Insufficient human capacity and financial resources are also limiting factors.

Given the increasing regularity and severity of natural disasters, a national coordinated and cooperative effort is required to enhance Namibia's capacity to withstand and recover from emergencies and disasters. Actions for preventing and managing disaster events are presented in Chapter 5.

7.3.4

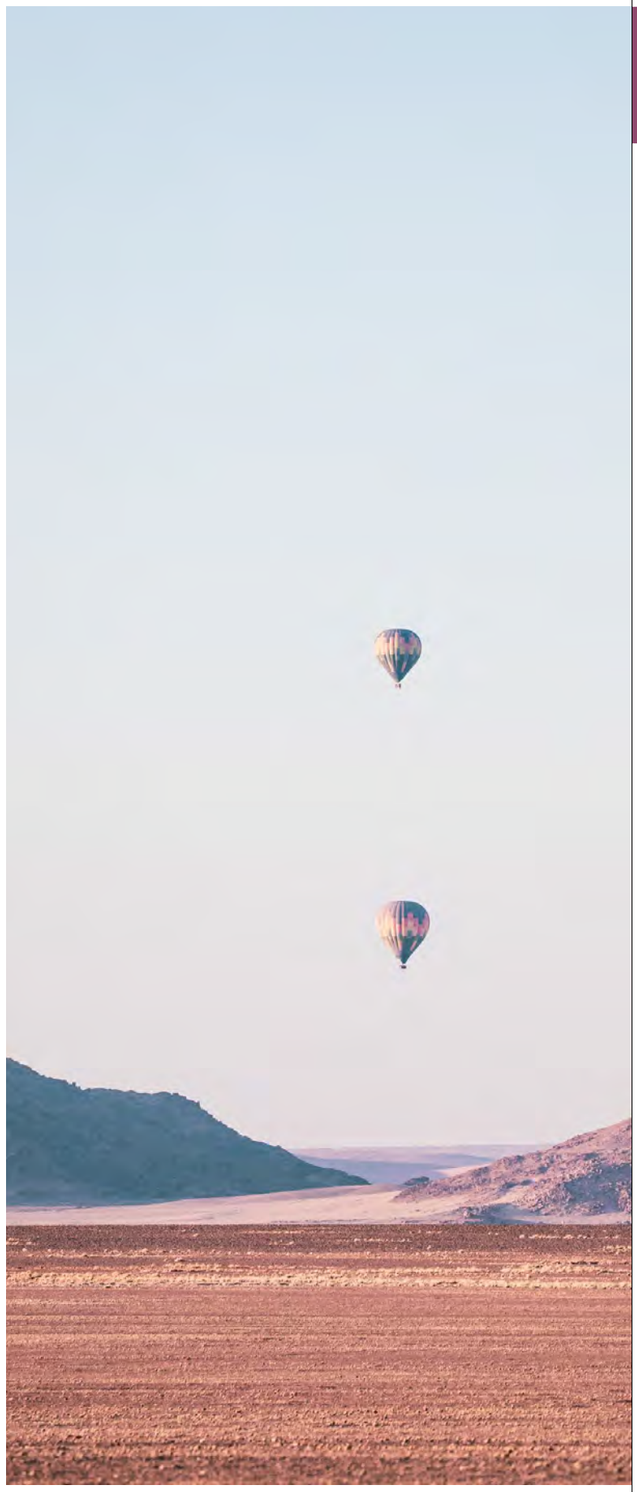
Environmental information & awareness

Although environmental information networks exist, there is an overall need to strengthen the capacity and resourcing of the various structures through measuring the impact of engagement processes and providing a live feedback system to encourage citizen participation in environmental management. It will be necessary to suitably package and share the information contained in the 2021 ISOER with stakeholders throughout Namibia.

7.4

Way forward

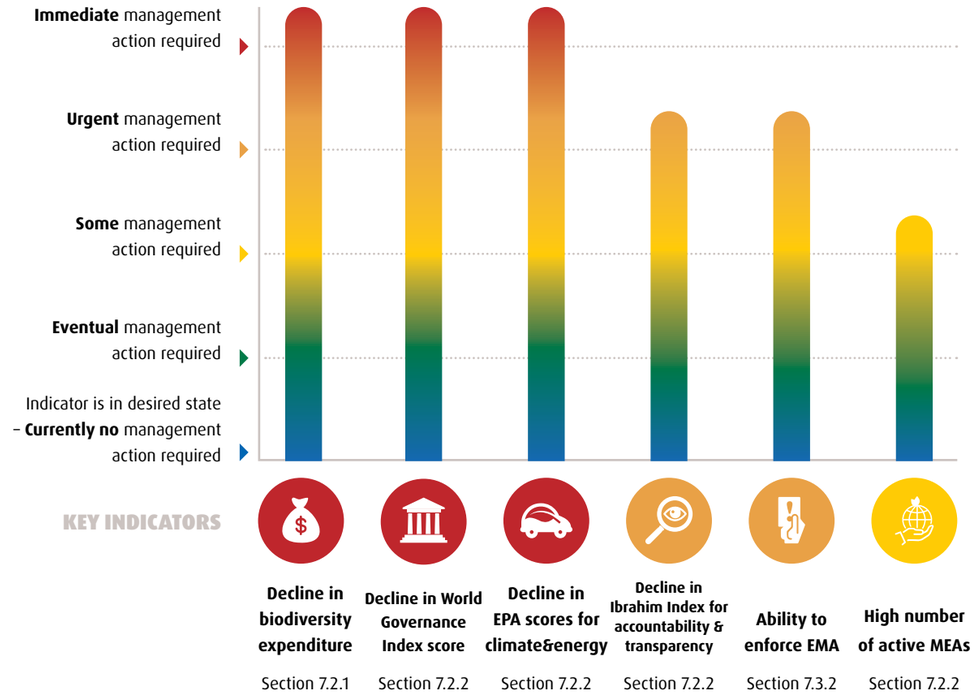
In charting a way forward for each of the FDES (2013) components of environmental management statistics, the most relevant indicators have been aggregated into an action dashboard. This approach provides a structured way forward and can support policy-makers and decision-makers with the setting of priorities. It also indicates in which subcomponents and underlying indicators funding is most urgently needed. The replicability and reliability of these dashboards will improve as Namibia's environmental statistics system expands and aligns with international databases. Figure 7-2 provides the action dashboard for Namibia's environmental protection, management and engagement. Recommended actions on each of these indicators can be found in Section 3 of this chapter and involves a variety of approaches from policy and capacity building, to funding and research.



Hot air balloons | Andrew Liu

9

Environmental Protection, Management & Engagement



Management actions

Decline in biodiversity expenditure Proactively identigy and source funding for the protection of biodiversity and conservation.

Decline in World Governance Index score Continue strengthening and maintaining governance structures and processes.

Decline in EPI scores for climate and energy Develop and implement strategies to reduce air emissions and reduce reliance on fossil-fuel based energy imports.

Hepatitis E cases Improve sanitation infrastructure to reduce the risk of Hepatitis E outbreaks.

Incidence of malaria Improve on advances and investments into malaria management through collaboration with international investment partners.

Infant mortality rate Continuously invest in the country's health system to improve maternal and infant health care.

Figure 7-2 *Action dashboard for environmental protection, management and engagement*

Our greatest task is the transformation of Africa, the transformation of Namibia. Our inequities are inherited, structural but also in how we view ourselves and the world. Changing that element brings real transformation.

JASON KASUTO

Sunset over Etosha National Park | Philipp Lublasser

Brandberg Massif - exhumed granite intrusion | United States Geological Survey

CHAPTER 8

Overarching Environmental Issues

A systemic view of the environment, such as encouraged by the FDES framework, highlights the interrelationship between environmental conditions, use, human interaction, global environmental and socio-economic factors (UN 2013). Throughout this report, recurring issues surface repeatedly – these include the interdependency between humans and their use of environmental resources, water security, and climate change.

8.1

Introduction

This chapter discusses several key overarching issues in the light of the indicators used throughout this report, and provides a summary of actions needed to respond to these issues. The SDGs also provide a lens through which to view overarching issues in environmental management and reporting; an overview of the alignment between the indicators used in this report and the indicators underlying the SDGs are provided in Appendix A.

