Toward a Drought-Resilient Southern Africa

SADRI Synthesis Report

SOUTHERN AFRICA
Drought Resilience Initiative

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ABOUT SADRI

The Southern Africa Drought Resilience Initiative (SADRI) is a technical support program launched by the World Bank in 2020 with support from CIWA to build analytical and institutional foundations to catalyze national and regional investments in drought preparedness and help to lay the foundations for a more resilient region to the multi-sectoral impacts of drought for the 16 member states of the Southern Africa Development Community (SADC). SADRI's work is structured around three key pillars: (i) Cities, (ii) Energy Systems, and (iii) Livelihoods and Food Security.

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SADRI Synthesis Report

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ABBREVIATIONS

Agbiz	South Africa Agricultural Business Chamber
CIWA	Cooperation in International Waters in Africa
CMIP6	Coupled Model Intercomparison Project Phase 6
CMU	Country Management Unit
DALRRD	Department of Agriculture, Land Reform and Rural Development
DSRAS	Drought Sensitivity and Resilience Assessment for SAPP
ECPG	Eastern Cape Provincial Government
FEWS NET	Famine Early Warning Systems Network
FLID	Farmer-led Irrigation Development
GCM	General Circulation Models
GDP	Gross Domestic Product
GESI	Gender and Social Inclusion
GIS	Geographic Information System
GLTFCA	The Great Limpopo Trans-Frontier Conservation Area
GWh	Gigawatt hours
HPP	Hydropower Plants
HVDC	High-voltage Direct Current
IFC	International Finance Corporation
IPC	Integrated Food Security Phase Classification
MEL	Monitoring, Evaluation, and Learning
MW	Megawatt
NDMC	National Drought Mitigation Center
NDVI	Normalized Difference Vegetation Index
NGO	Non-governmental Organization
O&M	Operations and Maintenance
PDNA	Post-Disaster Needs Assessment
PPP	Public-Private Partnership
RCP	Representative Concentration Pathway
RCRP	Regional Climate Resilience Program
RWH	Rainwater Harvesting
SADC	Southern Africa Development Community
SADRI	Southern Africa Drought Resilience Initiative
SAPP	Southern Africa Power Pool
SAPP-CC	SAPP Coordination Center
SGR	Strategic Grain Reserve
SSP	Shared Socio-economic Pathways
TFCA	Trans-frontier Conservation Area
TTL	Task Team Leader
UDRMF	Urban Drought Risk Management Framework
WBG	World Bank Group
WEAP	Water Evaluation and Planning
WEFE	Water-energy-food-environment
WHC	Water holding capacity
WMO	World Meteorological Organization

I. BACKGROUND

Historical records show that droughts are the most deadly and costly natural disaster for most of the 16 Member States of the Southern Africa Development Community (SADC)[1]. Recurrent and protracted droughts have exacted an immense human and economic toll, causing substantial economic damage and affecting millions of people in these countries (Davis-Reddy and Vincent 2017). These events weaken fiscal positions, leading more countries into debt distress, and undermine poverty reduction efforts. For example, recent analysis from the World Bank shows that each moderate-to-severe drought, on average, reduces the gross domestic product (GDP) growth rate in Mozambique by 0.27 percentage points. The impacts of droughts on GDP growth rates in other Southern African countries are similar (Zaveri et al., 2023). Not only are recurring droughts a costly regional hazard, but they also affect more people and cause more deaths than other natural hazards. Moreover, women are most impacted by droughts and famines, and the impacts can last for generations (Damania et al., 2017).

Since 2018, SADC has experienced protracted droughts, which are causing tremendous hardship. COVID-19, internal conflict, and political and economic instability compound the effects of repeated droughts and erratic rainfall and have created record-high levels of food insecurity. Between 2018 and 2019, food insecurity increased by 28 percent across the region, 7.4 percent higher than during the severe El Niño-related drought of 2016-2017. Roughly 45 million Southern Africans were food insecure from January to March 2020 and in the same period in 2022-2023 that number increased to 55.7 million people (SADC 2022).

1.1 THE NEED FOR IMPROVING DROUGHT PREPAREDNESS IN SOUTHERN AFRICA

The diversity of the Southern Africa sub-regional climate (arid, semi-arid, humid, sub-tropical, and Mediterranean) is influenced by natural climatic phenomena such as El Niño, which, in the SADC region, is usually characterized by a decrease in average rainfall. When strong El Niño events coincide with dry cycles, drought impacts are magnified. The frequency and intensity of such drought events are projected to increase from climate change. Climate change projections indicate that a large proportion of Southern Africa will become drier and hotter, with cycles of drought becoming more severe and intense (Abiodun et al., 2019). The warming trends will create an increasing risk for long-term droughts in Sub-Saharan Africa because of greater evapotranspiration in these already water-deficient climates, with some estimates indicating that "mega-droughts" could extend for up to 100 years on the continent, particularly in Southern Africa (Ault et al., 2014).

Meteorological, hydrological, and agricultural droughts affect landscapes beyond national borders. Most of Southern Africa shares a highly seasonal pattern of precipitation, with most annual rainfall accumulating in half the year, usually between October and March. As a result, failure to deliver the needed moisture in the rainy season leads to a year-long water deficit. Widespread precipitation deficiencies decrease soil moisture and agriculture production. When droughts persist for longer durations, they also affect surface water availability. As most river basins in Southern Africa are transboundary, these impacts accumulate across borders, resulting in broader ecological and economic impact. For example, the 1992 drought, which was one of the region's worst, deeply affected the Limpopo Basin and had severe impacts on its riparian countries, reducing Zimbabwe's agricultural production by 45 percent, causing Mozambique to spend roughly US$200 million on food aid, and contracting Southern Africa's GDP by 1.8 percent from impacts on the agriculture sector (Abiodun et al., 2019). Drought effects are wide-ranging:

- The impacts of droughts are felt across all economic sectors. When a drought hits Southern Africa, cities, which are hubs of economic activity, run out of water; hydro-power generation declines, cutting industrial productivity; and, rural livelihoods, largely based on subsistence agriculture or wildlife conservation, collapse, causing widespread food insecurity. Therefore, the drought-challenge requires an integrated and cross-sectoral response.
- Droughts are exacerbating water shortages in rapidly urbanizing cities across Southern Africa. With growing urbanization and African economies increasingly service- and manufacturing-oriented, maintaining services to urban centres is critical for building resilience in these economies.
- Droughts directly affect the availability and reliability of power in the Southern Africa region. Hydropower, which represents 21% of the installed capacity of the Southern Africa Power Pool (SAPP) and is the second largest source of power in the region after coal, is directly impacted by droughts.
- Droughts affect livelihoods of food producers and frequently leads to food insecurity. In many Southern African countries, agriculture employs large segments of society and contributes significantly to economic production. When droughts affect yields and livestock, whole value chains are impacted, causing food shortages and price hikes. This can result in greater rural poverty, environmental degradation, and reduced social cohesion in both urban and rural communities.

While drought is affecting water availability in SADC countries, it is not the only driver of water scarcity (Box 1). The seasonal shortfall in water resources resulting from inter-annual variability in precipitation can be compounded by factors such as population growth, overexploitation of water resources, and water pollution.

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[1] Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe (See map in Figure 2).

Both drought and water scarcity lead to the depletion of available water resources. However, they are two distinct phenomena with different driving forces and temporal characteristics.

Drought is commonly defined as a prolonged absence or marked deficiency of precipitation leading to a hydrological imbalance. Drought events are characterized according to their impacts on the environment or society (e.g., meteorological drought, agricultural drought, hydrological drought) during the progression of water shortages based on magnitude, location, duration, and timing. It is important to note that even though droughts are part of natural climate variability, their occurrence is often associated with extreme or protracted climate patterns connected with climate variability and/or climate change.

Water scarcity is a gap between the available supply of, and expressed demand for, freshwater in an area under prevailing institutional arrangements and infrastructural conditions. The drivers of water scarcity are either a reduction in water supply, an increase in water demand, or both simultaneously. While the former can be human- or nature-induced, the increase in demand is solely human-induced.

(Source: IDMP, 2022. Drought and Water Scarcity)

BOX 1 - INTERRELATIONSHIP BETWEEN DROUGHT AND WATER SCARCITY

The drought challenge requires an integrated and cross-sectoral approach. Southern African countries need to shift from ad-hoc drought response to proactive drought risk management and build resilience to multi-sectoral drought impacts. As in other regions, droughts in Southern Africa are typically managed in a reactive manner, with interventions mainly organized and targeted as the drought crisis is unfolding. Many countries lack an early-warning information system that enables early identification of the onset of drought and proactive mobilization of resources, programs, and activities to prevent the drought from developing into a crisis. The lack of preparedness measures and ex-post reactive responses usually lead countries to rely on humanitarian interventions instead of building long-term resilience at the household and community levels. Generally, these reactive approaches cost more than prevention and preparedness. Additionally, Post-Disaster Needs Assessments (PDNAs) show that post-drought expenditures can be felt across many sectors including water, energy, agriculture, tourism, public health, and education. Therefore, it is essential to break sectoral silos and take an integrated approach to drought management across the water-energy-food-environment (WEFE) nexus.

1.2 THE SOUTHERN AFRICA DROUGHT RESILIENCE INITIATIVE

Given the extensive challenges that drought poses to Southern Africa's development priorities, it is crucial to accelerate innovation and capacity sharing across sectors and countries to build regional drought resilience. In 2020, the World Bank launched the Southern Africa Drought Resilience Initiative (SADRI) with support from the Cooperation in International Waters in Africa (CIWA) to advance **an integrated multi-sector and multi-level approach to regional drought resilience** in 16 SADC Member States.

SADRI's vision is a drought-resilient SADC region in which governments, institutions, and households develop proactive mechanisms to withstand climate change impacts and associated economic shocks. Since its inception, SADRI has worked to develop a platform for dialogue, promote integrated drought risk management across the WEFE nexus, and improve coordination among regional and international institutions and stakeholders to lay the foundation for proactive multi-sectoral drought resilience.

SADRI has advanced its vision by working with selected countries, cities, and regional bodies to proactively adopt an integrated approach to drought risk assessment under three sectoral pillars—cities, energy systems, and livelihoods and food security—along with the crosscutting "umbrella" pillar. A dedicated Monitoring, Evaluation, and Learning (MEL) component was also integrated into the program. The SADRI team has undertaken key analytics with a transboundary dimension through each pillar to fill knowledge gaps and advise counterparts on drought risk management strategies and approaches. The umbrella pillar has both informed and drawn from the knowledge and partnerships generated under the sectoral pillars to ensure that national and regional drought resilience needs are considered and that demand for drought investments is generated and addressed. The following sections provide a summary of the drought resilience approaches and solutions developed and supported by SADRI under its three sectoral pillars. These are non-exhaustive and were prioritized based on sector- and context-specific needs and stakeholder engagement. Annex 1 lists the full set of analytical and knowledge products that SADRI developed.

The three key elements of SADRI's integrated drought risk management framework are aligned with internationally accepted good practice:

i) Drought monitoring and early warning systems;

ii) Drought vulnerability and risk assessment; and

iii) Drought preparedness, mitigation & response

FIGURE 1 - THE INTEGRATED DROUGHT RISK MANAGEMENT FRAMEWORK

SADRI's vision can only be achieved if priority actors (Figure 2) engage, cooperate, take ownership of, and sustain a process of change in the policies, practices, and relationships needed to realize a proactive and integrated approach to drought resilience. Aiming to catalyze this change process, SADRI created a vision statement that was not only ambitious in its timeframe (deliberately extending beyond the scope of what SADRI could achieve alone in the short timeframe of implementation) but also one that priority actors could get behind. In doing so, it sought input from key actors and other stakeholders to unpack what 'integrated drought resilience' would look like if successful: who will use new tools and analytics, for what, and for whose benefit. Crucially, early engagement with priority actors also included the creation of spaces for development partners to share perspectives and coordinate actions, an ongoing process that led to several positive outcomes and momentum.

Identifying and focusing strategies on priority actors were also central to the strategy of each thematic pillar. From the outset, key actors were identified for cities, energy and water, and food security and livelihoods. Desired behavior changes were defined and used as reference points to stimulate adaptive management during regular monitoring. Importantly, priority actors included not only external actors but also internal Bank staff (Country Management Units [CMUs] and Task Team Leaders [TTLs]) because of their central role in shaping investments. Annex 2 provides an overview of SADRI's experience with outcome-oriented MEL.

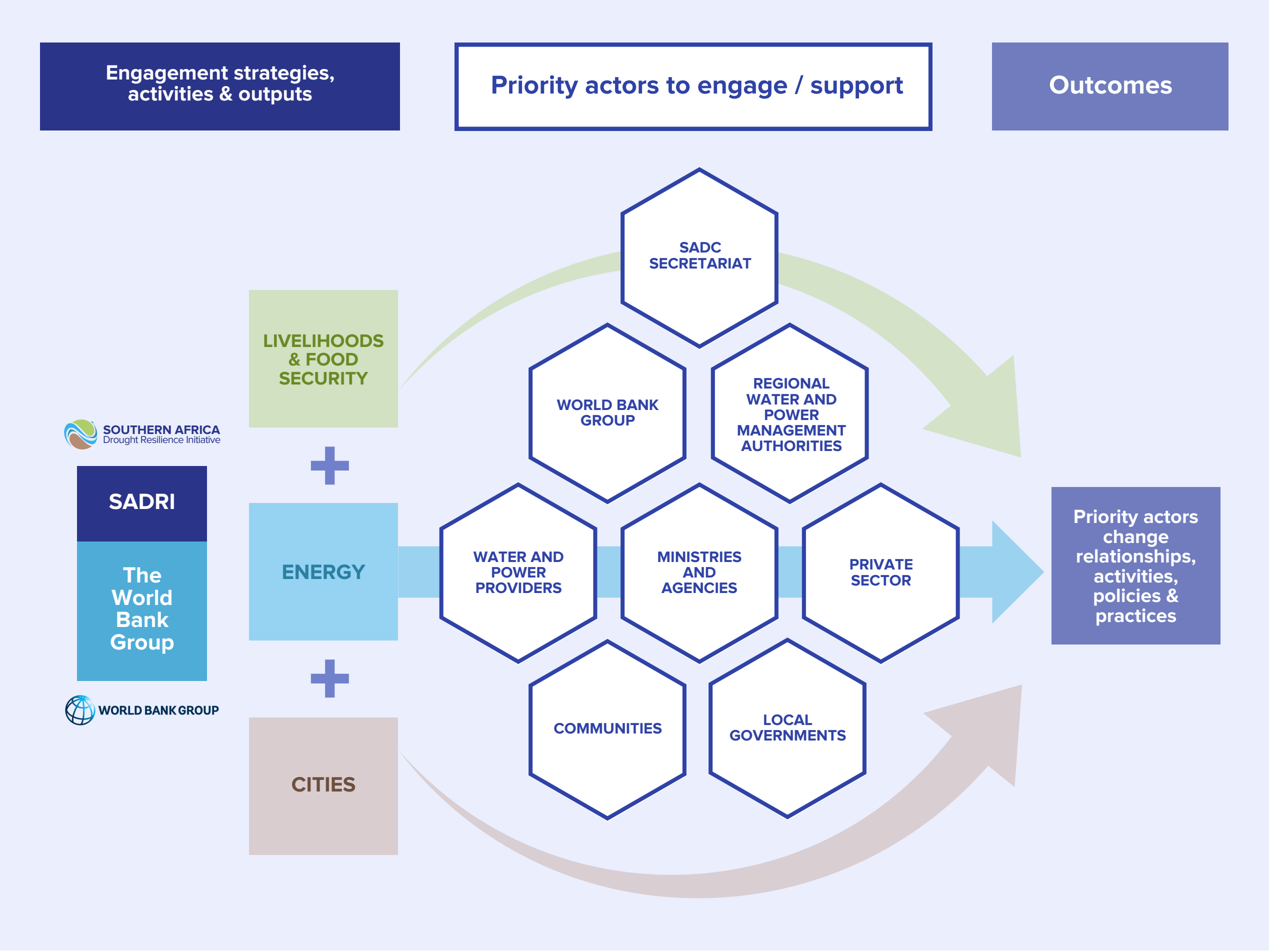


FIGURE 2 - SADRI STRUCTURE / THEORY-OF-CHANGE

1.3 ADVANCING A COMPREHENSIVE APPROACH TO MANAGING DROUGHT (AND CLIMATE CHANGE) RISK

Designing programs that build drought resilience requires understanding, and to the extent practicable, quantifying the vulnerabilities and impacts across key economic sectors. For SADRI, this initial assessment led to the focus on cities, energy systems, and livelihoods and food security. There are multiple sectors across each thematic area (e.g., water, agriculture, power, environment, tourism, disaster management, and social protection) and different levels of decision making (e.g., regional, basin, national, provincial, local, and community) that are relevant to building resilience. Clients responsible for delivering services in each of these sectors and at different levels face a distinct set of drought-related challenges and opportunities. Therefore, investments in infrastructure, information systems, and institutions need to be tailored to meet these sometimes common, but often disparate, needs. SADRI developed activities based on this principle, with the intention to provide the analytic underpinnings and shared vision for investments in drought resilience. All aspects have been informed by the three elements of the drought risk management framework described earlier. Taken together, the activities described in this synthesis report should be interpreted as the first step in developing a dedicated regional dialogue on drought resilience and supporting the development of a robust portfolio of investments for the SADC region.

As a slow-onset event that thoroughly permeates an economy, drought—and how it is managed—is in many ways a harbinger for how countries manage climate change more broadly. Therefore, building drought resilience through upgrades to institutions, information systems, and infrastructure serves the dual purpose of also increasing a country's overall climate change preparedness. This is why SADRI's vision includes an emphasis on preparing countries, their institutions, and their communities to be able to "...withstand climate change and associated economic shocks." Since its inception, SADRI has been successful in catalyzing behavior change in several key actors in the region to take ownership of the drought resilience agenda. It also provided a platform for regional entities to engage on drought-related challenges and innovative solutions. Thus, the analytical work, country engagement, and partnerships supported by SADRI over the last three years have laid the groundwork for the World Bank and partner countries and institutions to structure drought investments that will build resilience across different levels of decision making. There are several opportunities to capitalize on the momentum created by SADRI to advance integrated drought risk management in SADC countries. The following sections outline the work done by SADRI across its three thematic pillars to lay the groundwork for future actions to enhance the region's drought resilience. They also discuss how the work initiated by SADRI will be advanced by SADC stakeholders and provide insights into how SADRI's engagements and activities are informing different drought resilience interventions across the region.

