IWRM Plan 2020–24

Integrated Water Resources Management Plan for the Cuvelai River Basin

July 2019

Acknowledgements

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Drawing up the IWRM Plan would not have been possible without the enthusiastic support of many stakeholders who represented government and civil society on both sides of the border. Through well-attended meetings and workshops in Ondjiva, Ondangwa and Ongwediva a wide range of issues and concerns were tabled and discussed to ensure that the resultant IWRM Plan could be responsive to stakeholder concerns.

Photographs, unless otherwise stated, were taken by Stuart James Arnold, on commission by GIZ.

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Foreword

Integrated Water Resources Management (IWRM) has been recognised worldwide as the way forward for sustainable water resources management. IWRM aims to result in more holistic and coordinated management of water resources systems to support people, the economy and natural ecosystems.

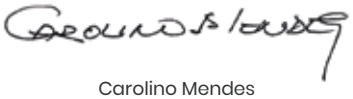
The Governments of the Republic of Angola and the Republic of Namibia have recognised the need for a holistic approach and cooperation in management of the Cuvelai River Basin by establishing the Cuvelai Watercourse Commission (CUVECOM). Through an agreement signed by the Member States in 2014, CUVECOM has undertaken to serve as an advisor to the Cuvelai Member States on matters relating to the equitable and reasonable utilization, sustainable development and efficient management of the water resources of the Cuvelai Watercourse.

The Cuvelai River Basin faces serious water resource management challenges. There have been no joint coordinating institutions to ensure that government, the private sector and other stakeholders talk with one another to encourage common understanding and joint efforts. Hydrological and climatological monitoring networks are weak, and an effective drought and flood monitoring system is much needed. Managers need to learn more about existing groundwater resources, and how to match the growing demand for water with supply. Pollution is a threat: increasing skills and knowledge related to water quality are a priority. All the needs of society and the economy must be better understood to ensure that water resources management meets those needs.

Taking into account the urgency of addressing these needs and challenges in water resources management, development and use, CUVECOM has developed its first basin-wide IWRM plan. The plan will serve as a road map, enabling the Member States to begin implementing the actions that will lead to economic efficiency, equity and environmental sustainability in basin water resources management and development.

Member States have envisaged implementation of this IWRM plan as a flexible and dynamic process to achieve the agreed Cuvelai basin vision: "A sustainably managed basin with a secure, resilient and prosperous population by 2040 and beyond". Working closely with basin stakeholders, the IWRM planners have developed strategic objectives meant to attain this vision of: i) sustainable development and integrated management, ii) safety, resilience, and adaptive capacity management iii) better livelihoods, iv) cooperation between Member States and good governance, and v) water resources security.

CUVECOM looks forward to working hand in hand with its Member States to ensure that the Integrated Water Resource Management Plan becomes well understood and well-known - a living tool - put to good use to guide all programmes and projects relevant to management of the basin water resources.



Carolino Mendes
CUVECOM Co-Chair, Angola

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Photo 1: In its upper reaches the Cuvelai River provides a source of water all the year round. Photo by Stuart Arnold, January 2019

Section 1

Introduction

The IWRM Plan sets out CUVECOM's Vision for the Cuvelai River basin and the wide-ranging actions that will be required to address the various challenges and best exploit the many opportunities available.

While CUVECOM will play a leading role in coordinating and promoting the IWRM Plan, its successful implementation will depend on the efforts of many stakeholders on both sides of the border, as well as the continued willingness of both countries to work together.

It is important to stress that the plan focuses on defining and prioritising only CUVECOM's actions and activities over the next five years. To do this, however, it has been necessary to develop a holistic plan within the spirit of IWRM, even though the majority of actions and activities in the plan are seen as planned, prioritised, and carried out at the national level by the national and locally-based institutions of each country without significant involvement of CUVECOM.

An Advisor and Guide

The objectives and functions of CUVECOM are provided in Article 4 of the CUVECOM Agreement, where it is stated that CUVECOM, "...shall serve as an advisor to the Parties on matters relating to the equitable and reasonable utilization, sustainable development and efficient management of the water resources of the Cuvelai watercourse and shall perform other functions pertaining to the integrated water resources management in the Cuvelai Watercourse as the Parties may agree to assign to the Commission". It should be stressed that "watercourse" is defined in the Agreement (Article 1) as including both surface and ground water systems as a unitary whole.

The Commission is, then, primarily a technical advisor, not an implementer. Although transboundary actions may be carried out jointly by both countries, implementing will usually be carried out by the individual countries, whether by national, regional level, or local entities. It is CUVECOM's responsibility to see that actions at all levels are mutually supportive and complementary. It will also play the leading role in facilitating and coordinating implementation of this plan.

The aim in development of this plan has been provision of convincing and integrated advice, where the reasons for various proposed actions can be easily understood within the development and management context of the basin and its peoples. The plan fits both within the frameworks of existing regional and national development plans and strategies, and reflects a broader and longer-term view.

An important point addressed in this plan is the role that CUVECOM should play with respect to its implementation. Although not an implementing agency, CUVECOM will be responsible for management of many transboundary elements of the plan, and will play a leading role in monitoring and evaluating progress made towards the future vision of the basin. It will also play a central brokerage role in ensuring that feedback from stakeholders is taken into account as the plan is reviewed and updated.

Photo 2: The Cuvelai River system in flood.
Photo by Helge Denker, March 2011

Section 2

Context and Objectives

General Context and Rationale

The Cuvelai Basin, a transboundary wetland area shared by Angola and Namibia, consists of hundreds of drainage channels, called iishana, many of which are dry for most of the year, but prone to extensive flooding during the rainy season. The channels flow from north to south, from the southern Angolan highlands to Namibia's Etosha pan. The Cuvelai is an endorheic basin with all its water converging into the Omadhiya Lakes and Etosha Pan, or evaporating along the way.

The Cuvelai River basin is very dry, prone to both floods and drought and supports a large rural population whose livelihoods are, in most cases, directly dependant on agriculture and the availability of water. This means that the people of the basin are vulnerable to the highly variable nature of the climate. This is amplified by increasing population pressures and climate change.

Figure 2.1: The Cuvelai River basin

Responding to Disasters and Demand

The need for the comprehensive monitoring of climate and water resources and the sharing of information has never been greater, as also the need to improve systems that can provide early warning of climate-related disasters. Other measures and interventions such as rainfall and flood water harvesting, and more and better planned groundwater abstraction are required to fill the increasing gap between water demands and water availability.

All of these require a coordinated, integrated and sustainable approach to planning and implementation. This plan is aimed at providing a comprehensive point of departure to make this possible.

The Cuvelai Basin covers approximately 160,000 km2 and is home to 1.2 million people. Despite the high flood risk, the population density is relatively high, at least compared to surrounding areas, and other rural areas in Southern Africa.

Relatively fertile soils and the availability of freshwater due to shallow aquifers have made the Cuvelai an attractive settlement area. Transboundary relations and linkages are strong among the basin population, both in the social sphere where a single tribal group, the Ambó or Owambo people, have traditionally dominated the landscape on both sides of the border, and in economic terms through formal and informal trade.

Existing Transboundary Ties

Transboundary cooperation at the governmental level is already high, especially since the construction in the early 1970s of the Calueque–Oshakati Canal, which transfers water from the Calueque Dam in Angola to Oshakati (and many other settlements along the way) in Namibia, where it is treated and used as drinking water, for livestock feeding, and irrigation. It is anticipated that existing social and economic transboundary linkages will facilitate the further development of CUVECOM, and generally help create favourable conditions for increased transboundary cooperation.

A recent GIZ financed scoping study for the Cuvelai River basin established a series of institutional and technical recommendations for actions that would support the ongoing development of CUVECOM. Among the institutional recommendations were (i) the need to improve knowledge management, which can be achieved through development of a knowledge sharing platform and (ii) the need for a visioning process and the development of a joint IWRM Plan. The CUVECOM work plan for 2018 includes development of a joint five-year IWRM Plan for the Cuvelai River Basin.

Photo 3: Water transported by canal and pipeline from the adjacent perennial Kunene River provides a lifeline for thousands of people. Photo by Stuart Arnold, January 2019

Scope, Objectives and Importance of The Plan

Preparatory work for the IWRM Plan started only a few years ago with the GIZ-supported Scoping Study for Enhancement of Transboundary Water Management in the Cuvelai River Basin in 2015, following the signing of the CUVECOM Agreement. This important study provided an analysis of the biophysical and socio-economic conditions in the basin and, while largely based on existing documentation, also involved stakeholders in several group discussion exercises aimed at identifying the key issues and challenges acting as barriers to sustainable socio-economic development in the basin. The Rapid Assessment, therefore, provides a starting point for the IWRM Planning process.

The overall objective of the CUVECOM basin-wide IWRM Plan is to provide a framework for sustainable development and management of water and associated natural resources of the Cuvelai River basin, to move towards an agreed vision for the basin, and to fulfil its associated strategic objectives.

As stated in the CUVECOM Agreement, the Commission is neither a policy maker nor an implementer. It is rather supposed to provide advice and make recommendations on a wide range of matters including:

- The collection, evaluation and dissemination of data and information
- The establishment of joint early warning systems
- Available yield of the system and the equitable and sustainable use of this yield
- Investigations and studies supporting the coordinated and harmonised management and development of the river system
- Dispute resolution
- Stakeholder consultation and participation.

Clearly, the Commission needs to be in a position to provide advice for these and other areas, based on an integrated and scientifically sound understanding of how best to manage and develop the basin's water resources, at both transboundary and national levels. The plan can be seen as a consolidated and integrated summary of anticipated advice for the next 20 years, with a focus on priority actions over the first five years.

Photo 4: Members of CUVECOM discussing the draft IWRM Plan. Photo by Julius Arnegger, 2018

The basin-wide plan will provide CUVECOM and its stakeholders with a comprehensive and integrated water resources management and development plan for the Cuvelai basin. The plan should:

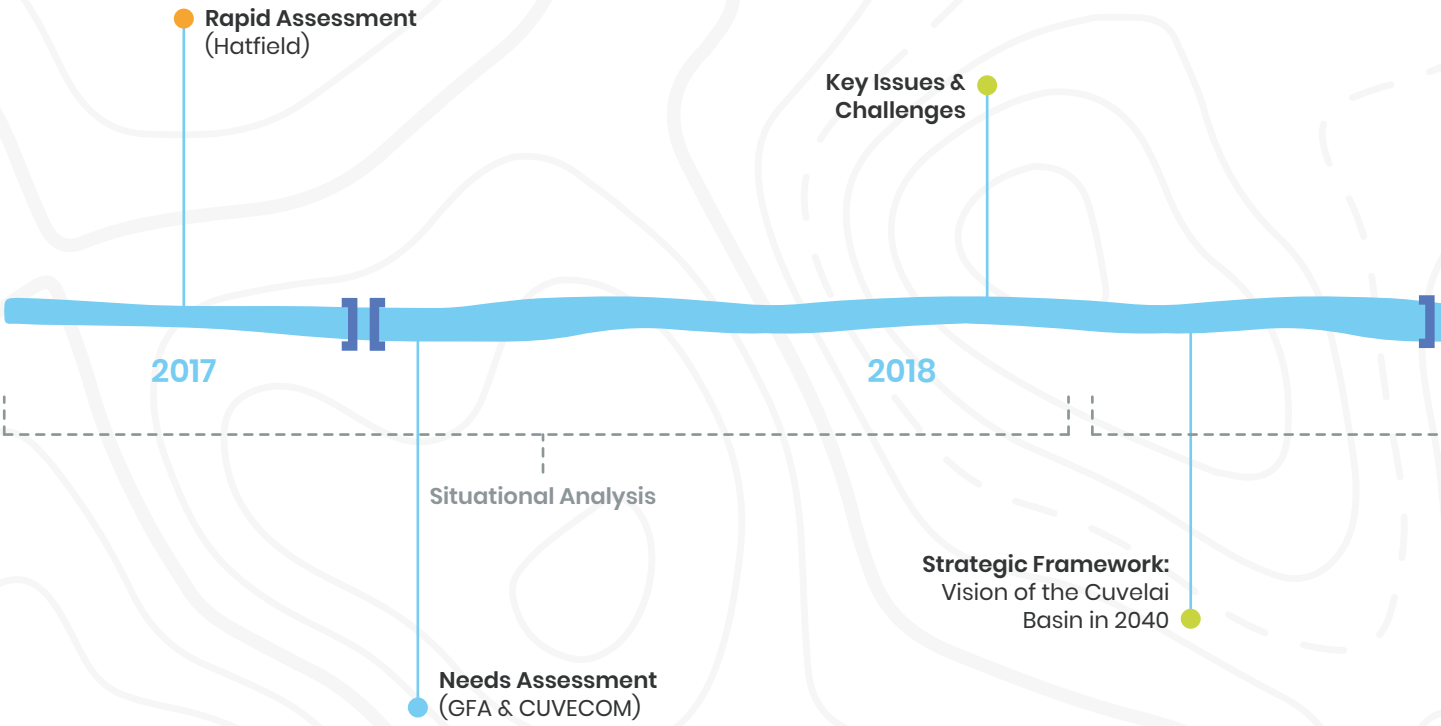
- Provide CUVECOM with a single tool to plan its activities within a greater framework towards agreed goals, including the vision and associated objectives
- Provide a clear basis with a transparent logic, but with allowance for review and adaptation to changing circumstances
- Enhance, clarify and strengthen the role of CUVECOM
- Support efficient and sustainable development of water resources and management of floods and droughts in the interests of the basin's population.

Amongst other things, the IWRM Plan:

- Will set out the short-term and long-term actions necessary to achieve the strategic objectives of CUVECOM, as well as those of the basin states
- Will signify the transition of CUVECOM from an inexperienced institution to a pro-active, technically competent advisor to the Parties as envisaged in the CUVECOM agreement
- Will address the issues and challenges that have been identified by the basin's stakeholders
- Will identify activities to be implemented collectively by all the Parties through CUVECOM, and those that will be implemented separately by the Parties, with CUVECOM activities developed at a higher level of detail
- Will strive to link the water sector with national economic growth and poverty alleviation strategies, recognising that IWRM is not an end in itself but rather a means to achieve economic and social development.

Section 3

The Process: Approach and Methodology



- Desktop Study, review of available literature and data
- Stakeholder Consultation
- Desktop study and stakeholder consultation

Approach and Methodology

The process for building the plan has been largely stakeholder-driven. The plan has been based on an IWRM-based vision of the Cuvelai basin in 20 years' time and this vision is based on a stakeholder-driven understanding of the issues and challenges that have to be addressed if the resources of the basin are to be properly managed and sustainably developed.

Figure 3.1 shows the process that has been followed to develop the basinwide IWRM Plan for the Cuvelai Basin following the signing of the CUVECOM Agreement in 2014, As indicated in the flow chart, the process has been highly dependent on stakeholder inputs.

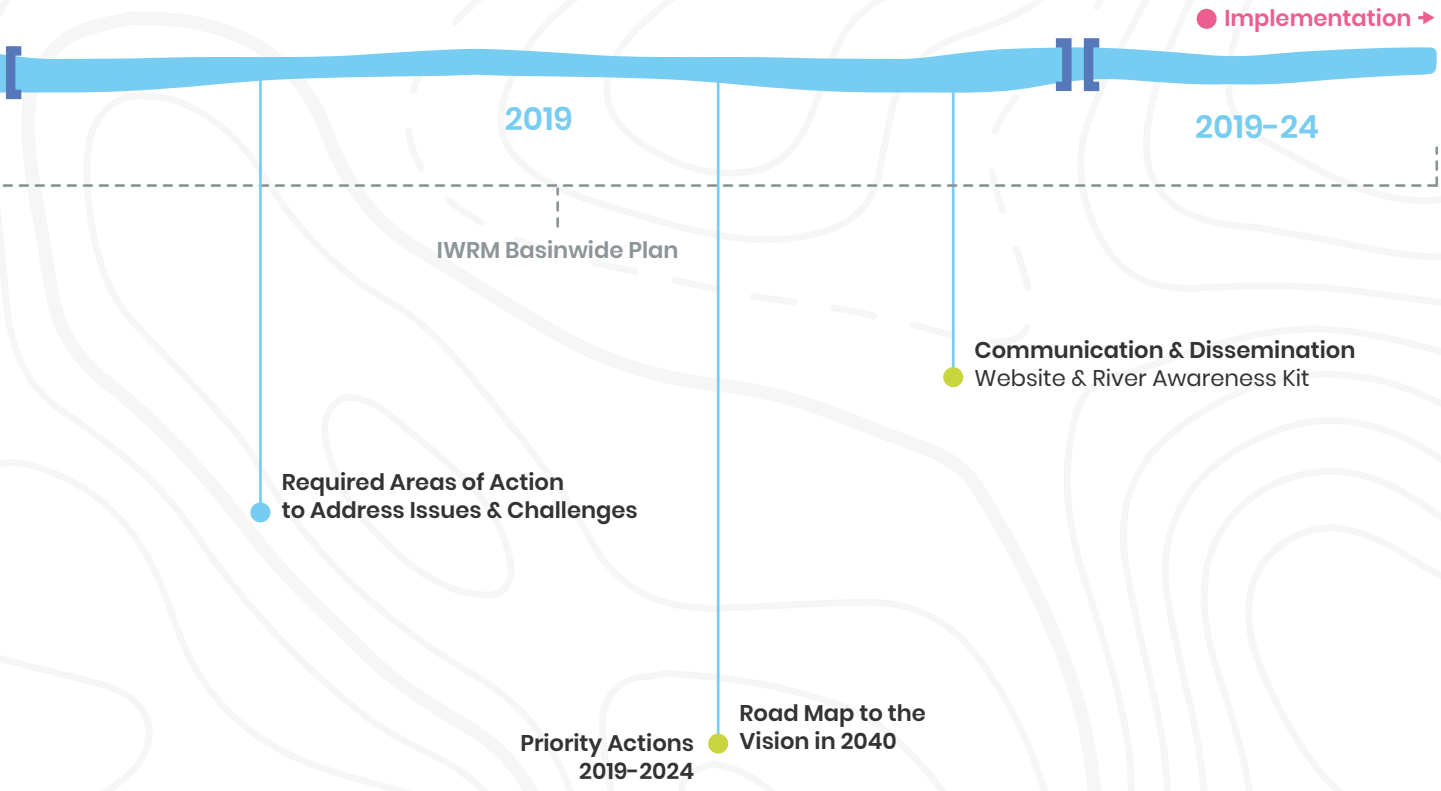


Figure 3.1: Drawing up the IWRM Plan – timeline and milestones

Section 4

The Cuvelai River Basin

Introduction

The aim of this chapter is to provide a rapid overview of the environmental and socio- economic context of the Cuvelai River Basin so that the context of issues and challenges that face the basin's inhabitants and other stakeholders can be properly appreciated. This is an important step towards developing a vision of the basin in which the barriers formed by these issues and challenges are recognised and, where possible, removed.

Environmental and Socio-economic Context

Topography and Geographical Extent of the Basin

As shown in Figure 4.1, the Cuvelai River takes its source in the hills of the northern part of the catchment at over 1100 metres above mean sea level, and more than 400 metres above the rest of the basin, which is otherwise extremely flat. The basin covers an area of about 159,620 km^2 (Mendelsohn & Weber, 2011).

The limits of the basin to the north are easily demarcated due to the relatively steep slopes. Demarcation in other parts of the basin is less obvious, and it is evident from the literature that there are several different basin boundaries in use. Difficulties in demarcation are mainly associated with the extremely flat, and even shifting, topography of the north-western and southern part of the basin. The basin demarcation adopted at this stage is that of the USGS as presented in the Rapid Assessment report (Hatfield Consultants, 2017).

Actions for the Plan: Finalisation of an agreed boundary for the basin taking into account both surface and groundwater.