8.2

Ecosystem services

Ecosystem services are defined as benefits that people obtain from the environment. It considers what nature offers as resources and how these support human life and quality of life on earth. Humankind often takes these services for granted and views them as an infinite resource. One of the core functions of viewing the environment as a partner in development – and delivering services to people – is that it enables stakeholders to determine the monetary value of the contribution the environment makes to human life and well-being.

Figure 8-1 depicts environmental reporting as seen through the lens of ecosystem services. The environment provides services that offer commodities such as arable land and water. It also provides services that support human life and quality of life (e.g. providing habitats and offering cultural value such as recreational services). The environment also serves people through regulating climatic, energy and water processes to maintain environmental equilibrium (Millennium Ecosystem Assessment, 2003).

Swakopmund Bay | Grant Durr

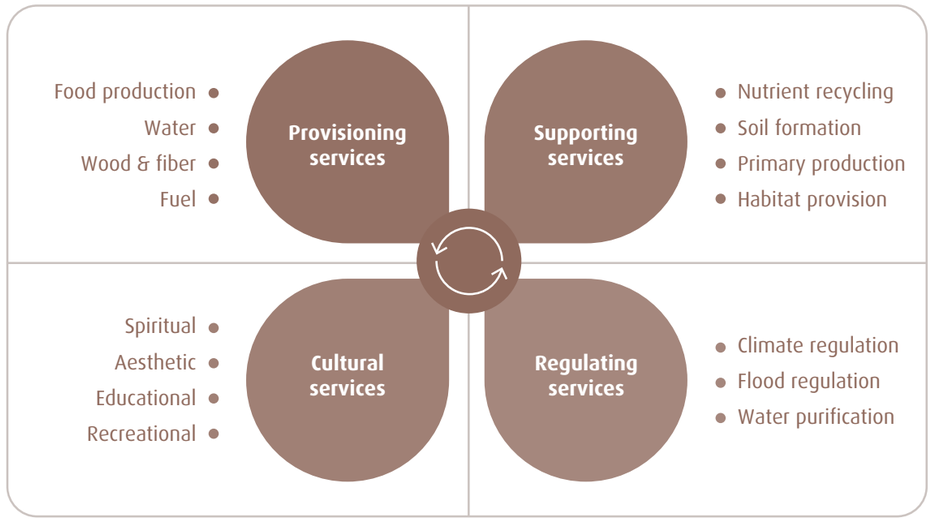


Figure 8-1 *Ecosystem services (Millennium Ecosystem Assessment, 2003)*

Throughout this report, and especially in Chapter 3, several indicators have illustrated the state of Namibia's use of its natural resources and ecosystem services. An important consideration in ecosystem services is not only how the environment provides for humans (and how ecosystem changes might impact human life on earth), but also how humans affect the environment – either in a negative or a positive manner. The Millennium Ecosystem Assessment was developed by a group of over 1,360 experts worldwide under the auspices of a variety of international donor organizations, to aid in policy-making regarding environmental matters (Millennium Ecosystem Assessment, 2003).

With the support of GIZ, and under the flag of the Resource Mobilisation for Biodiversity Conservation (ResMob) Project, the MEFT undertook extensive studies into Namibia's ecosystem services in recent years (Brown et al., 2014). The ResMob project endeavoured to build capacity to mobilise financial, human, technical and knowledge-based resources for biodiversity conservation; it has published five reports specifically investigating the economics of ecosystem services in Namibia, which are available on the ResMob website: https://resmob.org/reports/

As part of the ResMob project, the MEFT commissioned a group of environmental scientists and environmental economists to undertake a comprehensive ecosystem services inventory study, using the Common International Classification of Ecosystem Services (CICES) system and the System of Economic Environmental Accounting Experiential Ecosystem Accounting (SEEA EEA). It divided Namibia into 13 terrestrial and four marine zones to provide a framework for the description and analysis of ecosystem services (Brown et al., 2014).

The results of the study indicated that the provisioning services most under pressure are livestock farming and groundwater. The threat to livestock farming is due to the complex interaction between overgrazing, drought and unsustainable farming practices – leading to land degradation, as discussed in Chapters 2 and 3.

Pressures on groundwater recharge are discussed extensively in Chapters 2 and 3, and are also caused by multifactorial challenges. Surface water provisioning services – such as freshwater fish for livelihoods in the Kavanago Region – are under threat due to over-exploitation and variability in river flows due to the impacts of climate change.

The outcome of the ecosystem services inventory study included a roadmap for further investigation into ecosystem services and prioritizing services which are most under pressure. The study suggests five criteria for prioritizing ecosystem services, by listing the following considerations that should be taken into account by national decision-makers (Brown et al., 2014):

- The current and future expected impacts on the flow of the service should be considered in decision-making;
- Services affected by critical theats identified in NBSAP2 should be prioritized;
- Services with high economic importance (both current and potential) should be prioritized;
- The size and socio-economic characteristics of population affected by ecosystem services should be taken into account in decision-making; and
- The availability and accuracy of data available for ecosystem services.

The results align with the indicators used in this ISOER and highlight the intricate and fragile interrelationship between nature and people. Table 8-1 provides an overview, using indicators from the ISOER, of this dynamic.

The selected indicators show that Namibia's ecosystem services are under pressure. As far as cultural services are concerned, Namibian stakeholders are attempting to achieve a balance between what the environment can offer and how humans interact with it. This is evident from the creation of community forests and the implementation of a conservancy model as described in Chapter 3. In terms of the regulating services, global climatic factors have a local negative impact on human life and quality of life. In turn, localised behaviour negatively affects global indicators such as temperature change over time. Considering land and soil conditions as an indicator of supporting ecosystem services, the balance of benefit seems to be skewed towards human use, while the human impacts on these natural resources is leading to increased land degradation.

ResMob concurs that the way forward in ecosystem services reporting globally is to clearly define indicators for each of the types of services, and formulate a quantification system to standardize reporting across frameworks (Brown et al., 2014). As Namibia is still building its environmental indicator monitoring database, it will be prudent to align this database with the emerging research body on ecosystem services reporting. The ResMob (Brown et al., 2014) ecosystem services inventory provided a solid basis for the quanitification of services in Namibia, aligned with international good practice standards.

Table 8-1 *Ecosystem services applied to selected indicators in this report*

Ecosystem services component	Examples of indicators used in this report	Human impact on ecosystem services	Ecosystem changes impacts on humans
Provisioning services Water supply *Chapter 3*	• Percentage of water supply provided by groundwater in Namibia • Number and type of water schemes • Percentage of annual water consumption by sector • Percentage of water supply by volume per region • Livestock numbers		
Regulating services Climatic conditions *Chapter 2*	• Annual rainfall variability • Evaporation rate • Projected change in monthly temperature (2020-2039) • Projected change in monthly temperature (2040-2059) • Projected change in monthly precipitation (2020-2039) • Projected change in monthly precipitation (2040-2059)		
Cultural services Nature-based tourism *Chapter 3*	• TTCI index • Tourist arrivals in Namibia • Increase in community forests • Number and location of Namibia's community forests in 2018 • Areas under various kinds of conservation management		
Supporting services Soil and soil nutrients *Chapter 2*	• Soil suitable for agriculture • Total annual cost of land degradation • Cost of land degradation as % of GDP • Cost land degradation action • Cost of land degradation inaction		

KEY

= humans have a positive and/or neutral impact

= nature has a positive impact or contribution

= humans have a negative impact

= ecosystem changes have a negative impact

8.3

Water fragility

Namibia is a water-stressed country, and thus pollution of the limited freshwater resources is a priority concern. A large amount of water is used by industry and for agriculture. Other influences from agriculture are from stock production and processing of products, fertilizer run-off from fields, and pesticides that enter water, air or soils. Water resources are further stressed by pollutants from dump and landfill sites, industrial effluents, domestic and commercial sewage, and litter – with the leachates entering ground and surface water systems.

Solutions to these and similar problems are a priority, especially given the high cost of treatment of chemically polluted water, the downstream impacts on marine resources, and Namibia's responsibilities to downstream neighbours. Obligations on shared rivers are incorporated, inter alia, in the Protocol on Shared Watercourses in the SADC Region, concluded in 1995.