II. Cities

Enhancing Urban Drought Risk Management

II. ENHANCING URBAN DROUGHT RISK MANAGEMENT

2.1 INCIDENCE AND IMPACT OF DROUGHT IN SOUTHERN AFRICAN CITIES

By 2030, about 70 percent of the population of Southern Africa will live in cities (UN DESA 2018). While there are significant differences in urban growth trends within and between countries, public water services are predictably scarce in cities across the region. With African economies becoming increasingly service- and manufacturing-oriented, maintaining basic services to urban centers is critical to sustain economic growth. In many cities, the converging challenges of rapid population growth and urbanization (including proliferation of slums), skyrocketing demand for increasingly constrained water resources, and growing prevalence of drought exacerbate water shortages (Figure 3), threatening economies, livelihoods, and the health and well-being of millions of people. These infrastructure inadequacies coupled with institutional inefficiency and weakness affect the sustainability of urban water systems and intensify economic disparity, poor water management, and water governance issues. People living in informal urban settlements or slums are particularly vulnerable to drought impacts, which could have cascading effects arising from failures in public water supply, health risks, food insecurity, and conflict resulting in unemployment, migration, and social instability.

Although several cities acknowledge the strategic importance of sound water management, many municipal governments and water utilities remain unaware of the risk of drought-induced water shortages. City water managers pay limited attention to sustainability considerations; coordination with consumers; identification of, and planning for, water resources needed for economically productive activities; and the risks of disconnection from watersheds. As a result, and despite water crises affecting several cities in recent years, the typical response to urban drought has been a traditional engineering approach based on supply-side infrastructure solutions that seek to meet increasing demands for water from more distant and expensive sources.

To effectively prepare for increased water scarcity and the recurrence of drought, cities must shift from traditional approaches to more adaptive and innovative water management solutions. SADRI has supported several cities to strengthen early-warning systems and planning, assess physical and institutional vulnerabilities, and identify opportunities for enhancing drought resilience. It has developed and deployed toolkits and guidance notes to enable cities and urban service providers to undertake long- and medium-term drought-sensitive water resources and services planning; develop emergency response plans; and plan for and/or apply adaptive water management approaches, such as rainwater harvesting and other green infrastructure investments.

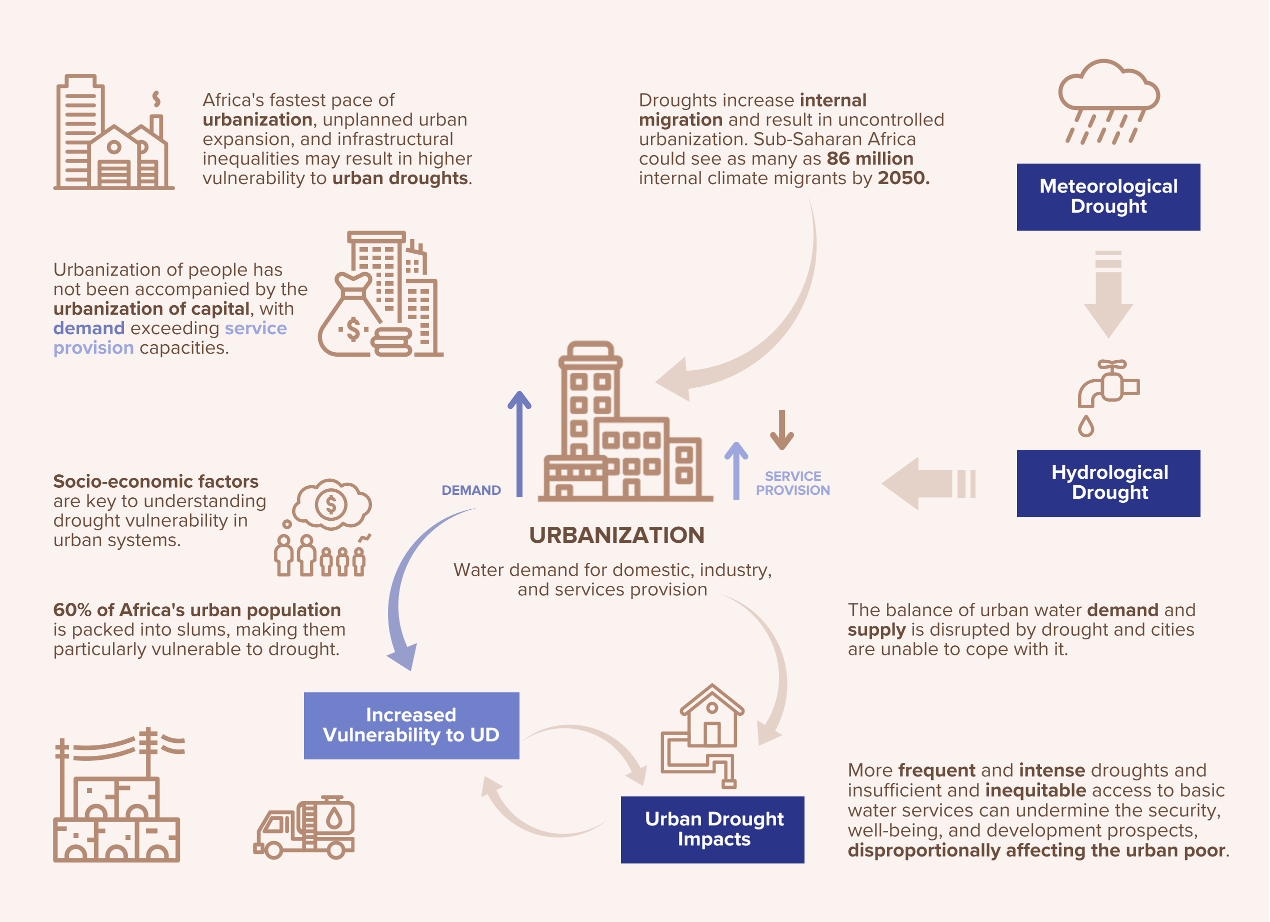


FIGURE 3 - URBAN DROUGHT

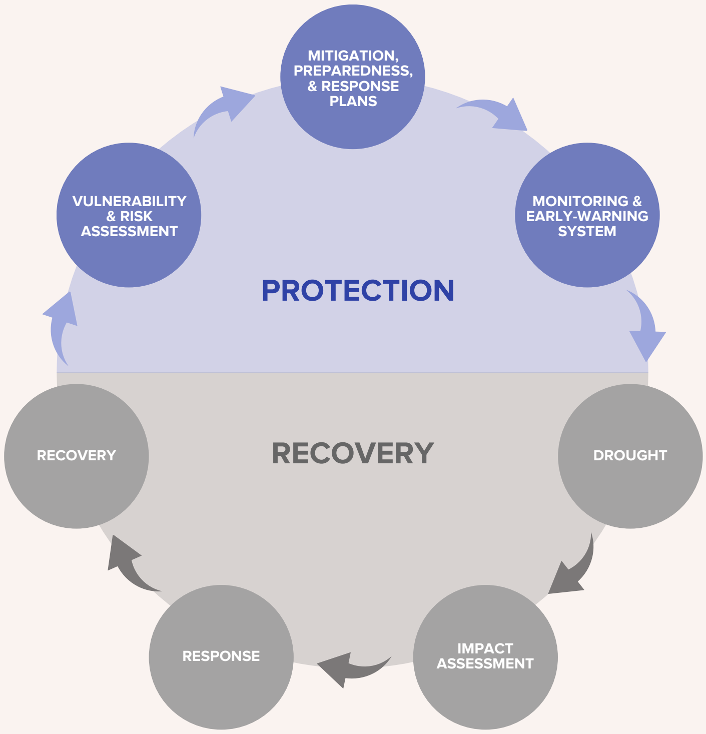
2.2 ENABLING INTEGRATED DROUGHT RISK MANAGEMENT FRAMEWORK IN URBAN AREAS

With most countries and cities still addressing droughts through crisis management, it is critical to adopt a proactive and integrated approach to drought risk management using a clear and agreed framework (Figure 4). Building on international best practices, SADRI pioneered the development of the Urban Drought Risk Management Framework (UDRMF), which facilitates integrated, proactive/preventive, comprehensive, and people-centered drought-risk management. The UDRMF aims to reduce existing drought risks and potential impacts of drought; prevent new risks; and strengthen resilience, recognizing links between urban drought, poverty, urbanization, and development. SADRI used the new framework to develop the Urban Drought Risk Management Toolkit and a Regional Guidance Note for SADC countries.

UDRMF approaches drought risk management and resilience by emphasizing the role of planning, preparedness, and early-warning systems in facilitating timely and tailored interventions. It establishes a clear set of principles and operating guidelines to govern the (risk) management of drought and its impact; and defines roles and coordination mechanisms for institutions and organizations at national, regional, and city levels that are crucial to implement a drought risk management policy. UDRMF adapts the three pillars of the integrated drought risk management framework to the urban context and focuses on interconnected, multidisciplinary, and multi-institutional activities (Figure 5).

SADRI tested UDRMF by applying it to seven cities in Southern Africa through pilot case studies, which began with discussions with city officials and were followed by questionnaires to assess the status of urban drought management. Once this primary assessment was complete, SADRI had discussions with national and city officials to validate its findings and identify measures to further assess drought risks and improve their management.

Integrated Drought Risk Management



Traditional Drought Crisis Management

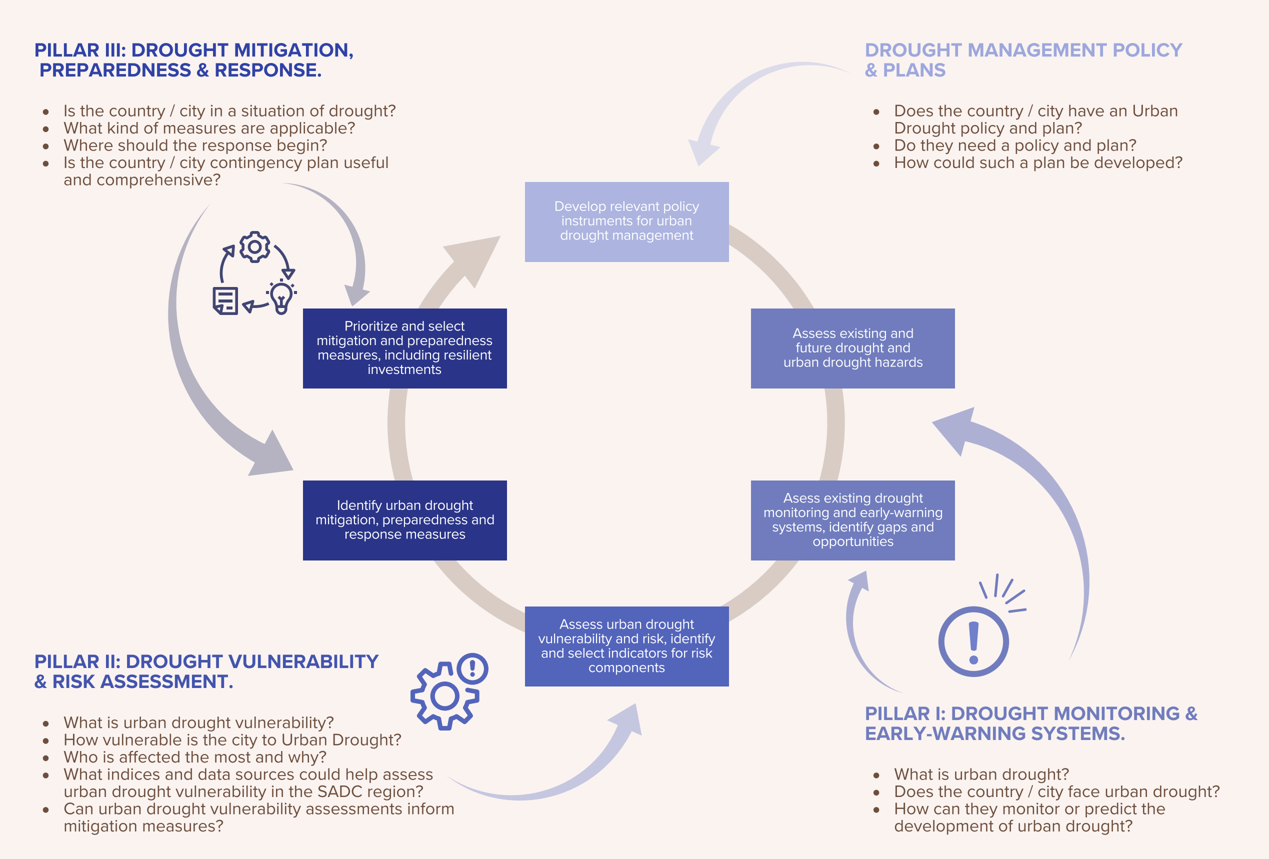
Proactive Approach Based on Drought Risk Management

- Includes all of the measures being designed in advance with appropriate planning tools and stakeholder participation.
- Based on both short-term and long-term measures and includes monitoring systems for a timely warning of drought conditions.
- Entails the planning in advance of necessary measures to prevent or minimize drought impact.

Reactive approach based on crisis management

- Includes measures and actions after a drought event has started has been identified.
- Taken in emergency situations
- Often results in inefficient technical and economic solutions because actions are taken with little time to evaluate optimal options.
- Stakeholder participation is often very limited.

FIGURE 4 - PLANNING APPROACHES: INTEGRATED DROUGHT RISK MANAGEMENT VERSUS DROUGHT CRISIS MANAGEMENT



PILLAR III: DROUGHT MITIGATION, PREPAREDNESS & RESPONSE.

- Is the country / city in a situation of drought?
- What kind of measures are applicable?
- Where should the response begin?
- Is the country / city contingency plan useful and comprehensive?

DROUGHT MANAGEMENT POLICY & PLANS

- Does the country / city have an Urban Drought policy and plan?
- Do they need a policy and plan?
- How could such a plan be developed?

PILLAR II: DROUGHT VULNERABILITY & RISK ASSESSMENT.

- What is urban drought vulnerability?
- How vulnerable is the city to Urban Drought?
- Who is affected the most and why?
- What indices and data sources could help assess urban drought vulnerability in the SADC region?
- Can urban drought vulnerability assessments inform mitigation measures?

PILLAR I: DROUGHT MONITORING & EARLY-WARNING SYSTEMS.

- What is urban drought?
- Does the country / city face urban drought?
- How can they monitor or predict the development of urban drought?

FIGURE 5 - THE THREE INTERCONNECTED PILLARS FOR EFFECTIVE UDRMF

PILLAR 1: URBAN DROUGHT MONITORING AND EARLY-WARNING SYSTEMS

Drought early-warning systems that are linked to planned mitigation, preparedness, and response actions are key to effectively manage drought risk in urban areas. To test UDRMF, SADRI conducted an exhaustive analysis of countries' drought monitoring capabilities, resources, and products, which showed that these countries lack urban drought monitoring systems.

The Urban Drought Toolkit recommends adoption of UDRMF, taking into consideration cities' capabilities along with regional and country-level efforts (Figure 5). SADC cities would greatly benefit from building capacity to develop their own urban drought monitoring and early-warning systems based on this framework. Such systems should leverage existing drought monitoring capabilities and tools such as global drought monitors, coupled with hydrometeorological data (precipitation, temperature, Normalized Difference Vegetation Index [NDVI], dam, stream, and piezometric measurements) and models.

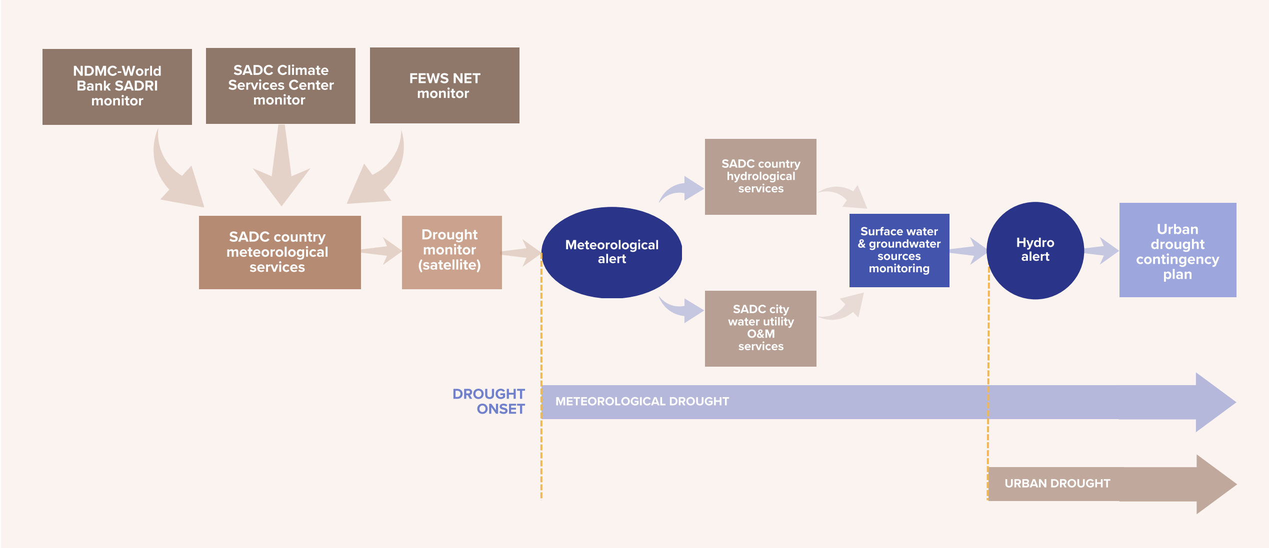


FIGURE 6 - RECOMMENDED URBAN DROUGHT MONITORING AND EARLY WARNING FRAMEWORK FOR SADC COUNTRIES

BOX 2. CASE STUDY TOLIARA, MADAGASCAR

Because of migration from rural to urban areas, there is a close link between agricultural drought and urban drought in Toliara. Additionally, the age of the water distribution network and the insufficiency of distribution tanks have amplified the negative effects of urban drought there. Toliara's drought response relies heavily on humanitarian aid, which does not reduce the underlying vulnerability. Governance of urban drought has also been very limited. The city's ability to undertake urban drought vulnerability and risk assessments is impeded by a set of challenges including weak institutional capacities. Urban drought monitoring and early-warning systems are limited throughout the country, as both JIRAMA (the state-owned electric utility and water services company) and Toliara rely on secondary sources of information. While efforts to enhance early-warning systems are being made, most local governments including Toliara and the water utility have limited access to relevant climate information and lack experience using this information for urban drought management. It is often difficult for local governments to interpret available information, which is not tailored for a particular urban setting. This inability to access and use relevant climate information restricts local government capacity to anticipate and act on emerging climate risks to urban infrastructure, services, and populations. SADRI discussed the findings and recommendations of the Toliara case study with local water utility, city officials, and national disaster risk reduction authorities to enhance their understanding of drought risk management.