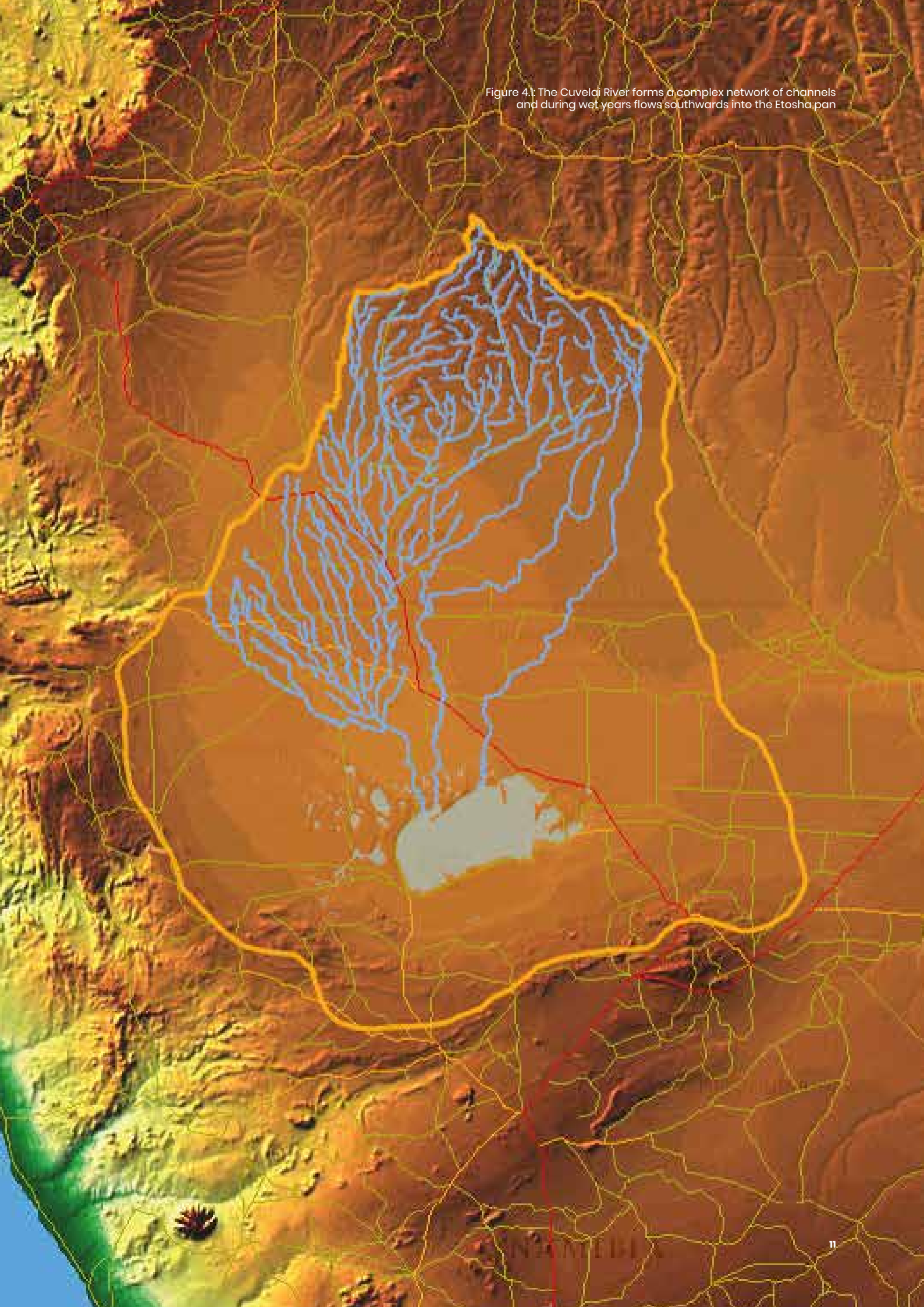


Figure 4.1: The Cuvelai River forms a complex network of channels and during wet years flows southwards into the Etosha pan

Critical need to quantify Groundwater potential

Geology and Soils

The Cuvelai is located in a sedimentary basin known as the Owambo Basin, a sub-division of the much larger Kalahari Basin. The Owambo strata are over 8,000 meters thick, consisting of three main super groups overlying a crystalline basement. It is bordered to the east and south by the Damara Belt, and to the west by a rift complex.

A brief description of the units is as follows:

- **Kalahari** – up to 600 metres thick consolidated and unconsolidated sediments, including silt, sand, gravel, sandstone, limestone and mudstone, all deposited by aeolian and fluvial deposition processes
- **Karoo** – up to 360 metres thick basalt, siltstone, sandstone, shale, coal, and tillite
- **Damara** – up to 8000 metres thick sandstone, siltstone, dolomite, limestone, shale, and phyllite. The unit has been folded and uplifted and is located in the southern and western edges of the Owambo basin
- **Congo Craton** – Meso Proterozoic to Paleo Proterozoic rocks consisting of granite, gneiss, schist, and gabbro.

Photo 5: Tranquil waters of the Cuvelai River in its upper reaches. Photo by Stuart Arnold, January 2019

Some parts of the basin have recently been investigated to define its potential oil and gas reserves, with attention to the Damara super-group. The Kalahari group has been studied for its groundwater supply potential.

The soils of the Cuvelai Basin are shown in Figure 4.2 (Mendelsohn & Weber, 2011). They are primarily weathered, leached, and sandy aerosols, especially in the east and north of the basin. Weakly defined cambisols are found in the west of the catchment, especially the saline Oshana Zone. Lime-rich calcisols are in the Central Zone and Cuvelai Delta zones. Soils are relatively fertile in the Cuvelai although there are some major differences across the basin. The aeolian sands in the east are particularly infertile and the few people in these areas farm on old pans and drainage lines. The best soils are to be found on the higher ground between the drainage channel where a mix of alluvial and aeolian sediments can be found.

Actions for the Plan: Improved mapping and understanding of soils, their potential and linkages with land-use.

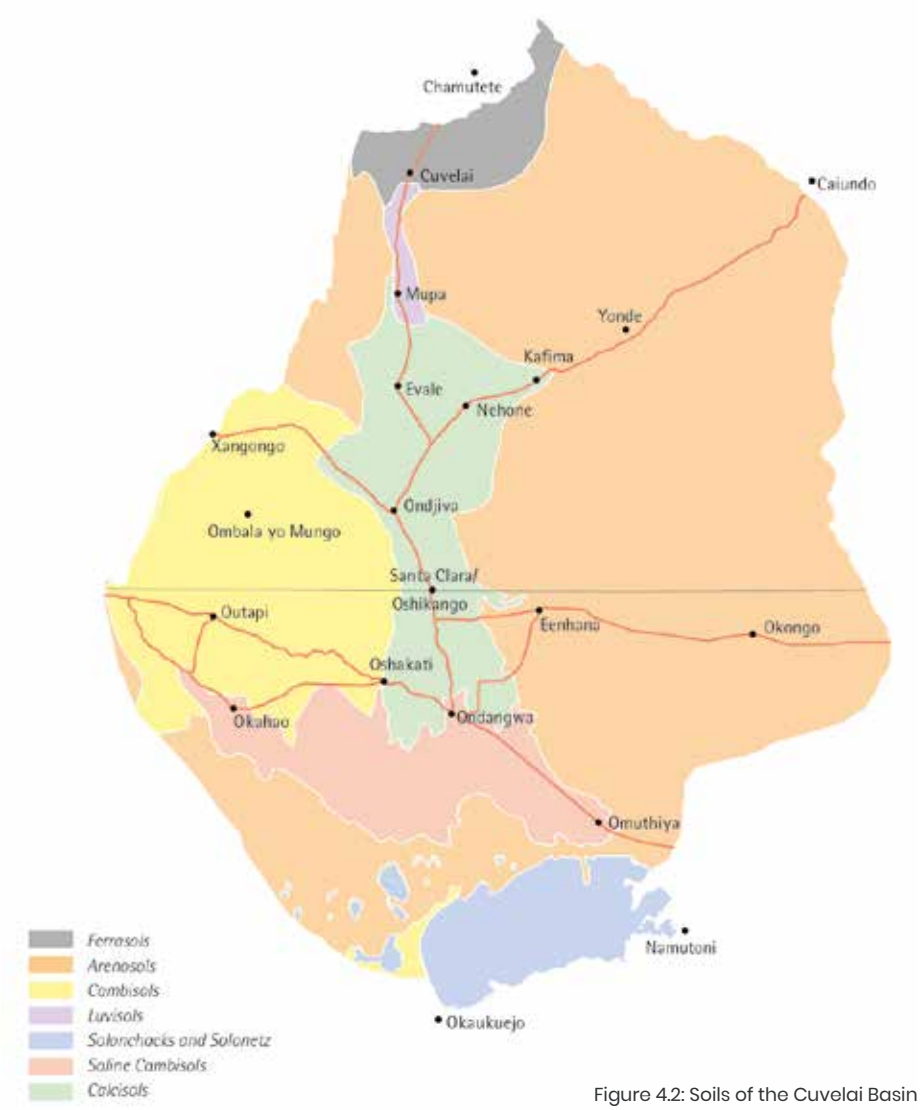


Figure 4.2: Soils of the Cuvelai Basin

Ecology and Landcover

Figure 4.3 presents the ecology and vegetation of the basin in three different ways, the biomes (after WWF), terrestrial ecoregions, and landcover. The basin is dominated by tropical and sub-tropical grasslands, savannas and shrublands. In terms of terrestrial ecosystems, this biome becomes subdivided into the Angolan Miombo woodlands in the higher ground of the northern part of the basin and the Zambezian Baikiae woodlands to the east. The rest of the biome is covered by Angolan Mopane woodlands, apart from a small portion in the south-east, which is classified as Namibian savanna woodlands.

Photo 6: In its upper reaches the Cuvelai River provides a source of water all the year round. Photo by Stuart Arnold, January 2019

The map of land cover included in Figure 4.3 shows broad land cover classes for the basin. Sparse forest and woodland cover the eastern portion of the basin, with some agricultural and barren land across most of the western basin. Landcover closely matches topography and eco-regions, but with marked changes in land use and land cover south of the border.

Photo 7: Fringes of the Etosha salt pan – no inflow from the Cuvelai River in 2019. Photo by Stuart Arnold, January 2019

While some concerns about land degradation, and the impact of land use management practices on biodiversity and ecosystems have been expressed, these ecosystems are generally rich. There is, however, a need to promote measures for protection of the environment and prevention of all forms of environmental degradation arising from utilisation of the resources of the shared watercourse systems. The northern areas of the Cuvelai Basin are considered degraded of bird species, as human encroachment has drastically affected habitats (El Obeid, Mendelsohn, & Roberts, 2000).

Living Wetlands

During periods of good rain, the iishana and pans fill with water and the area is abundant in various species of birds, fish, frogs, and many other small animals. The Cuvelai was once home to buffalo, reedbuck and other wetland mammals, but these species no longer occur there. Migratory routes have been blocked by fencing all around the basin and the Etosha National Park, and as a result, most large mammals can be found only within the Park.

Within Etosha National Park, there are more than 50,000 large herbivores, including zebras, blue wildebeest, and springbok. Elephants, giraffe, black rhinoceros, gemsbok, eland, kudu, steenbok, dik-dik, and black faced impala are also common in the park boundaries. Predators also found within the park include leopards, cheetah, hyena, jackals, fox and lions. The park includes 86 watering-holes, which become hives of activity during dry periods, while during the wet season populations tend to dissipate as water is less scarce. The Omadhiya lakes, the Cuvelai iishana and Etosha Pan are regarded as wetlands of national and global importance, and as such, were designated as a Ramsar site in 1995.

The Cuvelai Basin is an especially important bird nesting location, with more than 400 species recorded in Etosha National Park. The largest number of birds is found in the summer period (October to April) as the Etosha Pan is full of water and many nesting birds migrate to hatch their young, adding to the already significant number of birds that inhabit the Pan throughout the year. Birds such as pelicans and flamingos migrate from all over Southern Africa to the pan to feed and breed (Mendelsohn, El Obeid, & Roberts, 2000).

Figure 4.3: Biomes, terrestrial ecoregions and land cover of the Cuvelai River basin

Like the pans, the iishana system sees its highest levels of bird life during high water flows, which can be separated by months or years. Thus, extended high flow periods result in the highest and greatest concentration of avifauna activity.

The Cuvelai Basin is also home to many different species of fish with 12 species known to inhabit the iishana, and another 35 species that have entered the system through linkages between the Cuvelai and Kunene river systems. Many of these species only move into the basin channels during periods of flooding, while some species remain dormant in the substrate, only emerging when the iishana or pans are inundated.

Actions for the Plan: Improved mapping and understanding of ecology and vegetation and nature and magnitude of change over time.

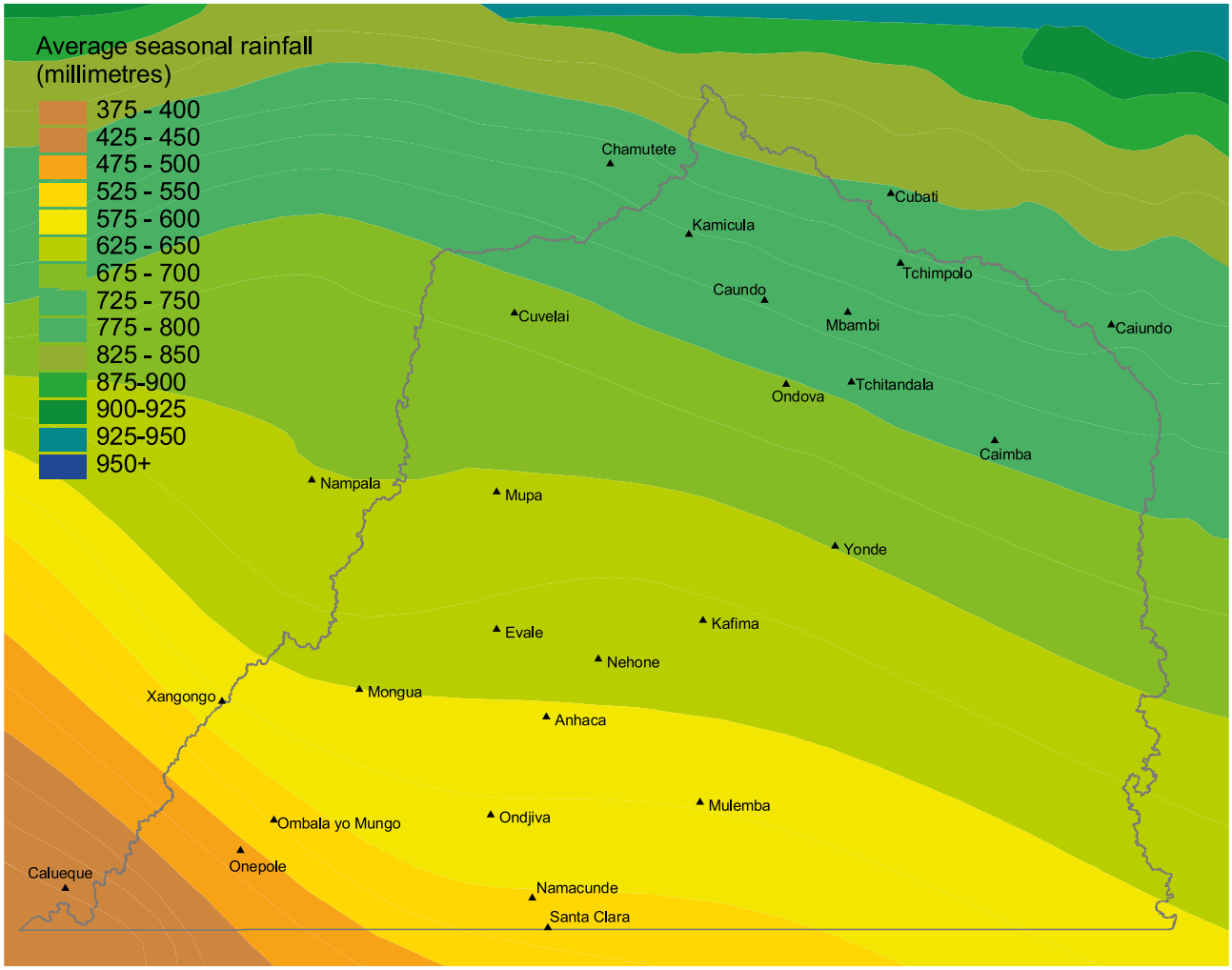


Figure 4.4: Average annual precipitation in the northern part of the catchment.

Climate and Water Resources

Precipitation

Precipitation in the Cuvelai Basin is controlled by the Intertropical Convergence Zone (ITCZ), and its migration throughout the year. The ITCZ is a band of low pressure circling the globe near the equator, caused by solar heating. It brings moisture to areas of the basin by drawing moisture from the Indian Ocean, and upwelling air releases moisture as it cools. In the wet season, the ITCZ is located over the basin, but in the dry season, the ITCZ migrates northwards.

Rainfall distribution, intensity, and duration are finely balanced in the Cuvelai Basin; too little rainfall can easily lead to drought conditions, and too much leads to flooding. The severity of floods is determined by the location, intensity, and duration of rainfall. Most flood waters cross the border as surface water discharge in the iishana region, spreading south through the shallow oshana channels, and the main Cuvelai channel.

Average annual precipitation decreases from more than 1000mm/a in the source areas of the basin to less than 500mm in the southern part. Even in the northern half of the basin, precipitation falls to around 550mm at the Angola/Namibia border, as shown in Figure 4.4.

Both inter-annual and intra-annual variability are high and increase with reducing rainfall. Precipitation extremes on the Angolan side of the Cuvelai have been calculated and mapped (República de Angola 2016a). For example, the 24-hour precipitation event with a one year return period is estimated at 60-90 mm, and for the 50 year return period at about 90-130 mm. Lower values would be expected in the lower rainfall areas. The wet season lasts roughly from December to March, when about 83% of the annual precipitation falls, and the dry season lasts from roughly April to October, when only 9% of the annual precipitation falls. However, there is significant variability in duration, intensity, and distribution.

Temperature and evapotranspiration

The hottest time of the year is during the months of October and November, just before the rainy season when daily maximum temperatures are between 35 and 40°C. Winter temperatures are lower in the south but everywhere in the basin is generally mild. Evapotranspiration patterns are the inverse of temperature and rainfall with an increase from north to south. In the middle of the basin potential evapotranspiration is more than three times greater than average annual rainfall.

Surface water runoff

The Cuvelai is an iishana system: a collection of ephemeral rivers, shallow pans, and wetlands. The lack of relief, seasonality of precipitation, and relatively impermeable soils contribute to episodic flooding. During floods, water flows for hundreds of kilometres from the north in Angola into the Etosha Pan, where it eventually evaporates. Iishana are dry most of the time, especially in the east of the basin. Flow is more regular over the northern and western portions of the catchment, especially the Mui and Cuvelai rivers, and the Oshana Zone (Mendelsohn & Weber, 2011) The Oshana Zone is particularly saline, since the channels are broad, and evaporation occurs efficiently. Water in the northern Cuvelai and Mui tends to be fresher, since precipitation is greatest in the northern portion of the catchment, and runoff occurs rapidly. The natural hydrologic regime has been highly modified by large-scale water diversions, extensive land use, and small-scale collection and storage of flood water.

The hydrologic regime of the Cuvelai Basin is highly variable within and between years because of varying precipitation patterns, geology, and soil. Perennial flow is limited to the north and west of the catchment. The central area of the Angolan portion of the Cuvelai River Basin, including the Cuvelai Delta, the Central Drainage, and Central Pans, features largely nonperennial flow, with flooding following high intensity rainfall events, except during drought periods. The ishana region, which extends approximately 140 km from the southwestern-most area of the Angola portion Cuvelai River Basin, into Namibia, with non-perennial flow usually restricted to the iishana themselves, which are less prone to flooding compared to the central drainage area.

Estimates of runoff volumes generated in the Cuvelai system vary. Estimates place outflow at between 100 and 150 million cubic metres per year which correspond to a unit runoff of less than 1mm per year. However, it is important to stress that the variation from year to year is large. In some years virtually no water reaches the Etosha Pan, while in others is may be several times the mean annual runoff.

It is important to stress that accurate information for rainfall and water resources, both surface and groundwater is lacking. Any data cited should be treated with caution. The water resources of the basin have never been adequately monitored and the current climate information network remains inadequate.

Photo 8: Small floodwater storage ponds constructed along the edges of the Cuvelai River so that the water lasts a few months longer. Photo by Stuart Arnold, January 2019

Photo 9: Balancing reservoir, part of the Calueque-Oshakati water transfer scheme. Photo by Stuart Arnold, January 2019

The natural hydrology of the Cuvelai system has been significantly modified by dams, diversions, transfers, and other human modifications. Most significant of these is the water transfer from the adjacent Kunene River. Water is pumped from Calueque Dam in Angola into the Olushandja Dam (capacity of 42.3 million cubic metres) in Namibia, and then conveyed further into the Cuvelai catchment via pipelines and canals.

Annual abstractions have ranged from 56 to 85 million cubic metres per year, generally increasing over time. The bilateral Third Water Use Agreement allows for a maximum withdrawal of 180 million cubic metres per year into Namibia, potentially around 15% of the Cuvelai system's own mean annual runoff.

Groundwater

Groundwater is an important water resource in the basin, although currently relatively underused. At present, groundwater is abstracted mainly from the Ohangwena Kalahari Aquifer and the Discontinuous Perched Aquifer - where fresh water is only found in certain parts of the aquifer, by means of boreholes. Shallow wells, known as omithima, and deep wells, known as oondungu, are used to supply water, especially to isolated villages in the basin. In the rural areas in the Angolan part of the basin, the majority of people depend on traditional wells, especially eendungu wells, which can be as much as 20 metres deep (see Photo 10). These are critical to survival, especially during the dry season. The underground water system in the Tsumeb sub-basin on the southern fringes of the basin is known as the Karst Aquifers, water bearing structures in dolomite rock formations.

Below Ground: Sinkholes, Caves & Buried Lakes

There is a large water filled cave, Dragon's Breath Cave, and sinkholes filled with water formed when the roof of an underground cave collapsed, namely the lakes at Otjikoto and Guinas.