Globally, increased attention is being given to the relationship between water security and regional fragility. The World Bank launched an Online Fragility Forum in August 2020, with its first focus being a series on Water and Peace (World Bank, 2020). Water insecurity is considered to be a destabilising factor and a risk multiplier; this implies that, in countries such as Namibia (where water-stress is a given, combined with other environmental and social risk factors) may cause increased instability on a national scale.

From an environmental reporting perspective, water insecurity and stress have been discussed at length in Chapters 2, 3, 5 and 6 of this report. This section aims to provide a summary of all indicators presented in the ISOER that point to water insecurity and water-related impacts. A risk-based depiction of this summary is provided in Table 8-2.

The collective water-related indicators used in this report all point to Namibia being at severe water risk. Responses to some of these water-related challenges were discussed in each of the respective chapters, and the most salient indicators where included in the action dashboards of each chapter. However, a coordinated response to water security and water risk is urgently needed and all water-related programmes, projects and initiatives should be fast-tracked as a priority.

Table 8-2 *Risk-based summary of water-related impacts in this report*

Chapter Name	Number of water-related indicators	Average risk level	Description
Environmental conditions and quality	15	Severe	High evaporation, increase in rainfall variability, decrease in total precipitation, surface water, limited recharge from hydrological cycle, total and potential water sources, no perennial rivers, limited ephemeral rivers, fluctuating dam levels, uncertain groundwater potential.
Environmental resources and their use	5	Serious	Sustainability of percentage water supply provided by groundwater, water consumption per section, projected increase in water demand for water up to 2030.
Waste and waste management	1	Severe	Lack of national database for data on wastewater treatment.
Extreme events and disasters	4	Serious	Increase in droughts and floods, increase in severe drought likelihood and number of people affected.
Human settlements and environmental health	6	Severe	Decrease in population with access to safe water, unmet targets in provision of sanitation, increase in water borne diseases – malaria, cholera and hepatitis E
Total water-related indicators	**31**		

8.4

Climate change mitigation & adaptation

Globally scientists, civil society and governments are unifying their responses to the impacts of climate change; they are starting to chart a way forward to formulate, firstly, mitigation measures for actions that cause increased GHG emissions, and secondly, adaptation strategies to the impacts of climate change (UNFCCC, 2020).

As reported in Chapter 4, Namibia is currently a net carbon sink country, with rising emissions. Namibia's updated NDC report shows that the country has recommitted to reduce its GHG emissions levels reduce by 91% below 2015 levels by the year 2030. The country recently updated the report from its intended NDCs submitted in 2015 to the UNFCCC as part of its international reporting obligations and commitment to the Paris Agreement. The plan has five components to address all aspects of the economy: policy and strategy; energy; industrial processes and product use (IPPU); agriculture, forestry and land use (AFOLU); and waste. This aligns with the requirements of the UNCCC (GRN 2018). Namibia's NDC envisioned a reduction of approximately 91% of its GHG emissions at the 2030 time horizon, compared to the BAU scenario. Namibia's GHG mitigation measures are indicated in Table 8-3.

Table 8-3 *Namibia's measures contributing to mitigation as per its NDC (GRN, 2021)*

Sector	Measure	Mitigation potential (Mt CO2 e)	% of BAU scenario in 2030
Energy	Renewable Energy Feed-in Tariff (REFIT) 70 MW PV - replacing imports plus Ruacana	0.246	1.12
	Solar Rooftop systems (45 MW PV) - replacing imports	0.016	0.07
	Embedded generation - 13 MW PV replacing imports	0.005	0.02
	Solar power - Omburu 20 MW PV - replacing imports & 20 MW Solar IPP Power Plant	0.014	0.06
	Wind power - Luderitz Wind 40 MW replacing imports & 50 MW Wind IPP Power Plant	0.022	0.05
	Biomass Energy plant 40MW - replacing imports	0.007	0.11
	Hydropower - Baynes Hydro 300 of 600 MW	0.201	0.91
	Solar Thermal Road Map - 20 000 Solar Water heaters (SWH)	0.017	0.08
	Promote passenger vehicle fuel efficiency standards (in 80 % of total passenger vehicle population)	0.614	2.79
	10 000 Electric Vehicles - replacing gasoline	0.007	0.03
	Fuel switching to low-carbon fuels - Hydrogen replacing diesel	0.946	3.59
	Light-duty vehicles (LDV) – reducing fuel use by 20%	0.684	3.11
IPPU	Replace 20% clinker in cement production	0.104	0.47
	Split residential air conditioners – switch to R290 (propane)	0.015	0.07
	Car air conditioning – safe disposal of old car ACs	0.0002	0.001
	Domestic refrigeration - switch to R600a (isobutane) and safe disposal of old refrigerators	0.001	0.005
	Commercial refrigeration (Stand-alone equipment) – switch to R290 (propane) and R744 (CO2) and safe disposal of old equipment	0.003	0.013
	Commercial refrigeration (Condensing units) – switch to R290 (propane) and R744 (CO2) and safe disposal of old equipment	0.011	0.052
AFOLU	Reduce deforestation rate by 75%	13.537	61.54
	Reforest 20,000 ha per year	1.779	8.09
	Restore 15.5 million ha of degraded savanna	2.3	10.46
	Plant 10,000 ha of trees per year under Agroforestry	0.358	1.63
	Plant 5,000 ha of trees under Urban Forestry	1.056	4.80
Waste	Transform 70 % to electricity and compost	0.0197	0.07
	Increase Recycling of plastic waste and e-waste by 70%	0.0016	0.01
	Zero waste by 2050 through re-use and recycling (75% of target achieved by 2030)	0.0101	
Subtotal		0.031	0.123
Total		**21.996**	**91%**

Approximately 8.9% or about 7,290,000 ha of Namibia is forested and reducing the deforestation rate by 75% from 0.9% per year to below 0.25% will be the major drive to achieving the 2030 target. More effort and investment are being put in place by Namibia to achieve this goal. Over 13.5 Mt CO^2 equivalent (e) will be mitigated in the next 10 years (2030). Namibia recognises that reforestation, agroforestry and urban forestry are key emissions reductions strategies.

Through the restoration of 15.5 million hectares of degraded savanna, it is expected that 2.3 Mt CO^2 e will be reduced from total emissions by 2030. The central parts of the country are covered by thornbush savanna, which is increasingly being affected by encroachment by indigenous woody bush species. This is considered a serious form of land degradation, adversely impacting biodiversity, groundwater recharge and land productivity as well as accessibility for eco-tourism activities. In total, it is estimated that in total 45 million hectares are affected by woody encroachment at varying intensity.

Namibia's land sector is reported as a large net sink and will remain so even in the scenario of increased bush biomass harvest. Even the largest upscaling scenarios of bush biomass utilization are not expected to compromise this terrestrial sink. Furthermore, the net impact of bush thinning in combination with the restoration of savanna rangelands is still subject to further research, especially with regards to changes in soil organic carbon. While the mitigation impact of bush thinning and rangeland restoration have not been determined conclusively, the climate change adaptation benefits of these measures are undisputed and manifold. Namibia's land sector will remain a sink but become CO^2 neutral under the scenario of increased harvest and use of the invader bush. The assumptions made when working emissions for the BAU scenario for the Land sector which governs mitigation are:

- National programmes for the protection of Forest lands in the north-eastern regions are deemed to reduce deforestation to a strict minimum with a loss of 7500 hectares annually.
- Other wooded land (OWL)[3] will also stabilize as woody encroachment into grassland in the central and southern part of the country is estimated to be not occurring due to rainfall being limiting.
- With no further encroachment of woody species occurring, the Grassland area of 3.8 million ha will remain the same. The utilisation of the encroacher bush in OWL is not expected to affect this land class as it will be primarily bush thinning as opposed to a full clearing.
- Settlement's area will increase marginally by 100 ha an annual basis from OWL as inclusion from Cropland or Grassland is estimated not to occur.
- The area of Wetlands and Other lands is estimated to remain stable.