PILLAR 2: IMPACT AND VULNERABILITY RISK ASSESSMENT

To manage drought risks in urban areas effectively, it is important to understand their likely impacts, identify who and what is at risk, and understand why. Assessing risk and vulnerability before droughts occur will allow city managers and communities to devise drought mitigation, preparedness, and response measures (pillar 3) that prevent or reduce the worst impacts of drought. Vulnerability to droughts depends heavily on both the sector and geographic context. The vulnerability assessment generally uses a composite index as proxy to represent drought by aggregating multiple indicators, accounting for various aspects of vulnerability. Indicators to assess urban drought vulnerability must focus on the root causes of drought. Water supply is influenced both by factors upon which water availability depends (e.g., institutional capacity for water resources management, water storage capacity, diversification of water sources, international water treaties, and national allocation rules) and factors upon which water distribution depends (e.g., production efficiency, technology, distribution systems, and institutional capacity of water utilities or water departments). The degree to which a society may be affected by a water shortage will depend, however, on population exposure and socioeconomic factors (e.g., degree of urbanization and urbanization trends, level of poverty, proportion of people living in slums, and level of inequality). To be operational, indicators must demonstrate relevance, simplicity, and affordability. Box 3 describes the various types of impacts of urban droughts on the economy, environment, and people that could be translated into vulnerability indicators.

ECONOMIC IMPACTS:

- Direct and indirect losses in production and profits (for businesses/industry)
- Unemployment
- Tourism losses
- Government revenue losses
- Increased cost of transporting water
- Costs to rehabilitate water sources or generate new water sources
- Welfare losses from water demand constraints
- Reduced economic development

ENVIRONMENTAL IMPACTS:

- Damage from increased groundwater depletion and land subsidence
- Reduced levels of bodies of water
- Deterioration in water quality
- Loss of biodiversity

SOCIAL IMPACTS:

- Mental and physical stress
- Waterborne diseases and other health issues
- Loss of life
- Public safety issues
- Increased conflict
- Alteration of recreational activities
- Public dissatisfaction
- Inequity in drought impacts by socioeconomic group, age, gender, and disability status
- Reduced quality of life

BOX 3 - ECONOMIC, ENVIRONMENTAL, AND SOCIAL IMPACTS OF URBAN DROUGHT

PILLAR 3: MITIGATION, PREPAREDNESS, AND RESPONSE

The impact and vulnerability assessment identifies the weaknesses and gaps to be filled for components such as water availability, distribution systems, and population exposure and informs the selection and prioritization of drought risk mitigation and preparedness measures. This could involve both structural (e.g., engineering projects) and nonstructural (e.g., policies, public awareness, and legal frameworks) measures on demand and supply sides. The selected measures are anchored in an urban drought risk management plan and include identifying appropriate triggers to phase in and out of mitigation actions, particularly short-term actions during drought onset and termination. SADRI recommends two groups of mitigation measures based on the risks and vulnerability identified (Box 5): (i) preventive measures to minimize drought impacts and (ii) contingency or responsive measures to reduce the impacts of an urban drought.

The final step in the UDRMF planning process is the development and adoption of a detailed set of procedures to ensure adequate implementation of drought assessment and response systems. The urban drought risk management plan should be monitored, periodically evaluated, learned from, updated, and improved with the intention of ensuring the plan's continued suitability and responsiveness to water utility needs.

BOX 4. CASE STUDY: GABORONE, BOTSWANA

Botswana's response to droughts increases its vulnerability and limits the country's ability to adapt. Currently, drought preparedness in Botswana is aimed at addressing the functions and activities required to deal with a likely or imminent hazard and is overseen by the National Committee on Disaster Preparedness. Gaborone has limited drought resilience and preparedness and needs to develop early-warning systems and finance resilient infrastructure projects to diversify its water supply. The development of such systems can play a fundamental role in drought preparedness and reduce socio-economics risks. Botswana's Drought Management Strategy should seek to outline short-to-medium-term proactive interventions, detailing how to use early-warning and related data. This can also support approaches for water management and early-warning systems in Gaborone and other urban centers by considering their economic and spatial growth trends.

The drought resilience agenda should include enhancing institutional and policy reforms, non-revenue water management, water resource management, optimization of resources including diversifying water sources and conveyance lines, and engagements within the country and across the region on sustainable financing solutions for drought-prone cities. Continual institutional coordination and information exchange among stakeholders is crucial for efficient drought preparedness. With multiple policies, committees, and departments playing a role in drought management, clear coordination by a lead entity is required to ensure alignment of roles, responsibilities, and actions to be taken when droughts strike. Sustainable financing and resilient infrastructure investment is also required to build Gaborone's water resilience.

The Government of Botswana has focused its efforts on Public-Private Partnerships (PPPs) to navigate short-to-medium-term water financing needs. While this approach presents opportunities for filling capacity and service delivery gaps and extending financial support structures, PPPs in this context can lead to regulatory and procurement challenges, which could increase public sector revenue losses. As a result, the government could seek appropriate PPP strategies for the longer-term. The Drought Management Strategy could be complemented by the development of a water resilience investment plan, which responds to the financial gaps and needs within Gaborone.

BOX 5. CASE STUDY OF WINDHOEK, NAMIBIA

Windhoek has made significant advancements in building urban drought resilience in a water-scarce context by applying integrated drought and water management. The city has developed drought response and water management plans, which include demand reduction, supply augmentation, and efficiency measures such as wastewater recycling for direct potable water supply. While efforts to introduce this measure have failed in many cities because of the perception that reclaiming drinking water from municipal effluent is generally unacceptable, the experience in Windhoek shows that with persistent, well-designed, and targeted communication, this perception can be changed. Today, Windhoek is one of only a few cities in the world where direct potable water reuse is practiced. There is evidence that this is indeed a safe practice: in 40 years of recycling water for drinking water supply, the city has not had a single outbreak of waterborne disease linked to this practice.

Increasing demand from urbanization and population growth, changing precipitation patterns, and rising temperatures from climate change will likely result in higher urban drought risk for Windhoek. New water infrastructure investments and policy reforms will be needed to improve the water supply, ensure equitable access for the urban poor, and mitigate socioeconomic impacts of future droughts.

MONITORING AND EVALUATION

While most international case studies only provide generic guidelines on the development and implementation of a monitoring and evaluation framework for urban drought plans and policies, SADRI developed a more comprehensive monitoring and evaluation approach by adopting UDRMF and considering other disaster risk policies and plans. The evaluation reviews urban drought risk management planning as a dynamic process rather than as a discrete event. The operational evaluation program has four segments: impact, effectiveness, efficiency, and appropriateness. A post-drought evaluation should be conducted as soon as the drought has ended and should analyze the physical aspects of a drought including its impacts on soil, groundwater, plants, and animals; its economic and social consequences; and the extent to which pre-drought planning was useful in mitigating impacts, facilitating relief or assistance to stricken areas, and helping recovery after the drought (Figure 7).

BOX 6. CASE STUDY: BLANTYRE, MALAWI

The Blantyre case study highlights the nexus of urban drought and electricity. Lake Malawi is the city's key water resource and a reservoir for hydropower generation on the Shire River, which originates at the southern outlet of the lake. Lake water needs to be pumped uphill through a 48-km pipeline across an elevation of 800m, with additional booster stations to distribute water throughout the hilly terrain. Electricity from hydropower accounts for 98 percent of Malawi's total power production. It has been estimated that the below-normal rainfall seasons of 2014–15 and 2015–16 resulted in falling lake water levels and reduced river flows, which lowered power production by more than 50 percent. Water supply to Blantyre is highly susceptible to power outages, given the need to pump water uphill over such a long distance.

The main findings from applying UDRMF to Blantyre include:

- Blantyre has no reliable urban drought monitoring and early-warning system.
- The issue of a lack of infrastructure to deliver water adds to the challenge of water scarcity in urban areas. Insufficient and aging water and sanitation infrastructure results in failure to meet water demand, coupled with high energy costs and non-revenue water losses.
- Population growth, particularly in informal settlements, puts additional strain on the city's already inadequate water provision capabilities.
- No preventive or contingency drought plan or strategy exists, and there is weak urban drought governance (as part of disaster risk reduction).

Based on this analysis, SADRI made the following recommendations:

- •Investments to reduce urban drought risk, including in resilient infrastructure to improve water supply, diversification of water sources such as groundwater, and development of an urban drought monitoring system.
- Policy recommendations for integrated urban drought risk management including development and implementation of policies and plans for risk management by linking urban development with water development plans; updating laws, regulations, and institutional mandates; and improving coordination between the city manager and Blantyre Water Board to reduce drought risk, especially in slums.
- Conducting analytical work to identify and address knowledge gaps including developing indicators for urban drought impact and vulnerability assessment, undertaking urban drought impact and vulnerability assessments to better inform mitigation, preparedness, and response, and linking them to national/city budget allocations.

SADRI discussed the findings and recommendations of the Blantyre case study with local and national authorities to enhance their understanding of drought risk management.

RECOMMENDED PREVENTIVE MEASURES

Policy and institutional arrangements:

- Develop urban drought risk management policies and plans, establish institutional arrangements, and improve water governance

Monitoring and early-warning systems:

- Develop or enhance urban drought monitoring and early-warning systems (urban drought monitoring networks, forecasting, and early warning capabilities)

Impact and vulnerability assessment:

- Develop impact and vulnerability assessments considering present and future conditions (e.g., climate change, urbanization trends, population growth, future water demand) to better inform mitigation, preparedness, and response

Mitigation, preparedness, and response:

- Design and construct drought-resilient infrastructure (reservoirs) to improve water efficiency and availability
- Reduce non-revenue water
- Diversify water sources and develop new water supply projects
- Achieve a balance of long-term water use efficiency and drought resilience

RECOMMENDED RESPONSIVE MEASURES

Monitoring and early-warning systems:

- Monitor the progress of drought (using monitoring networks, forecasting, and early-warning capabilities) and communicate this knowledge on a regular basis to all levels

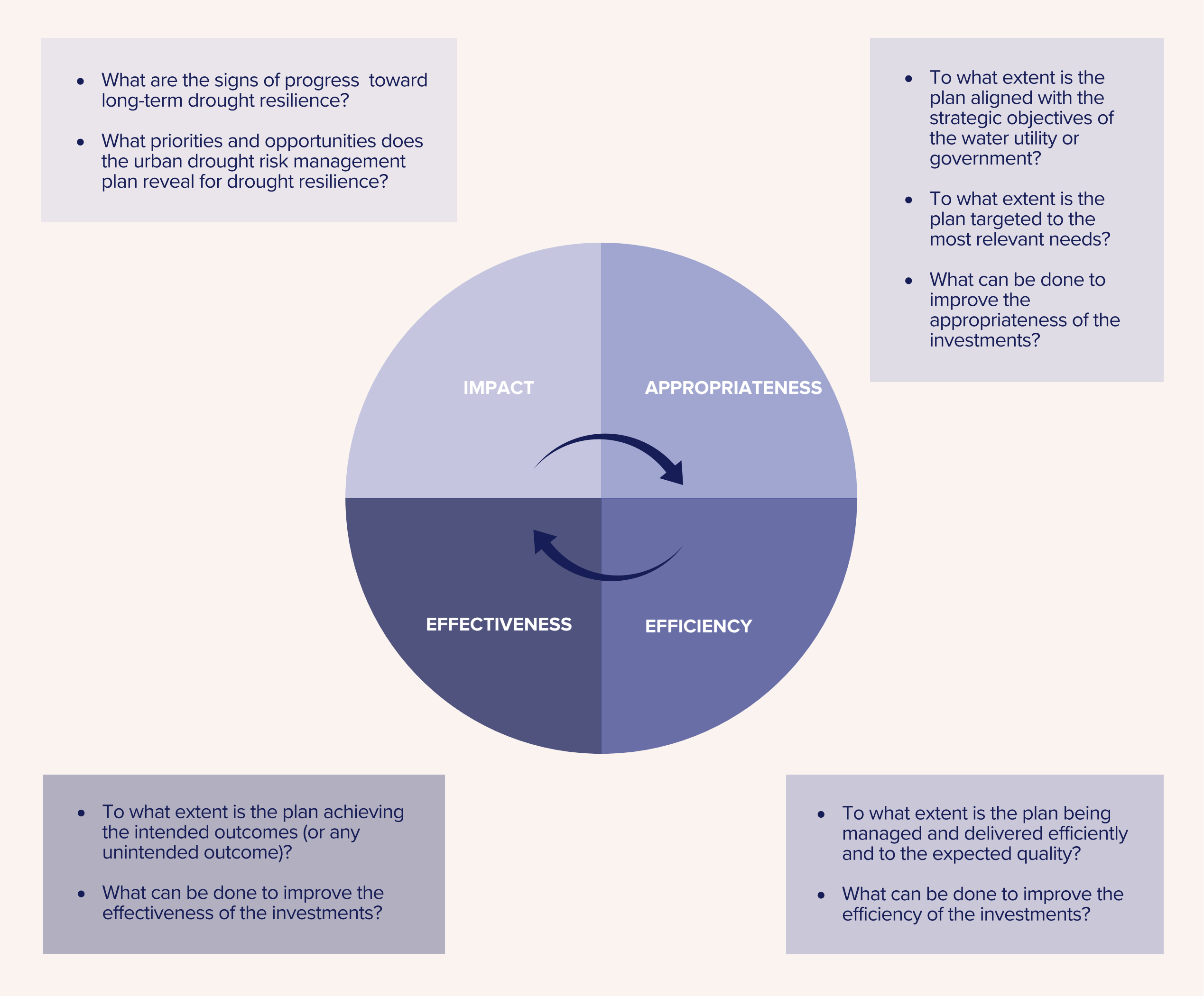
Impact and vulnerability assessment:

- Update the impact and vulnerability assessments considering the effects of response measures based on vulnerability indicators

Mitigation, preparedness, and response:

- Coordinate the water shortage contingency plan and its implementation
- Select appropriate water allocation methods for different users
- Balance water uses (agricultural and human consumption)
- Reduce non-revenue water
- Implement water supply sources , projects, or measures (e.g., water trucks and water tanks)

BOX 7 - ECONOMIC, ENVIRONMENTAL, AND SOCIAL IMPACTS OF URBAN DROUGHT



- What are the signs of progress toward long-term drought resilience?
- What priorities and opportunities does the urban drought risk management plan reveal for drought resilience?

- To what extent is the plan aligned with the strategic objectives of the water utility or government?
- To what extent is the plan targeted to the most relevant needs?
- What can be done to improve the appropriateness of the investments?

- To what extent is the plan achieving the intended outcomes (or any unintended outcome)?
- What can be done to improve the effectiveness of the investments?

- To what extent is the plan being managed and delivered efficiently and to the expected quality?
- What can be done to improve the efficiency of the investments?

FIGURE 7 - SCOPE OF THE OPERATIONAL EVALUATION PROGRAM

2.3

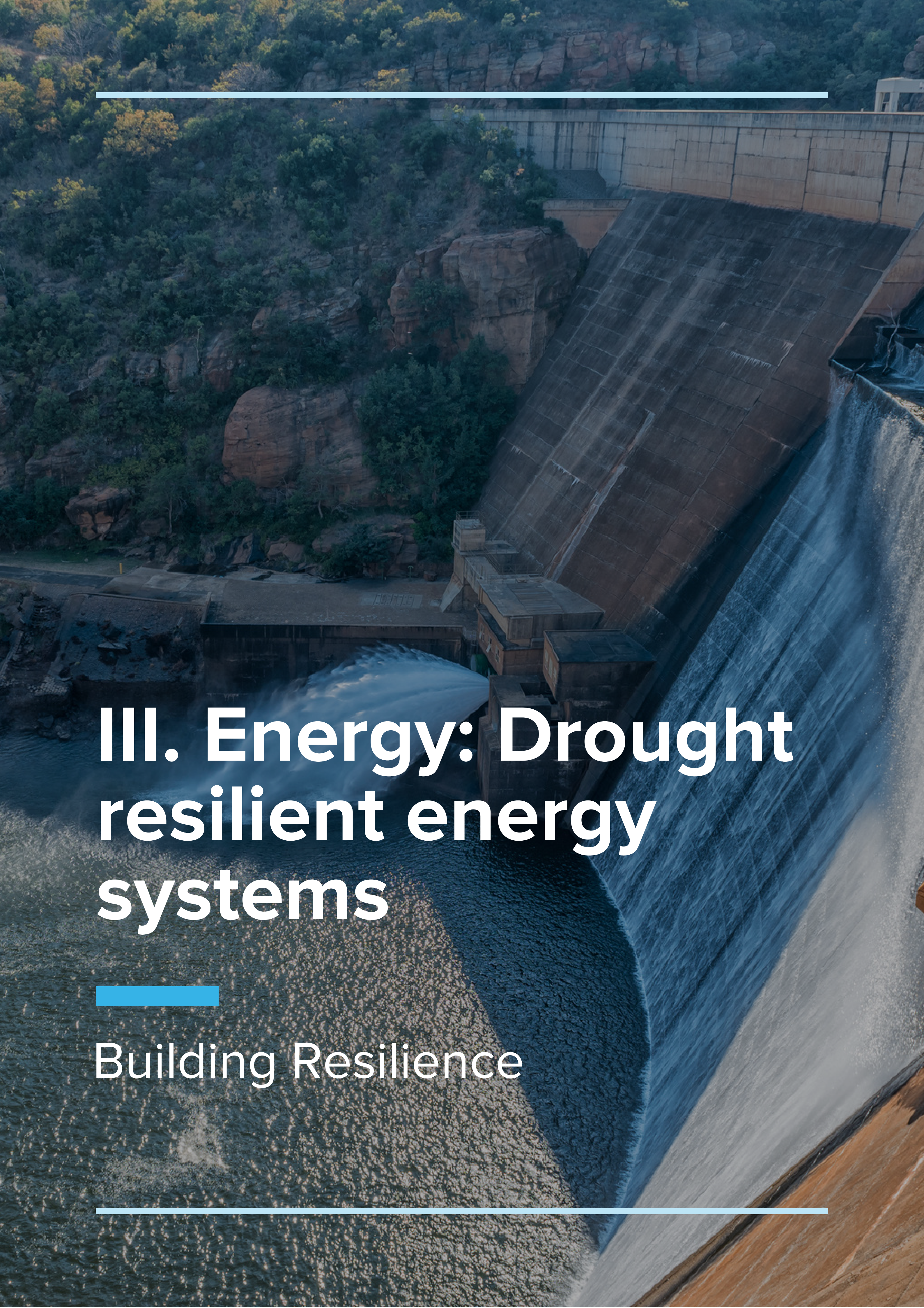
ADVANCING URBAN DROUGHT RESILIENCE IN SOUTHERN AFRICA

KEY OUTCOMES

Using UDRMF, SADRI provided evidence-based case study analyses of drought risk management systems and capacities and approaches for assessing and planning for physical and institutional vulnerabilities to drought in select cities across the SADC region. The introduction of UDRMF provided guidance to governments, water utilities, local authorities, and other stakeholders on mitigating urban drought risk and strengthening resilience. Governments and local authorities engaged by SADRI responded positively to the perspective that water shortages and droughts are not merely caused by natural hazards but are also shaped by how the community prepares for, and responds to, drought impacts. Through SADRI, water supply service providers and cities started collaborating with the World Bank by sharing data, plans, and strategies to conduct rapid risk analyses and vulnerability assessments and develop urban drought risk mitigation and management recommendations.