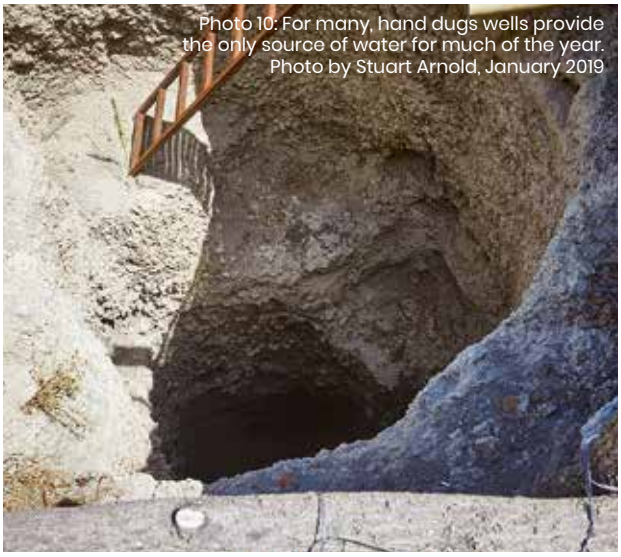


Photo 10: For many, hand dugs wells provide the only source of water for much of the year. Photo by Stuart Arnold, January 2019

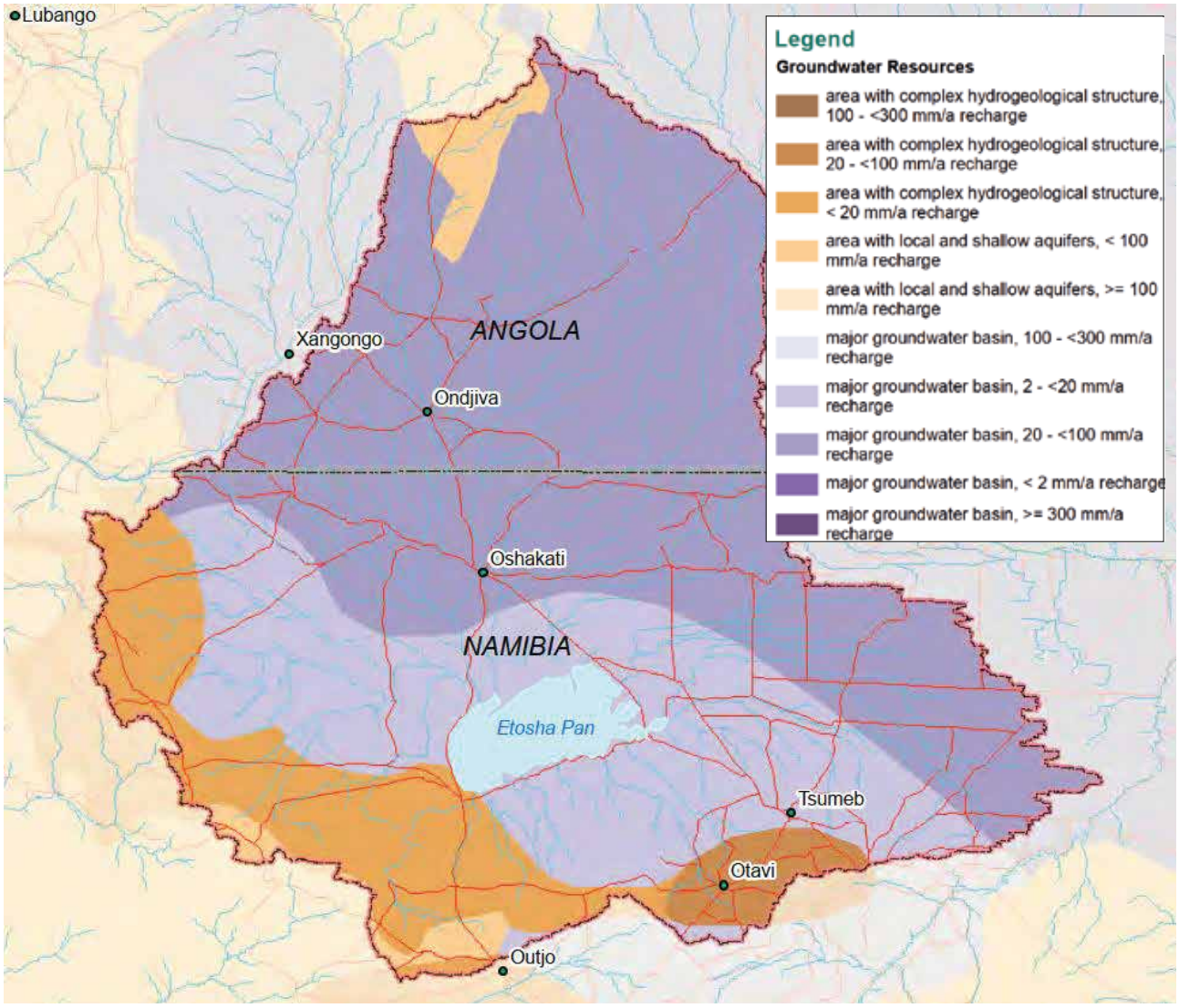


Figure 4.5: Aquifers underlying the Cuvelai Basin

There are six main aquifers defined within or overlapping with the basin as shown in Figure 4.5. Five of the aquifers are located within the Kalahari sequence, and one is located within the Damara sequence. The Karoo sequence acts as aquitard between the Damara and Kalahari units although, in some isolated areas, groundwater can be extracted from this unit. Many of the aquifers are multi-layered including the Otavi Dolomite Aquifer located in the Damara sequences.

Of these aquifers, only the Otavi Aquifer at the southern fringes of the basin, has consistently fresh water. Of the others, both the Oshivelo multi-layered Aquifer and the Ohangwena Multi-layered Aquifer have water ranging from fresh to brackish and potentially significant yields of between 25 and 200 m^3/hr. As with surface water, groundwater resources are generally not well quantified.

A more recent development is the investigation of the Ohangwena II Aquifer. Work carried out in 2012 (BGR, 2012) saw three drilling campaigns proving the extension of the deep seated freshwater body of the Ohangwena II aquifer. A thick confining layer caps the highly pressurized aquifer. Water quality is fresh with increasing values for salinity towards the centre of the Cuvelai-Etosha depression. According to Namibian and international standards, fluoride and arsenic concentrations are generally too high for drinking water use, so treatment or mixing of water would be required before using as drinking water. Further general investigations are required.

In the Angolan portion of the basin there is ongoing drilling investigation and borehole devleopment. Information is stored at the Angola Institute of Geology in Lubango (IGEO).

Photo 11: Much of Oshakati lying under flood waters. Radarsat image, March 2009

Flood and drought

Exceptionally high flows are known as *efundjas*. Since since 1941, floods have occurred in 1950, 1954, 1957, 1971, 1976, 1977, 1995, 2004, 2008-2011, and 2017. There have therefore been significant periods when no significant floods occurred, as well as periods when there were several over a short space of time. The Cuvelai River basin has recorded several significant seasonal floods since 2008, with substantial flood waters experienced across the central basin in March 2017.

Photo 12: Extensive flooding caused major damage in 2011. Photo by Helge Denker, March 2011

The flood waters of March 2017 caused numerous impacts on rural livelihoods, some positive, but mostly negative, with the greatest impact felt by vulnerable communities with limited means to prepare for, respond to, and survive these events (Shifidi, 2016). Poorer households are often situated in areas more susceptible to flooding and their dwellings constructed from materials less resistant to flooding. This can contribute to a higher likelihood of loss of assets.

Apart from the security risks posed by the actual floods to the basin's inhabitants, local livelihoods are threatened in the following ways:

- **Property** – damage to assets such as homes and property lead to reduced livelihood capacities, as does any damage to infrastructure such as roads (e.g. reduced access to markets)
- **Human health** – increased incidence of illness and fatalities due to drowning, disease and parasites, potentially exacerbated by reduced access to healthcare when roads are blocked
- **Plant and crop communities** – damage to crops through reduction of soil oxygen levels, clogging of soil pores, change in soil pH balance,
- **Livestock** – reduction in productivity due to food shortages and fatalities, and illness brought on by drowning, disease and parasite outbreaks.
- **Fish farming** – Damage to ponds, loss of fingerlings
- **Trade** – incomes are affected by loss of income related to flooding.

These, and other, negative impacts accumulated over the years before 2016 created damage estimated at USD 136.4 million in direct losses, and USD 78.2 million in indirect losses (Shifidi, 2016). While floods are, often for good reason, viewed as purely negative events, communities across the region largely believe the short-term negative impacts of floods are greatly outweighed by long-term benefits. Benefits of floods include increased harvest and livestock productivity in drier areas, and recharge of riparian and other aquifers, as well as the replenishment of fish stocks.

Floods are often thought of as causing the greatest impacts to the landscape, infrastructure and livelihoods, because of the rapid nature of their onset, and immediately observable physical destruction. However, unlike floods, droughts have no tangible benefits and can have greater impacts, with longer term effects on households, due to prolonged food insecurity and water scarcity.

Droughts in the region are partially controlled by large-scale ocean-atmosphere teleconnections, especially El Niño (Chishakwe 2010).The timing and magnitude of drought affects vegetation, human health and livelihoods, wildlife, and wildfires.

Drought - A state of emergency

There are different ways of defining drought. In terms of long-term drought periods, long periods of consistently dry conditions can be measured in different ways. Application of the Standardised Precipitation-Evapotranspiration Index (SPEI), shows that the worst periods of drought in the Cuvelai basin were the periods roughly between 1925 and 1935, and 1980 to 2000. Anecdotal evidence from the Angola portion of the basin reports that 1911 was one of the worst drought years. At the time of writing, a state of emergency had been declared in both countries as a result of severe drought and complete crop failure across the basin (2018/19 season).

Photo 13: Drought takes its toll – dried up well and water supply pipes near Lake Oponono in Namibia. By Stuart Arnold, January 2019

However, droughts of shorter duration also bring severe hardship. The failure of adequate rains in just one season, or even a critical part of the growing season, can bring food insecurity, since the majority of the basin's population are directly dependant on their own produce. In 2013 (as well as 2019), Namibia declared a state of emergency due to drought, with about one third of the population and a further 1.5 million people in Angola classified as food insecure (United Nations Office for Coordination of Humanitarian Affairs, 2013).

Vulnerability to drought in the region is magnified by the fact that potential evapotranspiration at 1,500mm per annum is so much higher than the mean annual precipitation. The difference is at its highest in the eastern and central areas of the basin. This, together with the fact that rainfall variability is also at its highest in this area, means that the risk of agricultural losses and feed insecurity is at its highest in these areas.

Floodwater Harvesting

There is renewed interest in floodwater harvesting, the practice of diverting or pumping a portion of floodwater in some sort of storage to last into or through the dry season. This practice is first documented as efforts made during the "Famine of Dams" (Mendelsohn et al, 2000) in 1929/30, when thousands of people excavated shallow dams in return for food.

More dams were built over the years. By 1971 the Namibian Department of Water Affairs had excavated 320 dams across the region. Each had a capacity of around 30,000 cubic metres and was designed to be filled with water flowing down the oshanas. Another 65 pump-storage dams were built at elevated sites and pumps were installed to lift water from the oshanas into the dams. Some were fitted with filtration plants and fenced. Most of these dams have fallen into disrepair over the years, and many excavated dams have silted up.

In the Angolan part of the basin, mainly on the Cuvelai River mainstream and less seasonal tributaries, huge numbers of small storage ponds have been excavated near the river banks (see Photo 8). When the flood waters recede, these ponds are left full of water and are a vital source of water through the drier months.

Actions for the Plan: Research into improved methodologies and the augmentation of rainwater and floodwater harvesting.

Climate Change

Climate change poses direct and real threats to the Cuvelai basin, characterized as it already is by flood and drought. The Cuvelai River Basin is extremely dry and supports a large rural population dependant on agriculture and water availability. These characteristics make the basin sensitive and vulnerable to climate change, making the assessment of likely changes and uncertainties essential for mitigation and planning (Angula & Kaundjua, 2015), and underline the need for comprehensive monitoring of hydro-climatic parameters, and the sharing of such information between the member states.

Photo 14: Boys taking a break from well-digging near Ondjiva, Angola. Photo by Stuart Arnold, January 2019

A temperature increase of between 1 and 7 degrees C is projected by the end of the 21st Century, as is an increase in temperature extremes, which can be expected to contribute further to an increase in evapotranspiration. These changes would influence crop survival, in a region highly dependent on agriculture. Temperature change is expected to be more drastic the further inland from the coast. While the impact of climate change on mean annual runoff is less clear - it could increase or decrease – there is general agreement that rainfall events will become more extreme and intense. The number of non-rain days will increase, and there may be some shift in wet and dry seasons. This all underlines and should act as a catalyst for what is already required – better hydro-climatic monitoring and forecasting with a a sustainable disaster management system that monitors key biophysical and hydroclimatic parameters, and provides early warning of climate-related disasters.

Actions for the Plan: i) Improved hydro-climatic monitoring and knowledge base; ii) Early warning systems for drought and flood; iii) measures to ensure access to an improved water supply; iv) measures to improve resilience to climate change.

Socio-economic Activities and Water Demands

Water Supply

Water supply coverage on both sides of the basin is low, especially in the rural areas where the majority of the population live. After serious water shortages in 2012 and 2013 (DAR Angola, 2014), a new scheme supplying treated water to Ondjiva is in operation. Water from the Cunene River is treated in Xangongo and transported to Ondjiva (as well as other destinations) via a 100km pipeline. A 4,200m^3 storage tank and a smaller elevated tank together with a pumping station have recently been completed near Ondjiva. System operations are monitored through optical fibre for all the installations along the 100km length of pipeline by the control room housed inside the treatment plant (Water Technology, 2017).

Photo 15: Storage reservoirs for treated water and pumping station serving Ondjiva, Angola. Photo by Stuart Arnold, January 2019

Most settlements on the Namibian side of the border are fed by water transported by canal and pipeline from the Cunene River. Water is abstracted from the Calueque weir and transferred to Oshakati and Okahao via open canal as shown in Figure 4.6.

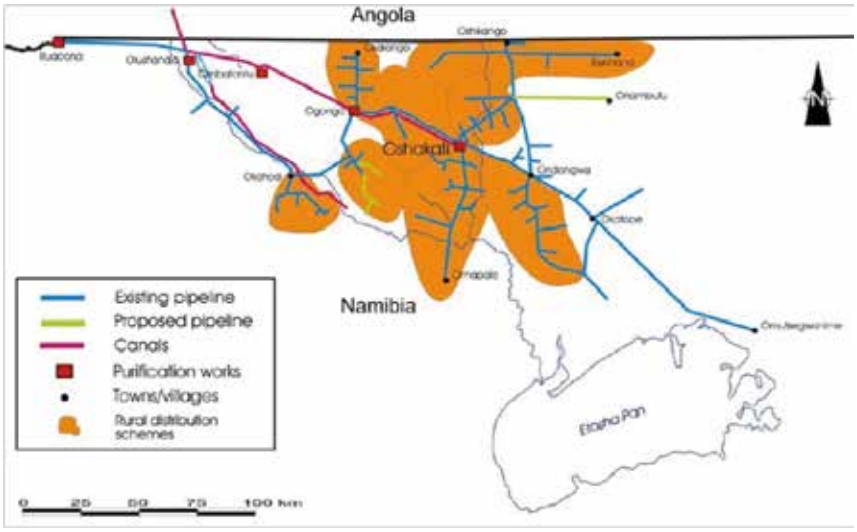


Figure 4.6: Calueque to Oshakati transfer system and associated distribution system

Despite the ongoing efforts to improve coverage in both countries, levels of access to safe water remain low in rural areas. Figure 4.7 summarises the situation in both rural and urban areas in each of the four regions in Namibia covering the Cuvelai basin, as per data sourced from the Namibia Statistics Agency (Namibia Statistics Agency, 2012)

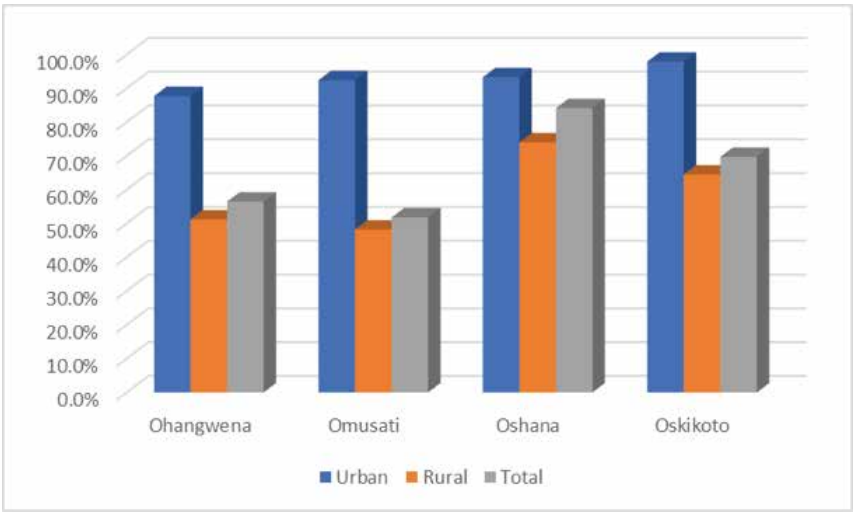


Figure 4.7: Level of access (%) to a safe water supply in each of the four regions in Namibia covering the Cuvelai basin

With respect to Ongoing and Planned Initiatives in the water supply sector cognisance must be given to the ongoing and planned measures in both countries within the Cuvelai basin. Such measures include those approved by the two countries prior to the signing of the CUVECOM Agreement. These initiatives and projects will be handled within the framework of joint planning by the Commission (CUVECOM). Some of these ongoing measures include:

- Groundwater studies (Ohangwena II Aquifer) - Namibia,
- Etunda irrigation scheme – Namibia,
- Water transfer system from the Cunene River near Cafú to the Oshanas zone, to the towns of Cuamato and Namacunde, including the Calucuve and Ndúe dams and the Mupa and Ndúe canals – Angola,
- Climate Resilience Development and Capacity Building Project for Disaster Risk Management in the Cuvelai River Basin - Angola

Sanitation

While the access to safe water is generally well above 50% in most of the basin, around 80% of the basin's population have no access to sanitation facilities. The worst covered parts of the basin in Namibia are the Omusati and Ohangwena Region. In general, the regions with highest urban populations are the best served.

The majority of households in the basin do not have access to any sort of sanitation facilities. Water-borne systems are limited to urban settlements and not all are connected to wastewater treatment plants.

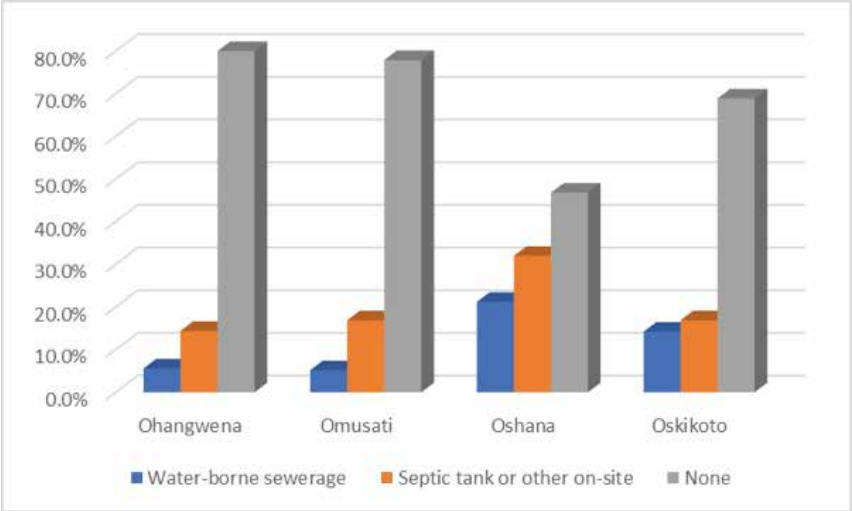


Figure 4.8: Sanitation coverage in in each of the four regions in Namibia covering the Cuvelai basin

Sewerage systems are present in many of the urban settlements in the basin. A sewerage network is being developed in Ondjiva but there is no waste water treatment system. Sewerage from Oshakati is treated at a set of oxidation ponds, while there is a small pilot waste water treatment in Outapi (CUVEwaters, 2017). The plant treats wastware from communal showers; toilets and cluster units serving 60 households. The treated effluent is then used for irrigation in a two-hectare gardening project. A new wastewater treatment plant is under construction in Oshikango. During a stakeholder workshop in Namibia (December 2018), stakeholders highlighted pollution issues associated with the indiscriminate dumping of effluent from septic tanks and pit latrines by exhausters. Clearly, the treatment of waste water is an area which will increasingly become a priority.

Agriculture and livestock

The Cuvelai basin supports a relatively high number of people per unit area compared to most rural areas in southern Africa. It is by far the most densely populated part of Namibia. This is a product of soils that are comparatively fertile and the ready availability of freshwater in shallow wells. As is the case over vast areas of the sandy Kalahari Basin, the the region's eastern aeolian sands are particularly infertile, and have poor moisture retention. The population density in the Angolan portion of the basin is generally less dense (average of 12 inhabitants per km2 for the Cunene province).

Land Use Changes

The relatively few people who live in these areas centre their livelihoods on old pans and drainage lines where the soils are more productive. While alluvial

sediments make up substantial areas of the Central Drainage, Cuvelai Delta and the western Shana sub-basin zones, these are really only concentrated within the drainage channels themselves. The soils here are not suitable for domestic crops, but on the higher ground between channels, there are better soils that were formed as a reworked mix of alluvial and aeolian sediments. These areas are very important to most people in the Cuvelai in providing fertile soils for crops. Together with fresh water in shallow wells, it is these soils that attracted people to settle and farm here 500 to 600 years ago.