[3] Other wooded land, or OWL, is defined by FRA-2000 as land with a tree crown cover (or equivalent stocking level) of 5–10% of trees able to reach a height of 5 meters at maturity, a crown cover of more than 10% of trees not able to reach a height of 5 meters at maturity (such as dwarf or stunted trees), or shrub and bush cover of more than 10%. OWL excludes areas with the tree, shrub, or bush cover just specified but of less than 0.5 hectares and width of 20 meters, as well as land predominantly used for agricultural practices (FAO 2000, 2001).

The targeted national mitigation contribution from the AFOLU sector is expected to result from implementation of different strategies that relate mainly to natural forest management and agroforestry, either with domestic or international support. The total area of intervention is expected to reach 15,000 ha with merely domestic support and 20,000 ha with international support.

The potential mitigation contribution from Agroforestry, represented by the total C storage of trees outside natural forest lands estimated at 0.358 Mt CO^2 e. However, this figure is the total from ≈10,000 ha of land by 2030. Like any other land use in Namibia urban forestry4 and its management can have immense potential in mitigating C emissions and performing other environmental services.

The transformation of MSW to compost and electricity is the most significant mitigation potential under the Waste sector. Though mitigation potential from waste sources is, by comparison, limited, the potential to expand the actions is high.

Overall, the updated NDC had a significant increment (22%) in mitigation potential across all sectors from 2015 targets (Table 8-3). Efforts under the IPPU sector increased three times more than the first NDC targets. The energy sector's mitigation potential also grew in the period 2020 – 2030 due to more technology-based options being availed to reduce GHG emissions. AFOLU had the least increment (3%) because of the nature of options created which are non-technological and the mitigation potential of the sector is almost saturated. Beyond that limit, AFOLU may shift to being an emitter of GHGs.

[4] The term "urban forestry" refers to the management of all trees within a densely populated area, including trees in parks, on streetways, and on private property.

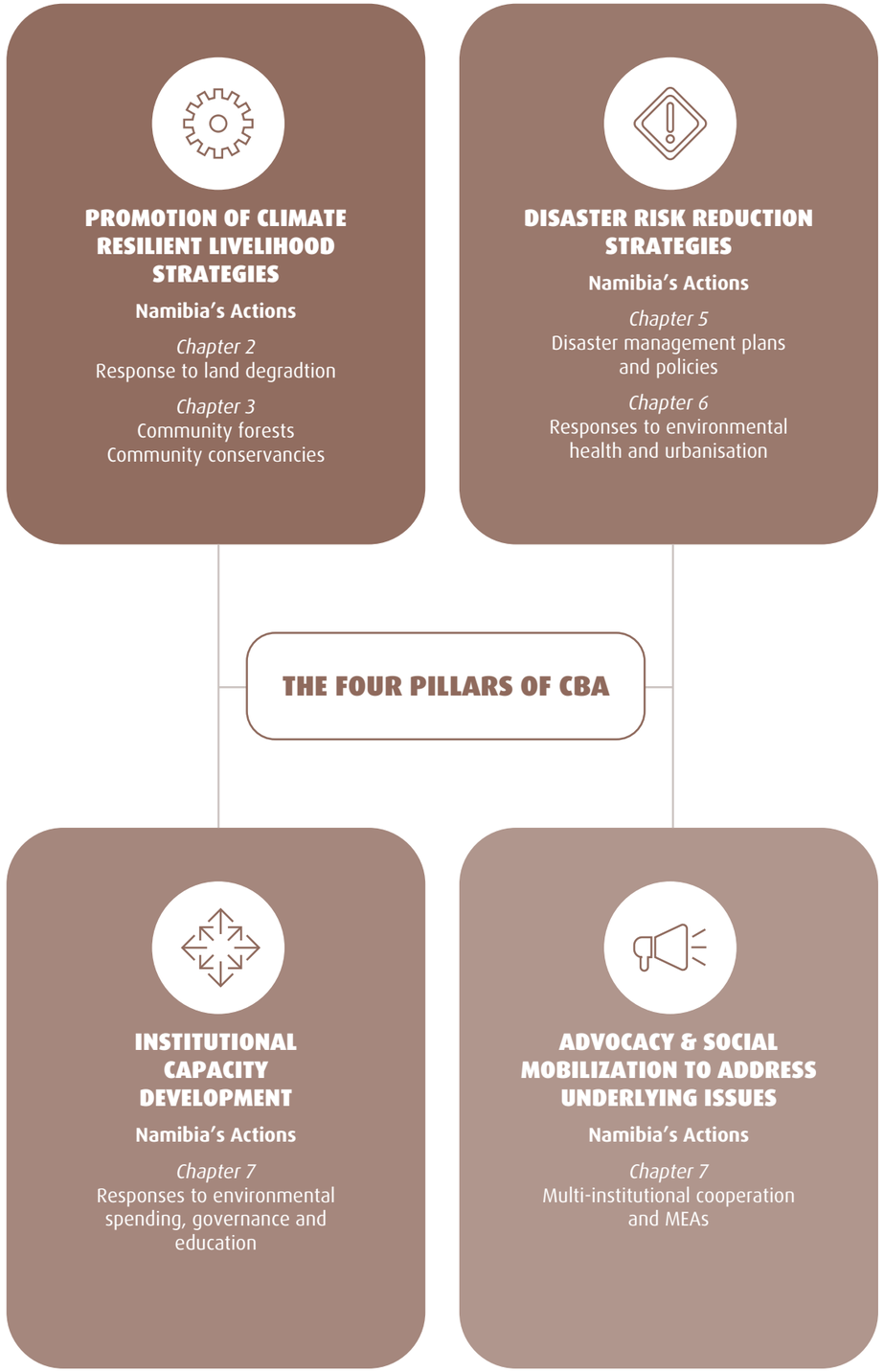


Figure 8-2 *Four pillars of CBA and Namibia's responses (adapted from CARE, 2020)*

8.5

Poverty & environmental health

The impact of inadequate pollution and waste management practices are by and large being disproportionately borne by the poor, as discussed in Chapter 4 and Chapter 6. There are still major challenges to overcoming past patterns of inequality, to ensure protection of communities from the impact of changing and poorly-managed environmental conditions. Insufficient refuse removal services in poverty-stricken areas and rural areas results in accumulation of waste and other environmental health risks. Environmental health problems in poor communities are compounded by the use of pesticides to control pest infestations, which are themselves exacerbated by inadequate waste removal.

Environmental responses are required in the form of policies and regulations, and most importantly in the consistent enforcement of these regulations, to ensure the right of the public to an environment that is not harmful to health and well-being, including from industry and mining.

Overstretched waste management services can pose several health challenges. Inadequate refuse removal also detracts from the aesthetic appeal of the environment, thus impacting on people's well-being and their sense of place in their surroundings. Further, access to basic sanitation and drinking water is of major concern to human health, due to potential spread of disease caused by contamination of drinking water sources, as discussed in Chapter 6. The demand for sanitation facilities which are dependent on water is outweighing the present infrastructural capacity.

The marked increase in urbanization has excacerbated the impacts arising from inadequate waste and sanitation services, as discussed in Chapter 6. The continuing rise in population in towns and cities poses a major challenge for Nambia. Infrastructure and services for basic needs must grow and develop with the increasing demand for these basic services. While poverty has been one of the driving factors for urbanization, rapid urbanization places pressure on existing infrastructure and services, thereby contributing to a growth in poverty levels in towns and cities (Savela et al, 2020). The over-use and poor management of local resources can endanger the vulnerable poor even further. Namibia is challenged to ensure that areas currently with inadequate access to water, health and sanitation facilities do not further impact the most vulnerable citizens – thereby contributing to further degradation of the environment.

8.6

Protecting & managing the natural resource base

Globally, there has been a strong shift in focus toward cleaner production and energy efficiency through the use of the best available technology. Predicted water shortages due to the increased occurrence of droughts, combined with water quality issues, has required government and regulators to place a greater emphasis on production efficiency in all spheres of the economy. Sustainable management of waste also constitutes a priority for cleaner production initiatives.

Namibia is aspiring to develop systems that ensure the sustainable use of natural resources, through increased government and donor funding that promotes and enhances activities that protect and manage the country's natural resources. The country is challenged to ensure that institutional frameworks and legislation are aligned to the sustainable management of Namibia's natural resource base. More important, however, is the consistent implementation and monitoring of policies and regulations – to ensure compliance and to promote the protection of valuable natural resources.