NEXT STEPS

The regional overview of urban drought risk management and the city case studies conducted by SADRI show various cross-cutting lessons learned and opportunities for improvement. These include the need for robust data production, collection, and sharing; data analysis for use by decision makers; effective use of internet technology; capacity building of water utilities and national and city institutions for effective urban drought risk management planning; and use of mass and social media for outreach and awareness raising. As a next step for the cities engaged through the case studies, options for resilient investments and policy recommendations (mitigation, preparedness, and response measures) should be discussed by the city and its water utility. Opportunities to engage with other cities should be explored by the World Bank through existing country engagements on water, urban development, and disaster risk management.



III. Energy: Drought resilient energy systems

Building Resilience

III. DROUGHT-RESILIENT ENERGY SYSTEMS

Droughts directly impact hydropower, which represents 21 percent of the installed capacity of SAPP and is the second largest source of power in the region after coal—affecting power availability and reliability. Countries such as the Democratic Republic of Congo and Zambia generate almost 100 percent of their electricity from hydropower, making them particularly vulnerable to drought. SADRI is filling critical analytical gaps in the water-energy-climate nexus in Southern Africa and supporting SAPP's strategic priorities to secure more resilient energy systems.

3.1

INCIDENCE AND IMPACT OF DROUGHT ON THE POWER SECTOR

In recent years, El Niño-related droughts, exacerbated by climate change, have affected the water flows of major rivers, including the Zambezi, Cunene, and Vaal, to the extent that most hydropower plants have had to ramp down to as little as 25 percent of their capacity during dry spells. Climate projections for this region show reduced precipitation with continued decrease in river flows (UNECA 2018 and IPCC 2022). The reductions in rainfall, particularly over the Zambezi River Basin, will have adverse impacts on hydropower generation without investments in new generation and transmission infrastructure. When droughts occur, reducing hydropower generation, vulnerable countries fall below their necessary generation capacity to meet demand, resulting in outages. The economic impacts of such outages are limited when they are relatively infrequent and short-lived. However, countries such as Zambia and Malawi have experienced extended periods of drought that have caused prolonged and widespread outages with magnified short- and long-term impacts on their economies. Outages create major disruptions in the daily activities of businesses, with even greater impacts if they occur unexpectedly. They often need to buy expensive standby generation equipment, which must be supplied with fuel and maintained. For example, companies in Tanzania have lost an estimated 12 percent of monthly sales from outages, while in Zimbabwe the industrial sector spends an estimated 0.4 percent-to-0.6 percent of the country's GDP each year in back-up generation to mitigate the impact of outages (Rentschler et al, 2019). Protracted and recurrent outages also result in households purchasing generators and deferring purchase of electrical appliances.

In countries such as South Africa, Zambia, and Mozambique, the cost of outage per kWh has been estimated at over 10 percent of provision, while the total economic cost of outages in countries such as Tanzania and Uganda has been estimated at between 4 percent and over 6 percent of GDP (2017 SAPP Power Pool Plan, Rentschler et al, 2019). Increased interconnectivity resulting from the development of SAPP has elevated this problem to the regional level, with hydro-energy exports becoming vulnerable to disruptions. In recent years, deficient power infrastructure has affected poverty reduction and economic development in SADC countries more than in other parts of Africa.

With the expected increase in frequency and severity of droughts from climate change, it is crucial to build efficiencies and tradeoff analyses into hydropower generation and promote SAPP integration to improve power system flexibility so that hydropower-dependent systems can adequately supply customers during droughts. The allocation of hydropower generation investments across the SAPP region should be optimized to minimize average power costs.

3.2

ASSESSMENT OF DROUGHT IMPACT ON SAPP

The World Bank is supporting a Drought Sensitivity and Resilience Assessment (DSRAS) for SAPP to develop a deeper understanding of the potential impacts of climate change on the security of the electricity supply across member countries and develop remedial adaptation and power system development measures. It is identifying the associated investments in electricity generation and transmission infrastructure and their sequencing under different climate change adaptation pathways. DSRAS is structured into three phases:

- **Phase 1 :** Analyzing the sensitivity of hydro-energy generation to climate-induced drought.
- **Phase 2** : Power system modeling, climate risk management planning, and options analysis.
- **Phase 3 :** Identifying priority investments and adaptation pathways for drought resilience.

SADRI spearheaded the first phase of DSRAS, which focused on the assessment of climate change impacts on basin runoff and the hydro-energy generation potential of five primary catchments feeding into SAPP.

Across the SAPP region there are approximately 102 existing hydropower plants (HPPs), 23 that are committed[2], and 87 HPP candidates, with a total existing and potential installed capacity of just under 56,000 MW. Eighty-eight percent of the region's hydropower potential is located within the five primary catchments—Congo, Zambezi, Rufiji, Cuanza, and Cunene river basins—which were the focus of the analysis during Phase I (Figure 8). Historically, the northern and western parts of the SAPP region (the Congo River and the Angolan Cuanza and Cunene river basins) have experienced fewer extreme droughts, which have been of shorter duration compared to droughts in the South and East (the Zambezi and Rufiji river basins), where severe drought events have lasted for significant periods. SADRI conducted a quantitative assessment of the potential impacts of climate change on streamflow and energy generation for the Congo and Zambezi river basins but had to conduct a qualitative analysis for the Cuanza, Cunene, and Rufiji basins because of information constraints.

DIVERGENT IMPACTS ON THE HYDROPOWER POTENTIAL OF ZAMBEZI AND CONGO BASINS

The Zambezi and Congo river basins are most critical for SAPP hydropower generation. SADRI's quantitative assessment used the Water Evaluation and Planning (WEAP) tool[3] to determine potential impacts of climate change on streamflow and changes in water demand (e.g., irrigation) on the hydro-energy-generating potential for these river basins (Figure 8). This tool was configured and run for relevant baselines for the two basins and a variety of scenarios representing possible basin futures in terms of physical changes to the system, such as in patterns of water use (e.g., increased irrigation and domestic water demands), in hydropower infrastructure, and in the climate driving the hydrological system (Box 8). In the absence of similar WEAP models, quantitative assessments for three smaller river basins, namely the Rufiji, Cuanza, and Cunene river basins were undertaken through a rapid climate risk assessment methodology, based on climate elasticities of basin runoff and generated hydro-energy.

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[2] Committed means that the plant is either under construction or decisions to build the plant have been taken.
[3] An integrated water resources planning tool used to represent current or future water conditions in a given area.

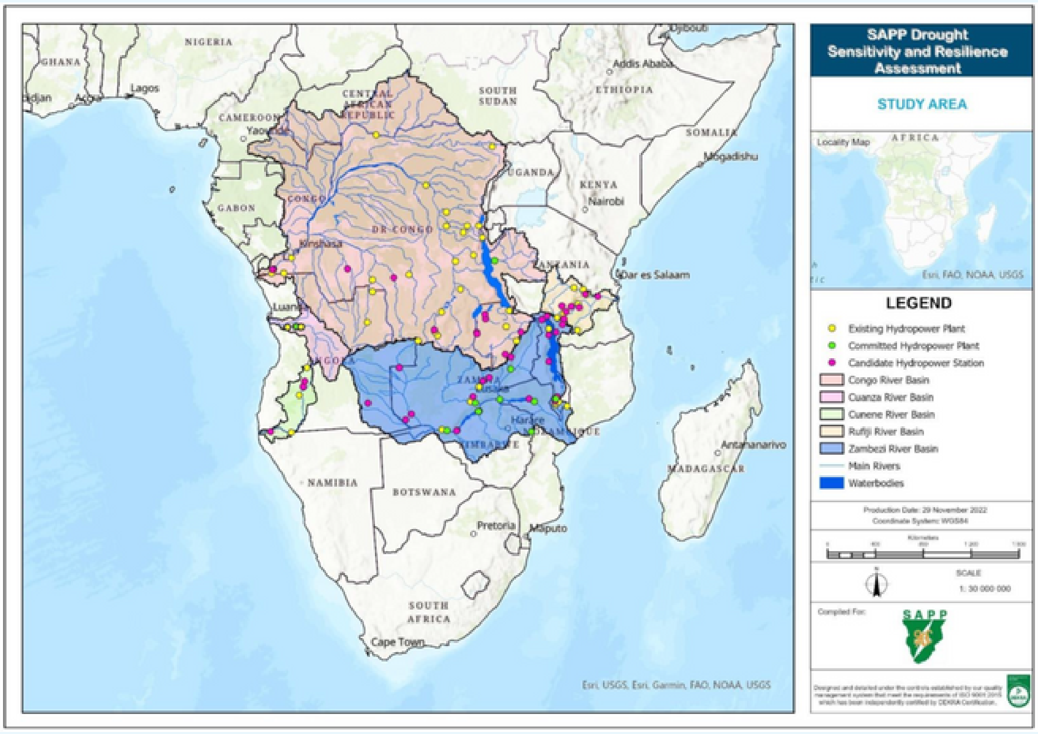

FIGURE 8. THE FIVE RIVER BASINS SELECTED FOR DETAILED STUDY IN DSRAS

SADRI ran climate change data from the Coupled Model Intercomparison Project Phase 6 (CMIP6), using Shared Socio-economic Pathways (SSPs) SSP2-4.5 and SSP3-7.0[4] using the WEAP model to provide simulated streamflow and energy generation time series for the period 2020–2060. First, the average annual totals of streamflow (m3), average annual temperature (°C), precipitation (mm), and energy (GWh) were summarized for 47 Global Climate Models (GCMs) for both SSPs for each key hydropower plant in both basins. Second, the percentage change in average annual streamflow, temperature, precipitation, and energy relative to the baseline of each was summarized. The intent was to analyze two sub-periods (2020-2040 and 2040-2060) with midpoints of 2030 and 2050, but as the changes are much more significant for the second period, the study focused on 2040-2060. HPPs that are currently ‘committed’ were added for 2030 and both committed and candidate HPPs were added for 2050.

Considering the differential impacts of climate change across the region, with adverse impacts on hydropower being much more severe in the Zambezi Basin than in the Congo Basin, specific percentiles of different datasets—future percentage changes in energy for the Zambezi and changes in streamflow for the Congo—were used to shape future climate scenarios (changes in energy were not notable at the majority of HPP sites in the Congo Basin due to limited turbine and intake canal capacities). Global Climate Models (GCMs) for both SPPs producing percentage changes in energy for the Zambezi and percentage changes in streamflow for the Congo that fell near the chosen percentile for each of the scenarios were averaged for each HPP and considered as the final datasets for those scenarios for the period 2040-2060.

1. **Baseline Scenario:** Historical climate time series for the period 1990 to 2010 and simulated series to 2060, incorporating the foreseen expansion of irrigation and domestic demands and committed and candidate HPPs.
2. **Plausible Scenario:** 50th percentile (median) of percentage change in both energy for the Zambezi Basin and streamflow for the Congo Basin.
3. **Drought Scenario:** 25th percentile of percentage change in both energy for the Zambezi Basin and streamflow for the Congo Basin.

Extreme Drought Scenario (worst-case): 10th percentile of percentage change in both energy for the Zambezi Basin and streamflow for the Congo Basin. This scenario is intended to be used for sensitivity analyses but is considered too extreme to be used for present planning purposes.

BOX 8. APPROACH TAKEN FOR DEFINING FUTURE CLIMATE SCENARIOS

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[4] The SSP2-4.5 scenario represents a future where strong efforts are made to lower GHG emissions and limit global warming in the 21st Century to less than 3°C greater than pre-industrial levels. The SSP3-7.0 scenario represents a society that continues to rely more heavily on fossil fuels and other high GHG-emitting sources, thereby increasing global warming to 4°C greater than pre-industrial levels by the end of the 21st Century.

The analysis for the **Zambezi Basin** focused on changes in hydro-meteorological variables such as temperature, precipitation, and streamflow for seven HPP sites selected based on energy generation capacity (GWh) and location. For the majority of the HPPs, which cover the western, central, and northern parts of the basin, there was a clear trend of a drier future, while a wetter future is predicted for the northeastern part (Shire River). The two biggest and most strategic HPPs, Lake Kariba and Cahora Bassa, show a potential reduction in total energy production of 38 percent and 37 percent, respectively, under these scenarios and without any mitigating measures (such as synchronization and seasonal optimization). A similar analysis for seven HPPs in the **Congo Basin** predicted a wetter, warmer future from a projected increase in precipitation across the basin. The Grand Inga HPP, which is of great significance to the SAPP region, shows a potential increase in streamflow of 21 percent. Scenario comparisons for the two basins reveal the following:

HPP, which is of great significance to the SAPP region, shows a potential increase in streamflow of 21 percent. Scenario comparisons for the two basins reveal the following:

Baseline: As limited irrigation expansion is anticipated in the Congo Basin, the baseline comparison applied only to the Zambezi and showed only limited impact with the largest reductions in streamflow (-5%) and power generation (-7%) at Lake Kariba.

Plausible Scenario: There is a drying trend in the Zambezi Basin, with a projected reduction in precipitation of about 6 percent and temperature increase of 1.5°C, yielding a significant corresponding reduction in streamflow and total power generation. In the Congo Basin, the trends indicate higher levels of rainfall and streamflow but only small increases in power generation because of limited installed turbine capacities. Significant potential exists at Inga and other sites for increased energy generation once more generation capacity is installed, which can balance reduced hydro-energy output in other parts of the SAPP region and even increase total output for SAPP.

Drought Scenario: The assessment suggested an extreme drying trend in the Zambezi Basin associated with about a 12 percent reduction in precipitation and a temperature increase of 1.8°C, yielding a substantial reduction in streamflow and total power generation. In the Congo Basin, the results suggest lower levels of streamflow than in the Plausible Scenario but, overall, the model simulates that there will be sufficient water to maintain near-maximum generation at current and committed HPPs.

Extreme Drought Scenario: In the Zambezi Basin, there is an exacerbation of drying trends, with a reduction in precipitation of 11 percent to 15 percent and in streamflow of 40 percent to 53 percent, resulting in a reduction in total power generation of 9 percent to 46 percent. For the Congo Basin, as with the other scenarios, the projected reduction of streamflow is not significant enough to threaten existing or future hydro-energy generation.

This analysis demonstrates that HPPs in the Zambezi Basin are highly vulnerable to drought, while HPPs in the Congo Basin are instead largely buffered from projected climate change impacts. This can be attributed to climate change projections pointing to a wetter future in the Congo Basin, coupled with the HPPs located there having generally lower capacities than the Basin's hydropower potential, particularly at Inga. As a result, the Congo Basin has sufficient water to operate the currently installed HPPs at close to full capacity even when river flows are reduced during droughts. Moreover, significant potential remains at Inga and other sites for increased energy production by increasing generation capacity.

A WETTER FUTURE FOR THE RUFIJI, CUANZA, AND CUNENE BASINS

The assessment of Rufiji, Cuanza, and Cunene basins was based on available information, and in particular, on a thorough literature review, supplemented by an analysis of climate data. Information was drawn from previous studies on the potential impacts of climate change on water availability. Additionally, projected changes in precipitation and temperature across different time periods for each river basin[5], along with relationships between relevant hydro-meteorological variables (precipitation, temperature, and streamflow) from neighboring river basins, provided an indication of possible changes in streamflow resulting from climate change. This information was then used to infer the potential impacts on energy generation and ultimately the level of drought sensitivity in each basin.

In the **Rufiji Basin**, there is likely to be little change in precipitation from climate change, but if it does change, it is likely that the basin's northern and eastern portions could become slightly wetter. Based on this, the Plausible Scenario could be no change in precipitation, while a temperature-induced reduction in streamflow of 6 percent is likely to occur, accompanied by an approximately 4 percent decrease in energy generation. The possible large-scale increase in irrigation development in the basin could create heightened drought sensitivity from extensive water use associated with irrigation. For the Drought Scenario, it can be assumed that precipitation will decrease by 10 percent and temperature will increase by 1.5°C, yielding an approximate 30 percent reduction in streamflow and a 20 percent reduction in energy.

The **Cuanza Basin** shows similar precipitation trends, with a small increase (<5%) in precipitation under the Plausible Scenario up to 2050, along with a temperature increase of 1.5°C, yielding virtually no change in streamflow and energy under this scenario. Under the Drought Scenario, a 5 percent reduction in precipitation is estimated along with a temperature increase of 1.5°C, yielding a 15 percent to 20 percent reduction in streamflow. A 10 percent to 15 percent reduction in energy production is also projected under this scenario.