Photo 16: The Etunda irrigation scheme in Namibia draws water from the Calueque to Oshakatri canal. Photo by Stuart Arnold, January 2019

Crops planted within the basin are rainfed. Pearl millet (mohangu) is the main subsistence cereal crop. Irrigation is limited to alongside the Kunene Transboundary Water Transfer Scheme canal between Olushandja Dam and Oshakati. The Etunda Agricultural project near Ruacana is the only large irrigation scheme using surface water and is shared by small-scale farmers and large-scale farmlng service providers. In the southern part of the basin farmers in Namibia's so-called maize triangle use groundwater to irrigate large areas during dry periods.

Cattle are moved between dry winter season grazing grounds and wet season areas around the homes of their owners. This practice – known as ohambo – involves cattle from each traditional authority area using an area specific to the authority. The winter grazing grounds were always in areas where few people lived and so there are no significant competing uses of land. This system is increasingly under threat because wintering grounds have been lost, or the grazing available per unit animal has been severely reduced (Mendelsohn, 2015). Many of the grazing areas have been expropriated by fenced farms for the exclusive use of individual cattle owners. In addition, the number of cattle moved to the grazing areas has increased.

Oshimolo is the last large area still used for open access winter grazing. This is the traditional wintering area for cattle belonging to Oshikwanyama speakers living in Angola and Namibia. It stretches over a zone between 100 and 250 kilometres north of the Angola - Namibia border. Huge expanses of floodplain grassland provide both nutrient-rich pastures and water for the animals, which are tended in large herds by groups of several young herders. By some estimates, more than 100,000 cattle move seasonally from Namibia into the Oshimolo ohambo area. In recent years, fencing off parts of Oshimolo has begun. As this may have significant consequences, the whole system has to be better understood at the transboundary level, and issues addressed, before escalation of conflicts.

Actions for the Plan: i) Measures to improve farming practices and the management of grazing; ii) Measures to increase off-farm activities and value addition.

Photo 17: Cattle drinking from Lake Oponono in Namibia. Photo by Stuart Arnold, January 2019

Fisheries and Aquaculture

While agriculture and livestock are the main livelihood activities in the basin, fisheries are also important during wet years. It is estimated that tens of thousands of fish belonging to about 45 species are to be found in the various channels in years of high rainfall (Mendelsohn, 2018). By contrast, fish are effectively absent during dry years. A high proportion of the fish biomass is harvested by people in the Cuvelai, thus providing food to several hundred thousand of people. The fish, particularly from harvests in the Omadhiya Lakes, also support some commercial sales. Most fish that are not harvested die when the waters of the Cuvelai become saline and evaporate. What happens in the dry season is not well understood. While refugia of some adults and eggs must survive somewhere in the basin, the locations are not known (Mendelsohn, 2015). There is thus work to be done, and questions to be answered.

In both countries, fish farming is viewed as an important contributing sector to food security. Pilot aquaculture projects have been initiated, some of them within the basin in the Omusati and Oshana and regions.

Actions for the Plan: Measures to i) better understand fisheries around the basin, and to improve sustainable productivity and opportunities for value addition and ii) expand sustainable fish farming and associated value addition.

Photo 18: Fish and vegetables for sale near Omindamba, Namibia.
Photo by Stuart Arnold, January 2019

Photo 19: Onkoshi Lodge, Etosha National Park, Namibia.
Photo by Stuart Arnold, January 2019

Photo 20: The Mupo National Park straddles parts of the Cuvelai and Cunene river basins; c 2014

Conservation and Tourism

Declared a reserve in 1938, specifically for the protection of the Angolan subspecies of giraffe, Giraffa camelopardalis angolensis, the Mupa Reserve was raised to the category of National Park in 1964. Covering parts of both the Cuvelai and Cunene river basins, Mupa National Park is located in the transition zone between the Brachystegia and Southwest Arid Biomes. About 40% of its 6,600 km² are integrated in the first of these biomes, characterized by dense forest of Brachystegia, with strips of capinzal on the drainage lines. The southern zone of the Park is made up of poorly drained soils, with well-developed Colophospermum forest.

Namibia's Etosha National Park centred around the vast Etosha salt Pan and designated as a game reserve in 1907, is one of Africa's major wildlife sanctuaries. Large floods only reach the pan every 7 to 10 years, mainly fed by the Cuvelai River system. The biodiversity of the park is entirely dependent on seasonal flooding events. Amphibians and aquatic invertebrates that are adapted to long dry spells come to life when the floodwaters enter the ephemeral pans and oshanas (Mendelsohn et al. 2000). The park is home to abundant wildlife that congregates around the waterholes, making it Namibia's number one tourist attraction.

Governance and Stakeholder Participation

National Level Institutions

Institutions with roles in water resources management and development include the following:

- Overall water resource inventory, monitoring, control, regulation and management: managed by the Directorate of Resources Management within the Ministry of Agriculture, Water and Forestry (MAWF) in Namibia. In Angola, the National Water Council is a Permanent Consultative Body of the President, coordinating and articulating the different Ministerial Departments. It is directly and indirectly linked to the planning, management and use of water resources, in the context of river basins, both national and transboundary, and includes water users and local communities. The Ministry of Energy and Water is the department responsible for water resources manage- ment, with tariff setting being the responsibility of the Ministry of Finance. The mission of the National Water Resources Institute (INRH), created in 2010, is to ensure the implementation of the National Water Resources Policy on Planning and Integrated Management, its use, conservation, protection, supervision and control. It is the responsibility of the Cunene River Basin Admin- istration Office, Cubango and Cuvelai (GABHIC) to pro- mote and ensure the integrated and sustainable man- agement of water resources in the Cunene, Cubango and Cuvelai river basins, with a view to increasing the social, environmental and economic benefits for the people who live in these basins, generally creating conditions for the sustainable development of the re- gion and the country.

- Bulk water supply. In Namibia, NamWater abstracts water from primary sources (eg. rivers, aquifers or dams) and supplies to some end-users directly. In Angola, the Office for the Management of the Cunene River Basin (GABHIC) like NamWater, is part of the Permanent Joint Technical Commission (PJTC) of the Cunene River but its mandate has been expanded to include the Cubango and Cuvelai rivers.

- Self-providers: Commercial farmers, tour operators, mines and nature conservation parks, subject to appropriate agreements and licences, supply their own water.

- Water supply to rural areas: In Namibia, this responsibility falls under the Directorate of Water Supply and Sanitation Coordination in the MAWF, while in Angola it is the responsibility of the Ministry of Energy and Water (MINEA) through the National Directorate of Water.

- Water supply to urban areas: In Namibia, local authorities and regional councils buy water from NamWater or supply water from own boreholes (such as in Tsumeb) for delivery to end users. In Angola water supply is supervised by MINEA (Ministry of Water and Energy), through the National Directorate of Water and Sanitation (DNAS) and implemented by the Provincial Water and Sanitation Companies. For the Cuvelai Basin there is EASC - Water and Sanitation Company of Cunene. For sanitation, the newly designated lead agency is the Ministry of the Environment (MINAMB), made operational through the National Technical Unit for Sanitation (UTNSA).

- Other sectors: There are many sectors, such as agriculture, energy, tourism and conservation, the environment, transport, health, which are both i) dependant on good quality and adequate quantities of water and ii) have a responsibility not to pollute the basin's water resources. Representation from these sectors through ministries, NGOs, and local level organisations is essential in the planning, management and development of the basin's water resources.

Management at the Community Level

Water management at the community level is well developed in Namibia. The key community level institutions are Water Point Associations (WPA), Water Point Committees (WPC), Local Water Committees (LWC), Regional Water Committees (RWC), and Basin Management Committees. All of these are active in the Cuvelai Basin.

Water management at the community level has also seen some development in Angola. The main actors involved are the DNA (National Water Directorate), GAS (Water and Sanitation Groups) that control water points at the rural community level, the Municipal Water Brigades, the Provincial Water and Sanitation Companies and the Local Department of Cuvelai Basin Management.

The development of the Community Water Management Model (MoGeCa) in Angola can also be highlighted. Its approach focuses on the involvement of local groups in the negotiation, construction and management of water points, as a basic assumption to promote local development. This model, through the provision of water supply, promotes, in the médium and long term, the creation of social capital and local structures that allow the participation of the community in the resolution of its own problems, independently of the external actors and is based on four fundamental principles, namely: decentralised management of water points, community participation, cost recovery and the establishment of institutional partnerships.

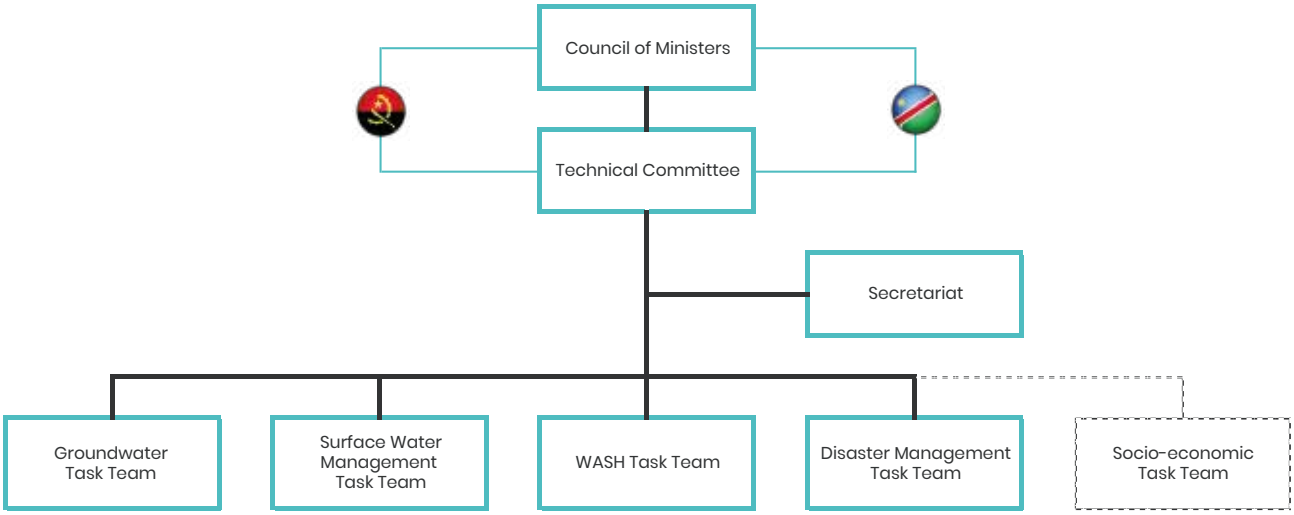


Figure 4.9: CUVECOM organisational structure

Transboundary Management

The Cuvelai River basin is transboundary. Both Angola and Namibia have agreed on the need for an IWRM-based approach to management of the basin's water and associated resources. To this end, the governments of the Republics of Angola and Namibia signed an agreement on the establishment of the Cuvelai Watercourse Commission on 16th September 2014.

The aim of the agreement is to promote cooperation in management of water resources in the transboundary Cuvelai River Basin. CUVECOM shall serve as an Advisor to the Parties on matters relating to:

- Equitable & reasonable utilization
- Sustainable development, and
- Efficient management of water resources of the Cuvelai Watercourse.

A secretariat was set up in 2018 with headquarters in Oshakati and a satellite office in Ondjiva.. This is in line with the institutional recommendations made as a result of the Scoping Study for Enhancement of Transboundary Water Management in the Cuvelai River Basin (Hatfield Consultants Africa, 2017). The proposed structure for the Commission is summarised in Figure 4.9.

Actions for the Plan: Measures to ensure the effectiveness and sustainability of CUVECOM.

Gender

According to gender roles in both Namibia and Angola, women hold the primary responsibilities of managing water supply and sanitation at the household level, while men are responsible for decision making concerning water resources management and development at international, regional, national and local levels (Dos Santos & Lipinge, 2012).

This is especially the case in the Cuvelai Basin where a large number of households are headed by women because of the large number of men that leave the area in search of work.

Photo 21: Collecting water in Ondjiva, Angola.
Photo by Stuart Arnold, January 2019

Women also play a major role in agriculture – in Cunene province it is estimated that women comprise 54% of the agricultural labour force (GIZ, 2018) and the figure in the Namibian part of the basin could be higher. While women's vulnerability to climate change and disaster in the Cuvelai Basin is similar to that of men, they do have specific additional concerns, linked to their responsibilities in collecting water and firewood, the immediate impact of crop failures, and the lack of access to markets and associated opportunities to generate cash.

Actions for the Plan: i) make preparations for mainstreaming of gender considerations into stakeholder participation and decision-making, communication and awareness raising and project implementation. More specifically, there is a need (GIZ, 2018) to:

- Sensitise stakeholders on the relevance of gender mainstreaming and gauge their interest or willingness
- Promote the dialogue and collaboration of gender experts in the basin, supporting activities on an ongoing basis
- Train all CUVECOM technical task teams and other relevant project steering committees on the value of gender mainstreaming, and provide concrete support
- Integrate gender mainstreaming in the Flood Risk Forecasting Systems.

Photo 22: Preparing the soil near Oshikuku, Namibia.
Photo by Stuart Arnold, January 2019

Photo 23: Processing marula fruit near Engela, Namibia.
Photo by Stuart Arnold, January 2019

Issues, Challenges and Opportunities

The context presented in the previous paragraphs provides a very rapid overview. It has aimed only at summarizing the environmental and socio-economic context of the Cuvelai River Basin so the various issues and challenges that face the basin's inhabitants and other stakeholders can be appreciated.

In the Rapid Assessment, a number of challenges were identified (Hatfield Consultants Africa, 2017). These challenges were further discussed with stakeholders in both the Angolan and Nambian parts of the basin in December 2018, and can be summarized as follows:

1.

Lack of coordinating institution to support co-management of the Cuvelai River Basin.

There is a need to operationalise the CUVECOM Agreement (2014), through establishment of a formal transboundary river basin management organisation. Benefits should include the provision of:

- An institutional focal point for transboundary management dialogue and decision making
- A platform for technical coordination of projects and programmes
- Knowledge and information sharing and dissemination, and
- A basin strategic action plan.

2.

Lack of enhanced hydrological and climatological monitoring network in the Basin.

There is a need to develop an integrated, basin-wide hydrological and climatological monitoring network, gathering data to agreed standards, providing access to essential data for several water resource management applications. Benefits should include:

- Supporting co-management of the Basin, and resultant wellbeing of the basin population
- Access to improved data and information for collaborative decision-making at a national and basin-scale
- Critical contribution to Early Warning Systems development for flood and drought, through the provision of monitoring data.

3.

Lack of an effective flood and drought early warning system for preparedness, mitigation and management during such events.

There is a need to establish an integrated early warning system for the Cuvelai River Basin, providing tangible benefits for range of stakeholders. Benefits include:

- Early warning of droughts, utilising national, basin-wide and regional/international data sources
- Warning of floods, including conducive conditions, and flows during events
- Data to support planning to reduce vulnerability
- Information to support management during events
- Communication tools and platforms for dissemination of warnings.

4.

Lack of understanding of groundwater resources in the Cuvelai River basin.

There is a need for a comprehensive and holistic understanding of groundwater resources in the Cuvelai River Basin, including groundwater quantity, quality, sustainable yield, and recharge. Benefits will include:

- Holistic understanding of groundwater at a transboundary scale
- Understanding of the potential contribution groundwater can make to water supply at the basin scale.

5.

Inadequate understanding/quantification of the gap between water demands and supply in the basin.

There is a need to explore the feasibility of enhancing and increasing sustainability of water supplies in the Cuvelai River Basin, through an integrated water supply and harvesting programme. Benefits would include:

- ensuring that water demands are met with conjunctive use solution reduction of the vulnerability of the basin population.

6.

Incomplete understanding of the socio-economic landscape within the basin.

There is a need for a comprehensive socio-economic survey of the Cuvelai River Basin for holistic and gender-disaggregated understanding of the basin 's human population, including livelihoods and agricultural practices. Benefits of achieving this would include:

- Generation of opportunities to provide data and information to establish impact in gender mainstreaming
- Potential opportunities to develop a baseline for quantifying impact at sub-basin or household level.

7.

Inadequate understanding of water quality and lack of pollution management.

There is a need to better understand the quality of existing water resources and also of the impacts of pollution resulting from inadequate sanitation and wastewater treatment. Benefits would include:

- Possibility of implementing appropriate sanitation and wastewater treatment facilities and disposal systems
- Reduced risk of health issues related to pollution.

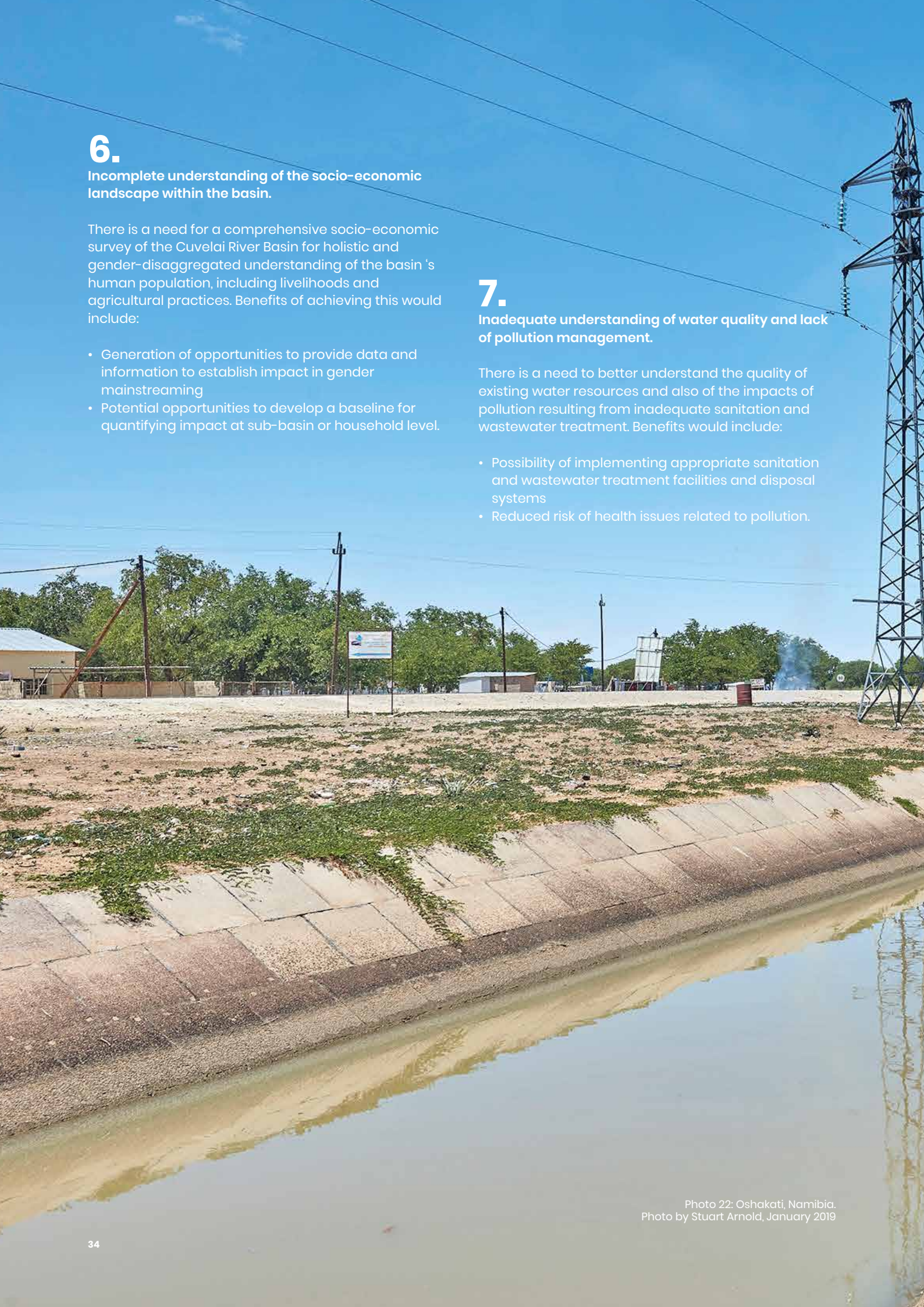


Photo 22: Oshakati, Namibia.
Photo by Stuart Arnold, January 2019

Section 5

The IWRM Plan – A Strategic Framework

Role of the Strategic Framework

Development of the IWRM Plan is built on a vision of the basin in the future and the associated strategic objectives that must be achieved to get there. The vision and strategic objectives are at the heart of the strategic framework, and the plan itself. They provide both the point of departure for the planning process and the necessary reference points for monitoring and evaluation of the eventual implementation of the plan.

Vision for the Cuvelai Basin

Development of the IWRM Plan is built on a vision of the Cuvelai River Basin and its inhabitants in 2040. The vison represents what we want to achieve through implementation of the plan - ultimately it is the vision that guides the design of the plan. Building the plan then requires the building of a chain of logic that allows us to understand why each action or intervention included in the plan plays a role towards achieving the vision.

Having considered the various issues, challenges and opportunities in the basin, CUVECOM agreed on the following statement of the Vision for the Cuvelai River Basin as follows:

CUVECOM's Vision for the Cuvelai River basin in 2040: "A sustainably managed basin with a secure, resilient and prosperous population."

The vision statement does not aim to state how or what has to be done for the envisioned future state to be achieved. The identification of those mechanisms will be achieved through consideration of what actions are required to realise the goals.