Namibia's resources, in particular water and vegetation, are sensitive to climatic change and human activities. This sensitivity means that these resources are vulnerable to extreme weather events such as droughts and flooding, as well as over-exploitation of land, fisheries and biodiversity. Namibia has taken this into account and has committed to managing this through vulnerability assessments and putting disaster risk management systems in place (United Nations, 2016). However, a major challenge that exists is for the country to build the capacity within these systems. Greater awareness and education are sorely needed to publicize the challenges to the effective protection and management of Namibia's natural resource base.

It is also of the utmost importance to establish a nationally cohesive and integrated system of environmental data collection and reporting. This system should be informed by a core set of indicators, many being featured in the ISOER. In pursuing this goal, it is important to break down barriers that prevent communication between government departments responsible for different aspects of environmental management.

8.7

Sustainable consumption patterns

There are a number of cross-cutting issues and interlinkages that have relevance to sustainable consumption patterns (SCP). The linkages between resource use and patterns of production, as well as societal attitudes and consumption, should be noted – while also considering the cumulative effects of unsustainable resource use. Achieving economic growth and sustainable development requires that Namibia urgently reduces its ecological footprint by changing the way goods and resources are produced and consumed. Agriculture is the biggest user of water worldwide, and irrigation claims the majority of all freshwater for human use – a trend mirrored in Namibia.

The efficient management of shared natural resources and the disposal of toxic waste and pollutants are important to achieving SCP targets for 2030. SCP strategies should take cognaisance of the role of increased urbanization in consumption – as this contributes significantly to the generation of wastes requiring management and generating emissions contributing to climate change. Government should also encourage industries, businesses and consumers to recycle and reduce waste. In some areas, Namibia has made progress in this regard – such as pioneering the use of wastewater in Windhoek (as described in Local Perspectives on page 96). Some progress has also been made in recycling efforts in the larger urban centres.

The linkages between production and consumption must be better understood in order to implement practical solutions, policies and response measures. Stronger governance, information dissemination and financial incentives will positively influence initiatives aimed at SCP implementation.

Aerial view | Craig Marshall

We need to ensure that all citizens are equipped with relevant knowledge, attitudes, values and skills required for managing natural resources.

POHAMBA SHIFETA

Sossusvlei | Wikimedia Commons

CHAPTER 9

Way Forward

Tribal dance in Rundu, Okavango | Miriam Eh

This chapter provides a conclusion and way forward for Namibian stakeholders and citizens regarding the management of natural resources in Namibia and the interaction between humans and the living environment in which they live.

9.1

Introduction

The GRN has made significant public commitments towards environmental stewardship and sustainability since the publication of the 2004 SOER. The publication of the second ISOER demonstrates Namibia's dedication to this cause. To attain these goals, there is a significant amount of work ahead to meet the obligations imposed by these commitments. The indicators presented and discussed in this report provide a roadmap to the improvement of environmental management and the sustainable use of environmental resources.

9.2

Roadmap to sustainable management of environmental resources

At the end of each chapter in this report, an action dashboard was presented to provide guidance to stakeholders, policy-makers and implementing agencies regarding management actions that need to be urgently implemented. This approach allows for easy visualization of the most salient and pressing environmental management issues in Namibia.

Figure 9-1 provides a broad overview of these prioritized environmental issues and Table 9-1 provides a more detailed description of the key management actions required.

In order to assist in prioritization, Table 9-1 categorizes the identified key management actions into short-, medium- and longer-term priorities. Responding to these actions will require robust governance, broad-based public-private partnerships and cross-cutting interventions. Ongoing commitment will be necessary, as it will take time to make improvements to the environmental status quo and effect positive change.

Sossusvlei desert | Eelco Bohlingk

Urgent short term management actions > 5 years	Important medium term management actions 5 - 10 years	CHAPTER	Important long term management actions < 10 years	Important ongoing management actions ∞
• Implement IWRM plan and develop desalination plants. • Continue to apply measures set out in INDCs.	• Continue to develop strategies, plans and programmes in collaboration with UNCBD and UNCCD. • Undertake a grassland assessment to better manage and limit the extent of bush encroachment.	3	• Monitor upwelling changes over time closely and determine impact on marine life.	
• Expand renewable energy sector to reduce reliance on energy imports and fossil fuels. • Continue investments into water supply infrastructure. • Utilize integrated land use planning mechanism to support the promotion of sustainable livestock farming.	• Expand and protect gazetted marine protection areas. • Investigate further means to reduce the reliance on imported energy supply in order to expand the renewable energy production.	4	• Promote low-impact nature-based tourism that supports national programmes and plans for the protection of the environment.	
• Develop an integrated solid waste management database. • Develop and implement strategies to reduce industrial air emissions and land degradation. • Establish a widespread culture of waste minimization and expand recycling systems.	• Prioritise registration monitoring and management of WWTPs.	5	• Improve the implementation of the MAWLR's permitting system for WWTPs to improve compliance.	
• Maintain and monitor disaster management infrastructure country-wide, including integrated database. • Indentify and implement climate-resistant crop farming practices and promote sustainable land management methods. • Regularly update and continue to implement drought response plan.	• Continuously adapt National Disaster Risk Management Policy to increase the country's carrying capacity for potential natural disasters.	6	• Develop a priority-based response to framework including high-level and multi-pronged policies to aid in improving early response approaches.	
• Strengthen WASH infrastructure and services to address weaknesses. • Implementation of national strategies to expand sanitation infrastructure to reach goal of improved sanitation for all by 2030. • Develop and implement programme to lower cost of land subsidize essential services, lower building standards and allow incremental building of houses. • Prepare a work programme to develop national urbanisation strategy for Namibia.	• Improve sanitation infrastructure to reduce risk of Hepatitis E outbreaks. • Improve on advances an investments into malaria management thorugh collaboration with international investment partners.	7	• Continuously invest in the country's health system to improve maternal and infant health	• UNFCC reporting *Continue reporting and follow up with actionable implementation plans related to reported data*
• Proactively identify and source funding for the protection of biodiversity. • Continue strengthening and maintaining governance structures and processes • Develop and implement strategies to reduce air emissions and reduce reliance on fossil-fuel based energy.	• Strengthen regulators capacity to enforce EMA and related regulations. • Strengthen Namibia's implementation of good governance practices that relate to transparency and accountability.	8	• Strengthen the implementation of active MEAs to ensure that cross border environmental protection priorities are addressed.	• Areas under environmental protection: *Improve implementation and enforcement of environmental protection regulations* • Improve environmental data management

Figure 9-1 *Roadmap to sustainable management of environmental resource*

Table 9-1 *Key management actions required*

Action required	Section	Indicators	Recommended management actions	Timeframe
Immediate management action required	Chapter 2 **Environmental conditions and quality**	Temperature increase over time Physical water stress risk	• Continue to apply the measures set out in the voluntarily developed NDCs to contribute to climate change mitigation efforts • Implement IWRM plan and continue to develop desalination plants along Namibia's coastline	Short-term (<5 years)
	Chapter 3 **Environmental resources and their use**	Energy supply consumption Sustainability of livestock farming Number and type of water supply schemes	• Actively support the expansion of a renewable energy sector to reduce reliance on energy imports and fossil fuels • Utlise integrated land use planning mechanism to support the promotion of sustainable livestock farming • Continue investments into water supply infrastructure	
	Chapter 4 **Wastes and their management**	Solid waste management data integrity Recycling volumes in Windhoek Mitigation of industrial emissions	• Develop an intergrated solid waste management database • Establish a widespread culture of waste minimisation and expand recycling systems • Develop and implement strategies to reduce air emissions and land degradation • Improve efficiency of Wastewater Treament Plants (WWTPs)	
	Chapter 5 **Extreme events and disasters**	Resilience of agriculture GDP contribution Extreme events and disaster data management Impact of COVID-19 Annual severe drought likelihood	• Identify and implement climate-resilient crop farming practices and promote sustainable land management methods • In support of the National Disaster Risk Management Framework and Action Plan, maintain and monitor disaster management infrastructure country-wide, including a database of extreme events and disasters • Strengthen WASH infrastructure and services to address weaknesses identified during the COVID-19 pandemic • Regularly update and continue to implement Drought Response Plan to proactively address reoccurring severe drought	
	Chapter 6 **Human settlements and environmental health**	Urbanization trends per region Trends in number of improvized houses Sanitation facility coverage	• Prepare a programme to develop a national urbanization strategy for Namibia • Revisit the housing strategy and give consideration to the following: lower the cost of land, subsidise essential services where it is not affordable, lower building standards, and allow individuals to build houses incrementally • Implement national strategies to expand sanitation infrastructure in fulfilment of the government's commitment to reach the universal target of improved sanitation for all by 2030	
	Chapter 7 **Environmental protection, management and engagement**	Level of biodiversity spending EPI decline in score for climate and energy Worldwide Governance Index score	• Proactively identify and source funding for the protection of biodiversity and conservation • Develop and implement strategies to reduce air emissions and reduce reliance on fossil-fuel based energy imports • Continue to strenghten and maintain governance structures and processes	