For the **Cunene Basin**, a 5 percent reduction in precipitation is anticipated under the Plausible Scenario and a 10 percent reduction under the Drought Scenario, along with a temperature increase of 1.7°C. The 5 percent reduction in precipitation under the Plausible Scenario is expected to lead to a 15 percent to 20 percent reduction in streamflow and subsequently a 10 percent to 15 percent reduction in hydropower production. A 10 percent reduction in precipitation under the Drought Scenario is anticipated to reduce streamflow by 30 percent and hydropower production by 20 percent.

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[5] Obtained from numerous GCMs from CMIP6, similar to those used for the Congo and Zambezi basins.

The contributions of these three basins to SAPP's overall hydropower generation are small relative to the Zambezi and Congo basins. The uncertainties embedded in the above qualitative analysis will therefore not significantly impact the trends observed at the regional level.

CLIMATE CHANGE IMPACTS ON HYDROPOWER GENERATION IN SAPP

From 2020 to 2040, the SAPP region is expected to have an installed hydropower capacity of 31,275 MW (existing and committed plants) across all basins, with baseline energy generation at 171,000 GWh/year, equivalent to a 61 percent capacity factor. The Zambezi and Congo basins account for 70 percent of this generation capacity, split about equally between the two. During this period, SAPP's hydropower generation is expected to decline by 2 percent in the Plausible Scenario and 8 percent in the Drought Scenario compared to the baseline. The overall reduction is modest since the sizeable reduction in hydro-energy generation in the Zambezi Basin is partially offset by the sustained capacity of the Congo Basin.

From 2040 to 2060, SAPP's installed hydropower capacity is expected to grow to 56,000 MW, with baseline energy generation at 292,500 GWh/year, equivalent to a capacity factor of 62 percent. The Congo and Zambezi basins will account for 50 percent and 30 percent of this generation capacity, respectively. While droughts are projected to be more severe during this period, the overall effect of the reduction in the generation capacity in the Zambezi Basin will be counterbalanced by the Congo Basin, if further developed. As a result, there is a modest reduction in the hydropower generation capacity relative to the baseline (3 percent in the Plausible Scenario and 9 percent in the Drought Scenario) during this period.

3.3

ASSESSMENT OF DROUGHT IMPACT ON SAPP

DROUGHT RESILIENCE STRATEGY FOR SAPP

The first phase of DSRAS demonstrates that the impact of climate change-induced drought on hydropower generation in SAPP is likely to vary significantly across basins including among the two largest hydropower basins, with the Zambezi Basin being significantly more vulnerable to drought than the Congo Basin. This highlights a strong opportunity to build drought resilience by developing hydropower generation capacity in the Congo Basin, along with high-voltage direct current (HVDC) interconnectors to bring power to demand centers in the Zambezi Basin. The World Bank will explore these options in subsequent phases of DSRAS, which will undertake power system modeling to evaluate drought-resilience investments in the sector and to assess the extent to which deepening power sector integration could deliver reliable and cost-efficient power to SAPP member countries.

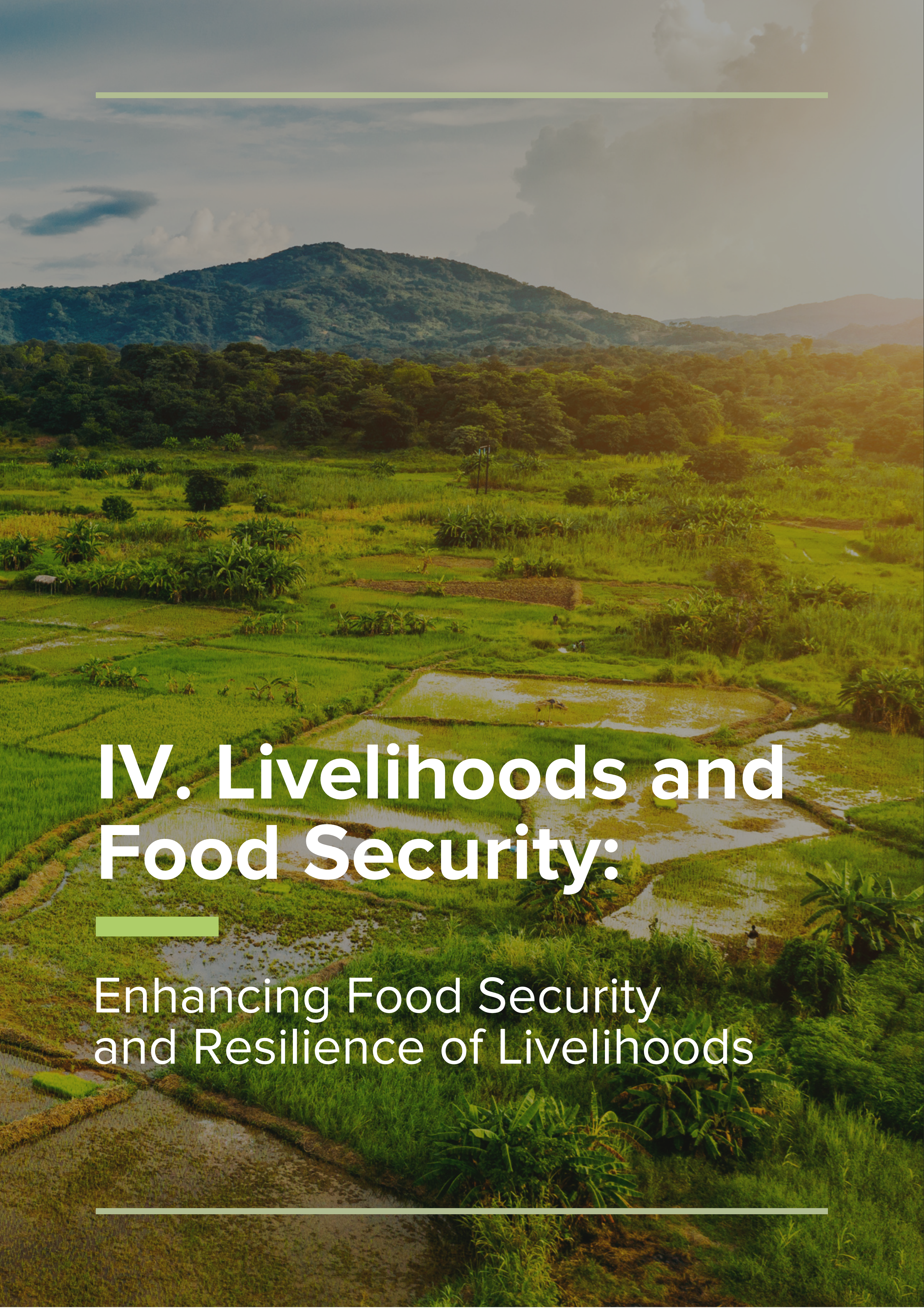
As risks from climate change intensify in Southern Africa, it is critical to build drought resilience in the region's power sector by improving efficiency in hydropower generation and investing in transmission, diversification, and regional integration. Even in the absence of drought, eight of the 12 SAPP countries face a shortfall in meeting current electricity demand. Increased regional integration of power systems and electricity trade across borders can help alleviate both structural and drought-induced power shortages. It can also improve power access and reliability by enabling countries to obtain cost-efficient power supply from neighboring countries, with their diversity of resources and differences in supply and demand patterns. In addition to optimizing hydropower generation and investments in transmission infrastructure, other renewable generation technologies are essential to enhance the power sector's resilience to drought. Development of the Inga HPP has for many decades been a regional aspiration, but successive development plans have been thwarted. Therefore, a drought resilience strategy for SAPP must include a broader range of generation and transmission options to mitigate the risk that Inga may not be developed.

The SAPP Drought Resilience Strategy should include near-term actions (e.g., soft actions such as flow forecasting, synchronization, and optimization) that can be implemented without major investments to enhance the system's performance and drought resilience. One such area is exploring more sophisticated approaches to system dispatch (distribution of electricity). It is well established that conjunctive operation of a cascade of hydropower stations (such as on the Zambezi River) can significantly increase energy output compared to operating each power station independently. The main challenge, however, is not in operating all the hydropower stations conjunctively, but rather that the entire generation fleet across SAPP must achieve a sustainable supply that is cost-effective and drought resilient. The suitability for SAPP of hydrological and dispatch optimization models operating in tandem that are being used on other continents should be explored as part of this strategy.

ENGAGING SAPP ON THE WAY FORWARD

The World Bank presented results of DSRAS Phase 1 to the SAPP Coordination Center (SAPP-CC) in November 2022. SAPP-CC and utility members expressed great interest in pursuing the drought resilience agenda after getting first-hand insights into the impact of drought on hydropower generation and endorsed pursuing subsequent phases of DSRAS. Recognizing the potential of Phase 1 study results to inform future planning and investments, SAPP-CC reaffirmed that SAPP is committed to DSRAS. SAPP-CC and participating utilities expressed strong interest in securing funding for phases 2 and 3. The growing support for DSRAS by SAPP-CC and the active involvement of member utilities will benefit the work envisaged under Phases 2 and 3, particularly in terms of required data, timely input, and buy-in at the utility level. A flexible and adaptable *Drought Resilience Strategy and Action Plan for SAPP* will be the final output of this engagement.

World Bank-administered Trust Funds have been identified for funding phases 2 and 3 of DSRAS. This may include further work (as deemed necessary) to update existing WEAP models used during Phase 1, including additional data-gathering and further hydrological modeling focusing on low flows during droughts. Phase 2 will comprise power system modeling (PLEXOS) to identify the key bottlenecks in SAPP's ability to ensure the security of supply at both pool and domestic levels and explore power trade and infrastructure investments for improving drought resilience for the period 2025-2065. Finally, Phase 3 will center on prioritization of the investments identified under Phase 2, based on economic and financial evaluation of promising investment opportunities and preliminary environmental and social impact assessments. Issues, constraints, and possible mitigation measures related to the preservation of biodiversity, environmental values, and socio-economic activities will be identified, including an assessment of how priority investments and other measures for increasing climate resilience will affect greenhouse gas emissions of electricity generation in the SAPP region. The output will be a report focused on addressing energy shortfalls and reliability bottlenecks in SAPP energy systems and prioritizing investments for increasing drought resilience, culminating in SAPP's Drought Resilience Strategy and Action Plan. Regional consultations with SAPP stakeholders will be conducted throughout Phases 2 and 3.



IV. Livelihoods and Food Security:

Enhancing Food Security and Resilience of Livelihoods

III. ENHANCING FOOD SECURITY AND RESILIENCE OF LIVELIHOODS

4.1 INCIDENCE AND IMPACT OF DROUGHT ON FOOD SECURITY AND LIVELIHOODS

Drought takes a toll on the SADC region's economy. In many countries, the agriculture sector employs large numbers of people and contributes significantly to economic production, making these economies susceptible to drought shocks. Agriculture accounts for more than a quarter of GDP in Madagascar, Mozambique, and Malawi. Beginning in 2019, South Africa's agriculture sector contracted by 6.9 percent for two consecutive years, which contributed to declines in agricultural trade surplus and larger macroeconomic volatility—including declines in GDP during the first, third, and fourth quarters of 2019. An analysis of the macroeconomic impacts of reduced maize output resulting from the El Niño-related drought of 2015-to-2017 estimated that households experienced a 1.7 percent decline in private consumption in real terms and that compensating for these impacts amounted to 1.9 percent of GDP in Malawi, 1.4 percent in Tanzania, 0.7 percent in Zimbabwe, and 0.5 percent in Lesotho and Eswatini.

Droughts lead to food insecurity for both urban and rural consumers. In the smallholder/subsistence agriculture sector, which accounts for the largest segment of working populations in most Southern African countries, many farming families produce food for their own consumption and market surpluses when possible. When drought leads to decreased yields and lost livestock, whole value chains are affected, causing food shortages and price hikes, which can lead to hunger and reduced social cohesion in both urban and rural communities. As estimated by SADC, 55.7 million people in 12 SADC Member States were considered food insecure in 2022, an increase of 10 percent from the previous year (SADC 2022).Droughts caused over 30,000 cattle deaths in Namibia between October 2018 and April 2019; 5.5 million people faced severe food insecurity in Zimbabwe between January and March 2020, and an estimated 2.3 million people faced hunger in Zambia after maize-producing areas in the South were hit by the worst drought since 1981 (United Nations 2019). While food aid provides short-term relief during crises, it is only temporary support, inadvertently undermines local food production, and leads to longer-term increases in food imports.

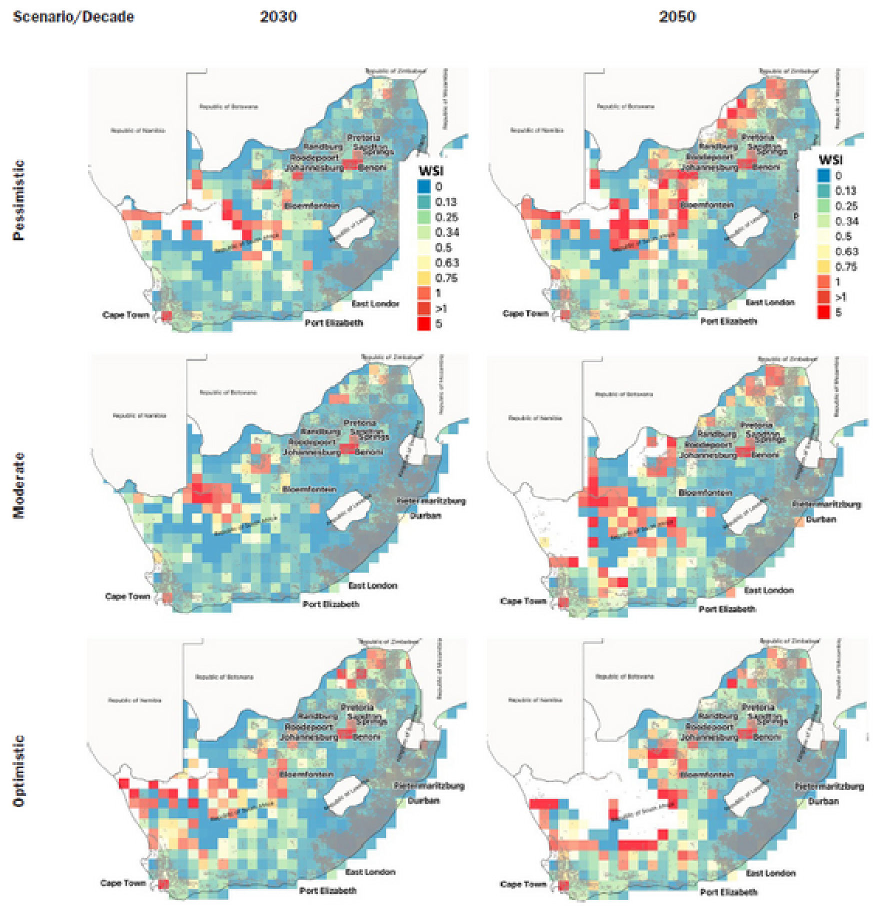
BOX 9. IMPACT OF HISTORIC AND FUTURE DROUGHT ON LIVELIHOODS AND FOOD SECURITY IN SOUTH AFRICA

Between 1998 and 2000, four major droughts were recorded in South Africa with an estimated cost of US$1.6 billion (Reuters 2016). Droughts between 2015 and 2017 caused a collapse in production of summer crops, severely impacting labor-intensive horticultural production in the Western Cape and reducing cattle and sheep herds by more than 50 percent in some areas of the Karoo and the Northern Cape. While the Integrated Food Security Phase Classification (IPC) for South Africa is better than for many Southern African countries, parts of the country with high poverty were classified as phase 3—"in crisis"—in 2021.

The frequency of, and areas affected by, drought in South Africa are projected to increase beginning in 2030, with approximately 22 years between 2030 and 2099 when more than 10 percent of the country will be affected and six years between 2050-2099 when more than 40 percent will be affected under low climate mitigation scenarios (see Figure 9). The West of the country is expected to be the most severely affected.

Climate change in South Africa is projected to cause a 1-to-7 percent decline in per capita consumption of all commodity groups, a large decline in fruit and vegetable production (reaching 17 percent by 2050), a large decline in net trade in fruits and vegetables (28 percent in 2050), a modest increase in cereal production (9 percent in 2050), and a large increase in net trade of cereals (40 percent by 2030) compared to the baseline scenario with no climate change, with implications for jobs in the labor-intensive horticulture sector (IFPRI 2019). Change in precipitation patterns will also impact livestock production. Figure 10 illustrates the changes in livestock production and rainfall patterns between 2000 and 2018.

YOUNG MAIZE SEEDLINGS, SOUTH AFRICA. @DELDEW / GETTY IMAGES



Source: World Bank.

Note: Red areas indicate areas where demand will be greater than availability. Grey shaded areas show the location of poorer households (Relative Wealth Index < 1, derived from Chi et al. 2022[35]*).*

FIGURE 9. SOUTH AFRICA'S WATER SCARCITY INDEX (2030 AND 2050)

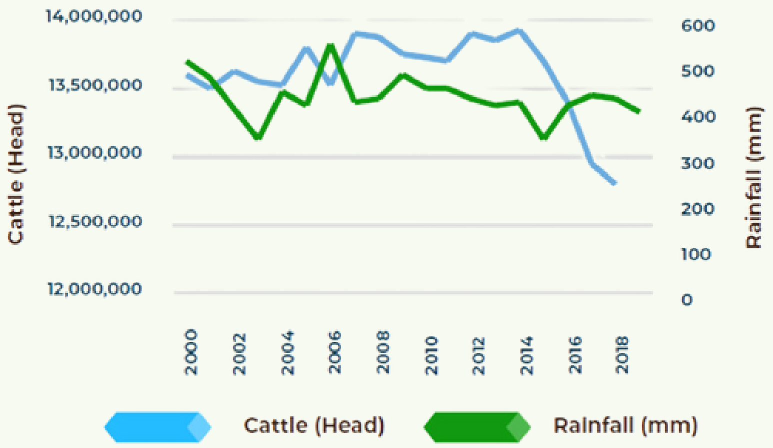


FIGURE 10. LIVESTOCK PRODUCTION AND RAINFALL PATTERNS IN SOUTH AFRICA (2000–2018)

Droughts also affect livelihoods of food producers, resulting in greater rural poverty and environmental degradation, creating an urgent need for investments in climate-smart agriculture and livelihood diversification. For farmers, especially subsistence farmers, a drought year can be a famine year with decreased yields and margins. In the absence of ex-ante provisions and safety nets, local rural economies collapse, and affected farmers often turn to survival strategies such as removing children from school to save on school fees and earn money, selling farm equipment or livestock at depressed prices, or relying on natural resources with detrimental consequences for ecosystems. For example, in Zambia, food and power shortages during the last El Niño-related drought led to increased deforestation as communities sought forest resources such as charcoal to supplement their income.