Strategic Objectives

Strategic objectives that should lead to the attainment of the vision were developed through a stakeholder-driven process. Agreement on the strategic objectives was based on an "un-picking" of the key elements of the vision:

- **Sustainably:** this word is chosen to underline that development of the basin's resources to support growth and to guarantee water security should be achieved without compromising the needs of the future generations. Development should be socially just, environmentally healthy, and support economic prosperity and poverty reduction.
- **Management:** Management should be integrated and adaptive, based on knowledge and information, and technologically advanced, coordinated and jointly implemented. Management and use of surface and groundwater should be 'conjunctive', that is the coordinated management and use of the two sources
- **Prosperous:** People in the basin use their natural resources to improve their livelihoods.
- **Resilient:** Resilience implies the capacity to adapt to climate change and to be prepared for flood and drought.
- **Basin:** The basin refers to the surface and groundwater resource of the entire Cuvelai basin, not just the river courses.

Appreciating the choice of these words and having a clear understanding of their meaning facilitated agreement on the strategic objectives of the plan.

Five Strategic Objectives have been defined for the Cuvelai IWRM Plan:

1. To promote ***sustainable development and integrated management*** of water and associated natural resources in the basin;

2. To maximize the ***safety, resilience and adaptive capacity*** to impacts of climate change and natural disasters;

3. To ***improve the livelihoods*** of the basin's population.

4. To strengthen ***cooperation between Member States and good governance*** of water resources;

5. To ensure ***water resources security*** (quality and quantity). A sustainably managed basin with a secure, resilient and prosperous population.

The importance of the strategic framework cannot be overstated. Not only do the strategic objectives provide the guiding framework for formulating the plan, they also provide the basis for the monitoring and evaluation framework required to ensure that the plan succeeds in moving the basin and its inhabitants towards the vision, as illustrated in Figure 5.1:

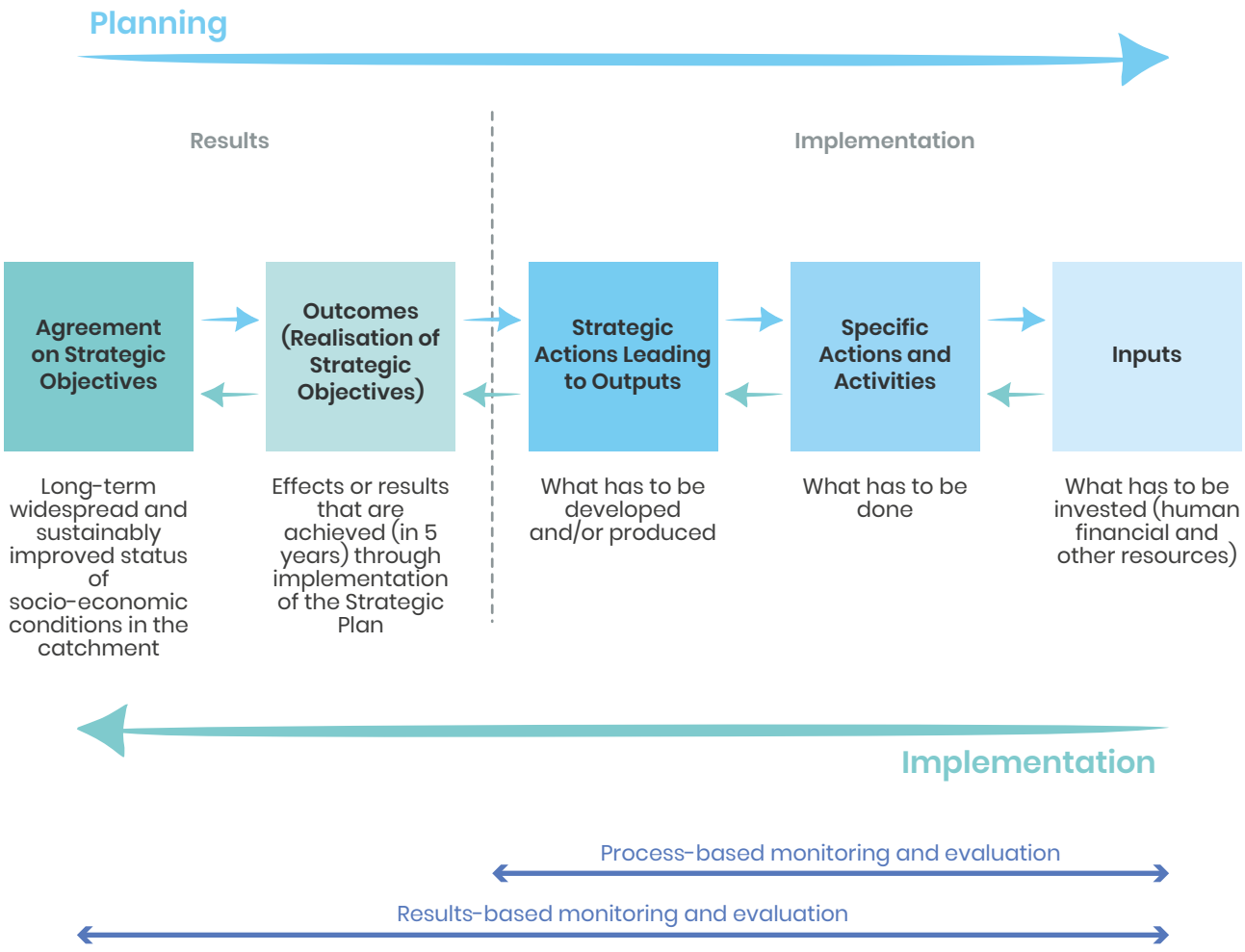


Figure 5.1: The relationship between planning, and monitoring and evaluation

Identification of Strategic Action Areas

Actions are required to realise the strategic objectives of the plan. Action areas have been identified through discussions with stakeholders, including during the visioning exercise carried out with CUVECOM. Some of these action areas are common to more than one of the strategic objectives. They are summarised in the following table.

Table 5.1: Summary of identified action areas

	Strategic Objective	**Main Action Areas**
1	To promote sustainable development and integrated management of water and associated natural resources in the basin.	1. Improved hydro-climatic knowledge base 2. Stakeholder consultation/participation' 3. Strong WRM institutions 4. Intersectoral cooperation/coordination 5. Technology, models, tools DSS 6. Gender
2	To maximise the safety, resilience and adaptive capacity to impacts of climate change and natural disasters.	7. Early warning 8. Improved water storage 9. Agriculture and livestock - adaptation, best practices 10. Alternative livelihoods/ diversification 11. Drought management 12. Flood management 13. Stakeholder consultation/participation 14. Gender
3	To improve the livelihoods of the basin's population.	15. Improved access to improved services 16. Economic growth 17. Addition of value, agro-processing etc. 18. Livelihood-based IWRM at the local scale 19. Stakeholder consultation/participation 20. Gender
4	To strengthen cooperation between Member States and good governance of water resources.	21. CUVECOM and governance structures 22. Capacity-building 23. Stakeholder participation 24. Harmonisation of policies, strategies
5	To ensure water resources security (quality and quantity).	25. Wastewater management 26. Rainwater harvesting 27. Floodwater harvesting 28. Groundwater development 29. Conjunctive use of surface and groundwater 30. Stakeholder consultation/participation 31. Gender

The next chapter focuses on the actions and activities that need to be carried out within each of these action areas, including looking at anticipated timelines and costs.

Section 6

The IWRM Plan – Roadmap and Priority Actions

Introduction

At the end of Chapter 5, the main action areas requiring attention to move towards the five agreed strategic objectives over the next 20 years, were summarized. This chapter of the report sets out the actions that will be required under each of these. These actions have been based on i) a review of the current situation in the basin based on the rapid assessment (Hatfield Consultants Africa, 2017), as well as other documentation, ii) inputs from stakeholders, especially in December 2018 in Ondjiva and Ondangwa, and iii) application of best practices in addressing the various identified challenges.

The duration of the Plan is aligned with the Vision of the basin in 20 years' time. Only the first five years of the Plan, however, are developed in detail, with timelines and estimated costs provided. Looking further ahead than five years in detail is not realistic, and, in any case, the Plan will be reviewed and updated on a regular basis. Ideally, the detail of the second five years of the Plan should be prepared during Year Four or Five, following a review and updating of the overall Plan. ,One of the critical aims of the Plan during the initial five years will be to fill significant gaps in the knowledge base for the Cuvelai .

Road Map Towards the Vision

The roadmap towards the vision has been defined in terms of outcomes required to achieve each strategic objective, outputs for each outcome, and the activities that have to be carried out for each output. The roadmap has been compiled in an Excel database, and is too large and detailed to be displayed in this report in full. Tables 6.1 to 6.5 present the roadmap at the output level for the Plan's five strategic objectives.

Table 6.1: Roadmap for Strategic Objective 1 towards CUVECOM's vision of the Cuvelai River basin in 2040

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	CRONOGRAMA / TIMELINE
Strategic Objective 1: To promote sustainable development and integrated management of water and associated natural resources in the basin	1.1.1	1.1: Improved hydro-climatic knowledge base and database	Comprehensive hydro-climatic informations system planned and agreed	
	1.1.2		Comprehensive hydro-climatic informations system implemented	
	1.1.3		Institutions fully capacitated for sustainable operation of the system	
	1.1.4		Surface water resources assessed	
	1.1.5		Ohangwena 2/Cuvelai Aquifer potential assessed	
	1.1.6		Overall groundwater potential assessed	
	1.2.1	1.2: Frequent consultation and high level of particpation amongst stakeholders	Stakeholders mapped	
	1.2.2		Communication Strategy in place	
	1.2.3		CUVECOM Website and RAK operating	
	1.2.4		Stakeholders consultation structures and systems designed and in place	
	1.2.5		Good intersectoral cooperation/ coordination	
	1.3.1	1.3: Strengthened WRM institutions	Strong WRM capacity at national levels	
	1.3.2		CUVECOM sustainability assured	
	1.4.1	1.4: Water utilisation and demands evaluated accross all sectors	Bulk water abstraction basinwide assessed	
	1.4.2		Diffuse (rural and scattered) abstraction basinwide assessed	
	1.5.1	1.5: Gender aspects mainstreamed	Assessment of gender issues and challenges in water resources management	
	1.5.2		Gender mainstreaming measures implemented	

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040

Table 6.2: Roadmap for Strategic Objective 2 towards CUVECOM's vision of the Cuvelai River basin in 2040

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	CRONOGRAMA / TIMELINE
Strategic Objective 2: To maximize the safety, resilience and adaptive capacity to impacts of climate change and natural disasters	2.1.1	2.1: Flood-risks are well managed and resilience improved	(Real-time) flood early warning system in place	
	2.1.2		Flood-risk mapping	
	2.1.3		Communication tools and platforms for dissemination of warnings and action plans	
	2.1.4		Monitoring and evaluation systems	
	2.2.1	2.2: Improved bulk water storage and transfers	Inventory and mapping of bulk water storage and transfers basinwide	
	2.2.2		Inventory and mapping of identified and planned new schemes (including extensions to existing schemes)	
	2.2.3		Planning of new bulk water storage / transfer schemes	
	2.2.4		Implementation of new bulk water storage / transfer schemes	
	2.3.1	2.3: Agriculture, livestock and fisheries adaptation and best practices adopted	Review and assessment of current crop and livestock farming practices (inputs, practices, outputs, storage,) and adaptation strategies	
	2.3.2		Approaches and methodologies for improving practices and adaptation in farming practices to increase resilience	
	2.3.3		Implementation of adaptation measures and practices	
	2.4.1	2.4: Alternative livelihoods developed and/or diversified	Review and assessment of current activities related to alternative livelihoods and diversification (off-farm activities, non-agriculture/livestock sectors etc)	
	2.4.2		Approaches and methodologies for increasing opportunities for development of alternative livelihoods and diversification	
	2.4.2		Implementation of proposed strategy, plans and measures	
	2.5.1	2.5: Drought risks are well managed and resilience improved	Review current procedures for early warning systems for drought (e.g. FEWS - Famine early warning System) in both countries are reviewed and assessed	
	2.5.2		Cuvelai Drought management strategy and Action Plan	
	2.6.1	2.6: Gender aspects masintreamed	Assessment of gender issues and challenges in water resources management	
	2.6.2		Implement gender mainstreaming measures	

Table 6.3: Roadmap for Strategic Objective 3 towards CUVECOM's vision of the Cuvelai River basin in 2040

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	CRONOGRAMA / TIMELINE
Strategic Objective 3: To improve the livelihoods of the basins population	3.1.1	3.1: Socio-economic profile of the basin population mapped	Socio-economic survey in Angolan portion of the basin	
	3.1.2		Socio-economic survey in Namibian portion of the basin	
	3.2.1	3.2: Greater access to improved water supply and sanitation	Access to water supply in all urban settlements improved	
	3.2.2		Access to improved water supply in all rural areas	
	3.2.3		Access to improved sanitation in all urban areas	
	3.2.4		Access to improved sanitation in rural areas	
	3.3.1	3.3: Livelihood-based watershed managment implemented at the local level	Local level multipurpose livelihood-based watershed management pilot projects established in the different agro-climatic-economic zones of basin	
	3.3.2		Implementation of local level multipurpose livelihood-based IWRM-style water resources development and management over all of each of the hotspot areas	
	3.4.1	3.4: Value added to natural resources, agro-processing opportunities well developed	Opportunities for value addition to natural resources and agricultural products identified	
	3.4.2		Promote the implementation of identified value addition opportunities	
	3.4.3		Expansion of programme	
	3.5.1	3.5: Gender aspects masintreamed	Collection of gender-disaggregated data in socio-economic surveys	
	3.5.2		Gender issues and concerns included in plans and design related to agro-processing and livelihood-based watershed management.	

Table 6.4: Roadmap for Strategic Objective 4 towards CUVECOM's vision of the Cuvelai River basin in 2040

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	CRONOGRAMA / TIMELINE
Strategic Objective 4: To strengthen cooperation between Member States and good governance of water resources	4.1.1	4.1: CUVECOM governance structure well developed and functional.	Plan for building CUVECOM capacity and governance roles developed	
	4.1.2		Plan for capacity building and improving governance implemented	
	4.2.1	4.2: Legislation, policies, strategies and plans are harmonised	Assessment of existing water management/development legislation, policies and strategies at the national levels	
	4.2.2		Harmonisation of legislation, policies, strategies and plans as necessary	
	4.3.1	4.3: Effective and productive cooperation between Higher learning institutions and CUVECOM	Cooperation between UNAM and UAN formalised.	
	4.3.2		Study and project to support CUVECOM implemented	
	4.4.1	4.4: Gender aspects masintreamed	Current situation with respect to water resources management and governance assessed	
	4.4.2		Adequate and appropriate representation of "gender" in water resources management and governance	

Table 6.5: Roadmap for Strategic Objective 5 towards CUVECOM's vision of the Cuvelai River basin in 2040

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	CRONOGRAMA / TIMELINE
Strategic Objective 5: To ensure water resources security (quality and quantity)	5.1.1	5.1: Effective water pollution management basinwide achieved	Diagnostic analysis of current practices and situation basin wide	
	5.1.2		Strategic wastewater management plan for the basin	
	5.1.3		Wastewater management plan implemented	
	5.2.1	5.2: Cost-effective Rainwater harvesting opportunities maximised	Diagnostic analysis of current practices and situation basin wide	
	5.2.2		Implement plan aimed at the widespread adoption of rainwater harvesting	
	5.3.1	5.3: Cost-effective floodwater harvesting maximised	Inventory and assessment of floodwater harvesting techniques basinwide	
	5.3.2		Report on conclusions and recommendations for further floodwater harvesting	
	5.3.3		Feasibility, Planning, design and implementation of Floodwater harvesting	
	5.4.1	5.4: Sustainable groundwater opportunities explored and developed	Groundwater development plan based on improved knowledge (see)	
	5.4.2		Implement groundwater development plan	
	5.5.1	5.5: Conjunctive use of surface and groundwater well developed	Development of conjunctive use of groundwater and surface water for bulk water supply	
	5.5.2		Development of conjunctive use of groundwater and surface water for diffuse water supply	
	5.6.1	5.6: Gender aspects masintreamed	Assessment of gender issues and challenges in water resources management	
	5.6.2		Implement gender mainstreaming measures	

Achieving Strategic Objective 1: Sustainable and Integrated Management

Strategic Objective 1 is aimed at moving towards the sustainable development and integrated management of water and associated resources across the basin.

Desired outcomes are summarised in the following table:

Table 6. 6: Summary of desired outcomes for Strategic Objective 1

	Outcomes	Explanatory Notes
1.1	Improved hydro-climatic knowledge base/ database.	Understanding of the climate and hydrology of the basin has always been limited. A focussed and significant effort basin wide is required to establish this knowledge. This will require implementation of several gauging stations combined with the use of remote sensing monitoring techniques. CUVECOM can play a major role in driving and coordinating this process, but operations and maintenance should be handled by the countries. The improved network should cover climate (including rainfall intensity), river flow, groundwater, and water quality. The proposed network should make use of real-time communications and can thus also form part of a flood early warning system (see Strategic Objective 2).
1.2	High level of stakeholder consultation and participation.	Integrated water resources management depends on a high level of stakeholder participation. The overall IWRM Plan is aimed at supporting and improving the livelihoods of the basin's inhabitants in a sustainable manner. The actions set out in the plan respond to the issues and challenges that have been raised by the basin stakeholders. It is now important that the actions and solutions proposed are implemented in close collaboration with the stakeholders. Mechanisms will be put in place to ensure that stakeholders are fully involved, and that they take an ever-increasing level of responsibility in implementation, monitoring, evaluation, and adaptation.
1.3	Strong WRM institutions.	Effective water resources management in the Cuvelai Basin will require a sustained and high level of commitment in both countries, and at the transboundary level. The establishment of CUVECOM should help to catalyse commitment since the countries will have clear roles and responsibilities in providing support.
1.4	Water utilisation and demands evaluated across all sectors.	Assessing available surface and groundwater resources depends on a knowledge of the resources (see 1.1 above) and on the size and location of current and future demands across all sectors basin wide.
1.5	Gender aspects mainstreamed.	While ongoing efforts are being made to ensure that women are fully represented in structures such as water point committees, it is important to see gender is considered across the complete water resources management process.

Achieving Strategic Objective 2: Coping with Natural Disasters

Strategic Objective 2 is aimed at maximizing safety, resilience, and adaptive capacity of the population to impacts of climate change and natural disasters.

Desired outcomes are s summarised in the following table:

Table 6. 7: Summary of desired outcomes for Strategic Objective 2

	Outcomes	**Explanatory Notes**
2.1	Floods are well managed.	Floods are arguably the biggest challenge in the Cuvelai Basin, sometimes causing widespread damage and loss of life. Establishment of an effective flood warning system based on accurate real-time information coming from upstream, coupled with accurate prediction of potential flood levels downstream, is the approach adopted. Once these forecasts are linked to effective communications providing potentially affected stakeholders with advance warning, it will be possible to take timely evasive and mitigation actions on the ground.
2.2	Improved bulk water storage/transfers.	For everyone in the basin to have access to water, even during dry periods and drought, there is a need to increase storage facilities and move water around the basin via transfers. The option of increasing the existing transfer from the Cunene River is also possible within the limits of an existing agreement. Increased storage will increase resilience.
2.3	Agriculture and livestock, adaptation, best practises adopted.	Current farming practices are not optimised, or as productive as they should be. In addition to climatic variability and climate change, access to inputs such as seed and fertilizers, availability of post-harvest storage, and access to credit, markets, insurance, and extension services are challenges. Achieving better agriculture would include implementation of pilot demonstration projects followed by a programme of taking to scale.
2.4	Alternative livelihoods developed and/or diversified.	Resilience to population pressures, climate variability and climate change can be increased through development of alternative livelihoods, and diversification, both off and on-farm. Proposals aimed at this will be developed and integrated in pilot projects before developing a programme of taking to scale.
2.5	Droughts are well managed.	Management of floods can greatly benefit from systems such as the Famine Early Warning System (FEWS). The status of FEWS and other similar systems in both countries will be reviewed with a view to stronger engagement with them. It would be useful for CUVECOM to be active in the use and application of such systems since the Commission is in a position to communicate effectively with basin stakeholders who are potentially vulnerable to drought.
2.6	Gender aspects mainstreamed.	Given that women are usually in charge of obtaining and managing water at the critical community and household levels, they must be involved in all of the Plan's activities, from the planning stage through to design and implementation. Facilitating their representation will be important in achieving all of the desired outcomes.

Achieving Strategic Objective 3: Improving Livelihoods

Strategic Objective 3 is aimed at improving the livelihoods of the basin's population.