...table continued on following page

Action required	Section	Indicators	Recommended management actions	Timeframe
Urgent management action required	Chapter 2 **Environmental conditions and quality**	Grasslands landcover changes over time	• Undertake a grassland assessment to better manageand limit the extent of bush encroachment • Contuinue developing strategies, plans and programmes through collaboration with UNCBD and UNCCD	Medium-term (5-10 years)
		Cost of land degradation as a % of GDP		
	Chapter 3 **Environmental resources and their use**	Renewable energy as a % of total	• Investigate further means to reduce the reliance on imported energy supply and improve more on self sufficient renewable energy prodution • Continue adapting Policies such as the Fish protection Areas Gazette to supplement the current fish harvest	
		Total fish harvest and seal population		
	Chapter 4 **Wastes and their management**	Governance of WWTP	• Registration, monitoring and management of WWTPs should be prioritised	
	Chapter 5 **Extreme events and disasters**	Spatial social vulnerability vs natural hazards	• Continously adapt National Disaster Risk Management Policy to increase the country's carrying capacity to potential natural disasters	
	Chapter 6 **Human settlements and environmental health**	Hepatitis E epidemic	• Improve sanitation infrastructure to rduce the risk Hepatitis E outbreaks • Improve/Increase malaria incidence-management investments to to a level which encourages national and international partners to collaborate with the country	
		Incidence of malaria		
	Chapter 7 **Environmental protection, management and engagement**	Decrease in donor funding	• Investigate future potential long-term donor funding projects which will aid in improving long-term national and internation investments • Strengthen Namibia's implementatin of good goevrnance practices that relate to transparency and accountability	
		Decrease in Ibrahim Index for accountability and transparency		
Some management action required	Chapter 2 **Environmental conditions and quality**	Upwelling index changes over time	• Monitor upwelling changes over time closely and determine impact on marine life	Longer-term (>10 years)
	Chapter 3 **Environmental resources and their use**	Income generated from tourism versus environmental protection	• Continue developing Green Scheme projects that focus more on nevironmental protection	
	Chapter 4 **Wastes and their management**	City of Windhoek daily WWTP volumes	• Improve the Implementation of the MAWLR's permitting system for WWTPs to improve compliance • Investigate various measures to allow treated wastewater to be used instream or for industrial purposes	
	Chapter 5 **Extreme events and disasters**	Disaster management policy framework	• In support of the National Disaster Risk Management Framework and Action Plan, maintain and monitor disaster management infrastructure country-wide, including a database of extreme events and disasters • Develop a priority based response framework which includes the high-level and multi-pronged policies to aid in improving early response approaches	
	Chapter 6 **Human settlements and environmental health**	Infant mortality rate	• Continously increase investments made in the country's health system to improve maternal and infant health care	
	Chapter 7 **Environmental protection, management and engagement**	Number of active MEAs	• Strengthen the implementation of active MEAs to ensure that corss border environmental protection priorities are addressed	
Eventual management action required	Chapter 2 **Environmental conditions and quality**	% of area under environmental protection	• Better implement and enforce environmental protection regulations	
	Chapter 4 **Waste management**	UNFCCC Reporting	• Continue reporting and follow up with actionable implementation plans related to reported data	

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The production and consumption choices that we as individuals take will ultimately determine whether we shift towards a greener economy.

POHAMBA SHIFETA

Warthogs at the Okaukuejo waterhole

Contributors

The development of the ISOER has required the input, guidance and involvement of several stakeholders. The list below provides the details of some of the key contributors:

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Ministry of Environment, Forestry and Tourism

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CIVIL SOCIETY COLLECTIVE

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List of Appendices

APPENDIX A

SDG ALIGNMENT

Sustainable Development Goals (SDG)	SDG indicators	Indicators used in this report	Reference
Goal 1 End poverty in all its forms everywhere	Proportion of total adult population with secure tenure rights to land, with (a) legally recognized documentation and (b) who perceive their rights to land as secure	• Environmental performance index • Gini index • World Resources institute water risk score • Multidimensional poverty index • Trends in population living below the national poverty line • Projected impact of COVID on economy	**Chapter 1** Sections 1.1, 1.5.3, and 1.5.4 **Chapter 2** Section 2.3.2
Goal 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Proportion of agricultural area under productive and sustainable agriculture.	• Trends in land allocation • Ownership patterns of agricultural land in Namibia in 2018 • Landcover change in Namibia • Increase in community forests • Number and location of Namibia's community forests in 2018 • Areas under various kinds of conservation management • Terrestrial and marine protected areas • Livestock census • Status of marine life • Status of fresh-water fish	**Chapter 2** Section 2.4.1 **Chapter 3** Section 3.5.1
Goal 3 Ensure healthy lives and promote well-being for all at all ages	• Mortality rate attributed to household and ambient air pollution • Number of new HIV infections per 1,000 uninfected population, by sex, age and key populations • Under-5 mortality rate • Tuberculosis incidence per 100,000 population • Malaria incidence per 1,000 population • Hepatitis B incidence per 100,000 population	• HIV/AIDS prevalence • Trends in the incidence of TB • Incidence of malaria • Number of cholera cases in 2014 and 2018 • Hepatitis E cases from 2017 to 2020	**Chapter 5** Sections 5.3.3 and 5.2.3
Goal 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Proportion of children and young people (a) in grades 2/3; (b) at the end of primary; and (c) at the end of lower secondary achieving at least a minimum proficiency level in (i) reading and (ii) mathematics, by sex.		
Goal 5 Achieve gender equality and empower all women and girls	Proportion of total agricultural population with ownership or secure rights over agricultural land, by sex; and (b) share of women among owners or rights-bearers of agricultural land, by type of tenure.	Ownership patterns of agricultural land in Namibia in 2018.	**Chapter 3** Sections 3.5.1 and 3.5.2

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Sustainable Development Goals (SDG)	SDG indicators	Indicators used in this report	Reference
Goal 6 Ensure availability and sustainable management of water and sanitation for all	• Change in water-use efficiency over time • Degree of integrated water resources management • Change in the extent of water-related ecosystems over time • Level of water stress: freshwater withdrawal as a proportion of available freshwater resources • Proportion of domestic and industrial wastewater flows safely treated	• % of population with access to safe water • Compliance status of WWTP in Namibia • Daily discharge of treated wastewater and type of water use for WWTPs in Windhoek • Percentage of water supply provided by groundwater in Namibia • Number and type of water schemes • Percentage of annual water consumption by sector • Percentage water supply by volume per region • Projected water demand for Namibia as of 2008 • Surface water in Namibia • Aquifer types, distribution and overall production • Total and potential water sources • Namibian dam levels • Groundwater potential • Projected increase in water demand	**Chapter 2** Section 2.2.2 and 2.3.2 **Chapter 3** Section 3.7.1 and 3.7.2 **Chapter 4** Section 4.2.2 **Chapter 6** Section 6.2.2 and 6.2.5
Goal 7 Ensure access to affordable, reliable, sustainable and modern energy for all	• Proportion of population with primary reliance on clean fuels and technology • Renewable energy share in the total final energy consumption • Energy intensity measured in terms of primary energy and GDP	• Proportion of population with access to electricity • Energy supply composition • Namibia's installed capacity • Renewable energy as a % • % of population with access to electricity for lighting • % of population who use wood and charcoal as main source of energy for cooking	
Goal 8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	• Material footprint, material footprint per capita, and material footprint per GDP • Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP	• Solid waste processed in Windhoek per month • Percentage distribution of households by means of waste disposal	**Chapter 4** Section 4.2.3 **Chapter 6** Section 6.2.4