Investing in climate-smart agricultural practices and diversifying economies simultaneously are critical to safeguard vulnerable livelihoods against droughts. Climate-smart practices such as agriculture risk planning and financing that considers gender and social inclusion (GESI) can diversify livelihoods away from agriculture dependence to enhance resilience.

SADRI has strategically focused on climate-smart agriculture and livelihoods diversification as the main levers for enhancing drought resilience in the agriculture sector. It has facilitated the development of agri-food value chain solutions for drought risks and undertaken a review of strategic food reserve policies. It has also underscored the role of Trans-frontier Conservation Areas (TFCAs), including the Great Limpopo TFCA, in potential solutions for advancing climate-smart agriculture and livelihoods diversification approaches.

4.2 AGRI-FOOD VALUE CHAIN SOLUTIONS

BUILDING SMALLHOLDER RESILIENCE TO DROUGHT THROUGH IRRIGATION IMPROVEMENT

Insecure water supplies and vulnerability to drought are the main constraints to smallholders producing surpluses for the market, building their asset base, and saving to improve household food security and resilience to drought. With very small land plots (less than half a hectare), diversification into higher-value irrigated crops is an opportunity to greatly increase incomes but requires improved capture, storage, and distribution of water. Hydrological and land use assessments are critical for identifying locations where improved irrigation can build drought resilience. In certain locations, hydrological assessments reveal that even with investments in improved water capture and storage there is insufficient water to support irrigated agriculture. In such cases, measures to improve rainfed crop productivity including through soil conservation and adoption of drought-resilient varieties are a better alternative. Even where water is potentially available, investment in improved irrigation could be a high-risk option, as farmers and communities often grapple with multiple constraints simultaneously such as the initial costs of infrastructure, ensuring cash flow while tree crops mature, and securing access to agricultural inputs, technology, finance, and markets.

These constraints need to be addressed comprehensively both *across the watershed* (beyond the target area) and *along the value chain* to improve access to technology and markets. Attempts to address these constraints in isolation have often failed. Therefore, both a *landscape approach* and a *value chain approach* are needed. Public investment and partnerships with the private sector are essential given the level of investment and scope of interventions needed.

SADRI has identified six key steps for implementing this approach and deployed them in South Africa's Eastern Cape Province to develop horticulture through smallholder rainwater harvesting (Box 10):

(i) In cooperation with farmers and agribusinesses, identify market opportunities that could raise rural incomes if drought resilience were improved through irrigation.

(ii) Conduct land use suitability and hydrological assessments to determine potential water availability for target crops and identify locations for development.

(iii) Identify technical and institutional options for improving access to irrigation tailored to farm type and location and base hydrological assessments on these criteria.

(iv) Assess the financial and economic viability of the proposed investments.

(v) Where development is technically feasible, explore land tenure arrangements, communities' and farmers' interests, and potential partnerships with agribusinesses.

(vi) Identify upstream investment needs to protect the watershed, which may necessitate parallel investments in livestock and improved pasture management, land restoration, biomass enterprise development and invasive species control, community agroforestry, upstream water management, and water harvesting.

BOX 10. SOUTH AFRICA: EASTERN CAPE SMALLHOLDER RAINWATER HARVESTING AND IRRIGATION

The Eastern Cape Provincial Government (ECPG) asked the World Bank to explore opportunities to build a more inclusive and resilient horticultural sector. While the eastern part of Eastern Cape is one of few the areas in South Africa that typically has a surplus of water for agricultural development if water is well managed, the Eastern Cape Province is periodically affected by drought (2015 to 2019). Horticulture is potentially very profitable but highly risky and vulnerable to drought without irrigation. Government investments in irrigation have focused on smallholder irrigation schemes, but these have been poorly maintained. Farmer-led irrigation development (FLID) that puts maintenance of farm infrastructure in the hands of farmers usually has better outcomes.

Land use suitability and hydrological assessments undertaken for this province identified potential locations for irrigation improvement under three models: homesteads (0.3 ha each, 3,000ha), riverside farms (50 ha each, 11,000ha), and former estates (500 ha each, 2000 ha). Homestead irrigation was prioritized because it did not suffer from the intractable land tenure constraints of other models.

Agribusinesses expressed interest in developing partnerships for input supply and marketing with homesteads in the longer term if water supply constraints could be addressed and a critical mass of homesteads identified. Capture of and storing surface run-off for homestead irrigation is a key opportunity for this model. As part of this effort, a rainwater harvesting investment was designed including a pond and solar-fed irrigation that would be sufficient to irrigate 0.3 ha of tree crop (such as macadamia) per household. A high-resolution hydrological assessment identified sufficient site-specific water availability. The proposed investment was financially viable albeit with high investment costs of around R130,000 per homestead including irrigation and tree crop establishment, necessitating some public funding. The ECPG has expressed interest in funding and is currently preparing a budget proposal.

To help ensure the sustainability of water supply, SADRI identified other necessary investments in the five watersheds serving the project areas including in land restoration, agroforestry, biomass entrepreneurship, improved livestock and pasture management, upstream water harvesting, and improved water management. A landscape approach to drought resilience requires work with livestock and other value chains upstream and horticulture and agriculture downstream.

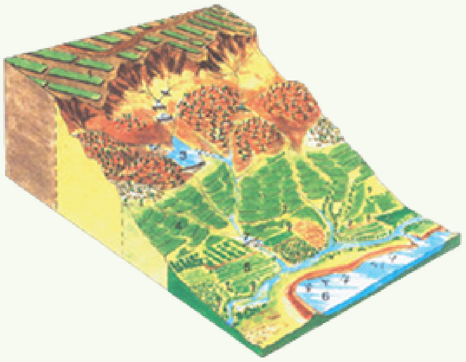
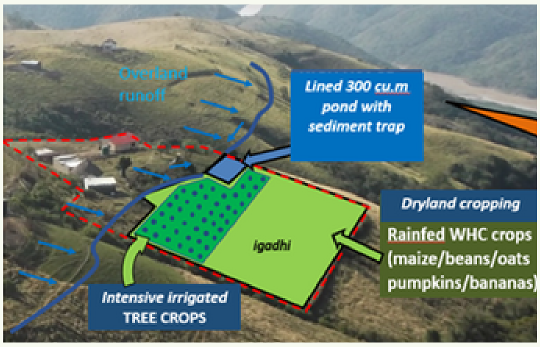


FIGURE 11 - LANDSCAPE APPROACH



*WHC = Water holding capacity

FIGURE 12 - HOMESTEAD RWH MODEL

BOX 10 SOUTH AFRICA: EASTERN CAPE SMALLHOLDER RAINWATER HARVESTING AND IRRIGATION

LEVERAGING RAINWATER HARVESTING FOR ENHANCING DROUGHT RESILIENCE OF SMALLHOLDERS

After demonstrating the financial viability of homestead rainwater harvesting (RWH), SADRI collaborated with the South Africa Agricultural Business Chamber (Agbiz) and the International Finance Corporation (IFC) to consult with potential agribusiness investors in the country. In 2021, two agribusinesses agreed to work with SADRI on (i) identifying locations for macadamia production based on solar-powered RWH for homesteads and (ii) conceptualizing investments in macadamia production based on an estate-outgrower model whereby homesteads would be the outgrowers. Previously, agribusiness investments in macadamia production had been limited to the estate model. Agribusinesses had not considered investing in homesteads, which had tried rainfed macadamia production, because of low productivity from this approach. Investing in RWH is expected to be important for making homestead macadamia production viable, which would in turn benefit both homesteads and agribusinesses. The incomes of homesteads would potentially increase, and agribusinesses would be able to expand without investing in infrastructure, albeit in small volumes compared to their core estates.

In June 2022, the Eastern Cape Provincial Department of Agriculture, Land Reform and Rural Development (DALRRD) proposed repurposing some spending on grants for investments recommended by SADRI such as rainwater harvesting. ECPG had not previously funded solar-powered homestead rainwater harvesting pilots but instead had funded either large irrigation schemes with operation, maintenance, and financial sustainability challenges or boreholes for larger farmers. The ECPG proposal to provide funding for these investments represents an important shift away from financing often financially nonviable, technically inefficient systems toward investment in water storage using water that would otherwise not be used downstream, which could contribute to high-value production and alleviate poverty.

THE WAY FORWARD

Once ECPG's proposal for investment in RWH is finalized, site selection will be fine-tuned through observation of land suitability, hydrological assessment, and further consultations with communities and farmers on RWH design and beneficiary commitments. The RWH proposal will then be tested on a first batch of approximately 20 homesteads.

4.3

STRATEGIC FOOD RESERVE POLICIES

In Zambia and Zimbabwe, Strategic Grain Reserves (SGRs) have been used as a tool to cope with emergency food shortages arising from increasing numbers of floods and droughts. However, the efficiency and effectiveness of SGRs in addressing food emergencies have been less clear. In 2021, SADRI commissioned a study, *The Role of Strategic Grain Reserves in Enhancing Food Security in Zimbabwe and Zambia,* to provide a diagnostic of SGR operations and management of emergency food responses and recommend improvements.

State-administered SGRs are intended to respond to impending food security crises caused by domestic drought, regional drought or low global stock, and price increases. While SGRs provide an important tool for addressing such crises, they have often been used for other purposes such as state procurement or ineffective market price stabilization beyond periods of food crises. SGR operations often have a high fiscal cost, create uncertainty in markets, and disincentivize private investment in the grain sector. The study's recommendations on the reform of SGRs addressed:

(i) (The high fiscal cost of the food reserve and market intervention operated by the Grain Marketing Board;

(ii) (The opportunity to reduce these costs, accelerate market response to supply deficits including importation and distribution to regions by providing greater space for the private sector to respond and reducing crowding out by the state;

(iii) The opportunity to use warehouse receipts to encourage storage, improve access to finance, and help stabilize markets.

Additional World Bank funding broadened the study's focus to include resilience and facilitate strategic policy dialogue at the country level. It was instrumental in demonstrating that while food reserves may help mitigate the impacts of food crises in the short term, they carry a high fiscal cost and fail to address the underlying causes of these crises, among which the drought vulnerability of the agriculture sector is key. This study highlighted that SGRs in Zambia and Zimbabwe have the potential to contribute to food security only when the fiscal cost is contained, keeping the reserves to amounts sufficient to meet food shocks. As a result, SGRs should be considered as tools to address short-term food security challenges, while the main food security strategy should focus on addressing drivers of food insecurity through investments that enhance long-term resilience and productivity.

INFLUENCING SGR POLICY REFORM

Using evidence from this study, the World Bank followed up with policy dialogue with the ministries of agriculture and finance in Zambia and Zimbabwe to reorient their policies and expenditures toward more resilience-driven objectives. Subsequently, in 2021, several government officials and national bodies in Zimbabwe including the Grain Board, the Minister of Agriculture, and the Agricultural Marketing Authority; the Ministry of Finance and the Reserve Bank; and the Ministry of Industry and Commerce engaged in reforming policy to address challenges with SGRs.

While this is a good starting point, building drought resilience through SGRs involves a wide group of stakeholders beyond the Ministry of Agriculture such as departments and non-governmental organizations (NGOs) concerned with health and nutrition, trade and finance, labor, social welfare, and the private sector. Early consultation and dissemination with these parties can advance effective policy reforms, which could be facilitated through a dedicated stakeholder platform on SGRs.

4.4

LIVELIHOODS DIVERSIFICATION IN TRANS-FRONTIER CONSERVATION AREAS

TFCAs are natural systems that encompass one or more protected areas straddling at least two countries. Communities living in and around TFCAs are among the more marginalized groups in Southern Africa and disproportionality derive their livelihoods from land-based activities, including agriculture. While men and women engaged in these activities play different roles and derive differentiated benefits, both are highly susceptible to drought because of their primary reliance on natural resources. Local communities, both historically and presently, often demonstrate best practices in the sustainable use of natural resources such as the way the Makuleke community managed water resources before their removal from the Pafuri area, when it was designated as a protected area in 1969 and incorporated into Kruger National Park.[1] However, there are also instances where communities have a negative impact on natural resources including their tendency to drain wetlands for agriculture. Investing in livelihoods diversification is essential for enhancing adaptive capacity and livelihoods security, but it must be done sustainably.

TFCAs approach conservation of critical biodiversity from a regional perspective, seeking regional solutions for sustainable land use and economic development. To take advantage of regional approaches to natural resources management, SADRI has explored options for livelihoods diversification to support sustainable land use practices and conservation of critical biodiversity hotspots by leveraging existing TFCA governance structures.

OPTIONS FOR LIVELIHOOD DIVERSIFICATION IN THE GREAT LIMPOPO TRANS-FRONTIER CONSERVATION AREA (GLTFCA)

The Great Limpopo Trans-Frontier Conservation Area (GLTFCA) covers an area where the borders of Mozambique, South Africa, and Zimbabwe meet. Populations here are vulnerable to prolonged dry conditions because of their high reliance on natural resources and low level of resilience to impacts on natural systems.

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[6] Land ownership of the Makuleke was restored through a land restitution process in 1999; however, as part of the settlement agreement, the protected area status of the land remains and the community cannot change how the land is used.

As a result, droughts threaten their livelihoods, water security, and food security. The GLTFCA Joint Management Board has designated the GLTFCA Pafuri-Sengwe Node, which spans all three countries, as a key socio-economic development focus area as part of its Integrated Livelihoods Diversification Strategy. Key drivers identified as the most significant to be considered, monitored, and designed for in future interventions include water security governance and resource management issues, food security concerns, and climate change projections. SADRI undertook analytical work to better understand water governance and use in the Pafuri-Sengwe Node to inform drought preparation and mitigation measures and improve river system governance at the community level. This work was conducted on four water systems: the Limpopo River, Mwenezi (name in Zimbabwe) / Nuanetsi (name in Mozambique) River, Luvuvhu River, and Bubye River.

An important component of this work was the focus on improving water resources knowledge (and data management), which was outdated and, in some areas, no longer correctly documented on official maps. The goal was to generate current baseline information on wetlands, groundwater, and the interaction between these surface and groundwater resources. The analysis sought to determine the extent of water availability in targeted aquifer, wetland, and river systems. A series of maps were created to delineate the wetland systems in the project area linked to the river systems using geographic information system (GIS) mapping and remote sensing. SADRI also conducted a hydro-census to assess current demand and usage of this water, especially by communities, and existing governance structures and practices for managing these waters. SADRI then developed country- and transboundary-specific recommendations and near-, medium-, and long-term investment needs to build drought resilience of communities dependent on the region's freshwater resources (Box 11).

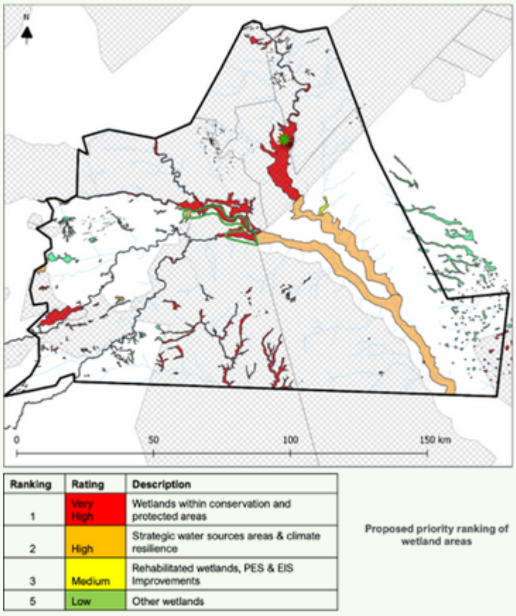

FIGURE 13: DEMARCATION OF WETLANDS THAT REQUIRE SPECIFIC CONSERVATION FOCUS

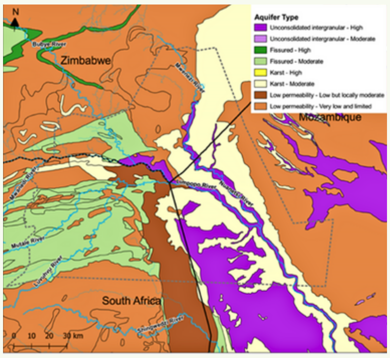

FIGURE 14: TRANSBOUNDARY AQUIFERS SHOWING AQUIFER PRODUCTIVITY

BOX 11 - KEY TRANSBOUNDARY INVESTMENT NEEDS IDENTIFIED BY SADRI

I. Investment needs to support improved transboundary management of wetland systems:

1. Develop a wetland inventory, standardize wetland inventory data requirements, and enforce a basin-wide data sharing protocol.
2. Improve technical capacity in planning, managing, and monitoring wetland ecosystems.
3. Standardize wetland management tools across the three countries. South Africa has advanced tools to assess and manage wetlands, which can be workshopped, modified per local conditions, and applied across countries to ensure reporting is similar in all Member States.
4. Encourage the development of community-based monitoring of groundwater levels and rainfall measurements using mobile platforms.
5. Develop and set ecological control limits for groundwater at ecological sites.

III. Investment needs to support community livelihoods:

1. Develop, operationalize, and maintain a geospatially-enabled Nodal database.
2. Support small business development (including supplier development) and formal and informal trade.
3. Provide improved market access and linkages for agriculture produced from the irrigation schemes in Zimbabwe.

BOX 11: KEY TRANSBOUNDARY INVESTMENT NEEDS IDENTIFIED BY SADRI

Another key component of SADRI's work in this TFCA was leveraging local knowledge about natural resources management and strengthening stakeholder engagement around drought resilience. To date, no integrated, holistic approach to improve water resources governance and management has been used. A multi-stakeholder transboundary approach is required for the effective management of a transboundary natural resource to ensure efficient and fair use of the water resource and provide a common platform for building drought resilience. Building this multi-stakeholder approach included consultations with community elders to document traditional and indigenous knowledge and the creation of a technical reference group comprising nominees from TFCA-implementing agencies to guide activities.