Desired outcomes are summarised in the following table:

Table 6. 8: Summary of desired outcomes for Strategic Objective 3

	Outcomes	Explanatory Notes
3.1	Socio-economic profile of the basin population mapped.	The Rapid Assessment (Hatfield Consultants Africa, 2017), identified a lack of socio-economic data and analysis for the basin. This information is important for effective development planning if the basin's stakeholders are really to benefit. The accurate socio-economic mapping of the basin's inhabitants will support planning of a wide range of interventions, ensuring that these meet the real needs of communities.
3.2	Greater access to improved services.	Given the water related focus of the IWRM Plan, this outcome is focussed on improved water supply and sanitation in both urban and rural areas. In most cases, these actions are entirely handled at the national level. CUVECOM will have no significant role to play, but should maintain a watching brief.
3.3	Livelihood-based watershed management implemented at the local level.	This outcome links with Outcomes 2.3 and 2.4 under Strategic Objective 2, and is focussed on achieving a "win-win" in terms of environmental protection and improved livelihoods, especially for the basin's farmers in the different agro-economic areas of the region. The first steps will include setting up pilot projects in the different zones to demonstrate how best practices can prevent land degradation while increasing productivity, and (with the integration of actions under Outcomes 2.3 and 2.4) significantly improve the livelihoods of those involved. In a second step, taking to scale is planned.
3.4	Value added to natural resources, agro-processing opportunities well developed.	This outcome is aimed at building on Outcome 3.3 by investigating and developing opportunities for adding value to farming produce. Agro-processing opportunities will be evaluated and developed as part of the pilot demonstration projects developed under Outcome 3.3.
3.5	Gender aspects mainstreamed.	There are major opportunities for women within these proposed outcomes, in particular Outcomes 3.2, 3.3., and 3.4. Their inputs should be secured at all points of the process. This will be supported by ensuring that gender disaggregated data are collected under Outcome 3.1.

Achieving Strategic Objective 4: Cooperation and Good Governance

Strategic Objective 4 is aimed at strengthening cooperation between Member States, and good governance of water resources.

Desired outcomes are summarised in the following table:

Table 6. 9: Summary of desired outcomes for Strategic Objective 4

	Outcomes	**Explanatory Notes**
4.1	CUVECOM and governance structures are well developed and functioning well.	Successful implementation of the IWRM Plan will depend on good governance at all levels. This outcome is aimed at supporting the required capacity-building in governance and is aimed at CUVECOM at both transboundary and national levels.
4.2	Legislation, policies, strategies and plans are harmonised.	A stepwise approach is proposed to achieve this outcome, starting with a review of existing legislation, policies, strategies, and plans to identify potential issues and disconnects that could hinder an integrated transboundary approach. This will then be followed by a clear statement of priority areas where harmonisation is necessary, and recommendations as to how this could be achieved.
4.3	Effective and productive cooperation between universities and with CUVECOM.	Cooperation among the University of Namibia, Agostinho Neto University, and CUVECOM was initiated during the preparatory work for this Plan. The aim is that these universities, both of which have a presence in the basin, can work together to provide support to CUVECOM in several ways. Benefits are mutual, with opportunities for students to gain scientific and political experience within the basin while working on research and/or in the form of internships within CUVECOM.
4.4	Gender aspects mainstreamed.	Given that women play the leading role in management of water at the community and household level, it is important they also take a leading role in all matters relating to water governance. Their meaningful involvement should be included in all of these outcomes.

Achieving Strategic Objective 5: Enough Clean Water

Strategic Objective 5 is aims to ensure water resources security (quality and quantity).

Desired outcomes are summarised in the following table:

Table 6. 10: Summary of desired outcomes for Strategic Objective 5

	Outcomes	Explanatory Notes
5.1	Effective water waste management basin wide.	Discussions with stakeholders during the preparation of this Plan identified pollution resulting from untreated waste water as a significant and growing problem. A major challenge is the indiscriminate and illegal disposal of waste by exhausters at various locations around the basin, instead of at the designated sites. It is clear that a basin wide wastewater management strategy and plan is required to enforce existing regulations, and facilitate new solutions that ensure water quality.
5.2	Cost-effective rainwater harvesting opportunities maximised.	Rainwater harvesting has long been recognised as a useful strategy that contributes to water resources security at the household level. Cost is often cited as a constraint. A rapid diagnostic assessment of current practices in the basin and in other areas within the countries, especially where climatic conditions are similar, will be a first step in addressing this problem. Based on this diagnosis, a plan, including careful consideration of constraints such as cost, will be drawn up.
5.3	Cost-effective floodwater harvesting maximised.	The need for floodwater harvesting was continuously highlighted as a priority during discussions with stakeholders who are frustrated by the frequent abundance of water and the lack of opportunity to make use of it. There are examples of different styles of floodwater harvesting all around the basin. In the headwaters it is generally small-scale. In Namibia, it is larger-scale and the result of organised development programmes with significant expenditure. The assessment and comparison of best practices can lead to uptake of sustainable solutions.
5.4	Sustainable groundwater opportunities explored and developed.	Groundwater is an important and essential resource in many parts of the basin, and yet, its extent and quality is not yet well understood or mapped. Groundwater can play a major role in providing water security. This outcome is aimed at better quantifying the availability and spatial distribution of groundwater for abstraction. This knowledge will also contribute to the realisation of Outcome 5.5.
5.5	Conjunctive use of surface and groundwater well developed.	The conjunctive management and use of surface and groundwater, although already developed in other parts of the riparian states, particularly in the central area of Namibia, is not well developed in the basin. The opportunity is there, however, and this outcome is aimed at building on a better knowledge of the basin's surface and groundwater resources to inform decision-making.
5.6	Gender aspects mainstreamed.	The targeted outcomes under this strategic objective are largely concerned with making water more readily and consistently available. This can have a very positive impact on everyone in the basin, but especially on women who currently bear the burden of collecting water. It is important that women are involved at all stages of the process to ensure water quality and quantity.

Priority Actions – The First Five Years

The detail of this plan is focused on the first five years. In this section of the Plan, the priority actions are presented in some detail, including a presentation of the timelines and associated estimated costs.

The total estimated costs for the required actions under each of the five strategic objectives are summarized in Figure 6.1.

Figure 6.1: Estimated costs (2020-2024) for actions under each of the 5 strategic objectives

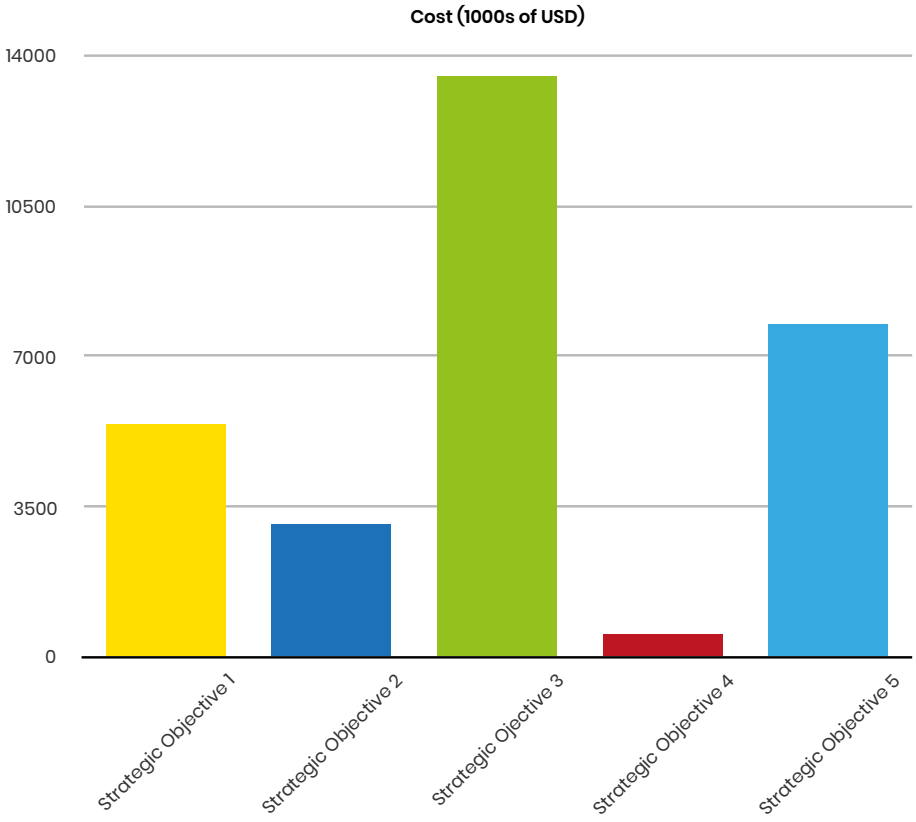


Table 6-11: Summary of estimated costs (2020-2024) at the outcome level

1	Strategic Objective	Outcome & Cost (2020/40)		Cost
	To promote sustainable development and integrated management of water and associated natural resources in the basin.	1. Improved hydro-climatic knowledge base and database 2. Frequent consultation and broad participation of stakeholders 3. Strengthened WRM institutions 4. Water utilisation and demands evaluated across all sectors 5. Gender aspects mainstreamed	4.565 275 290 180 110	5,420

2	Strategic Objective	Outcome & Cost (2020/40)		Cost
	To maximise the safety, resilience and adaptive capacity to impacts of climate change and natural disasters.	1. Flood risks are well managed and resilience improved 2. Improved bulk water storage and transfer 3. Agriculture, livestock and fisheries adaptation and best practise adopted 4. Alternative livelihoods developed and/or diversified 5. Drought risk are well managed and resilience improved 6. Gender aspects mainstreamed	1,325 730 360 360 185 110	3,070

3	Strategic Objective	Outcome & Cost (2020/40)		Cost
	To improve the livelihoods of the basin's population.	1. Socio-economic profile of the basin population mapped 2. Greater access to improved water supply and sanitation 3. Livelihood-based watershed management implemented at the local level 4. Value added to natural resources, agro-processing opportunities well developed 5. Gender aspects mainstreamed	140 9,800 1,715 1,730 115	13,500

4	Strategic Objective	Outcome & Cost (2020/40)		Cost
	To strengthen cooperation between Member States and good governance of water resources.	1. CUVECOM governance structure well developed and functional 2. Legislation, policies, strategies and plans are harmonised 3. Effective and productive cooperation between higher learning institutions and CUVECOM 4. Gender aspects mainstreamed	165 130 90 160	545

5	Strategic Objective	Outcome & Cost (2020/40)		Cost
	To ensure water resources security (quality and quantity).	1. Effective water pollution management basin wide achieved 2. Cost-effective rainwater harvesting opportunities maximised 3. Cost-effective floodwater harvesting maximised 4. Sustainable groundwater opportunities explored and developed 5. Conjunctive use of surface and groundwater well developed 6. Gender aspects mainstreamed	1,430 140 4,965 480 640 95	7,750

Progress towards Strategic Objective 1 by 2024

Many of the outcomes to be achieved under this strategic objective are prioritised for the first five years of the Plan. A key area requiring significant investment in the first five years is the design and implementation of a hydroclimatic information system based on a comprehensive gauging network on both sides of the border. Improving knowledge of surface and groundwater (quantity and quality), based on the improved data availability should also be well underway during the first five years of the plan. This will include investigation of the Ohangwena 2/Cuvelai transboundary aquifer. Work on this aquifer on the Namibia side (Ohangwena 2) is already well advanced.

Capacity building is included in support of these activities. The estimated costs of achieving each required outcome under this objective are summarised in Figure 6.2.

Figure 6.2: Costs (x 1000 USD) at the Outcome level (2020-2024) for priority actions under Strategic Objective 1

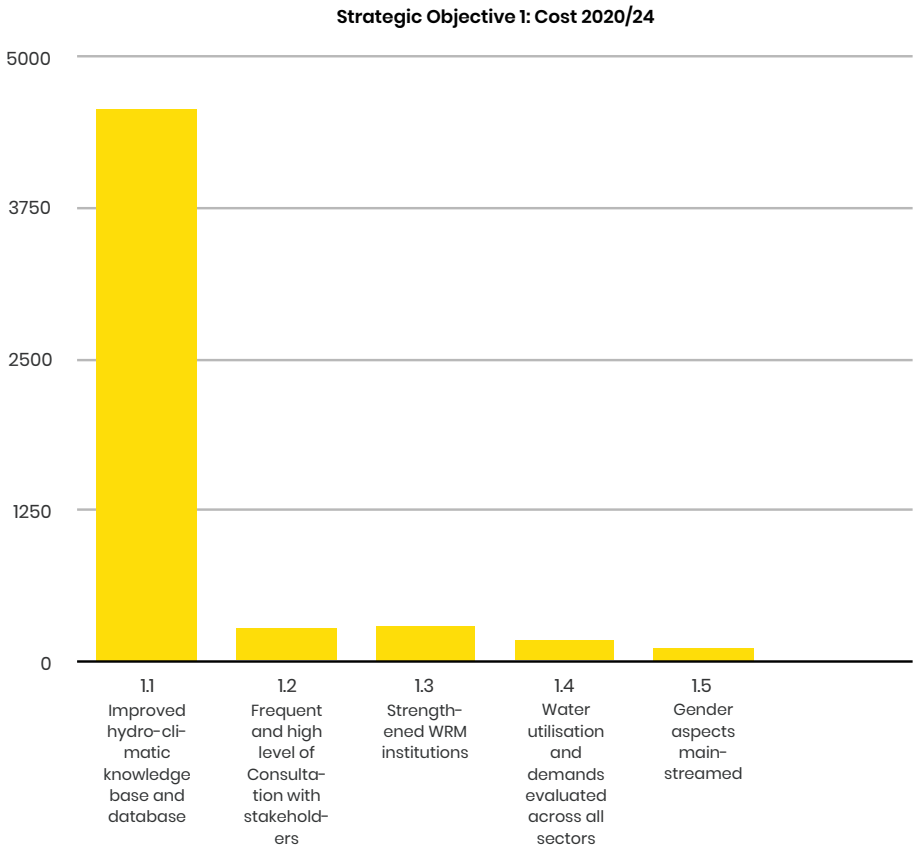


Table 6.12 provides details for the proposed actions aimed at making progress towards Strategic Objective 1 during the first five years of the plan. The role of CUVECOM in the implementation of the different elements of the Plan is indicated in the responsibilities column in Tables 6.12 to 6.16 using a colour coding system as follows:

	High level of CUVECOM involvement. For the majority of activities leading to this outcome, CUVECOM bodies (Commissioners, task teams, Secretariat, etc.) will be involved in execution or management during project/programme implementation.
	Significant level of CUVECOM involvement. For the majority of activities leading to this outcome, CUVECOM bodies (Commissioners, task teams, Secretariat, etc.) will be involved in management for most in the facilitation role during project/ programme implementation.
	For the majority of activities leading to this outcome, CUVECOM bodies (TTT, CTT, etc. and Secretariat) will be involved **only in facilitation or support** of project/ programme implementation.
	CUVECOM involvement **limited to review or none** in most of the activities leading to this outcome.

Table 6.12: Outputs and actions towards Strategic Objective 1 during 2020-2024

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	ACTIONS	Responsibilities		CRONOGRAMA / TIMELINE																									
					Lead	CUVECOM	2020				2021				2022				2023				2024									
							1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		
Strategic Objective 1: To promote sustainable development and integrated management of water and associated natural resources in the basin	1.1.1	1.1: Improved hydro-climatic knowledge base and database	Comprehensive hydro-climatic informations system planned and agreed		CUVECOM, MINEA, MAWF																											
	1.1.1.1			Plan, design and cost a fit for purpose information system																												
	1.1.1.2			Countries agree on design and operationalisation procedures																												
	1.1.2		Comprehensive hydro-climatic informations system implemented																													
	1.1.2.1			Put out to tender and appoint contractors for implementation																												
	1.1.2.2			Construct and operationalise Phase 1																												
	1.1.2.3			Construct and operationalise Phase 2																												
	1.1.3		Institutions fully capacitated for sustainable operation of the system																													
	1.1.3.1			Contractor provides supervision and capacity building																												
	1.1.3.2			Hand systems over to national institutions/CUVECOM																												
	1.1.3.3			Capacity building of member states' officials throughout the process																												
	1.1.4		Surface water resources assessed																													
	1.1.4.1			Assess existing modelling capacity at national levels																												
	1.1.4.2			Acquire and implement modelling tools, including capacity building																												
	1.1.4.3			Build knowledge base - Phase 1																												
	1.1.4.4			Build knowledge base - Phase 2																												
	1.1.5		Ohangwena 2/Cuvelai Aquifer potential assessed																													
	1.1.5.1			Detail and cost assessment work in Angola																												
	1.1.5.2			Complete isotope surveys and carry out drilling investigations in both countries																												
	1.1.5.3			Finalise assessment																												
	1.1.6		Overall groundwater potential assessed																													
	1.1.6.1			Assess existing modelling capacity at national levels																												
	1.1.6.2			Acquire and implement modelling tools and provide adequate capacity building																												
	1.1.6.3			Build knowledge base - Phase 1																												
	1.1.6.4			Build knowledge base - Phase 2																												
	1.2.1	1.2: Frequent consultation and high level of particpation amongst stakeholders	Stakeholders mapped		CUVECOM																											
	1.2.1.1			Identify all stakeholders																												
	1.2.1.2			Map interests and concerns of all stakeholders																												
	1.2.2		Communication Strategy in place																													
	1.2.2.1			Draw up Communication strategy																												
	1.2.2.2			Agree and implement communication strategy																												
	1.2.3		CUVECOM Website and RAK operating																													
	1.2.3.1			Design and operationalise CUVECOM website and Cuvelai RAK																												
	1.2.3.2			Maintain CUVECOM website and Cuvelai RAK																												
	1.2.4		Stakeholders consultation structures and systems designed and in place																													
	1.2.4.1			Design and formalise stakeholder consultation structures and systems																												
	1.2.4.2			Operationalise Stakeholder consultation structures and systems																												
	1.2.5		Good intersectoral cooperation/ coordination																													
	1.2.5.1			Agree coordination and cooperation systems for intersectoral planning at national and Transboundary levels																												
	1.2.5.2			Implement coordination and cooperation systems for intersectoral planning at national and Transboundary levels																												
	1.3.1	1.3: Strengthened WRM institutions	Strong WRM capacity at national levels		Line Ministries, and CUVECOM																											
	1.3.1.1			Assess existing WRM capacity and gaps in Angola																												
	1.3.1.2			Assess existing WRM capacity and gaps in Namibia																												
	1.3.1.3			Plan and implement capacity-building programme in Angola																												
	1.3.1.4			Plan and implement capacity-building programme in Namibia																												
	1.3.2		CUVECOM sustainability assured		Both countries																											
	1.3.2.1			Develop sustainability strategy for CUVECOM																												
	1.3.2.2			Implement sustainability strategy																												
	1.4.1	1.4: Water utilisation and demands evaluated accross all sectors	Bulk water abstraction basinwide assessed		CUVECOM, MINEA, MAWF																											
	1.4.1.2			Design and carry out study																												
	1.4.1.3			Evaluate and disseminate results																												
	1.4.2		Diffuse (rural and scattered) abstraction basinwide assessed																													
	1.4.2.1			Design and carry out study																												
	1.4.2.2			Evaluate and publish results																												
	1.5.1	1.5: Gender aspects mainstreamed	Assessment of gender issues and challenges in water resources management		CUVECOM, MINEA, MAWF																											
	1.5.1.1			Carry out field surveys and stakeholder consultation (included in Actions 3.1.1 and 3.1.2)																												
	1.5.1.2			Draw up assessment																												
	1.5.2		Gender mainstreaming measures implemented																													
	1.5.2.1			Develop the gender mainstreaming strategy and action plan																												
	1.5.2.2			Implement the strategy and action plan																												

Progress towards Strategic Objective 2 by 2024

Many of the outcomes under this strategic objective are prioritised for the first five years of the plan. A key area requiring significant investment in the first five years is the management of floods. This will be based largely on mapping of flood risk and an improved early warning system. Other outcomes are also aimed at promoting resilience.

The estimated costs of achieving each required outcome under this objective are summarised in Figure 6.3.

Figure 6.3: Costs (x 1000 USD) at the Outcome level (2020-2024) for priority actions under Strategic Objective 2

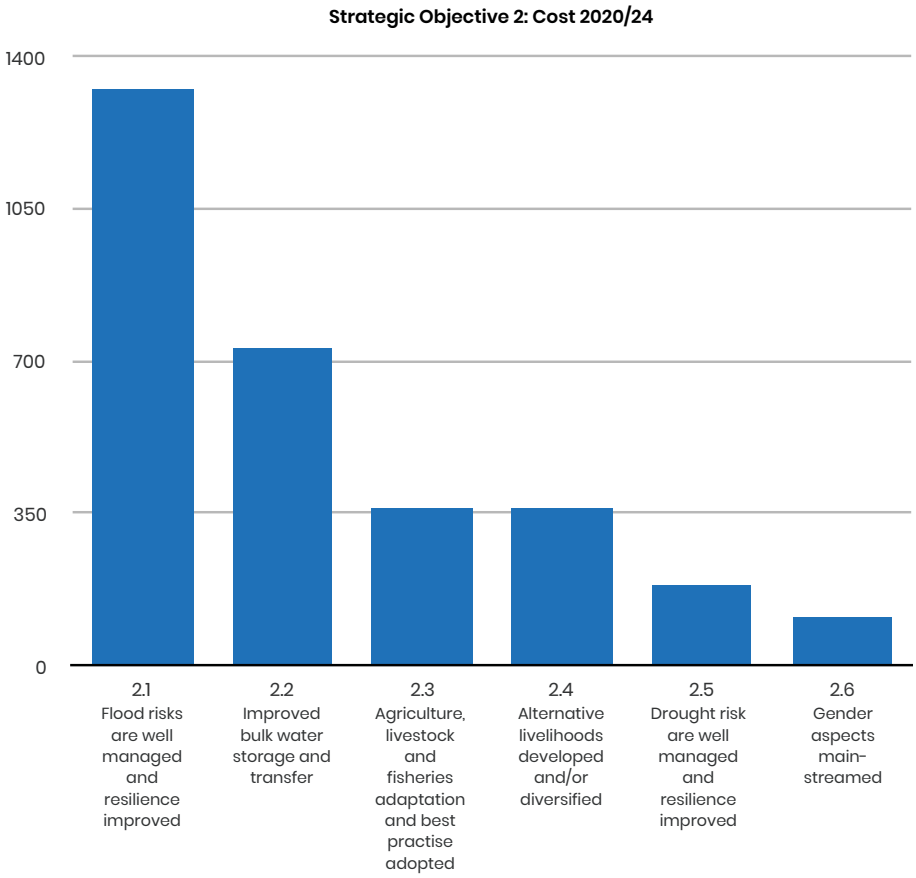


Table 6.13 provides details for the proposed actions aimed at making progress towards Strategic Objective 2 during the first five years of the plan.