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Sustainable Development Goals (SDG)	SDG indicators
Goal 9 Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Proportion of the rural population who live within 2 km of an all-season road.
Goal 10 Reduce inequality with and among countries	Proportion of people living below 50 percent of median income, by sex, age and persons with disabilities.
Goal 11 Make cities and human settlements inclusive, safe, resilient and sustainable	Ratio of land consumption rate to population growth rate.
Goal 12 Ensure sustainable consumption and production patterns	• Material footprint, material footprint per capita, and material footprint per GDP • Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP • National recycling rate, tons of material recycled
Goal 13 Take urgent action to combat climate change and its impacts	• Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030 • Number of deaths, missing persons and directly affected persons attributed to disasters per 100 000 population • Total GHG emissions per year
Goal 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development	• Proportion of fish stocks within biologically sustainable levels • Sustainable fisheries as a proportion of GDP in small island developing States, least developed countries and all countries

Indicators used in this report	Reference
• Urbanization trends • Urbanization trends per region • Landcover change in Namibia • Number of urban households with garbage collection • Number of urban households in Kavango with garbage collection • Number of water infrastructure projects by NamWater	**Chapter 3** Section 3.7.2 **Chapter 6** Sections 6.2.1 and 6.2.4
Trends in population living below the national poverty line.	**Chapter 1** Section 1.5.3
• Population growth rate • Trends in land allocation • Land tenure % • Landcover change in Namibia	**Chapter 1** Section 1.5.3 **Chapter 2** Section 2.4.1 **Chapter 3** Section 3.5.1
• Solid waste processed in Windhoek per month • Percentage distribution of households by means of waste disposal • Recycling volumes in Windhoek	**Chapter 4** Section 4.2.3 and 4.2.4 **Chapter 6** Section 6.2.4
• Annual average number of people affected by floods in Namibia • History of drought events in Namibia from 2003 to 2019 • Annual severe drought likelihood • Possible climate change effect on GDP per sector • Major epidemics over the past 20 years • Distribution of suspected and confirmed COVID-19 cases by district • National emissions, removals and net removals • Emissions per sector	**Chapter 4** Section 4.2.1 **Chapter 5** Sections 5.2.1, 5.2.2 and 5.2.3
• Total fish harvest • Status of marine life • Terrestrial and marine protected areas • Percentage contribution to GDP of agriculture, forestry and fishing	**Chapter 2** Section 2.4.1 **Chapter 3** Sections 3.5.1 and 3.6.1

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Sustainable Development Goals (SDG)	SDG indicators
Goal 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	• Progress towards sustainable forest management • Proportion of traded wildlife that was poached or illicitly trafficked • Proportion of land that is degraded over total land area
Goal 16 Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Number of victims of intentional homicide per 100,000 population, by sex and age.
Goal 17 Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	• Total government revenue as a proportion of GDP, by source • Net official development assistance, total and to least developed countries, as a proportion of the Organization for Economic Cooperation and Development (OECD) Development Assistance Committee donors' gross national income (GNI)

Indicators used in this report	Reference
• Increase in community forests • Number and location of Namibia's community forests in 2018 • Areas under various kinds of conservation management • Terrestrial and marine protected areas • Terrestrial biomes • Contributions to the protection of major biomes • Number of species and level of endemism • Number of rhino's and elephants poached • Percentage contribution to GDP of agri, forestry and fishing • Total annual cost of LD • Cost of LD as % of GDP • Trends in national biodiversity expenditure over time	**Chapter 2** Section 2.4.1 and 2.2.4 **Chapter 7** Section 7.2.1
• GEF funding and number of projects • USAID funding trends • 2018 Ibrahim index of African Governance • Number of MEA's • Number of MEA's since 2004	**Chapter 7** Sections 7.2.1 and 7.2.2

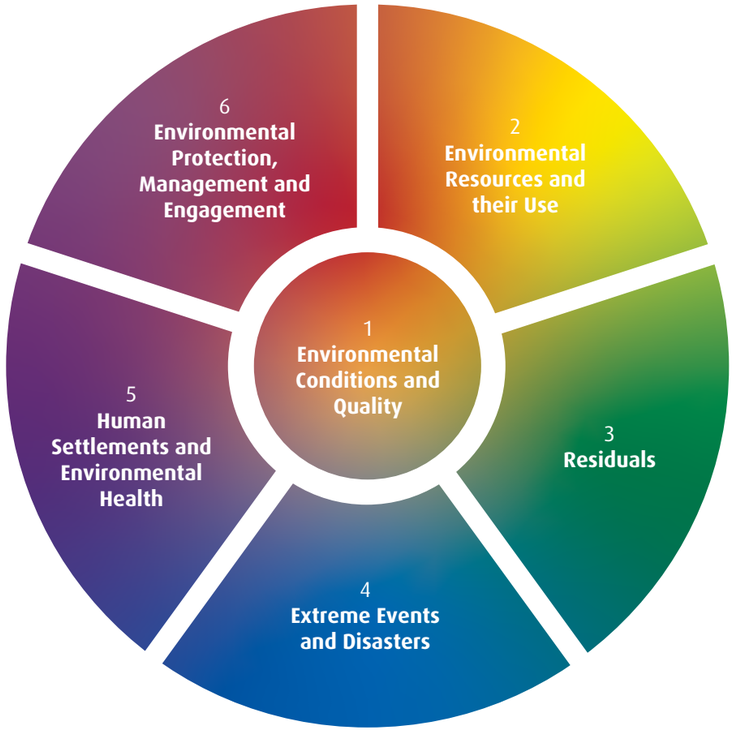
Solar panel at Gobabeb Research Station | Klemens Riha

APPENDIX B

DPSIR ALIGNMENT

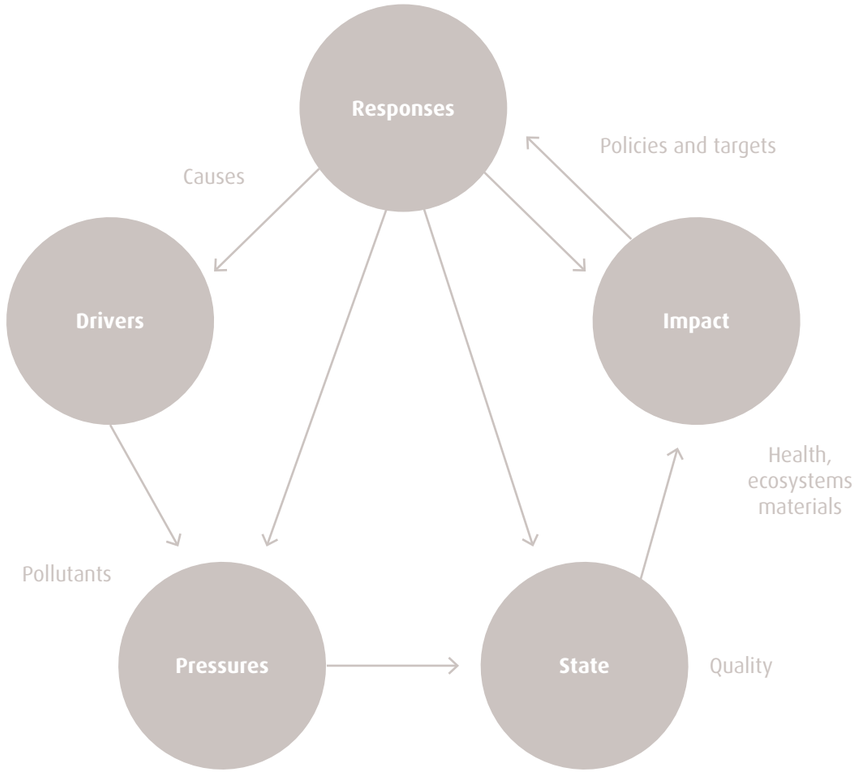
Framework for the Development of Environment Statistics (FDES)

The Framework for the Development of Environment Statistics (FDES 2013) is a flexible, multi-purpose conceptual and statistical framework that is comprehensive and integrative in nature. It marks out the scope of environment statistics and provides an organizing structure to guide the collection and compilation of environment statistics at the national level. It brings together data from the various relevant subject areas and sources. It is broad and holistic in nature, covering the issues and aspects of the environment that are relevant for policy analysis and decision making by applying it to cross-cutting issues such as climate change.