KEY OUTCOMES

SADRI strengthened coordination among Pafuri-Sengwe Node stakeholders through the creation of a multi-stakeholder platform dedicated to drought resilience and water and food security in GLTFCA. SADRI's mapping and delineation of the wetland systems in the project area facilitated an improved understanding of existing water use and governance; conservation priorities linked to the Limpopo, Luvuvhu, Mwenezi/Nuanetsi, and Bubye river systems; and investment priorities to improve drought resilience, community livelihoods diversification, and land-use needs.

FOLLOW-ON EFFORTS

Potential areas for further support beyond SADRI will be identified based on the investment priorities to improve drought resilience in the Pafuri-Sengwe Node. A working session with key GLTFCA stakeholders is being planned to discuss outputs and outcomes and agree on the way forward. An action plan and a resource mobilization strategy will be developed to facilitate the implementation of key measures and investment priorities.

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V. MOVING TOWARD A DROUGHT-RESILIENT REGION

5.1 HOW COUNTRIES CAN ADVANCE A COMPREHENSIVE APPROACH TO DROUGHT RISK MANAGEMENT

With climate change projected to exacerbate drought risks in Southern Africa in the coming decades, building resilience to the multi-sectoral impacts of drought will be crucial for countries to sustain economic growth and meet development goals. As a starting point, countries need to overcome sectoral silos and build a strong foundation for proactive, integrated drought risk management by creating an enabling environment for risk-informed decision making. Regional and national entities should prioritize the development and adoption of early-warning systems and enhance capabilities to assess drought vulnerabilities across core economic and interlinked sectors. They should work with key stakeholders such as sub-national entities, water and power management authorities and providers, communities, and private sector financiers to identify policies, practices, and processes along with investment needs to enable proactive drought management. It is also important to foster collaboration between these entities through formal coordination mechanisms to determine the cascading impacts of droughts across economies and populations, deploy contingency measures, and mobilize resources at scale.

Further, the groundwork laid by SADRI can be leveragedto enhance drought resilience across the WEFE nexus. Cities and urban service providers can explore adaptive and innovative water management solutions and undertake drought-informed water resources and services planning in the medium- and long-term. Improving efficiency in hydropower generation and investing in transmission, diversification, and regional integration will be crucial for building drought resilience in the power sector. Investing in climate-smart agricultural practices and diversified livelihoods simultaneously will be critical to build the adaptive capacity of the most vulnerable population groups, such as subsistence farmers, against droughts. These efforts should be complemented by broader measures to safeguard food security, such as reorientation of public policies and expenditures toward resilience-driven objectives.

5.2 SUMMARY OF KEY SADRI OUTCOMES

This section examines the 25 documented SADRI outcomes[1] to identify patterns and characteristics of the changes to which the initiative contributed. The outcomes show the relevance of SADRI among an array of stakeholders and evidence about how SADRI succeeded in fostering engagement, cooperation, and ownership of change processes, both externally and internally within the WBG (see Tables). Such wide-ranging influence is an important achievement because it is needed to sustain an integrated approach to drought risk management.

INTERNAL STAKEHOLDERS	EXTERNAL STAKEHOLDERS
• Country teams • Regional energy team • Country Management Units • Task Team Leaders • Global Unit • Practice group • Peers	• Local governments • National governments • Service providers • Natural resources management agencies • Private sector • Development partners

TABLE 1. TYPES OF INTERNAL AND EXTERNAL STAKEHOLDERS INFLUENCED BY SADRI

Externally, the relevance of SADRI is shown by the engagement and motivation of stakeholders around the SADRI agenda, specifically by a request for diagnostics or other technical assistance by a client and city authority (outcome #3) and by collaborations with a service provider (outcome #1), agri-businesses (outcome #12), a transboundary conservation agency (outcomes #8, 11), and development partners (outcomes #17, 18, 21).

Internally, the relevance of, and motivation around, the SADRI agenda is shown by TTLs from each of the four CMUs from the SADC region contributing to SADRI drought profiles (outcome #19), a country team using SADRI's proactive approach to drought risk management (outcome #2), a regional team asking for SADRI's diagnostics (outcome #5), and a global unit providing co-finance to support country-level policy dialogues based on SADRI analytics (outcome #15).

For SADRI to have a lasting effect, others need to take ownership of the agenda it has promoted. Several outcomes show ownership by external actors of ideas, analytics, and processes initiated by SADRI: provincial agricultural authorities have aligned funding with SADRI objectives (outcomes #13, 14), SAPP and SAPP members have taken leadership of the drought sensitivity assessment (outcomes #6, 7), and the GLTFCA authority initiated a local community engagement process (outcome #9). Most strikingly, in part because of the work of SADRI, the government of Zimbabwe has revised its policy on strategic grain reserves (outcome #16).

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[7] SADRI defined outcomes as: An observable and significant change in an actor's behavior (relationships, activities, policies, or practice) that has been influenced by SADRI (and potentially also by other actors), in a small or large way, directly or indirectly, intentionally or not. This definition follows the Outcome Harvesting and Outcome Mapping approaches to monitoring, evaluation, and learning.

Central to SADRI's approach has been catalyzing action in others, thereby building momentum and scaleup beyond the specific, targeted analytical work it supported. Many change processes initiated by SADRI have the potential to inform practices of others, and some outcomes already show SADRI's catalytic effect. Notably, at the regional level, development partners initiated collaborations that furthered SADRI's agenda following dialogues facilitated by SADRI (outcome #23), while the SADC Secretariat and other development partners engaged around the creation of a multi-hazard early-warning/monitoring platform (outcome #24) and have begun implementing a new regional drought risk management strategy that incorporates SADRI analysis (outcome #25). Still, SADRI faced challenges in solidifying strong linkages between its activities and those being undertaken by the SADC Secretariat. Despite ongoing dialogue and a mutual understanding of the utility of the SADRI work, institutional protocols limited the ability of the SADC Secretariat to fully embrace the work of the project.

At the transboundary level, a trans-frontier conservation authority started development of an integrated water resource management plan and strategy (outcome #10). Highly significant, catalytic internal outcomes involved the four CMUs in the SADC region that endorsed the drought resilience profiles developed by SADRI (outcome #20), peer reviewers who authorized the use of SADRI's city diagnostics approach (outcome #4), and the World Bank's Sustainable Development Practice Group that used SADRI's proactive approach to drought risk management in the design of an operation to build resilience to climate change (outcome #22).

	EXTERNAL STAKEHOLDERS	INTERNAL STAKEHOLDERS
Engagement and motivation around the SADRI agenda	**Outcome #1:** City service providers in three countries collaborated with the World Bank team on urban drought risk management.	**Outcome #2:** World Bank Tanzania team used proactive approach to urban drought risk management.
	Outcome #3: National government and water utility requested SADRI support on preventative drought risk management.	**Outcome #5:** World Bank regional energy team requested a SADRI drought-sensitivity assessment.
	Outcome #8: Trans-frontier conservation authority partnered with the World Bank to create multi-stakeholder platform.	**Outcome #15:** Additional funding mobilized for resilience-focused food reserves dialogue.
	Outcome #11: Knowledge on water management, food security, natural resource management, and governance exchanged across borders.	**Outcome #19:** TTLs from all four CMUs in the SADC region contributed to development of SADRI drought profiles.
	Outcome #12: Two agribusinesses agreed to explore use of solar-powered rainwater for homestead production of macadamia.	
	Outcome #17: External partners joined SADRI team in monthly coordination meetings.	
	Outcome #18: New development partners joined monthly coordination meeting leading to strategic cooperation.	
	Outcome #21: World Food Program published SADRI's drought profiles.	
	Outcome #6: SAPP invested resources in drought sensitivity assessment.	
	Outcome #7: SAPP motivated member utility leadership of drought sensitivity assessment.	

Ownership of SADRI ideas, analytics, and processes	**Outcome #9:** Trans-frontier conservation authority engaged holders of traditional knowledge .	
	Outcome #13: Sub-national agricultural department sought funding for solar-powered homestead rainwater harvesting.	
	Outcome #14: Sub-national authorities invested in SADRI approach.	
	Outcome #16: Zimbabwe reformed strategic grain reserves policy.	
	Outcome #7: Southern Africa Power Pool motivated member utility leadership of drought sensitivity assessment.	
	Outcome #9: Trans-frontier conservation authority engaged holders of traditional knowledge.	
SADRI's catalytic effect	**Outcome #10:** Trans-frontier conservation authority started development of an integrated water resource management plan and strategy.	**Outcome #4:** World Bank peers authorized and supported SADRI diagnostics and approach.
	Outcome #23: Partners developed connections and initiated collaborations.	**Outcome #20:** All four CMUs in the SADC region endorsed the drought resilience profiles.
	Outcome #24: SADC Secretariat engaged with development partners on a common agenda.	**Outcome #22:** Design of new regional program on climate resilience informed by SADRI.
	Outcome #25: Development partners promoted a new drought risk management strategy.	

TABLE 2. THEMES IN SADRI OUTCOMES

5.3 RECOMMENDATIONS BUILDING ON THE WORK DONE BY SADRI

SADRI has been a three-year structured journey in the drought landscape of Southern Africa. The program has provided the World Bank a unique opportunity to promote a cross-sectoral approach for addressing one of the most far-reaching impacts of climate variability and change in the region. SADRI concluded its work as a World Bank technical and analytical project in 2023, but the products and processes it supported are being used by Bank teams to support drought resilience-building efforts in the region through ongoing and upcoming engagements. One example is a recently approved cross-sectoral regional integration operation, the Regional Climate Resilience Program (RCRP) for Eastern and Southern Africa. Its objective is to improve the management of water-related climate impacts, including to enhance institutional capacity for long-term climate risk management. The program is considering SADRI outcomes and lessons learned, especially at the institutional engagement level, and will have participation from the SADC Secretariat and other regional and national development partners. RCRP intends to develop consistent drought severity designations for the region, procedures for triggering assistance across boundaries, drought impacts reporting, and drought contingency planning at the community level. SADRI is also applying its output to the context of specific countries based on demand from World Bank teams (see Annex 3).

Beyond the Bank, SADRI has developed a platform for engagement with external partners, client countries, and institutions that can more proactively build regional preparedness to droughts. Because of its slow onsetting nature, drought is a natural calamity that should be addressed in a strategic and long-term way, with a robust cross-sectoral and cross-institutional approach underpinning activities and interventions. SADC countries have a significant opportunity to further strengthen a shared dialogue around drought that goes beyond their national boundaries. Identifying and creating protocols for the collection, management, and sharing of data is a steppingstone to building systems that are resilient to droughts (and to other climate shocks). Countries can develop regional early-warning systems and take coordinated actions across river basins, TFCAs, and urban areas to improve drought preparedness and response.

Such actions can yield benefits at multiple administrative and geographical levels, encompassing improved robustness to droughts in cities and towns, household livelihoods improvements and food security, and low carbon energy generation in the long-term by leveraging hydropower and fostering a sustainable energy generation mix.

Countries cannot do this alone, however. The SADC Secretariat has a critical role to play in shaping and maintaining a cohesive vision for a drought-resilient region, building on SADRI efforts over the past several years. The Secretariat and its Member States have approved several programs that can provide formal linkages with future investments, such as those planned and under implementation through RCRP, to apply and scale up the analytical and capacity-building work on drought resilience developed by SADRI. These programs include the Drought Risk Management and Mitigation Strategy 2022-2032, Regional Strategy for Implementation of Great Green Wall Initiative 2030, and Regional Indicative Strategic Development Plan. These programs fall under the responsibilities of various units and directorates, such as the Food Agriculture and Natural Resources Directorate, the Disaster Risk Reduction Unit, and the Infrastructure Directorate. As is the case with most governments and internally at the World Bank, the Secretariat faces a challenge (and an opportunity) in overcoming institutional silos to truly realize an integrated and cross-sectoral approach to building drought resilience. The World Bank and other development partners can provide key support to the SADC Secretariat to seize this opportunity through ongoing and future analytical work and investment programs. Over the past three years, SADRI has delivered analyses and tools to support capacity building at local, national, and regional levels and has fostered partnerships, knowledge exchange, and collaboration. The SADRI outputs and outcomes thus showcase the impact that cross-sectoral and multi-tier approaches to the persistent threat of droughts in the region can have—approaches that are essential for enhancing longer-term drought and climate change resilience in the SADC region and beyond.

ANNEX 1: ANALYTICAL AND KNOWLEDGE PRODUCTS DEVELOPED UNDER SADRI

Umbrella Pillar

1. Drought Resilience Country Profiles
2. Regional Drought Profile
3. Knowledge Hub on Drought Resilience

Cities Pillar

4. City Drought Resilience Toolkit
5. Regional Guidance Note for Water Systems

Energy Pillar

6. Drought Sensitivity Assessment for SAPP

Livelihoods and Food Security Pillar

7. Technical Note on Homestead Farm-ponds for Micro-scale Irrigation in the Eastern Cape of South Africa

8. Review of Strategic Food Reserves Policies for Improving Resilience to Drought

9. Water Production, Use, and Governance in the Pafuri Sengwe node of the Greater Limpopo Transfrontier Conservation Area

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SOUTHERN AFRICA
Drought Resilience Initiative

WORLD BANK GROUP
Water

CIWA

ANNEX 2:

The SADRI experience with outcome-oriented monitoring, evaluation and learning (MEL))

THE SADRI EXPERIENCE WITH OUTCOME-ORIENTED MONITORING, EVALUATION AND LEARNING (MEL)

Southern Africa Drought Resilience Initiative (SADRI)

- From 2020-23, the World Bank led the Southern Africa Drought Resilience Initiative (SADRI) with the aim of catalyzing uptake and investment in a proactive, multi-sector and multi-level approach to drought resilience in the 16 SADC Member States.

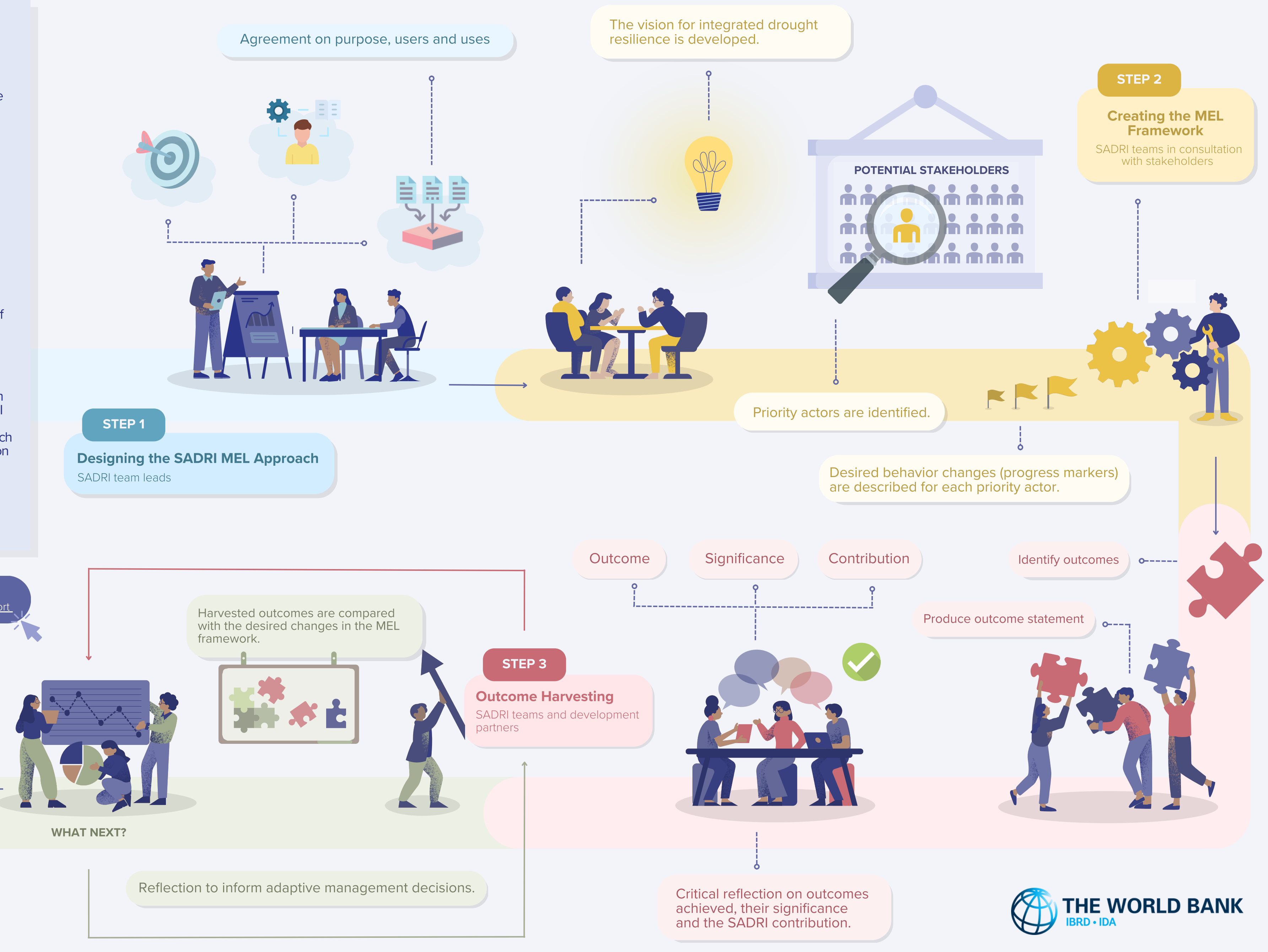
SADRI had a two-pronged approach:

- i) Developing analytics to fill knowledge gaps and advise counterparts on drought risk management strategies.
- ii) Catalyzing behavior changes in priority actors so they engaged, took ownership and sustained processes of change.

Why a participatory, outcome-oriented monitoring framework?

- Faced with the complex and long-term challenge of catalyzing change, SADRI needed to complement activity and budget monitoring with a MEL approach that supported innovation, collaboration and adaptive management.
- The MEL framework was a fusion of Outcome Mapping and Outcome Harvesting.

Discover more:
SADRI MEL report | SADRI Synthesis report



STEP 1

Designing the SADRI MEL Approach

SADRI team leads

Agreement on purpose, users and uses

The vision for integrated drought resilience is developed.

Priority actors are identified.

Desired behavior changes (progress markers) are described for each priority actor.

STEP 2

Creating the MEL Framework

SADRI teams in consultation with stakeholders

STEP 3

Outcome Harvesting

SADRI teams and development partners

Identify outcomes

Produce outcome statement

Outcome

Significance

Contribution

Critical reflection on outcomes achieved, their significance and the SADRI contribution.