Table 6.13: Outputs and actions towards Strategic Objective 2 during 2020-2024

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	ACTIONS	Responsibilities		CRONOGRAMA / TIMELINE
					Lead	CUVECOM	2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040
Strategic Objective 2: To maximize the safety, resilience and adaptive capacity to impacts of climate change and natural disasters	2.1.1	2.1: Flood-risks are well managed and resilience improved	(Real-time) flood early warning system in place		CUVECOM & line Ministries (MINEA, INAMET, SPCB and MAWF, Met office, OPM: Disaster Risk Mgt)		
	2.1.1.1			Plan, design and cost real-time monitoring network (precipitation and water level/discharge), including remote sensing			
	2.1.1.2			Purchase equipment, carry out civil works and construct and equip monitoring stations			
	2.1.1.3			Operationalise the real-time system including testing and capacity-building			
	2.1.2		Flood-risk mapping				
	2.1.2.1			Prepare ToR for and carry out lidar survey of flood-prone areas			
	2.1.2.2			Carry out modelling and other analysis to establish flood-risk maps			
	2.1.2.3			Calibrate and recalibrate the models and associated mapping using observed river discharge data			
	2.1.3		Communication tools and platforms for dissemination of warnings and action plans				
	2.1.3.1			Working with stakeholders, agree on dissemination and reception system (technical options, responsibilities etc)			
	2.1.3.1			Develop and test action plans (impact minimisation, evasion, evacuation, contingency planning etc)			
	2.1.3.3			Implement and operate system			
	2.1.4		Monitoring and evaluation systems				
	2.1.4.1			Design monitoring and evaluation system			
	2.1.4.2			Implement monitoring and evaluation system			
	2.1.4.3			Revise models and action plans as necessary			
	2.2.1	2.2: Improved bulk water storage and transfers	Inventory and mapping of bulk water storage and transfers basinwide		MAWF, NAMWATER, MINEA		
	2.2.1.1			Inventorise and map storage and transfers in Angolan portion (volumes and flows			
	2.2.1.2			Inventorise and map storage and transfers in Namibian portion (volumes and flows			
	2.2.2		Inventory and mapping of identified and planned new schemes (including extensions to existing schemes)				
	2.2.2.1			Inventorise and map planned storage and transfers in Angolan portion (volumes and flows			
	2.2.2.2			Inventorise and map planned storage and transfers in Namibian portion (volumes and flows			
	2.2.3		Planning of new bulk water storage / transfer schemes				
	2.2.3.1			Plan and design new bulk water storage / transfer schemes in Angolan portion of basin*			
	2.2.3.2			Plan and design new bulk water storage / transfer schemes in Namibian portion of basin*			
	2.2.4		Implementation of new bulk water storage / transfer schemes				
	2.2.4.1			Implement new bulk water storage / transfer schemes in Angolan portion of basin*			
	2.2.4.2			Implement new bulk water storage / transfer schemes in Namibian portion of basin*			
	2.3.1	2.3: Agriculture, livestock and fisheries adaptation and best practices adopted	Review and assessment of current crop and livestock farming practices (inputs, practices, outputs, storage,) and adaptation strategies		MAWF, MFMR (Namibia) & Ministry of Agriculture & Forestry, Ministry of Fisheries & Provincial government (Angola)		
	2.3.1.1			Review and assess current crop and livestock farming practices (inputs, practices, outputs, storage,) and adaptation strategies in Angolan part of the basin			
	2.3.1.2			Review and assess current crop and livestock farming practices (inputs, practices, outputs, storage,) and adaptation strategies in Namibian part of the basin			
	2.3.2		Approaches and methodologies for improving practices and adaptation in farming practices to increase resilience				
	2.3.2.1			Identify and assess options for improving practices and increasing resilience			
	2.3.2.2			Detail proposals for integration into pilot demonstration projects (see CCC)			
	2.3.3		Implementation of adaptation measures and practices (see also)				
	2.3.3.1			Implement adaptation measures and practices as part of pilot projects (see)			
	2.3.3.2			Monitor and evaluate impacts of measures and adapt as necessary			

Table 6.13 (cont): Outputs and actions towards Strategic Objective 2 during 2020-2024

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	ACTIONS	Responsibilities		CRONOGRAMA / TIMELINE
					Lead	CUVECOM	2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040
	2.4.1	2.4: Alternative livelihoods developed and/or diversified	Review and assessment of current activities related to alternative livelihoods and diversification (off-farm activities, non-agriculture/livestock sectors etc)		MAWF, MURD and IDA		
	2.4.1.1			Review and assess current crop and livestock farming practices (inputs, practices, outputs, storage,) and adaptation strategies in Angolan part of the basin			
	2.4.1.2			Review and assess current crop and livestock farming practices (inputs, practices, outputs, storage,) and adaptation strategies in Namibian part of the basin			
	2.4.2		Approaches and methodologies for increasing opportunities for development of alternative livelihoods and diversification				
	2.4.2.1			Identify and assess options for alternative livelihoods and diversification			
	2.4.2.2			Detail proposals for integration into pilot demonstration projects (see CCC)			
	2.4.2		Implementation of proposed strategy, plans and measures				
	2.4.2.1			Implement adaptation measures and practices as part of pilot projects (see)			
	2.4.2.2			Monitor and evaluate impacts of measures and adapt as necessary			
	2.5.1	2.5: Drought risks are well managed and resilience improved	Review current procedures for early warning systems for drought (e.g. FEWS - Famine early warning System) in both countries are reviewed and assessed		Cuvecom & Line Ministries (MINEA, INAMET, SPCB, Provincial government & MAWF, Met office, OPM: Disaster Risk Mgt)		
	2.5.1.1			Review and assess advance warning systems for drought and/or famine currently in place or which could be suitable			
	2.5.1.2			Review current systems in operation for the Cuvelai Basin			
	2.5.1.3			Review current procedures for dissemination of warnings and communications with the communities			
	2.5.2		Cuvelai Drought management strategy and Action Plan				
	2.5.2.1			Based on previous output, develop a drought management strategy aimed at providing real and useful advance warning to stakeholders and a strategy for managing challenges associated with drought			
	2.5.2.2			Develop a detailed Action plan with appropriate actions triggered according to specific thresholds in advance of critical drought situation being reached.			
	2.5.2.3			Countries agree and sign off on the strategy and action plan with assignment of clear responsibilities for CUVECOM			
	2.5.2.4			Implement strategy and plan			
	2.6.1	2.6: Gender aspects masintreamed	Assessment of gender issues and challenges in water resources management				
	2.6.1			Carry out interviews basinwide in order to understand gender-issues related to flood, drought management and resilience (see 3.1.1 & 3.1.2)			
	2.6.2			Draw up assessment			
	2.6.2		Implement gender mainstreaming measures				
	2.6.2.1			Agree on gender-related measures to be included in the drought management strategy and plan, development of alternative livelihoods, improved farming practices etc			
	2.6.2.2			Implement measures			

Progress towards Strategic Objective 3 by 2024

Strategic Objective 3 is aimed at improving the livelihoods of the basin's population. A priority action is building on work started through cooperation with the universities in building a gender disaggregated socio-economic baseline. Other priority actions include fast-tracking access to improved water and sanitation, improving agricultural productivity and developing opportunities for adding value through agro-processing. The role of CUVECOM in the implementation of these actions will be limited to facilitation, monitoring and evaluation, with the lead being taken by line ministries in each country.

The estimated costs of achieving each required outcome under this objective are summarised in Figure 6.4. Table 6.14 provides details of the proposed actions aimed at making progress towards Strategic Objective 3 during the first five years of the Plan.

Figure 6.4: Costs (x 1000 USD) at the Outcome level (2020-2024) for priority actions under Strategic Objective 3

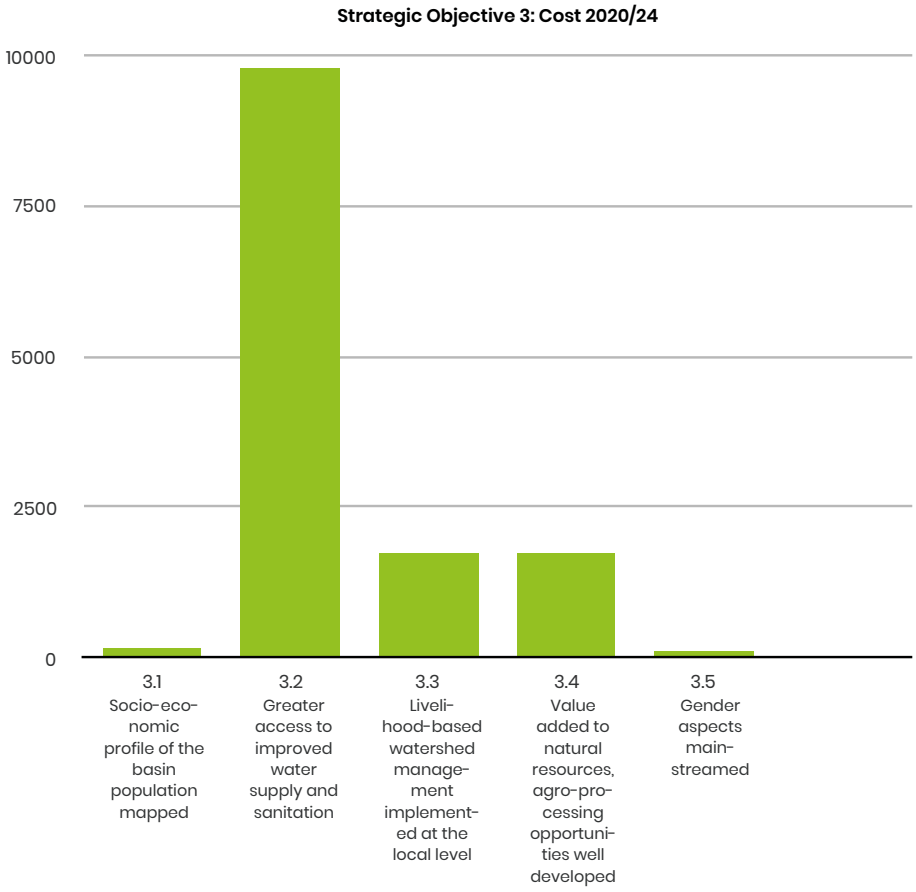


Table 6.14: Outputs and actions towards Strategic Objective 3 during 2020-2024

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	ACTIONS	Responsibilities: Lead	Responsibilities: CUVECOM	CRONOGRAMA / TIMELINE
Strategic Objective 3: To improve the livelihoods of the basins population	3.1.1	3.1: Socio-economic profile of the basin population mapped	Socio-economic survey in Angolan portion of the basin		Planning Minisitries, UAN, UNAM		
	3.1.1.1			Review of literature and existing data			
	3.1.1.2			Plan and design socio-economic surveys			
	3.1.1.3			Implement surveys			
	3.1.1.4			Analyse and disseminate results			
	3.1.2		Socio-economic survey in Namibian portion of the basin				
	3.1.2.1			Plan and design socio-economic surveys			
	3.1.2.2			Implement surveys			
	3.1.2.3			Analyse and disseminate results			
	3.2.1	3.2: Greater access to improved water supply and sanitation	Access to water supply in all urban settlements improved		CUVECOM, MINEA, MAWF		
	3.2.1.1			Plan and design for all urban settlements to meet shortfall			
	3.2.1.2			Implement projects/schemes to meet shortfalls			
	3.2.2		Access to improved water supply in all rural areas				
	3.2.2.1			Plan and design for all rural households/settlements to meet shortfall			
	3.2.2.2			Implement projects/schemes to meet shortfalls			
	3.2.3		Access to improved sanitation in all urban areas				
	3.2.3.1			Plan and design for all urban settlements to meet shortfall			
	3.2.3.2			Implement projects/schemes to meet shortfalls			
	3.2.4		Access to improved sanitation in rural areas				
	3.2.4.1			Carry out assessment of existing infrastructure			
	3.2.4.2			Plan and design for rural households/settlements to meet shortfall			
	3.2.4.3			Implement projects/schemes to meet shortfalls			
	3.3.1	3.3: Livelihood-based watershed managment implemented at the local level	Local level multipurpose livelihood-based watershed management pilot projects established in the different agro-climatic-economic zones of basin		MAWF, MFMR (Namibia) & Ministry of Agriculture & Forestry, Ministry of Fisheries & Provincial government (Angola)		
	3.3.1.1			Reconnaissance, mapping and zoning of agro-economic and identification of socio-environmental hotspot areas			
	3.3.1.2			Work with stakeholders in identification, planning and design of pilot projects in each agro-economic zone			
	3.3.1.3			Implement pilot demonstration project in each zone			
	3.3.2		Implementation of local level multipurpose livelihood-based IWRM-style water resources development and management over all of each of the hotspot areas				
	3.3.2.1			Develop plan for taking to scale of pilot demonstration projects over all hotspot areas in each zone			
	3.3.2.2			Implement plan for taking to scale in close cooperation with stakeholders, national institutions and CUVECOM			
	3.4.1	3.4: Value added to natural resources, agro-processing opportunities well developed	Opportunities for value addition to natural resources and agricultural products identified		MAWF, MFMR (Namibia) & Ministry of Agriculture & Forestry, Ministry of Fisheries & Provincial government (Angola)		
	3.4.1.1			Identify and assess opportunities for value addition based on existing activities and regional experience			
	3.4.1.2			Identify and assess specific value addition opportunities within each agro-economic zone			
	3.4.2		Promote the implementation of identified value addition opportunities				
	3.4.2.1			Work with stakeholders in planning and design of pilot demonstration projects			
	3.4.2.2			Implementation of pilot projects in each agro-economic zone			
	3.4.3		Expansion of programme				
	3.4.3.1			Assess pilot demonstration projects and develop plan for replication/taking to scale			
	3.4.3.2			Implementation of plan			
	3.5.1	3.5: Gender aspects masintreamed	Collection of gender-disaggregated data in socio-economic surveys		MGECW (Namibia), Minstry of Culture (Angola), planning ministries and CUVECOM		
	3.5.1.1			Plan and design for inclusion of gender-disaggregated data collection			
	3.5.1.2			Participate in socio-economic surveys			
	3.5.2		Gender issues and concerns included in plans and design related to agro-processing and livelihood-based watershed management.				
	3.5.2.1			Ensure full participation of women in the planning process			
	3.5.2.2			Integrate gender issues, concerns and opportunities			

Progress towards Strategic Objective 4 by 2024

Actions aimed at making CUVECOM effective and sustainable are included as priority actions in support of strengthening cooperation between the Member States and good governance of water resources.

Other areas prioritised include starting the process of harmonising legislation, policies and strategies across borders, and concrete actions to facilitate support from UNAM and UAN. Proposing mechanisms to ensure adequate and appropriate representation of women in water resources management structures at community, sub-national, national, transboundary levels is also a priority action.

The estimated costs of achieving each required outcome under this objective are summarised in Figure 6.5. Table 6.15 provides details of the proposed actions aimed at making progress towards Strategic Objective 4 during the first five years of the Plan.

Figure 6.5: Costs (x 1000 USD) at the Outcome level (2020-2024) for priority actions under Strategic Objective 4

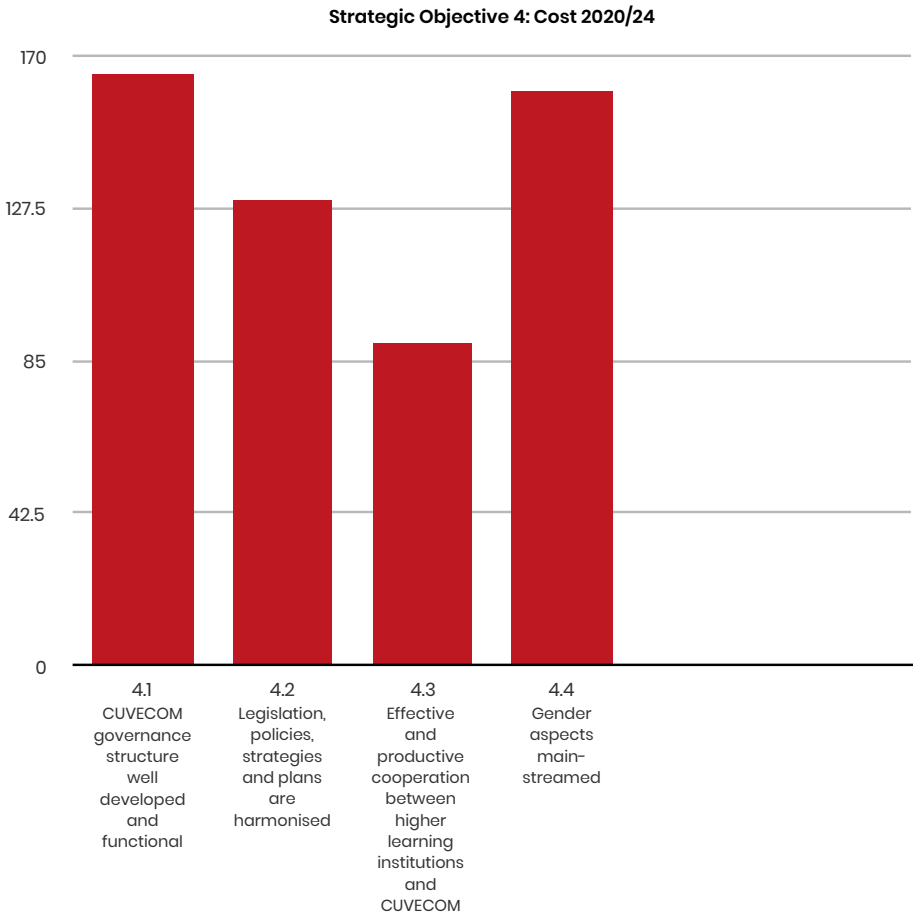


Table 6.15: Outputs and actions towards Strategic Objective 4 during 2020-2024

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	ACTIONS	Responsibilities		CRONOGRAMA / TIMELINE
					Lead	CUVECOM	2020 (1 2 3 4) · 2021 (1 2 3 4) · 2022 (1 2 3 4) · 2023 (1 2 3 4) · 2024 (1 2 3 4)
Strategic Objective 4: To strengthen cooperation between Member States and good governance of water resources	4.1.1	4.1: CUVECOM governance structure well developed and functional.	Plan for building CUVECOM capacity and governance roles developed		CUVECOM, MINEA, MAWF		
				Carry out needs assessment for capacity building and develop plan			
	4.1.1.1			Improve governance of transboundary water resources at CUVECOM and National level			
	4.1.1.2			CUVECOM approve and adopts capacity building Plan for implementation.			
	4.1.2		Plan for capacity building and improving governance implemented				
	4.1.2.1			Implement plan in Angolan part of the basin and associated national offices			
	4.1.2.2			Implement plan in Namibian part of the basin and associated national offices			
	4.1.2.3			Implement the plan at CUVECOM			
	4.2.1	4.2: Legislation, policies, strategies and plans are harmonised	Assessment of existing water management/development legislation, policies and strategies at the national levels		CUVECOM, MINEA, MAWF		
	4.2.1.1			Review national-level legislation, policies, strategies and plans relating to the management and development of water and related natural resources in the basin			
	4.2.1.2			Highlight and prioritise existing/potential problem areas requiring harmonisation			
	4.2.2		Harmonisation of legislation, policies, strategies and plans as necessary				
	4.2.2.1			Make recommendations on measures to harmonise national legislation, policies, strategies and/or plans as necessary			
	4.2.2.2			Make necessary revisions			
	4.3.1	4.3: Effective and productive cooperation between Higher learning institutions and CUVECOM	Cooperation between UNAM and UAN formalised.		CUVECOM, universities		
	4.3.1.1			Draft and sign a tripartite memorandum of understanding between the Universities and CUVECOM			
	4.3.1.2			Agree with CUVECOM on a 5 year programme of studies for students and support to CUVECOM			
	4.3.2		Study and project to support CUVECOM implemented				
	4.3.2.1			Carry out studies and projects (by students)			
	4.3.2.2			Provide support to CUVECOM (expertise and internships)			
	4.4.1	4.4: Gender aspects masintreamed	Current situation with respect to water resources management and governance assessed		MGECW (Namibia), Minstry of Culture (Angola), planning ministries and CUVECOM		
	4.4.1.1			Identify and describe the status quo for representation of women in water resources management structures at different levels (community, sub-national, national & regional (CUVECOM)			
	4.4.1.2			Propose mechanisms to ensure adequate & appropriate representation of women in water resources management structures at all levels (community, sub-national, national, regional (CUVECOM).			
	4.4.2		Adequate and appropriate representation of "gender" in water resources management and governance				
	4.4.2.1			Get endorsement of proposals/measures			
	4.4.2.2			Implement measures/proposals			

Progress towards Strategic Objective 5 by 2024

Priority actions to support the improvement of water security in terms of both quantity and quality include planning and implementing actions to deal with the basin's increasing pollution problem.