DPSIR Framework

The DPSIR Framework as described by Kristensen (2004) is an analytical framework that is based on the causal relationship between its D-P-S-I-R components. Driving forces are the socioeconomic and sociocultural forces driving human activities, which increase or mitigate pressures on the environment. Pressures are the stresses that human activities place on the environment. State, or state of the environment, is the condition of the environment. Impacts are the effects of environmental degradation. Responses refer to the responses by society to the environmental situation. Describing the causal chain from driving forces to impacts and responses is a complex task, and tends to be broken down into sub-tasks, e.g. by considering the pressure-state relationship.



General comparison of the two frameworks

It is often difficult, however, to distinguish human and natural stressors on the environment, and it is even more challenging to link a particular stressor to a specific impact. In the natural world, each process and state influences and is influenced, making it difficult to separate pressure, state and response. Nevertheless, the DPSIR framework facilitates consistent handling of information and avoids gaps in assessment and analysis. As such, it is useful for grouping and reporting existing data and indicators.

While adopting certain concepts of the DPSIR framework, the FDES does not apply its causal sequence as an organizing principle. However, the statistical topics of the FDES can be rearranged according to the logic of the DPSIR framework.

Framework for the Development of Environment Statistics (FDES)
Component 1 | Environmental Conditions and Quality
Subcomponent 1.1 Physical Conditions • Atmosphere, climate and weather • Hydrographical characteristics • Geological and geographical information • Soil characteristics
Subcomponent 1.2 Land Cover, Ecosystems and Biodiversity • Land cover • Ecosystems and biodiversity • Forests
Subcomponent 1.3 Environmental Quality • Air quality • Freshwater quality • Marine water quality • Soil Pollution • Noise

DPSIR Framework	
This forms part of the State and Impact element in DPSIR	**Chapter reference**
As a result of pressures, the 'state' of the environment is affected; that is, the quality of the various environmental compartments (air, water, soil, etc.) in relation to the functions that these compartments fulfil. State elements that feature both in the DSIR and FDES include amongst other things soil quality (national, local, natural areas, agricultural areas), soil use, ecosystems (biodiversity, vegetation, soil organisms, water organisms), air quality (national, regional, local, urban, etc.) and water quality (rivers, lakes, seas, coastal zones, groundwater).	Chapter 2

...table continued on following page

Component 2 | Environmental Resources and their Use
Subcomponent 2.1 Mineral Resources • Stocks and changes of mineral resources • Production and trade of minerals
Subcomponent 2.2: Energy Resources: • Stocks and changes of energy resources • Production, trade and consumption of energy
Subcomponent 2.3 Land • Land use • Use of forest land
Subcomponent 2.4 Soil Resources
Subcomponent 2.5 Biological Resources • Timber resources • Aquatic resources • Crops • Livestock • Other non-cultivated biological resources
Subcomponent 2.6 Water Resources • Water resourcesw • Abstraction, use and returns of water
Component 3 | Residuals
Subcomponent 3.1 Emissions to Air • Emissions of greenhouse gases (GHGs) • Consumption of ozone depleting substances (ODSs) • Emissions of other substances
Subcomponent 3.2 Generation and Management of Wastewater • Generation and pollutant content of wastewater • Collection and treatment of wastewater • Discharge of wastewater to the environment
Subcomponent 3.3 Generation and Management of Waste • Generation of waste • Management of waste
Subcomponent 3.4 Release of Chemical Substances

Environmental Resources form part of the Driving force, Pressure and State elements in DPSIR	Chapter reference
There are various 'Driving force' elements which effect Environmental Resources and their Use. A 'driving force' is a need - directly impacting environmental resources and their use. Some examples include population (number, age structure, education levels, political stability), transport (persons, goods; road, water, air, off-road), energy use (energy factors per type of activity, fuel types, technology), power plants (types of plants, age structure, fuel types), industry (types of plants, age structure, resource types), refineries/mining (types of plant/mines, age structure), agriculture (number of animals, types of crops, stables, fertilizers), landfills (type, age), sewage systems (types), non-industrial sectors and land use. While example of the state elements are soil quality (national, local, natural areas, agricultural areas), soil use, ecosystems (biodiversity, vegetation, soil organisms, water organisms), air quality (national, regional, local, urban, etc.) and water quality (rivers, lakes, seas, coastal zones, groundwater). Moreover pressure on the envrionement include sectoral water use, agriculture, industry, households and tourism.	Chapter 3
Residuals form part of the Pressures and State elements within the DPSIR	**Chapter reference**
Human activities exert 'pressures' on the environment, as a result of production or consumption processes, which can be divided into three main types: (i) excessive use of environmental resources, (ii) changes in land use, and (iii) emissions (of chemicals, waste, radiation, noise) to air, water and soil. Pressures that feature both in the DSIR and FDES frameworks as residuals include amongst other things emissions (per driving force for numerous compounds), direct emissions to air, water and soil, indirect emissions to air, water and soil, production of waste, production of noise, radiation, vibration and hazards (risks). Some examples of state elements are the chemical composition of water in rivers, lakes and marine waters, nitrate in groundwater, organic matter in rivers and chlorophyll in lakes and marine waters.	Chapter 4

Component 4 | Extreme Events and Disasters
Subcomponent 4.1 Natural Extreme Events and Disasters • Occurrence of natural extreme events and disasters • Impact of natural extreme events and disasters
Subcomponent 4.2 Technological Disasters • Occurrence of technological disasters • Impact of technological disasters
Component 5 | Human Settlements and Environmental Health
Subcomponent 5.1 Human Settlements • Urban and rural population • Access to selected basic services • Housing conditions • Exposure to ambient pollution • Environmental concerns specific to urban settlements
Subcomponent 5.2 Environmental Health • Airborne diseases and conditions • Water-related diseases and conditions • Vector-borne diseases • Health problems associated with excessive UV radiation exposure • Toxic substance- and nuclear radiation-related diseases and conditions

Response, Pressure and Impact elements in DPSIR	Chapter reference
The 'impact' element features the extreme events and disasters through changes in the physical, chemical or biological state of the environment which determine the quality of ecosystems and the welfare of human beings. A prime example is climate change induced droughts. Responses to disaster and extremem events include drought, flood and climate change policies and regulation.	
Driving force, Pressure and Impact elements in DPSIR	**Chapter reference**
Human settlement form part of the driving force and pressures elements - the need for resources to fulfil their livelhoods through amongst other things shelter, food and water, while examples of secondary driving forces are the need for mobility and entertainment and culture. This may result on in an 'impact' on the environmental health. A few examples of these impacts include the presence of toxic substance- and nuclear radiation-related diseases or airborne diseases and conditions.	Chapter 6

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Component 6 | Environmental Protection, Management and Engagement
Subcomponent 6.1 Environmental Protection and Resource Management Expenditure • Government environmental protection and resource management expenditure • Corporate, non-profit institution and household environmental protection and resource management expenditure
Subcomponent 6.2 Environmental Governance and Regulation • Institutional strength • Environmental regulation and instruments • Participation in MEAs and environmental conventions
Subcomponent 6.3 Extreme Event Preparedness and Disaster Management • Preparedness for natural extreme events and disasters • Preparedness for technological disasters
Subcomponent 6.4 Environmental Information and Awareness • Environmental information • Environmental education • Environmental perception and awareness • Environmental engagement

Response element in DPSIR	Chapter reference
A 'response' by society or policy makers is the result of an undesired impact and can affect any part of the chain between driving forces and impacts. An example of a response related to driving forces is a policy to change mode of transportation, e.g from private (cars) to public (trains), while an example of a response related to pressures is a regulation concerning permissible SO2 levels in flue gases. Within the FDES the regulatory environment regarding environmental protection, management and engagement is a crucial component of the response element.	Chapter 7

We as Africans must be willing and ready to give each other a helping hand in every way that we can.

DR SAM NUJOMA

Quiver tree | Eric Deschaintre