Harvested outcomes are compared with the desired changes in the MEL framework.

STEP 4

Outcome Sensemaking

SADRI team & thematic and country staff

WHAT NEXT?

Reflection to inform adaptive management decisions.

SOUTHERN AFRICA Drought Resilience Initiative

THE WORLD BANK IBRD • IDA

SADRI THEORY OF CHANGE

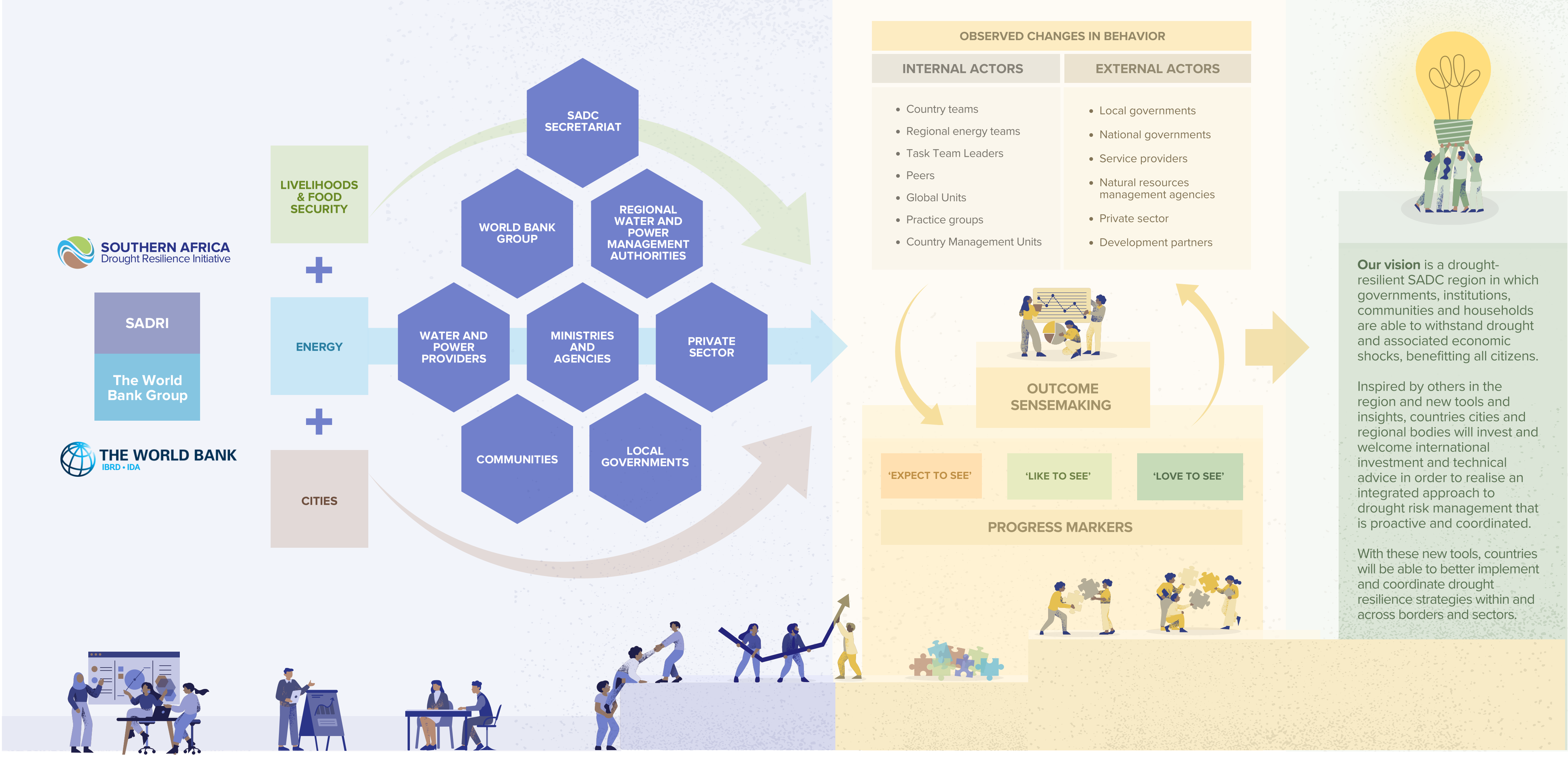
ENGAGEMENT STRATEGIES, ACTIVITIES & OUTPUTS

PRIORITY ACTORS TO ENGAGE / SUPPORT

MONITORING, EVALUATION & LEARNING

OUTCOME HARVESTING & SENSEMAKING

SADRI'S VISION



SOUTHERN AFRICA
Drought Resilience Initiative

SADRI
The World Bank Group

THE WORLD BANK
IBRD • IDA

LIVELIHOODS & FOOD SECURITY
+
ENERGY
+
CITIES

SADC SECRETARIAT

WORLD BANK GROUP

REGIONAL WATER AND POWER MANAGEMENT AUTHORITIES

WATER AND POWER PROVIDERS

MINISTRIES AND AGENCIES

PRIVATE SECTOR

COMMUNITIES

LOCAL GOVERNMENTS

OBSERVED CHANGES IN BEHAVIOR

INTERNAL ACTORS	EXTERNAL ACTORS
• Country teams • Regional energy teams • Task Team Leaders • Peers • Global Units • Practice groups • Country Management Units	• Local governments • National governments • Service providers • Natural resources management agencies • Private sector • Development partners

OUTCOME SENSEMAKING

'EXPECT TO SEE'
'LIKE TO SEE'
'LOVE TO SEE'

PROGRESS MARKERS

Our vision is a drought-resilient SADC region in which governments, institutions, communities and households are able to withstand drought and associated economic shocks, benefitting all citizens.

Inspired by others in the region and new tools and insights, countries cities and regional bodies will invest and welcome international investment and technical advice in order to realise an integrated approach to drought risk management that is proactive and coordinated.

With these new tools, countries will be able to better implement and coordinate drought resilience strategies within and across borders and sectors.

ADDED VALUE

- **Sustainability of changes.** The outcome-oriented approach focused the team on catalyzing behavior changes in others to sustain change processes.
- **Adaptive management.** Comparing observed outcomes with anticipated changes (progress markers) helped the team take stock of progress and recalibrate next steps.
- **A change narrative.** The documented outcomes complemented the quantitative measures of progress used in indicator reporting.
- **New skills.** Team members gained experience in outcome-oriented thinking and practices.

CHALLENGES

- **Additional resources were needed.** Outcome - oriented monitoring was an additional task for team members.
- **No face-to-face events were possible because of COVID-19.** The engagement of external actors could have been greater with in-person engagement opportunities.
- **Initial learning investment.** Team members had to learn how to document anticipated and observed changes as outcomes.

SUCCESS FACTORS

- **Championing of the participatory MEL approach.** The team leads articulated the rationale for using the approach and created a team culture in which participation was expected.
- **Time and space for a participatory, learning-oriented process.** The team used the outcome harvesting and sensemaking workshops as the main spaces to reflect on progress.
- **Expertise and support.** An expert in outcome-oriented MEL was engaged to design, facilitate, and coach the team in using the outcome-oriented MEL process.

ANNEX 3:

SADRI outputs curated for Lesotho and Madagascar

INTEGRATING AGAINST DROUGHT

Southern Africa Drought Resilience Initiative

LESOTHO

INCIDENCE OF DROUGHT | 1970-2020

1983 > 1990 > 2002 > 2007

2011 > 2016 > 2019 > 2020

IMPACT OF DROUGHT

POPULATION

2.2 million affected

Over a quarter of the population (2.2 million) faced severe food insecurity during the 2019/2020 drought.

COST

US$82 million

Total funding mobilised to respond to the 2015/16 drought was US$82 million (M 1.25 billion), or 3.6% of GDP in 2016.

HUNGER

Over 300,000 food insecure

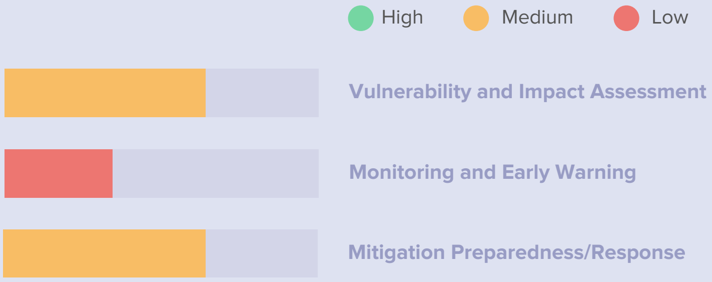
About 328,000 people in 2022 are food-insecure and require assistance to reduce food gaps and prevent acute malnutrition.

WATER ACCESS

90% of water dries up

In November 2019, the Katse dam was at 13%, while the Mohale dam was at 32%. 90% of rural water sources dried up including along the Senqu, Mohokare and Makhaleng rivers. Up to 12% of households used unprotected water sources.

STATE OF DROUGHT PREPAREDNESS



Lesotho can improve on its drought resilience measures.

Vulnerability and Impact Assessment (Medium)

42% of the agricultural areas in the regions of Leribe, Mafeteng, Mohale's Hoek, Berea and Quthing are amongst the most drought-prone areas in Lesotho. Despite adequate institutional arrangements, as well as the support from institutions such as the FAO and WFP on vulnerability and impact assessments, there is a lack of consistent information, awareness and sufficient networks. The gaps in coordination and information exchange result in information that is often not adequately shared between government departments.

Monitoring and Early Warning (Low)

🟢 Yes 🟠 Limited 🔴 No

- 🟠 Official definition of drought
- 🟢 Drought indicators used
- 🔴 Existence of a DEWS
- 🟠 Capacity to tailor EWS messages to end-user needs
- 🟠 Early warnings with built-in feedback mechanisms
- 🟠 Communication channels to reach all
- 🟠 Use of community relays, extensions services, local media to communicate EWS and reach at risk communities promptly
- 🟠 Official definition of drought

Mitigation Preparedness / Response (Medium)

While Lesotho has in place legal and policy frameworks for disaster risk management that encompass drought, it lacks a dedicated drought policy and a Disaster Risk Financing (DRF) strategy. This not only results in a reactive approach to drought response, mitigation and preparedness, but also perpetuates inherent vulnerabilities and the dependence on external aid.

Drought Resilience Funding Gap in Lesotho

12.5 million

US$ Million Annual Average

SOUTHERN AFRICA Drought Resilience Initiative

WORLD BANK GROUP Water

CIWA

INTEGRATING AGAINST DROUGHT

SADRI output relevant for gascar's drought resilience

LESOTHO

SADRI generated 11 drought resilience knowledge outputs

Umbrella Pillar

- Drought Resilience Country Profiles
- Regional Drought Profile
- Knowledge Hub on Drought Resilience

Cities Pillar

- City Drought Resilience Toolkit
- Regional Guidance Note for Water Systems

Energy Pillar

- Drought Sensitivity Assessment for SAPP

Livelihood and food security pillar

- Technical Note on Homestead Farm-ponds for Micro-scale Irrigation in the Eastern Cape of South Africa
- Review of Strategic Food Reserves Policies for Improving Resilience to Drought
- Water Production, Use, and Governance in the Pafuri Sengwe node of the Greater Limpopo Transfrontier Conservation Area

Lesotho Drought Profile, SADC Regional Drought Profile and Drought Knowledge Hub

The drought profile of Lesotho provides an in-depth overview of the state of drought resilience in Lesotho.

- Drought vulnerability and assessment
- Early warning systems and
- Drought preparedness and mitigation

provides an entry point to understand where there are gaps in drought resilience and areas for improvement.

Urban Drought Risk Management Toolkit

Developed under the Cities pillar of SADRI, the toolkit will be useful for Lesotho in providing direction for cities, national and regional institutions on proactive drought management and mitigation. Building on international best practice, it can be used to improve understanding of the scale and causes of urban drought vulnerability in SADC cities and address growing urban drought challenges through integrated, proactive, comprehensive, and people-centered risk management,

Drought Regional Guidance Note for clients

The note targets all SADC countries and cities using 8 case studies (Blantyre, Bulawayo, Cape Town, Dar es Salaam, Gaborone, Lilongwe Toliara, Windhoek.) developed interactively with the city authorities, some ministries, and Bank staff. The cases show an holistic approached to addressing drought resilience in the region by taking advantage of existing regional institutions and infrastructure.

Southern Africa Power Pool (SAPP): Drought sensitivity and resilience assessment

Delivered future hydrometeorological scenarios for the SAPP and an assessment of the potential impacts of future climate change and irrigation development on the water resources and present and future hydro-energy generation potential of the SAPP.

Lesotho can use the assessment when planning power pool investments at both regional and national levels.

Strategic Grain Reserves Report for Zimbabwe and Zambia

The report informed major reforms of the strategic grain reserves by Zimbabwean authorities in 2021 including: (i) a reduction in the role of the state in procurement and creating space for the private sector to respond to market deficits; and (ii) development of a warehouse receipts system so that small farmers can store grain and use it as collateral. These reforms have the potential to reduce fiscal costs, increase private sector responsiveness to market deficits, and reduce market instability. The report and experiences of Zimbabwe could be used by Lesotho to review its own Strategic Grain Reserve policy.

Agribusiness Partnerships Initiative (Irrigated Horticulture) – Eastern Cape Province

SADRI produced a land use suitability assessment, hydrological assessment, technical note on rainwater harvesting pilot design, and watershed management scoping study for Eastern Cape Province, as well as a watershed management investment needs study for the Umzimvubu Water Catchment.

Eastern Provincial Government has proposed to repurpose part of the Department of Agriculture, Land Reform and Rural Development (DRDAR) grants (typically inefficient grants for inputs to farmers) into investments in rainwater harvesting for homesteads.

Lesotho can benefit from a similar intervention to improve the sustainability and commercial viability of small scale production of high-value agricultural products.

Analytical Work to Fill Knowledge Gaps in Water Production, Use, and Governance in the Pafuri-Sengwe Node to mitigate drought risk

- Mapping / land capability assessments and master development and implementation
- Investment needs for sustainable management of natural resources at country and transboundary level
- Sustainable use of shared groundwater resources and aquifers
- Supporting common approaches to nature-based solutions, natural capital accounting, and ecosystem services valuation (in support of rural livelihoods)

Similar analytical works in Lesotho will be key to improving water governance, production and use.

INTEGRATING AGAINST DROUGHT

Southern Africa Drought Resilience Initiative (SADRI)

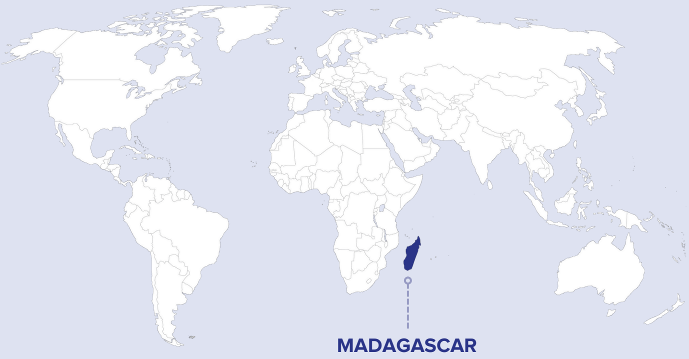
MADAGASCAR

INCIDENCE OF DROUGHT | 1970-2020

1970 > 1981 > 2000 > 2002 > 2005

2008 > 2014 > 2016 > 2017 > 2020

The incidence of drought in Madagascar has intensified since the year 2000.



POPULATION

1.6 million affected

The worst period of drought hit the country in 2019 when around 1.6 million people faced food insecurity.

COST

7.14% GDP decline in 2020

Approximately 70% of the Malagasy population is engaged in agriculture, much of it rain-fed. The latest drought incidence 2020 saw a decline in annual GDP growth by 7.14%.

HUNGER

Madagascar going hungry

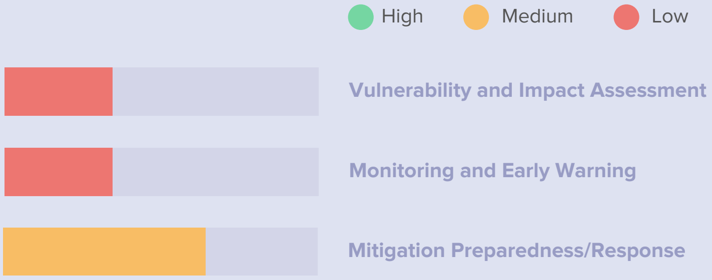
Drought has caused a massive decline of crop and livestock production with up to 60% losses in some southern areas. More than 740,000 people, including 500,000 children, need nutrition services in the Grand Sud.

WATER ACCESS

10-15 times water price hike

Water levels are lower because of drought, increasing the cost of water extraction and trucking. Water prices increased by 10–15 times in 2021, driving people to use unsafe water.

STATE OF DROUGHT PREPAREDNESS



Madagascar can improve on its drought resilience measures.

Vulnerability and Impact Assessment (Low)

In terms of the policy and enabling environment for drought vulnerability and impact assessment, in 2010, Madagascar formulated a National Climate Change Policy. Madagascar has conducted local risk and vulnerability assessments to inform adaptation options and has had several external aid partners supporting the government with vulnerability and/or impact assessments. Despite these assessments, most local governments have limited access to relevant and regular climate information and lack experience in how to put this information to use. This restricts their capacity to anticipate and act on emerging climate risks and may hinder timely investment on adaptation.

Monitoring and Early Warning (Low)

🟢 Yes 🟡 Limited 🔴 No

- 🟢 Official definition of drought
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Mitigation Preparedness / Response (Medium)

The government has made progress moving from a reactive, post-disaster relief approach to using a proactive approach to disaster risk management and measures to increase climate resilience. With the adoption of its first National DRM Strategy in 2003, the GoM was one of the first in sub-Saharan Africa to establish a comprehensive framework for disaster preparedness, response, recovery and prevention. Despite this progress, Madagascar's DRM policy framework still has several strategic, financial and sectoral shortcomings. Clarity on institutional roles and responsibilities across public sector institutions responsible for DRM policy and practice could be improved. Its capacity in drought mitigation, preparedness and response is therefore categorized as medium.

INTEGRATING AGAINST DROUGHT

SADRI output relevant for Madagascar's drought resilience

MADAGASCAR

SADRI generated 11 drought resilience knowledge outputs

Umbrella Pillar

- Drought Resilience Country Profiles
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