Water security in terms of quantity will be improved by the increased use of rainwater harvesting and floodwater harvesting, currently practiced in different ways across the basin. Several actions are planned during the first five years of the Plan.

The estimated costs of achieving each required outcome under this objective are summarised in Figure 6.6. Table 6.16 provides details of the proposed actions aimed at making progress towards Strategic Objective 5 during the first five years of the Plan.

Figure 6.6: Costs (x 1000 USD) at the Outcome level (2020-2024) for priority actions under Strategic Objective 5

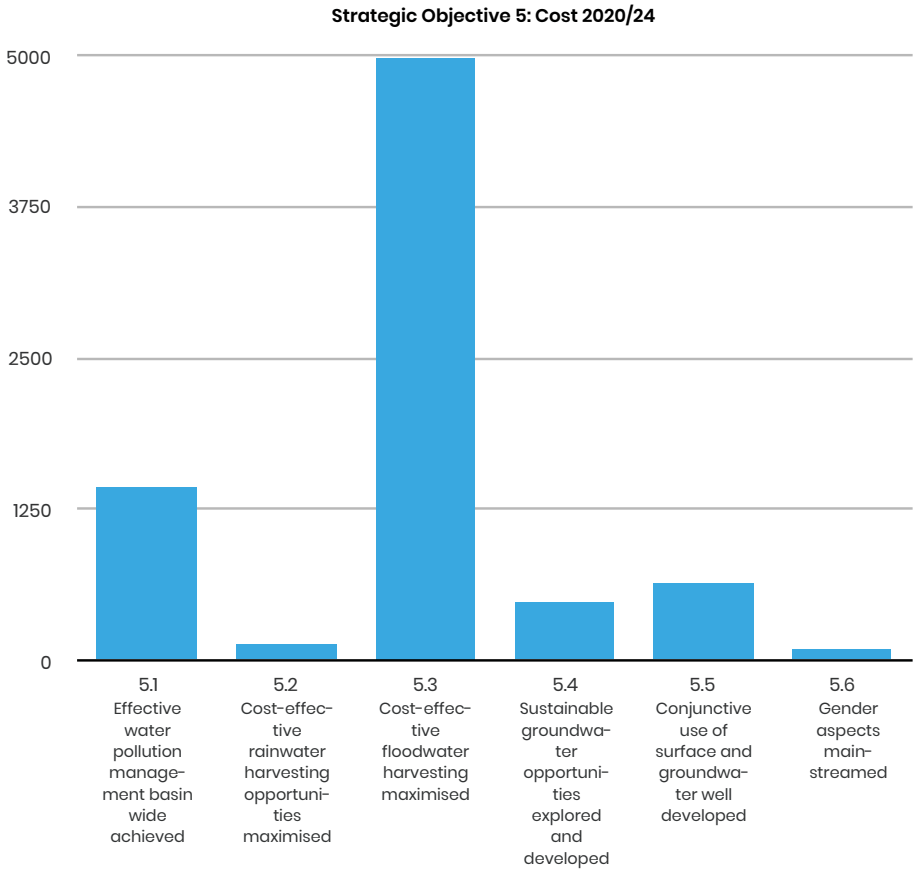


Table 6.16: Outputs and actions towards Strategic Objective 5 during 2020-2024

STRATEGIC OBJECTIVES	ID	OUTCOMES	OUTPUTS	ACTIONS	Responsibilities		CRONOGRAMA / TIMELINE
					Lead	CUVECOM	2020 1 2 3 4 | 2021 1 2 3 4 | 2022 1 2 3 4 | 2023 1 2 3 4 | 2024 1 2 3 4
Strategic Objective 5: To ensure water resources security (quality and quantity)	5.1.1	5.1: Effective water pollution management basinwide achieved	Diagnostic analysis of current practices and situation basin wide		CUVECOM, MINEA, MAWF		
	5.1.1.1			Draw up inventory of all water pollution sources			
	5.1.1.2			Assess activities related to wastewater and sources of pollution (sewerage, on-site sanitation, industries, agriculture..			
	5.1.1.3			Assessment of effluent and wastewater disposal systems			
	5.1.1.4			Summarise findings and draw conclusions			
	5.1.2		Strategic wastewater management plan for the basin				
	5.1.2.1			Draw up strategic wastewater management plan for the basin			
	5.1.2.2			Review and approve strategic wastewater management plan for implementation			
	5.1.3		Wastewater management plan implemented				
	5.1.3.1			Implement in phases according to priority			
	5.1.3.2			Carry out monitoring and evaluation and adapt plan accordingly			
	5.2.1	5.2: Cost-effective Rainwater harvesting opportunities maximised	Diagnostic analysis of current practices and situation basin wide		CUVECOM, MINEA, MAWF		
	5.2.1.1			Working with stakeholder identify and assess current practices around the basin			
	5.2.1.2			Identify issues constraining further develop of rainwater harvesting			
	5.2.1.3			Draw up a plan for widespread adoption of rainwater harvesting basinwide, addressing identified constraints			
	5.2.2		Implement plan aimed at the widespread adoption of rainwater harvesting				
	5.2.2.1			Set up and run project management unit with representation of stakeholders			
	5.2.2.2			Implement rainwater harvesting plan			
	5.2.2.3			Carry out monitoring and evaluation and adapt plan and implementation accordingly			
	5.3.1	5.3: Cost-effective floodwater harvesting maximised	Inventory and assessment of floodwater harvesting techniques basinwide		CUVECOM, MINEA, MAWF		
	5.3.1.1			Plan inventory of floodwater harvesting techniques and infrastructure basinwide			
	5.3.1.2			Carry out inventory of current floodwater harvesting techniques and infrastructure			
	5.3.2		Report on conclusions and recommendations for further floodwater harvesting				
	5.3.2.1			Analyse results of survey and assessment			
	5.3.2.2			Draw up and disseminate conclusions and recommendations			
	5.3.3		Feasibility, Planning, design and implementation of Floodwater harvesting				
	5.3.3.1			Phase 1: Investigate feasibility, plan and design for the expansion of floodwater harvesting basinwide in phases			
	5.3.3.2			Phase 2: Planning and Design of floodwater harvesting interventions			
	5.3.3.3			Phase 3: Implementation/Construction of floodwater harvesting interventions			
	5.4.1	5.4: Sustainable groundwater opportunities explored and developed	Groundwater development plan based on improved knowledge (see)		CUVECOM, MINEA, MAWF		
	5.4.1.1			Assess opportunities for the development of groundwater for bulk water supply and diffuse abstraction			
	5.4.1.2			Identify Draw up phased groundwater development plan for bulk water and diffuse abstraction			
	5.4.2		Implement groundwater development plan				
	5.4.2.1			Implement Phase 1			
	5.4.2.2			Implement Phase 2			
	5.5.1	5.5: Conjunctive use of surface and groundwater well developed	Development of conjunctive use of groundwater and surface water for bulk water supply		CUVECOM, MINEA, MAWF		
	5.5.1.1			Based on understanding of availability and level of assuredness of surface and groundwater supplies, identify priorities for conjunctive use			
	5.5.1.2			Implement conjunctive use where feasible (relates to 5.4.2)			
	5.5.2		Development of conjunctive use of groundwater and surface water for diffuse water supply				
	5.5.2.1			Based on understanding of availability of groundwater, identify priority areas where there is a shortfall in surface water for application of conjunctive use			
	5.5.2.2			Implement conjunctive use at the small-scale level for diffuse users			
	5.6.1	5.6: Gender aspects masintreamed	Assessment of gender issues and challenges in water resources management		MGECW (Nam) Minstry of Culture (Ang), planning ministries & CUVECOM		
	5.6.1.1			Carry out field surveys and stakeholder consultation			
	5.6.1.2			Draw up assessment			
	5.6.2		Implement gender mainstreaming measures				
	5.6.2.1			Agree on measures			
	5.6.2.2			Implement measures			

Mid-term Review and Responsiveness of the Plan to change

One of the priority aims of the Plan during its initial years will be to fill some of the significant gaps in knowledge. While this gap-filling will not have an impact on the agreed strategic framework for the Plan, it should produce new and improved information that will influence the design and prioritisation of many of the existing planned actions and activities.

To ensure that the plan remains responsive to the identified issues, challenges and opportunities, the following measures are proposed:

Continuous monitoring and evaluation by CUVECOM with support from other stakeholders as necessary
The monitoring and evaluation framework is briefly presented in Chapter 7. It will permit CUVECOM to monitor progress towards the various agreed outcomes. Where progress is below expectations this will signal that there may be problems with implementation of actions, either because the actions are inadequate or inappropriate, or because there is a delay in their implementation. CUVECOM will be in a position to take, or advise, action.

Mid-term review
A full mid-term review is proposed for the second half of 2022 with the aim of making i) preliminary proposals for improving and/or adjusting the Plan in terms of actions, timelines, and budgets, and ii) addressing any clear implementation challenges.

Detailed design of second five year period
During the first half of 2024, the second five years of the Plan should be carefully designed at the required level of detail. This work will take into account i) any data that have been collected for filling gaps in the knowledge base, ii) lessons learned from implementation of the 2019-2024 Plan, and iii) any other new developments.

Photo 23: Lady preparing the soil near Oshikuku, Namibia. Photo by Stuart Arnold, January 2019

Section 7

Implementation Modalities

Roles and Responsibilities

Like any cross-sectoral and integrated plan, implementation will be carried out by a wide range of institutions at both national and transboundary levels. CUVECOM is not an implementation agency, but it will be responsible for the management of many transboundary elements of the Plan, and it will play a leading role in monitoring and evaluating progress that is made toward a future Vision of the basin. CUVECOM will also play a role in ensuring that feedback received from stakeholders is heard, and taken into account, as the Plan is reviewed on a regular basis.

In terms of some of the priority areas of the IWRM Plan, CUVECOM is seen as having an important role to play. These include:

- Supporting an improved transboundary hydro-climatic knowledge base and the use of these data in improving the management of floods and drought,
- Supporting the building of climate resilience through a variety of measures ranging from building capacity in the communities through to more concrete actions such as rain and flood water harvesting.
- Promoting and increasing the participation of stakeholders at various levels
- Protection of the water and associated natural resources of the basin though improved land use practices
- Gender mainstreaming in all aspects of the IWRM Plan

Communication Strategy

CUVECOM will play the leading role in development of a communication strategy and stakeholder roadmap. The implementation of a CUVECOM website and River Awareness Kit (RAK) were the first steps in this direction.

Gender Responsiveness

A gender mainstreaming output is included in support of each one of the strategic objectives. Gender mainstreaming is one of the key principles of IWRM. Information on gender roles and the different access of men and women to water resources management and related services is, however, often lacking in many water strategies and policies. There are a several challenges for gender mainstreaming as it relates to water resources management in the Cuvelai River Basin.

- **Access to water:** Levels of access to potable water vary considerably across the basin. Lack of access to water to meet multi-faceted basic human needs is intrinsic to poverty. Female-headed households within the Cuvelai Basin form a significant portion of the population that lacks access to water.
- **Gender and disaggregated data:** Information and data about water resources in various policies, strategies, and national statistical documents lacks gender related evidence.
- **Gender and participation:** Within the different governance structures for water resources management at national and local levels men play a much greater role than women for a variety of reasons. While women and men are equally represented in higher decision making structures within CUVECOM, the equal participation and the involvement of women in water governance at the community level is generally inadequate.

Monitoring and Evaluation

Monitoring and Evaluation and Adaptive Management

Monitoring and evaluation is required to ensure that the various components of implementation of the IWRM Plan are on track and especially that they will lead to the desired outcomes, essentially progress towards meeting the strategic objectives and realising the Vision of the Cuvelai basin. A monitoring and evaluation system is only effective if the understanding of the desired outcomes is clear and measurable in some way, hence the development of indicators is critical.

The overall aim of the monitoring and evaluation framework can be seen in two distinct parts:

- To track progress towards the achievement of the strategic objectives of the IWRM Plan and
- To provide feedback on the implementation process in terms of whether actions are being carried out according to the planned timeline and on budget.

The first of these is what is commonly referred to as "results-based" monitoring and evaluation and is at the core of the proposed monitoring and evaluation framework. It is the process that allows adaptive management to take place effectively. The process of result-based monitoring and evaluation, and how it supports adaptive management is illustrated in Figure 7.1. The flow chart shows that If application of the monitoring and evaluation framework shows that the agreed success indicators are not being met, this would imply:

- Either that there may be problems with the basic design of some of elements of the IWRM Plan or the implementation strategy OR
- That the Plan is not being executed in a timely way or according to specification.

It should be stressed that the monitoring and evaluation programme is an integral part of the IWRM Plan and not something outside of it.

Project Management Framework

For month to month monitoring and evaluation of implementation of the IWR5M Plan, CUVECOM will use a Project Management Framework (PMF). This has been developed in Microsoft Excel and features the following elements for each strategic objective, outcome and indicator:

- Performance indicator,
- Data source for the indicator (updating),
- Indicator collection method,
- Frequency of reporting,
- Baseline value,
- Target value

The design makes the system easy to use, suitable for review, adjustment and improvement and is ideal for measuring progress towards the vision. It should be seen as an essential tool for implementation and for facilitating adaptive management.

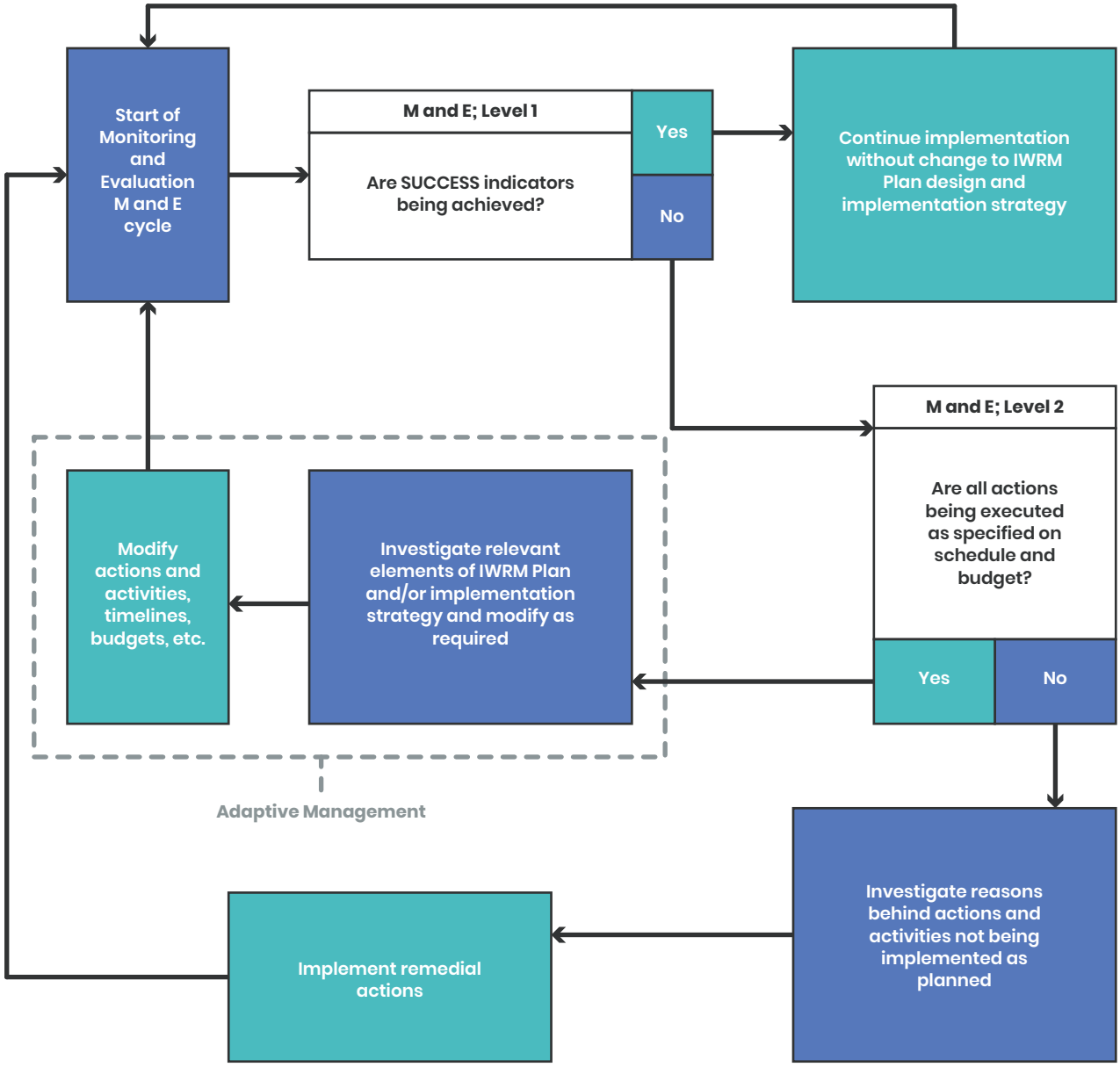


Figure 7.1 : Adaptive management as part of the Monitoring and Evaluation process

Annual Action Plans

Since the IWRM Plan is strategic in nature and cannot go into the detail of individual projects and interventions, it will be necessary to draw up 12 or 24 month actions plans on an annual basis. These should take into account the various existing updated planned actions across the various sectors. The IWRM Plan database system provided to CUVECOM can be used as a tool to support carrying out this exercise, including the detailing of costs. CUVECOM should take the lead in this exercise.

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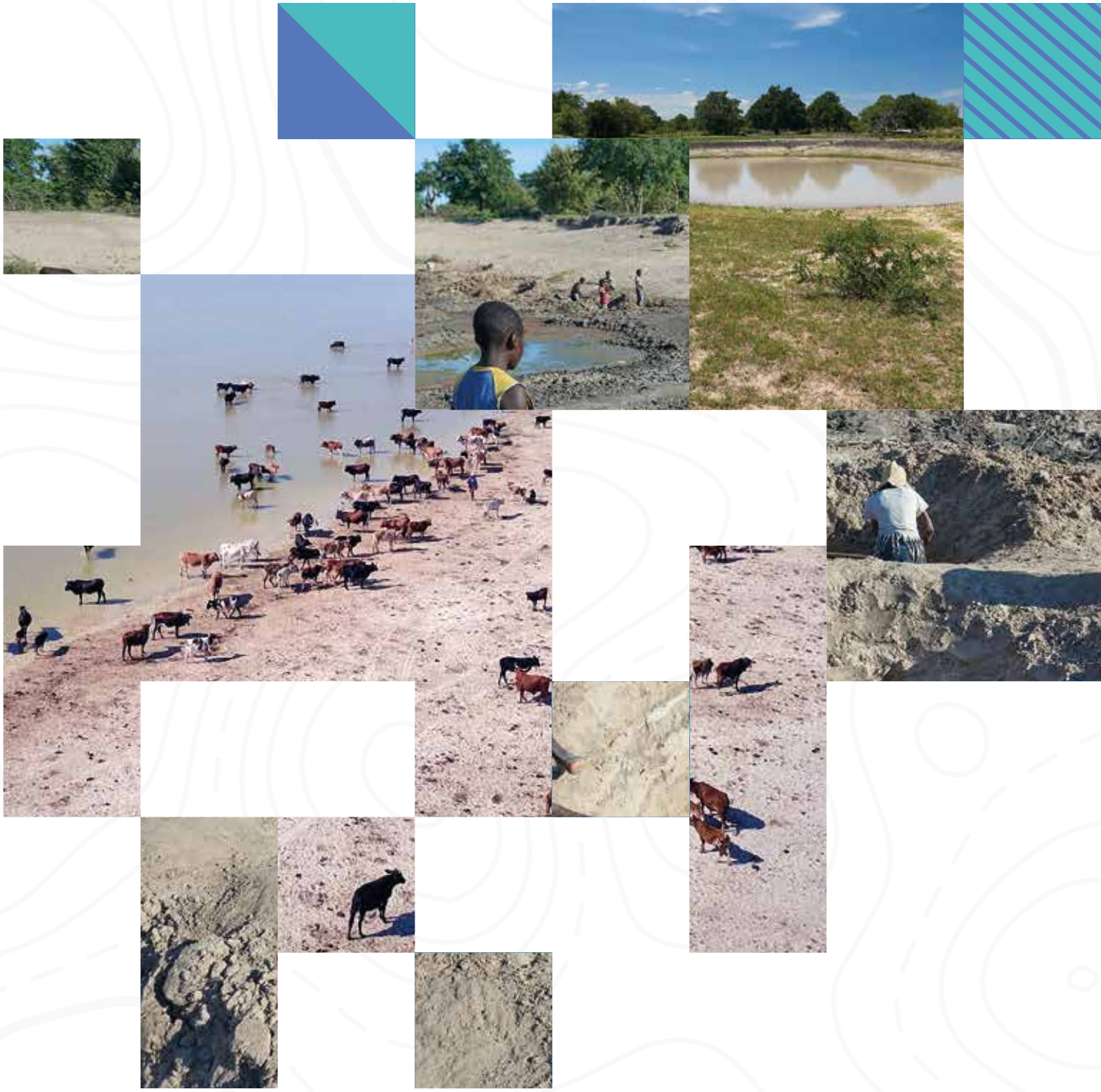

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